

Henri Poincaré

en.wikipedia.org

March 20, 2022

On the 28th of April 2012 the contents of the English as well as German Wikibooks and Wikipedia projects were licensed under Creative Commons Attribution-ShareAlike 3.0 Unported license. A URI to this license is given in the list of figures on page 77. If this document is a derived work from the contents of one of these projects and the content was still licensed by the project under this license at the time of derivation this document has to be licensed under the same, a similar or a compatible license, as stated in section 4b of the license. The list of contributors is included in chapter Contributors on page 55. The licenses GPL, LGPL and GFDL are included in chapter Licenses on page 81, since this book and/or parts of it may or may not be licensed under one or more of these licenses, and thus require inclusion of these licenses. The licenses of the figures are given in the list of figures on page 77. This PDF was generated by the \LaTeX typesetting software. The \LaTeX source code is included as an attachment (`source.7z.txt`) in this PDF file. To extract the source from the PDF file, you can use the `pdfdetach` tool including in the `poppler` suite, or the <http://www.pdfplabs.com/tools/pdftk-the-pdf-toolkit/> utility. Some PDF viewers may also let you save the attachment to a file. After extracting it from the PDF file you have to rename it to `source.7z`. To uncompress the resulting archive we recommend the use of <http://www.7-zip.org/>. The \LaTeX source itself was generated by a program written by Dirk Hünninger, which is freely available under an open source license from http://de.wikibooks.org/wiki/Benutzer:Dirk_Huenniger/wb2pdf.

Contents

1	Henri Poincaré	3
1.1	Life	7
1.2	Work	14
1.3	Character	30
1.4	Publications	32
1.5	Honours	32
1.6	Philosophy	34
1.7	Bibliography	35
1.8	See also	37
1.9	References	39
1.10	Further reading	47
1.11	External links	51
2	Contributors	55
	List of Figures	77
3	Licenses	81
3.1	GNU GENERAL PUBLIC LICENSE	81
3.2	GNU Free Documentation License	82
3.3	GNU Lesser General Public License	83

1 Henri Poincaré

French mathematician, physicist, engineer, and philosopher of science



This article **needs additional citations for verification**¹. Please help improve this article² by adding citations to reliable sources³. Unsourced material may be challenged and removed.

Find sources: "Henri Poincaré"⁴ – news⁵ · newspapers⁶ · books⁷ · scholar⁸ · JSTOR⁹
(*April 2017*)(*Learn how and when to remove this template message*¹⁰)

Henri Poincaré

Henri Poincaré

(photograph published in 1913)

Born 29 April 1854
Nancy, Meurthe-et-Moselle,
France

Died 17 July 1912 (aged 58)
Paris, France

Nationality French

Other names Jules Henri Poincaré

Education

- Lycée Nancy (now Lycée Henri-Poincaré)
- École Polytechnique
- École des Mines
- University of Paris (Dr, 1879)

-
- 1 <https://en.wikipedia.org/wiki/Wikipedia:Verifiability>
 - 2 https://en.wikipedia.org/w/index.php?title=Henri_Poincar%C3%A9&action=edit
 - 3 https://en.wikipedia.org/wiki/Help:Referencing_for_beginners
 - 4 http://www.google.com/search?as_eq=wikipedia&q=%22Henri+Poincar%C3%A9%22
 - 5 <http://www.google.com/search?tbm=nws&q=%22Henri+Poincar%C3%A9%22+-wikipedia&tbs=ar:1>
 - 6 <http://www.google.com/search?q=%22Henri+Poincar%C3%A9%22&tbs=bkt:s&tbm=bks>
 - 7 <http://www.google.com/search?tbs=bks:1&q=%22Henri+Poincar%C3%A9%22+-wikipedia>
 - 8 <http://scholar.google.com/scholar?q=%22Henri+Poincar%C3%A9%22>
 - 9 <https://www.jstor.org/action/doBasicSearch?Query=%22Henri+Poincar%C3%A9%22&acc=on&wc=on>
 - 10 https://en.wikipedia.org/wiki/Help:Maintenance_template_removal

Henri Poincaré

Known for

- Poincaré conjecture
- Poincaré–Bendixson theorem
- Poincaré–Lindstedt method
- Poincaré recurrence theorem
- Poincaré–Bjerknes circulation theorem
- Poincaré group
- Poincaré gauge
- Poincaré–Hopf theorem
- Poincaré duality
- Poincaré–Birkhoff–Witt theorem
- Poincaré inequality
- Hilbert–Poincaré series
- Poincaré series
- Poincaré metric
- Automorphic form
- Coining the term "Betti number"
- Brouwer fixed-point theorem
- Bifurcation theory
- Chaos theory
- Dynamical system theory
- French historical epistemology
- Fundamental group
- Gravitational wave
- Hairy ball theorem
- Homological algebra
- Limit cycle
- Phase space
- Preintuitionism/conventionalism
- Predicativism
- Qualitative theory of differential equations
- Special relativity
- Sphere-world
- Rotation number
- Uniformization theorem
- Three-body problem
- Topology

Henri Poincaré**Awards**

- RAS Gold Medal (1900)
- Sylvester Medal (1901)
- Matteucci Medal (1905)
- Bolyai Prize (1905)
- Bruce Medal (1911)

Scientific career

Fields Mathematics and physics

**Institu-
tions**

- Corps des Mines
- Caen University
- La Sorbonne
- Bureau des Longitudes

Thesis *Sur les propriétés des fonctions définies par les équations différences* (1879)

**Doctoral
advisor** Charles Hermite

**Doctoral
students** • Louis Bachelier
 • Jean Bosler
 • Dimitrie Pompeiu
 • Mihailo Petrović

Other notable

students • Tobias Dantzig
 • Théophile de Donder

**Influ-
ences**

- Lazarus Fuchs
- Immanuel Kant^[1]
- Ernst Mach^[2]

**Influ-
enced**

- Louis Rougier
- George David Birkhoff
- Albert Einstein^[3]

Signature**Notes**

He was an uncle of Pierre Boutroux.

Jules Henri Poincaré (UK¹¹: /ˈpwæŋkɑːreɪ/¹²[4] [US: stress final syllable], French: [ʒi pwɛ̃kaʁe]¹³ (¹⁴listen¹⁵);^[5]^[6] 29 April 1854 – 17 July 1912) was a French¹⁶ mathematician¹⁷, theoretical physicist¹⁸, engineer¹⁹, and philosopher of science²⁰. He is often described as a polymath²¹, and in mathematics as "The Last Universalist",^[7] since he excelled in all fields of the discipline as it existed during his lifetime.

As a mathematician and physicist²², he made many original fundamental contributions to pure²³ and applied mathematics²⁴, mathematical physics²⁵, and celestial mechanics²⁶.^[8] In his research on the three-body problem²⁷, Poincaré became the first person to discover a chaotic deterministic system²⁸ which laid the foundations of modern chaos theory²⁹. He is also considered to be one of the founders of the field of topology³⁰.

Poincaré made clear the importance of paying attention to the invariance³¹ of laws of physics under different transformations, and was the first to present the Lorentz transformations³² in their modern symmetrical form. Poincaré discovered the remaining relativistic velocity transformations and recorded them in a letter to Hendrik Lorentz³³ in 1905. Thus he obtained perfect invariance of all of Maxwell's equations³⁴, an important step in the formulation of the theory of special relativity³⁵. In 1905, Poincaré first proposed gravitational waves³⁶ (*ondes gravifiques*) emanating from a body and propagating at the speed of light as being required by the Lorentz transformations.

The Poincaré group³⁷ used in physics and mathematics was named after him.

-
- 11 https://en.wikipedia.org/wiki/British_English
 - 12 <https://en.wikipedia.org/wiki/Help:IPA/English>
 - 13 <https://en.wikipedia.org/wiki/Help:IPA/French>
 - 14 https://en.wikipedia.org/wiki/File:Fr-Henri_Poincar%C3%A9.ogg
 - 15 http://upload.wikimedia.org/wikipedia/commons/7/70/Fr-Henri_Poincar%C3%A9.ogg
 - 16 https://en.wikipedia.org/wiki/French_people
 - 17 <https://en.wikipedia.org/wiki/Mathematician>
 - 18 https://en.wikipedia.org/wiki/Theoretical_physicist
 - 19 <https://en.wikipedia.org/wiki/Engineer>
 - 20 https://en.wikipedia.org/wiki/Philosophy_of_science
 - 21 <https://en.wikipedia.org/wiki/Polymath>
 - 22 <https://en.wikipedia.org/wiki/Physicist>
 - 23 https://en.wikipedia.org/wiki/Pure_mathematics
 - 24 https://en.wikipedia.org/wiki/Applied_mathematics
 - 25 https://en.wikipedia.org/wiki/Mathematical_physics
 - 26 https://en.wikipedia.org/wiki/Celestial_mechanics
 - 27 https://en.wikipedia.org/wiki/Three-body_problem
 - 28 https://en.wikipedia.org/wiki/Deterministic_system
 - 29 https://en.wikipedia.org/wiki/Chaos_theory
 - 30 <https://en.wikipedia.org/wiki/Topology>
 - 31 [https://en.wikipedia.org/wiki/Invariant_\(mathematics\)](https://en.wikipedia.org/wiki/Invariant_(mathematics))
 - 32 https://en.wikipedia.org/wiki/Lorentz_transformations
 - 33 https://en.wikipedia.org/wiki/Hendrik_Lorentz
 - 34 https://en.wikipedia.org/wiki/Maxwell%27s_equations
 - 35 https://en.wikipedia.org/wiki/Special_relativity
 - 36 https://en.wikipedia.org/wiki/Gravitational_wave
 - 37 https://en.wikipedia.org/wiki/Poincar%C3%A9_group

Early in the 20th century he formulated the Poincaré conjecture³⁸ that became over time one of the famous unsolved problems in mathematics³⁹ until it was solved in 2002–2003 by Grigori Perelman⁴⁰.

1.1 Life

Poincaré was born on 29 April 1854 in Cité Ducale neighborhood, Nancy, Meurthe-et-Moselle⁴¹, into an influential French family.^[9] His father Léon Poincaré (1828–1892) was a professor of medicine at the University of Nancy⁴².^[10] His younger sister Aline married the spiritual philosopher Émile Boutroux⁴³. Another notable member of Henri's family was his cousin, Raymond Poincaré⁴⁴, a fellow member of the Académie française⁴⁵, who would serve as President of France from 1913 to 1920.^[11]

³⁸ https://en.wikipedia.org/wiki/Poincar%C3%A9_conjecture
³⁹ https://en.wikipedia.org/wiki/Unsolved_problems_in_mathematics
⁴⁰ https://en.wikipedia.org/wiki/Grigori_Perelman
⁴¹ https://en.wikipedia.org/wiki/Nancy,_Meurthe-et-Moselle
⁴² https://en.wikipedia.org/wiki/University_of_Nancy
⁴³ https://en.wikipedia.org/wiki/%C3%89mile_Boutroux
⁴⁴ https://en.wikipedia.org/wiki/Raymond_Poincar%C3%A9
⁴⁵ https://en.wikipedia.org/wiki/Acad%C3%A9mie_fran%C3%A7aise

1.1.1 Education



Figure 2 Plaque on the birthplace of Henri Poincaré at house number 117 on the Grande Rue in the city of Nancy

During his childhood he was seriously ill for a time with diphtheria⁴⁶ and received special instruction from his mother, Eugénie Launois (1830–1897).

In 1862, Henri entered the Lycée in Nancy⁴⁷ (now renamed the Lycée Henri-Poincaré⁴⁸ in his honour, along with Henri Poincaré University⁴⁹, also in Nancy). He spent eleven years at the Lycée and during this time he proved to be one of the top students in every topic he studied. He excelled in written composition. His mathematics teacher described him as a "monster of mathematics" and he won first prizes in the concours général⁵⁰, a competition between the top pupils from all the Lycées across France. His poorest subjects were music and physical education, where he was described as "average at best".^[12] However, poor eyesight and a tendency towards absentmindedness may explain these difficulties.^[13] He graduated from the Lycée in 1871 with a baccalauréat⁵¹ in both letters and sciences.

⁴⁶ <https://en.wikipedia.org/wiki/Diphtheria>

⁴⁷ https://en.wikipedia.org/wiki/Nancy,_Meurthe-et-Moselle

⁴⁸ https://en.wikipedia.org/w/index.php?title=Lyc%C3%A9e_Henri-Poincar%C3%A9&action=edit&redlink=1

⁴⁹ https://en.wikipedia.org/wiki/Henri_Poincar%C3%A9_University

⁵⁰ https://en.wikipedia.org/wiki/Concours_g%C3%A9n%C3%A9ral

⁵¹ <https://en.wikipedia.org/wiki/Baccalaur%C3%A9at>

During the Franco-Prussian War⁵² of 1870, he served alongside his father in the Ambulance Corps⁵³.

Poincaré entered the École Polytechnique⁵⁴ as the top qualifier in 1873 and graduated in 1875. There he studied mathematics as a student of Charles Hermite⁵⁵, continuing to excel and publishing his first paper (*Démonstration nouvelle des propriétés de l'indicatrice d'une surface*) in 1874. From November 1875 to June 1878 he studied at the École des Mines⁵⁶, while continuing the study of mathematics in addition to the mining engineering⁵⁷ syllabus, and received the degree of ordinary mining engineer in March 1879.^[14]

As a graduate of the École des Mines, he joined the Corps des Mines⁵⁸ as an inspector for the Vesoul⁵⁹ region in northeast France. He was on the scene of a mining disaster at Magny⁶⁰ in August 1879 in which 18 miners died. He carried out the official investigation into the accident in a characteristically thorough and humane way.

At the same time, Poincaré was preparing for his Doctorate in Science⁶¹ in mathematics under the supervision of Charles Hermite. His doctoral thesis was in the field of differential equations⁶². It was named *Sur les propriétés des fonctions définies par les équations aux différences partielles*. Poincaré devised a new way of studying the properties of these equations. He not only faced the question of determining the integral of such equations, but also was the first person to study their general geometric properties. He realised that they could be used to model the behaviour of multiple bodies in free motion within the Solar System⁶³. Poincaré graduated from the University of Paris⁶⁴ in 1879.

52 https://en.wikipedia.org/wiki/Franco-Prussian_War

53 https://en.wikipedia.org/wiki/Ambulance_Corps

54 https://en.wikipedia.org/wiki/%C3%89cole_Polytechnique

55 https://en.wikipedia.org/wiki/Charles_Hermite

56 https://en.wikipedia.org/wiki/%C3%89cole_des_Mines

57 https://en.wikipedia.org/wiki/Mining_engineering

58 https://en.wikipedia.org/wiki/Corps_des_Mines

59 <https://en.wikipedia.org/wiki/Vesoul>

60 <https://en.wikipedia.org/wiki/Magny-l%C3%A8s-Jussey>

61 https://en.wikipedia.org/wiki/Doctorate_in_Science

62 https://en.wikipedia.org/wiki/Differential_equations

63 https://en.wikipedia.org/wiki/Solar_System

64 https://en.wikipedia.org/wiki/University_of_Paris



Figure 3 The young Henri Poincaré

1.1.2 First scientific achievements

After receiving his degree, Poincaré began teaching as junior lecturer⁶⁵ in mathematics at the University of Caen⁶⁶ in Normandy (in December 1879). At the same time he published his first major article concerning the treatment of a class of automorphic functions⁶⁷.

⁶⁵ <https://en.wikipedia.org/wiki/Lecturer>

⁶⁶ https://en.wikipedia.org/wiki/Caen_University

⁶⁷ https://en.wikipedia.org/wiki/Automorphic_function

There, in Caen⁶⁸, he met his future wife, Louise Poulain d'Andecy and on 20 April 1881, they married. Together they had four children: Jeanne (born 1887), Yvonne (born 1889), Henriette (born 1891), and Léon (born 1893).

Poincaré immediately established himself among the greatest mathematicians of Europe, attracting the attention of many prominent mathematicians. In 1881 Poincaré was invited to take a teaching position at the Faculty of Sciences of the University of Paris⁶⁹; he accepted the invitation. During the years 1883 to 1897, he taught mathematical analysis⁷⁰ in the École Polytechnique⁷¹.

In 1881–1882, Poincaré created a new branch of mathematics: qualitative theory of differential equations⁷². He showed how it is possible to derive the most important information about the behavior of a family of solutions without having to solve the equation (since this may not always be possible). He successfully used this approach to problems in celestial mechanics⁷³ and mathematical physics⁷⁴.

1.1.3 Career

He never fully abandoned his mining career to mathematics. He worked at the Ministry of Public Services⁷⁵ as an engineer in charge of northern railway development from 1881 to 1885. He eventually became chief engineer of the Corps des Mines⁷⁶ in 1893 and inspector general in 1910.

Beginning in 1881 and for the rest of his career, he taught at the University of Paris⁷⁷ (the Sorbonne⁷⁸). He was initially appointed as the *maître de conférences d'analyse* (associate professor of analysis).^[15] Eventually, he held the chairs of Physical and Experimental Mechanics, Mathematical Physics and Theory of Probability,^[16] and Celestial Mechanics and Astronomy.

In 1887, at the young age of 32, Poincaré was elected to the French Academy of Sciences⁷⁹. He became its president in 1906, and was elected to the Académie française⁸⁰ on 5 March 1908.

68 <https://en.wikipedia.org/wiki/Caen>

69 https://en.wikipedia.org/wiki/University_of_Paris

70 https://en.wikipedia.org/wiki/Mathematical_analysis

71 https://en.wikipedia.org/wiki/%C3%89cole_Polytechnique

72 https://en.wikipedia.org/wiki/Qualitative_theory_of_differential_equations

73 https://en.wikipedia.org/wiki/Celestial_mechanics

74 https://en.wikipedia.org/wiki/Mathematical_physics

75 https://en.wikipedia.org/w/index.php?title=Ministry_of_Public_Services&action=edit&redlink=1

76 https://en.wikipedia.org/wiki/Corps_des_Mines

77 https://en.wikipedia.org/wiki/University_of_Paris

78 https://en.wikipedia.org/wiki/University_of_Paris

79 https://en.wikipedia.org/wiki/French_Academy_of_Sciences

80 https://en.wikipedia.org/wiki/Acad%C3%A9mie_fran%C3%A7aise

In 1887, he won Oscar II, King of Sweden⁸¹'s mathematical competition for a resolution of the three-body problem⁸² concerning the free motion of multiple orbiting bodies. (See three-body problem⁸³ section below.)



Figure 4 The Poincaré family grave at the Cimetière du Montparnasse

81 https://en.wikipedia.org/wiki/Oscar_II_of_Sweden

82 https://en.wikipedia.org/wiki/Three-body_problem

83 [#Three-body_problem](#)

In 1893, Poincaré joined the French Bureau des Longitudes⁸⁴, which engaged him in the synchronisation of time⁸⁵ around the world. In 1897 Poincaré backed an unsuccessful proposal for the decimalisation of circular measure⁸⁶, and hence time and longitude⁸⁷.^[17] It was this post which led him to consider the question of establishing international time zones and the synchronisation of time between bodies in relative motion. (See work on relativity⁸⁸ section below.)

In 1904, he intervened in the trials⁸⁹ of Alfred Dreyfus⁹⁰. He attacked the spurious scientific claims of some of the evidence brought against Dreyfus, who was a Jewish officer in the French army charged with treason by colleagues.

Poincaré was the President of the Société Astronomique de France (SAF)⁹¹, the French astronomical society, from 1901 to 1903.^[18]

Students

Poincaré had two notable doctoral students at the University of Paris, Louis Bachelier⁹² (1900) and Dimitrie Pompeiu⁹³ (1905).^[19]

1.1.4 Death

In 1912, Poincaré underwent surgery for a prostate⁹⁴ problem and subsequently died from an embolism⁹⁵ on 17 July 1912, in Paris. He was 58 years of age. He is buried in the Poincaré family vault in the Cemetery of Montparnasse⁹⁶, Paris.

A former French Minister of Education, Claude Allègre⁹⁷, proposed in 2004 that Poincaré be reburied in the Panthéon⁹⁸ in Paris, which is reserved for French citizens of the highest honour.^[20]

84 https://en.wikipedia.org/wiki/Bureau_des_Longitudes
85 https://en.wikipedia.org/wiki/Clock_synchronization
86 https://en.wikipedia.org/wiki/Decimal_degrees
87 <https://en.wikipedia.org/wiki/Longitude>
88 [#Work_on_relativity](#)
89 https://en.wikipedia.org/wiki/Dreyfus_affair
90 https://en.wikipedia.org/wiki/Alfred_Dreyfus
91 https://en.wikipedia.org/wiki/Soci%C3%A9t%C3%A9_astronomique_de_France
92 https://en.wikipedia.org/wiki/Louis_Bachelier
93 https://en.wikipedia.org/wiki/Dimitrie_Pompeiu
94 <https://en.wikipedia.org/wiki/Prostate>
95 <https://en.wikipedia.org/wiki/Embolism>
96 https://en.wikipedia.org/wiki/Cimetière_du_Montparnasse
97 https://en.wikipedia.org/wiki/Claude_Allègre
98 https://en.wikipedia.org/wiki/Panthéon,_Paris

1.2 Work

1.2.1 Summary

Poincaré made many contributions to different fields of pure and applied mathematics such as: celestial mechanics⁹⁹, fluid mechanics¹⁰⁰, optics¹⁰¹, electricity¹⁰², telegraphy¹⁰³, capillarity¹⁰⁴, elasticity¹⁰⁵, thermodynamics¹⁰⁶, potential theory¹⁰⁷, quantum theory¹⁰⁸, theory of relativity¹⁰⁹ and physical cosmology¹¹⁰.

He was also a populariser of mathematics and physics and wrote several books for the lay public.

Among the specific topics he contributed to are the following:

- algebraic topology¹¹¹
- the theory of analytic functions of several complex variables¹¹²
- the theory of abelian functions¹¹³
- algebraic geometry¹¹⁴
- the Poincaré conjecture¹¹⁵, proven in 2003 by Grigori Perelman¹¹⁶.
- Poincaré recurrence theorem¹¹⁷
- hyperbolic geometry¹¹⁸
- number theory¹¹⁹
- the three-body problem¹²⁰
- the theory of diophantine equations¹²¹
- electromagnetism¹²²
- the special theory of relativity¹²³
- the fundamental group¹²⁴

99 https://en.wikipedia.org/wiki/Celestial_mechanics
100 https://en.wikipedia.org/wiki/Fluid_mechanics
101 <https://en.wikipedia.org/wiki/Optics>
102 <https://en.wikipedia.org/wiki/Electricity>
103 <https://en.wikipedia.org/wiki/Telegraphy>
104 <https://en.wikipedia.org/wiki/Capillarity>
105 [https://en.wikipedia.org/wiki/Elasticity_\(physics\)](https://en.wikipedia.org/wiki/Elasticity_(physics))
106 <https://en.wikipedia.org/wiki/Thermodynamics>
107 https://en.wikipedia.org/wiki/Potential_theory
108 https://en.wikipedia.org/wiki/Quantum_mechanics
109 https://en.wikipedia.org/wiki/Theory_of_relativity
110 https://en.wikipedia.org/wiki/Physical_cosmology
111 https://en.wikipedia.org/wiki/Algebraic_topology
112 https://en.wikipedia.org/wiki/Several_complex_variables
113 https://en.wikipedia.org/wiki/Abelian_variety
114 https://en.wikipedia.org/wiki/Algebraic_geometry
115 https://en.wikipedia.org/wiki/Poincar%C3%A9_conjecture
116 https://en.wikipedia.org/wiki/Grigori_Perelman
117 https://en.wikipedia.org/wiki/Poincar%C3%A9_recurrence_theorem
118 https://en.wikipedia.org/wiki/Hyperbolic_geometry
119 https://en.wikipedia.org/wiki/Number_theory
120 https://en.wikipedia.org/wiki/Three-body_problem
121 https://en.wikipedia.org/wiki/Diophantine_equation
122 <https://en.wikipedia.org/wiki/Electromagnetism>
123 https://en.wikipedia.org/wiki/Special_relativity
124 https://en.wikipedia.org/wiki/Fundamental_group

- In the field of differential equations¹²⁵ Poincaré has given many results that are critical for the qualitative theory of differential equations, for example the Poincaré sphere¹²⁶ and the Poincaré map¹²⁷.
- Poincaré on "everybody's belief" in the *Normal Law of Errors*¹²⁸ (see normal distribution¹²⁹ for an account of that "law")
- Published an influential paper providing a novel mathematical argument in support of quantum mechanics¹³⁰.^{[21][22]}

1.2.2 Three-body problem

The problem of finding the general solution to the motion of more than two orbiting bodies in the Solar System¹³¹ had eluded mathematicians since Newton's¹³² time. This was known originally as the three-body problem and later the n -body problem¹³³, where n is any number of more than two orbiting bodies. The n -body solution was considered very important and challenging at the close of the 19th century. Indeed, in 1887, in honour of his 60th birthday, Oscar II, King of Sweden¹³⁴, advised by Gösta Mittag-Leffler¹³⁵, established a prize for anyone who could find the solution to the problem. The announcement was quite specific:

Given a system of arbitrarily many mass points that attract each according to Newton's law¹³⁶, under the assumption that no two points ever collide, try to find a representation of the coordinates of each point as a series in a variable that is some known function of time and for all of whose values the series converges uniformly¹³⁷.

In case the problem could not be solved, any other important contribution to classical mechanics would then be considered to be prizeworthy. The prize was finally awarded to Poincaré, even though he did not solve the original problem. One of the judges, the distinguished Karl Weierstrass¹³⁸, said, *"This work cannot indeed be considered as furnishing the complete solution of the question proposed, but that it is nevertheless of such importance that its publication will inaugurate a new era in the history of celestial mechanics."* (The first version of his contribution even contained a serious error; for details see the article by Diacu^[23] and the book by Barrow-Green¹³⁹^[24]). The version finally printed^[25] contained many important ideas which led to the theory of chaos¹⁴⁰. The problem as stated originally

¹²⁵ https://en.wikipedia.org/wiki/Differential_equations

¹²⁶ https://en.wikipedia.org/wiki/Poincar%C3%A9_homology_sphere

¹²⁷ https://en.wikipedia.org/wiki/Poincar%C3%A9_map

¹²⁸ https://en.wikiquote.org/wiki/Henri_Poincar%C3%A9

¹²⁹ https://en.wikipedia.org/wiki/Normal_distribution

¹³⁰ https://en.wikipedia.org/wiki/Quantum_mechanics

¹³¹ https://en.wikipedia.org/wiki/Solar_System

¹³² https://en.wikipedia.org/wiki/Isaac_Newton

¹³³ https://en.wikipedia.org/wiki/N-body_problem

¹³⁴ https://en.wikipedia.org/wiki/Oscar_II_of_Sweden

¹³⁵ https://en.wikipedia.org/wiki/G%C3%B6sta_Mittag-Leffler

¹³⁶ https://en.wikipedia.org/wiki/Newton%27s_law_of_universal_gravitation

¹³⁷ https://en.wikipedia.org/wiki/Uniform_convergence

¹³⁸ https://en.wikipedia.org/wiki/Karl_Weierstrass

¹³⁹ https://en.wikipedia.org/wiki/June_Barrow-Green

¹⁴⁰ https://en.wikipedia.org/wiki/Chaos_theory

was finally solved by Karl F. Sundman¹⁴¹ for $n = 3$ in 1912 and was generalised to the case of $n > 3$ bodies by Qiudong Wang¹⁴² in the 1990s. The series solutions have very slow convergence. It would take millions of terms to determine the motion of the particles for even very short intervals of time, so they are unusable in numerical work.^[23]

1.2.3 Work on relativity



Figure 5 Marie Curie and Poincaré talk at the 1911 Solvay Conference

Main articles: Lorentz ether theory¹⁴³ and History of special relativity¹⁴⁴

Local time

Poincaré's work at the Bureau des Longitudes on establishing international time zones led him to consider how clocks at rest on the Earth, which would be moving at different speeds relative to absolute space (or the "luminiferous aether"¹⁴⁵), could be synchronised. At the same time Dutch theorist Hendrik Lorentz¹⁴⁶ was developing Maxwell's theory into a theory of the motion of charged particles ("electrons" or "ions"), and their interaction

¹⁴¹ https://en.wikipedia.org/wiki/Karl_F._Sundman

¹⁴² https://en.wikipedia.org/wiki/Qiudong_Wang

¹⁴³ https://en.wikipedia.org/wiki/Lorentz_ether_theory

¹⁴⁴ https://en.wikipedia.org/wiki/History_of_special_relativity

¹⁴⁵ https://en.wikipedia.org/wiki/Luminiferous_aether

¹⁴⁶ https://en.wikipedia.org/wiki/Hendrik_Lorentz

with radiation. In 1895 Lorentz had introduced an auxiliary quantity (without physical interpretation) called "local time" $t' = t - vx/c^2$ ^[26] and introduced the hypothesis of length contraction¹⁴⁷ to explain the failure of optical and electrical experiments to detect motion relative to the aether (see Michelson–Morley experiment¹⁴⁸).^[27] Poincaré was a constant interpreter (and sometimes friendly critic) of Lorentz's theory. Poincaré as a philosopher was interested in the "deeper meaning". Thus he interpreted Lorentz's theory and in so doing he came up with many insights that are now associated with special relativity. In *The Measure of Time*¹⁴⁹ (1898), Poincaré said, "A little reflection is sufficient to understand that all these affirmations have by themselves no meaning. They can have one only as the result of a convention." He also argued that scientists have to set the constancy of the speed of light as a postulate¹⁵⁰ to give physical theories the simplest form.^[28] Based on these assumptions he discussed in 1900 Lorentz's "wonderful invention" of local time and remarked that it arose when moving clocks are synchronised by exchanging light signals assumed to travel with the same speed in both directions in a moving frame.^[29]

Principle of relativity and Lorentz transformations

Further information: History of Lorentz transformations - Poincaré (1881)¹⁵¹ and History of Lorentz transformations - Poincaré (1905)¹⁵² In 1881 Poincaré described hyperbolic geometry¹⁵³ in terms of the hyperboloid model¹⁵⁴, formulating transformations leaving invariant the Lorentz interval¹⁵⁵ $x^2 + y^2 - z^2 = -1$, which makes them mathematically equivalent to the Lorentz transformations in 2+1 dimensions.^{[30][31]} In addition, Poincaré's other models of hyperbolic geometry (Poincaré disk model¹⁵⁶, Poincaré half-plane model¹⁵⁷) as well as the Beltrami–Klein model¹⁵⁸ can be related to the relativistic velocity space (see Gyrovector space¹⁵⁹).

In 1892 Poincaré developed a mathematical theory¹⁶⁰ of light¹⁶¹ including polarization¹⁶². His vision of the action of polarizers and retarders, acting on a sphere representing polarized states, is called the Poincaré sphere¹⁶³.^[32] It was shown that the Poincaré sphere possesses an underlying Lorentzian symmetry, by which it can be used as a geometrical representation of Lorentz transformations and velocity additions.^[33]

¹⁴⁷ https://en.wikipedia.org/wiki/Length_contraction

¹⁴⁸ https://en.wikipedia.org/wiki/Michelson%E2%80%93Morley_experiment

¹⁴⁹ https://en.wikisource.org/wiki/The_Measure_of_Time

¹⁵⁰ <https://en.wikipedia.org/wiki/Postulate>

¹⁵¹ https://en.wikipedia.org/wiki/History_of_Lorentz_transformations#Poincare

¹⁵² https://en.wikipedia.org/wiki/History_of_Lorentz_transformations#Poincare3

¹⁵³ https://en.wikipedia.org/wiki/Hyperbolic_geometry

¹⁵⁴ https://en.wikipedia.org/wiki/Hyperboloid_model

¹⁵⁵ https://en.wikipedia.org/wiki/Lorentz_interval

¹⁵⁶ https://en.wikipedia.org/wiki/Poincar%C3%A9_disk_model

¹⁵⁷ https://en.wikipedia.org/wiki/Poincar%C3%A9_half-plane_model

¹⁵⁸ https://en.wikipedia.org/wiki/Beltrami%E2%80%93Klein_model

¹⁵⁹ https://en.wikipedia.org/wiki/Gyrovector_space

¹⁶⁰ https://en.wikipedia.org/wiki/Mathematical_theory

¹⁶¹ <https://en.wikipedia.org/wiki/Light>

¹⁶² [https://en.wikipedia.org/wiki/Polarization_\(waves\)](https://en.wikipedia.org/wiki/Polarization_(waves))

¹⁶³ [https://en.wikipedia.org/wiki/Poincar%C3%A9_sphere_\(optics\)](https://en.wikipedia.org/wiki/Poincar%C3%A9_sphere_(optics))

He discussed the "principle of relative motion" in two papers in 1900^{[29][34]} and named it the principle of relativity¹⁶⁴ in 1904, according to which no physical experiment can discriminate between a state of uniform motion and a state of rest.^[35] In 1905 Poincaré wrote to Lorentz about Lorentz's paper of 1904, which Poincaré described as a "paper of supreme importance." In this letter he pointed out an error Lorentz had made when he had applied his transformation to one of Maxwell's equations, that for charge-occupied space, and also questioned the time dilation factor given by Lorentz.^[36] In a second letter to Lorentz, Poincaré gave his own reason why Lorentz's time dilation factor was indeed correct after all—it was necessary to make the Lorentz transformation form a group—and he gave what is now known as the relativistic velocity-addition law.^[37] Poincaré later delivered a paper at the meeting of the Academy of Sciences in Paris on 5 June 1905 in which these issues were addressed. In the published version of that he wrote:^[38]

The essential point, established by Lorentz, is that the equations of the electromagnetic field are not altered by a certain transformation (which I will call by the name of Lorentz) of the form:

$$x' = k\ell(x + \varepsilon t), t' = k\ell(t + \varepsilon x), y' = \ell y, z' = \ell z, k = 1/\sqrt{1 - \varepsilon^2}.$$

and showed that the arbitrary function $\ell(\varepsilon)$ must be unity for all ε (Lorentz had set $\ell = 1$ by a different argument) to make the transformations form a group. In an enlarged version of the paper that appeared in 1906 Poincaré pointed out that the combination $x^2 + y^2 + z^2 - c^2 t^2$ is invariant¹⁶⁵. He noted that a Lorentz transformation is merely a rotation in four-dimensional space about the origin by introducing $ct\sqrt{-1}$ as a fourth imaginary coordinate, and he used an early form of four-vectors¹⁶⁶.^[39] Poincaré expressed a lack of interest in a four-dimensional reformulation of his new mechanics in 1907, because in his opinion the translation of physics into the language of four-dimensional geometry would entail too much effort for limited profit.^[40] So it was Hermann Minkowski¹⁶⁷ who worked out the consequences of this notion in 1907.^[citation needed¹⁶⁸]

Mass–energy relation

Like others¹⁶⁹ before, Poincaré (1900) discovered a relation between mass¹⁷⁰ and electromagnetic energy¹⁷¹. While studying the conflict between the action/reaction principle¹⁷² and Lorentz ether theory¹⁷³, he tried to determine whether the center of gravity¹⁷⁴ still moves with a uniform velocity when electromagnetic fields are included.^[29] He noticed that the action/reaction principle does not hold for matter alone, but that the electromagnetic field has its own momentum. Poincaré concluded that the electromagnetic field energy of an electromagnetic wave behaves like a fictitious fluid¹⁷⁵ (*fluide fictif*) with a mass density

¹⁶⁴ https://en.wikipedia.org/wiki/Principle_of_relativity

¹⁶⁵ [https://en.wikipedia.org/wiki/Invariant_\(mathematics\)](https://en.wikipedia.org/wiki/Invariant_(mathematics))

¹⁶⁶ <https://en.wikipedia.org/wiki/Four-vector>

¹⁶⁷ https://en.wikipedia.org/wiki/Hermann_Minkowski

¹⁶⁹ https://en.wikipedia.org/wiki/Mass%E2%80%93energy_equivalence#Electromagnetic_mass

¹⁷⁰ <https://en.wikipedia.org/wiki/Mass>

¹⁷¹ https://en.wikipedia.org/wiki/Electromagnetic_energy

¹⁷² https://en.wikipedia.org/wiki/Newton%27s_laws_of_motion

¹⁷³ https://en.wikipedia.org/wiki/Lorentz_ether_theory

¹⁷⁴ https://en.wikipedia.org/wiki/Center_of_gravity

¹⁷⁵ <https://en.wikipedia.org/wiki/Fluid>

of E/c^2 . If the center of mass frame¹⁷⁶ is defined by both the mass of matter *and* the mass of the fictitious fluid, and if the fictitious fluid is indestructible—it's neither created or destroyed¹⁷⁷—then the motion of the center of mass frame remains uniform. But electromagnetic energy can be converted into other forms of energy. So Poincaré assumed that there exists a non-electric energy fluid at each point of space, into which electromagnetic energy can be transformed and which also carries a mass proportional to the energy. In this way, the motion of the center of mass remains uniform. Poincaré said that one should not be too surprised by these assumptions, since they are only mathematical fictions.

However, Poincaré's resolution led to a paradox¹⁷⁸ when changing frames: if a Hertzian oscillator radiates in a certain direction, it will suffer a recoil¹⁷⁹ from the inertia of the fictitious fluid. Poincaré performed a Lorentz boost¹⁸⁰ (to order v/c) to the frame of the moving source. He noted that energy conservation holds in both frames, but that the law of conservation of momentum¹⁸¹ is violated. This would allow perpetual motion¹⁸², a notion which he abhorred. The laws of nature would have to be different in the frames of reference¹⁸³, and the relativity principle would not hold. Therefore, he argued that also in this case there has to be another compensating mechanism in the ether¹⁸⁴.

Poincaré himself came back to this topic in his St. Louis lecture (1904).^[35] This time (and later also in 1908) he rejected^[41] the possibility that energy carries mass and criticized the ether solution to compensate the above-mentioned problems:

The apparatus will recoil as if it were a cannon and the projected energy a ball, and that contradicts the principle of Newton, since our present projectile has no mass; it is not matter, it is energy. [...] Shall we say that the space which separates the oscillator from the receiver and which the disturbance must traverse in passing from one to the other, is not empty, but is filled not only with ether, but with air, or even in interplanetary space with some subtle, yet ponderable fluid; that this matter receives the shock, as does the receiver, at the moment the energy reaches it, and recoils, when the disturbance leaves it? That would save Newton's principle, but it is not true. If the energy during its propagation remained always attached to some material substratum, this matter would carry the light along with it and Fizeau has shown, at least for the air, that there is nothing of the kind. Michelson and Morley have since confirmed this. We might also suppose that the motions of matter proper were exactly compensated by those of the ether; but that would lead us to the same considerations as those made a moment ago. The principle, if thus interpreted, could explain anything, since whatever the visible motions we could imagine hypothetical motions to compensate them. But if it can explain anything, it will allow us to foretell nothing; it will not allow us to choose between the various possible hypotheses, since it explains everything in advance. It therefore becomes useless.

176 https://en.wikipedia.org/wiki/Center_of_mass_frame

177 https://en.wikipedia.org/wiki/First_law_of_thermodynamics

178 <https://en.wikipedia.org/wiki/Paradox>

179 <https://en.wikipedia.org/wiki/Recoil>

180 https://en.wikipedia.org/wiki/Lorentz_boost

181 <https://en.wikipedia.org/wiki/Momentum#Conservation>

182 https://en.wikipedia.org/wiki/Perpetual_motion

183 https://en.wikipedia.org/wiki/Frames_of_reference

184 <https://en.wikipedia.org/wiki/Ether>

He also discussed two other unexplained effects: (1) non-conservation of mass implied by Lorentz's variable mass γm , Abraham's theory of variable mass and Kaufmann¹⁸⁵'s experiments on the mass of fast moving electrons and (2) the non-conservation of energy in the radium experiments of Marie Curie¹⁸⁶.

It was Albert Einstein¹⁸⁷'s concept of mass–energy equivalence¹⁸⁸ (1905) that a body losing energy as radiation or heat was losing mass of amount $m = E/c^2$ that resolved^[42] Poincaré's paradox, without using any compensating mechanism within the ether.^[43] The Hertzian oscillator loses mass in the emission process, and momentum is conserved in any frame. However, concerning Poincaré's solution of the Center of Gravity problem, Einstein noted that Poincaré's formulation and his own from 1906 were mathematically equivalent.^[44]

Gravitational waves

In 1905 Poincaré first proposed gravitational waves¹⁸⁹ (*ondes gravifiques*) emanating from a body and propagating at the speed of light. He wrote:

It has become important to examine this hypothesis more closely and in particular to ask in what ways it would require us to modify the laws of gravitation. That is what I have tried to determine; at first I was led to assume that the propagation of gravitation is not instantaneous, but happens with the speed of light.^{[45][38]}

Poincaré and Einstein

Einstein's first paper on relativity was published three months after Poincaré's short paper,^[38] but before Poincaré's longer version.^[39] Einstein relied on the principle of relativity to derive the Lorentz transformations and used a similar clock synchronisation procedure (Einstein synchronisation¹⁹⁰) to the one that Poincaré (1900) had described, but Einstein's paper was remarkable in that it contained no references at all. Poincaré never acknowledged Einstein's work on special relativity¹⁹¹. However, Einstein expressed sympathy with Poincaré's outlook obliquely in a letter to Hans Vaihinger¹⁹² on 3 May 1919, when Einstein considered Vaihinger's general outlook to be close to his own and Poincaré's to be close to Vaihinger's.^[46] In public, Einstein acknowledged Poincaré posthumously in the text of a lecture in 1921 titled "*Geometrie und Erfahrung* (Geometry and Experience)" in connection with non-Euclidean geometry¹⁹³, but not in connection with special relativity. A few years before his death, Einstein commented on Poincaré as being one of the pioneers of relativity, saying "Lorentz had already recognized that the transformation named after him is essential for the analysis of Maxwell's equations, and Poincaré deepened this insight still further"^[47]

185 [https://en.wikipedia.org/wiki/Walter_Kaufmann_\(physicist\)](https://en.wikipedia.org/wiki/Walter_Kaufmann_(physicist))

186 https://en.wikipedia.org/wiki/Marie_Curie

187 https://en.wikipedia.org/wiki/Albert_Einstein

188 https://en.wikipedia.org/wiki/Mass%E2%80%93energy_equivalence

189 https://en.wikipedia.org/wiki/Gravitational_waves

190 https://en.wikipedia.org/wiki/Einstein_synchronisation

191 https://en.wikipedia.org/wiki/Special_relativity

192 https://en.wikipedia.org/wiki/Hans_Vaihinger

193 https://en.wikipedia.org/wiki/Non-Euclidean_geometry

Assessments on Poincaré and relativity

Further information: History of special relativity¹⁹⁴ and Relativity priority dispute¹⁹⁵
 Poincaré's work in the development of special relativity is well recognised,^[42] though most historians stress that despite many similarities with Einstein's work, the two had very different research agendas and interpretations of the work.^[48] Poincaré developed a similar physical interpretation of local time and noticed the connection to signal velocity, but contrary to Einstein he continued to use the ether-concept in his papers and argued that clocks at rest in the ether show the "true" time, and moving clocks show the local time. So Poincaré tried to keep the relativity principle in accordance with classical concepts, while Einstein developed a mathematically equivalent kinematics based on the new physical concepts of the relativity of space and time.^{[49][50][51][52][53]}

While this is the view of most historians, a minority go much further, such as E. T. Whittaker¹⁹⁶, who held that Poincaré and Lorentz were the true discoverers of relativity.^[54]

1.2.4 Algebra and number theory

Poincaré introduced group theory¹⁹⁷ to physics, and was the first to study the group of Lorentz transformations¹⁹⁸.^[55] He also made major contributions to the theory of discrete groups and their representations.

¹⁹⁴ https://en.wikipedia.org/wiki/History_of_special_relativity

¹⁹⁵ https://en.wikipedia.org/wiki/Relativity_priority_dispute

¹⁹⁶ https://en.wikipedia.org/wiki/E._T._Whittaker

¹⁹⁷ https://en.wikipedia.org/wiki/Group_theory

¹⁹⁸ https://en.wikipedia.org/wiki/Lorentz_transformations

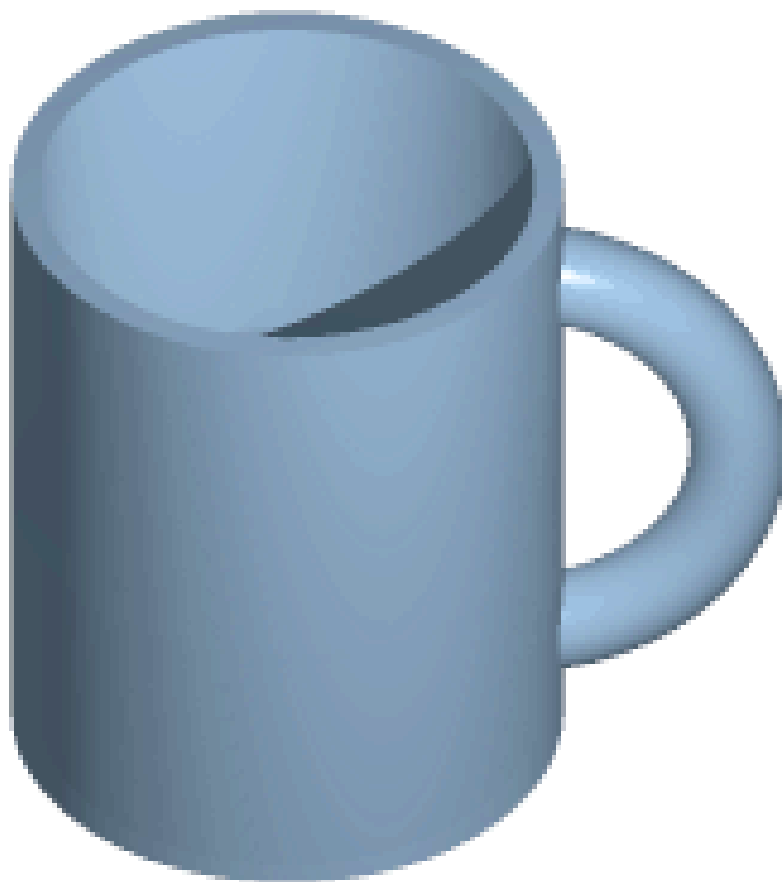


Figure 6 Topological transformation of a mug into a torus

1.2.5 Topology

The subject is clearly defined by Felix Klein¹⁹⁹ in his "Erlangen Program" (1872): the geometry invariants of arbitrary continuous transformation, a kind of geometry. The term "topology" was introduced, as suggested by Johann Benedict Listing²⁰⁰, instead of previously used "Analysis situs". Some important concepts were introduced by Enrico Betti²⁰¹ and

¹⁹⁹ https://en.wikipedia.org/wiki/Felix_Klein

²⁰⁰ https://en.wikipedia.org/wiki/Johann_Benedict_Listing

²⁰¹ https://en.wikipedia.org/wiki/Enrico_Betti

Bernhard Riemann²⁰². But the foundation of this science, for a space of any dimension, was created by Poincaré. His first article on this topic appeared in 1894.^[56]

His research in geometry²⁰³ led to the abstract topological definition of homotopy²⁰⁴ and homology²⁰⁵. He also first introduced the basic concepts and invariants of combinatorial topology, such as Betti numbers²⁰⁶ and the fundamental group²⁰⁷. Poincaré proved a formula relating the number of edges, vertices²⁰⁸ and faces of n -dimensional polyhedron²⁰⁹ (the Euler–Poincaré theorem²¹⁰) and gave the first precise formulation of the intuitive notion of dimension.^[57]

202 https://en.wikipedia.org/wiki/Bernhard_Riemann

203 <https://en.wikipedia.org/wiki/Geometry>

204 <https://en.wikipedia.org/wiki/Homotopy>

205 [https://en.wikipedia.org/wiki/Homology_\(mathematics\)](https://en.wikipedia.org/wiki/Homology_(mathematics))

206 https://en.wikipedia.org/wiki/Betti_numbers

207 https://en.wikipedia.org/wiki/Fundamental_group

208 https://en.wikipedia.org/wiki/Triangulated_irregular_network

209 <https://en.wikipedia.org/wiki/Polyhedron>

210 https://en.wikipedia.org/wiki/Euler_characteristic

1.2.6 Astronomy and celestial mechanics

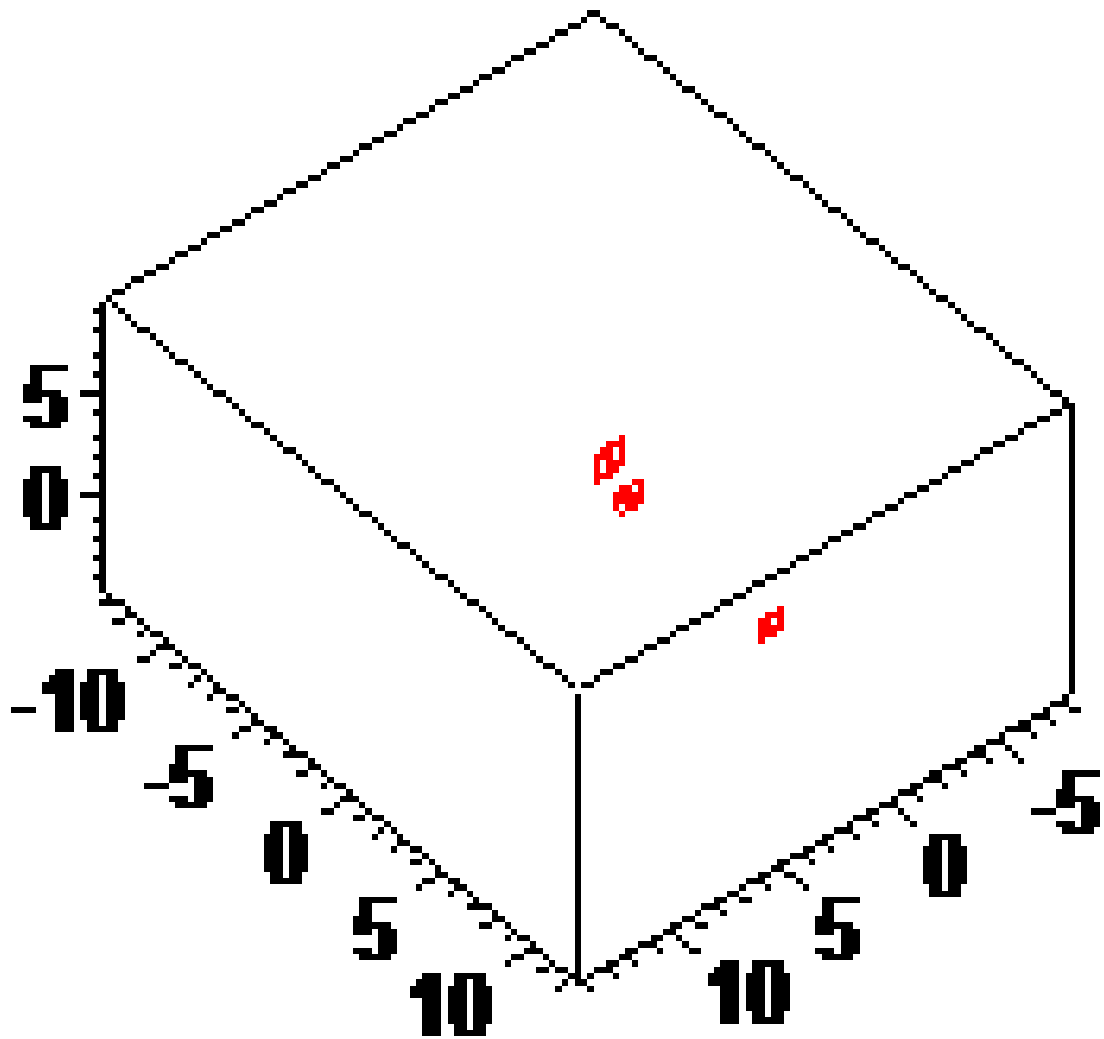


Figure 7 Chaotic motion in three-body problem (computer simulation).

Poincaré published two now classical monographs, "New Methods of Celestial Mechanics" (1892–1899) and "Lectures on Celestial Mechanics" (1905–1910). In them, he successfully applied the results of their research to the problem of the motion of three bodies and studied in detail the behavior of solutions (frequency, stability, asymptotic, and so on). They introduced the small parameter method, fixed points, integral invariants, variational equations, the convergence of the asymptotic expansions. Generalizing a theory of Bruns (1887), Poincaré showed that the three-body problem is not integrable. In other words, the general solution of the three-body problem can not be expressed in terms of algebraic²¹¹ and transcendental functions²¹² through unambiguous coordinates and velocities of the bodies.

²¹¹ <https://en.wikipedia.org/wiki/Algebra>

²¹² https://en.wikipedia.org/wiki/Transcendental_functions

His work in this area was the first major achievement in celestial mechanics since Isaac Newton²¹³.^[58]

These monographs include an idea of Poincaré, which later became the basis for mathematical "chaos theory"²¹⁴ (see, in particular, the Poincaré recurrence theorem²¹⁵) and the general theory of dynamical systems²¹⁶. Poincaré authored important works on astronomy²¹⁷ for the equilibrium figures of a gravitating rotating fluid²¹⁸. He introduced the important concept of bifurcation points²¹⁹ and proved the existence of equilibrium figures such as the non-ellipsoids, including ring-shaped and pear-shaped figures, and their stability. For this discovery, Poincaré received the Gold Medal of the Royal Astronomical Society (1900).^[59]

1.2.7 Differential equations and mathematical physics

After defending his doctoral thesis on the study of singular points of the system of differential equations²²⁰, Poincaré wrote a series of memoirs under the title "On curves defined by differential equations" (1881–1882).^[60] In these articles, he built a new branch of mathematics, called "qualitative theory of differential equations"²²¹. Poincaré showed that even if the differential equation can not be solved in terms of known functions, yet from the very form of the equation, a wealth of information about the properties and behavior of the solutions can be found. In particular, Poincaré investigated the nature of the trajectories of the integral curves in the plane, gave a classification of singular points (saddle²²², focus²²³, center²²⁴, node²²⁵), introduced the concept of a limit cycle²²⁶ and the loop index²²⁷, and showed that the number of limit cycles is always finite, except for some special cases. Poincaré also developed a general theory of integral invariants and solutions of the variational equations. For the finite-difference equations²²⁸, he created a new direction – the asymptotic²²⁹ analysis of the solutions. He applied all these achievements to study practical problems of mathematical physics²³⁰ and celestial mechanics²³¹, and the methods used were the basis of its topological works.^[61]

- The singular points of the integral curves

213 https://en.wikipedia.org/wiki/Isaac_Newton

214 https://en.wikipedia.org/wiki/Chaos_theory

215 https://en.wikipedia.org/wiki/Poincar%C3%A9_recurrence_theorem

216 https://en.wikipedia.org/wiki/Dynamical_system

217 <https://en.wikipedia.org/wiki/Astronomy>

218 https://en.wikipedia.org/wiki/Hydrostatic_equilibrium

219 https://en.wikipedia.org/wiki/Bifurcation_theory

220 https://en.wikipedia.org/wiki/Differential_equations

221 https://en.wikipedia.org/wiki/Qualitative_theory_of_differential_equations

222 https://en.wikipedia.org/wiki/Saddle_point

223 [https://en.wikipedia.org/wiki/Focus_\(geometry\)](https://en.wikipedia.org/wiki/Focus_(geometry))

224 [https://en.wikipedia.org/wiki/Center_\(algebra\)](https://en.wikipedia.org/wiki/Center_(algebra))

225 [https://en.wikipedia.org/wiki/Vertex_\(graph_theory\)](https://en.wikipedia.org/wiki/Vertex_(graph_theory))

226 https://en.wikipedia.org/wiki/Limit_cycle

227 https://en.wikipedia.org/wiki/Control_flow#Loop_system_cross-reference_table

228 https://en.wikipedia.org/wiki/Finite_difference

229 <https://en.wikipedia.org/wiki/Asymptotic>

230 https://en.wikipedia.org/wiki/Mathematical_physics

231 https://en.wikipedia.org/wiki/Celestial_mechanics

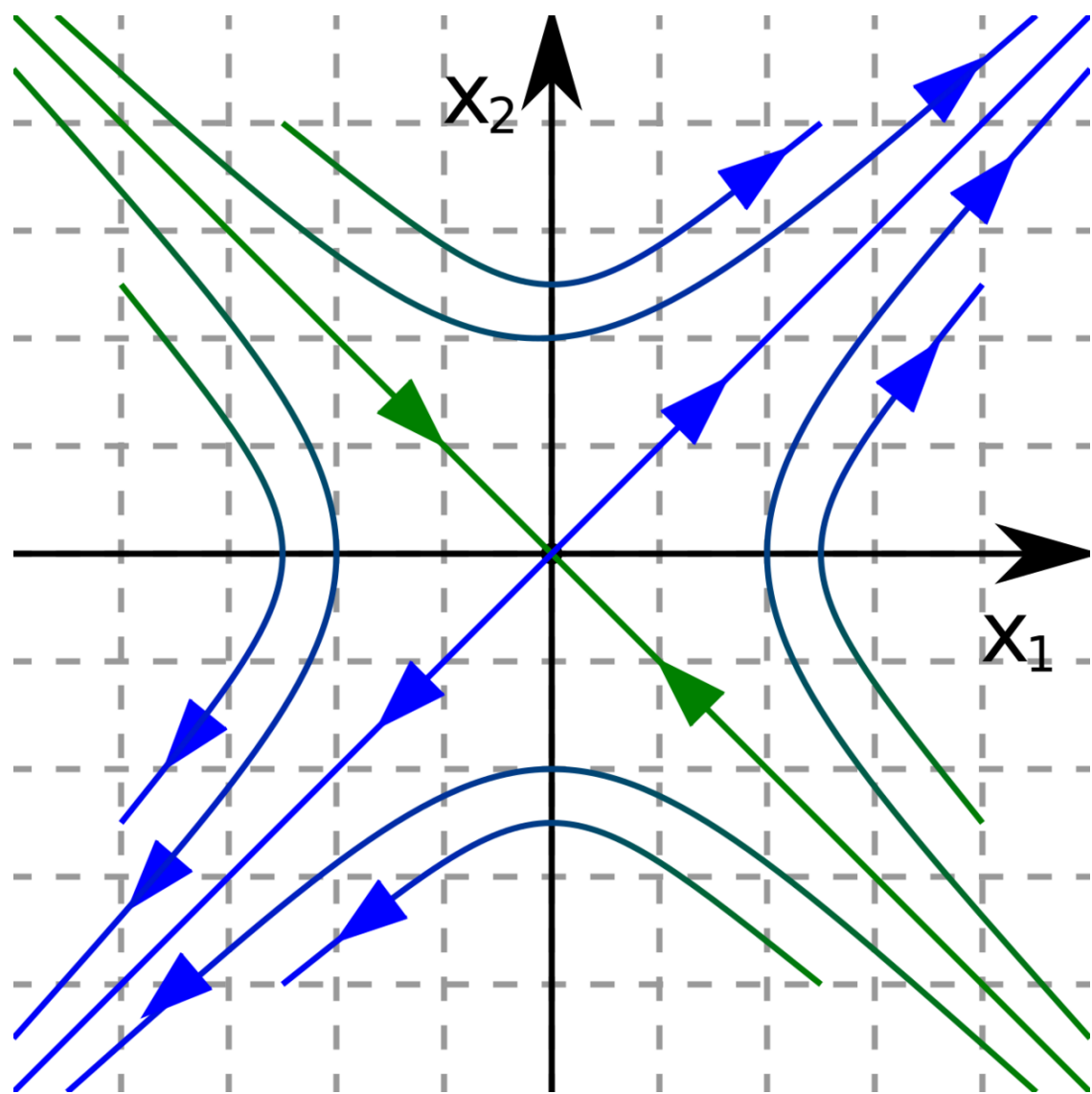


Figure 8 Saddle

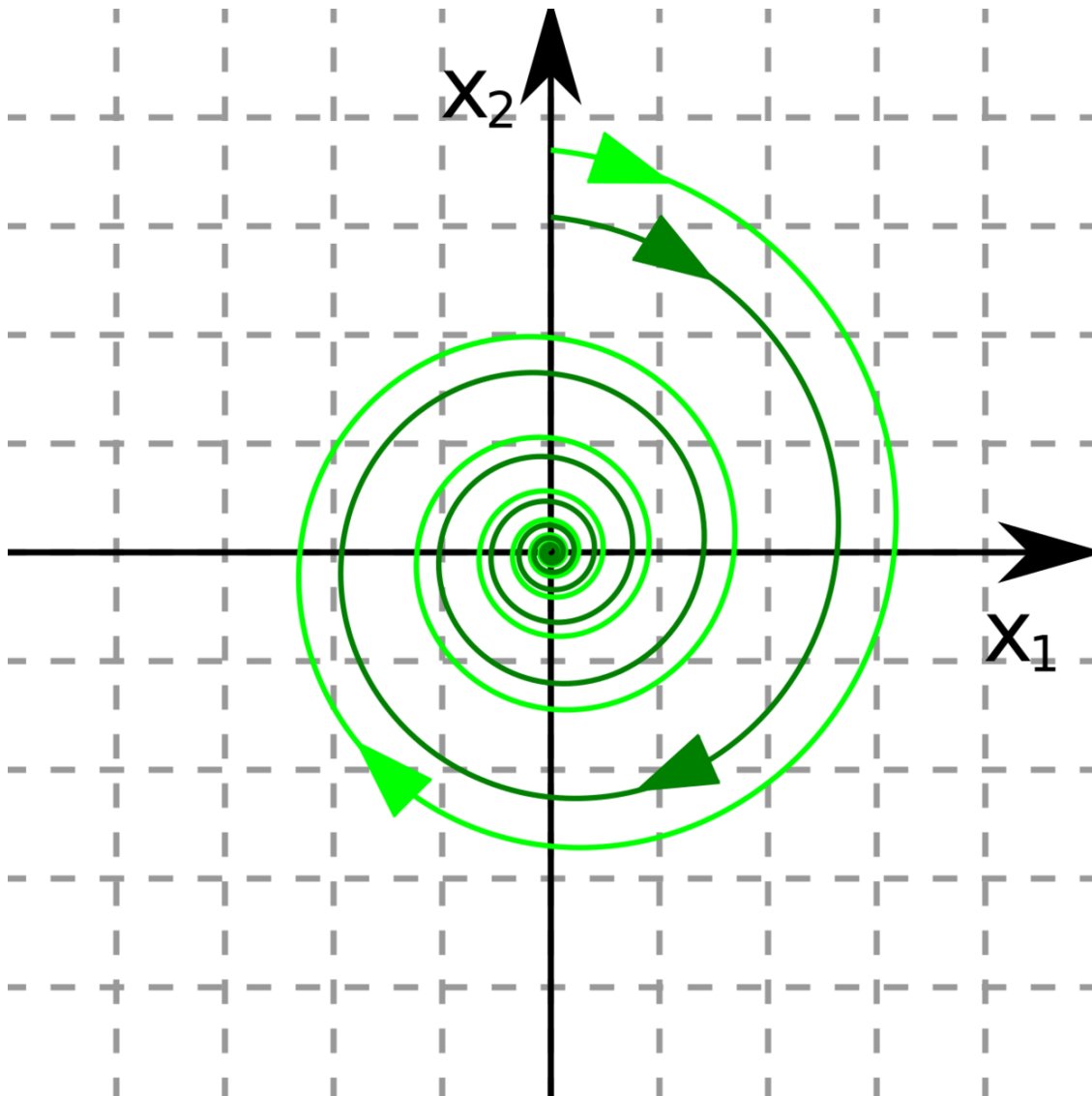


Figure 9 Focus

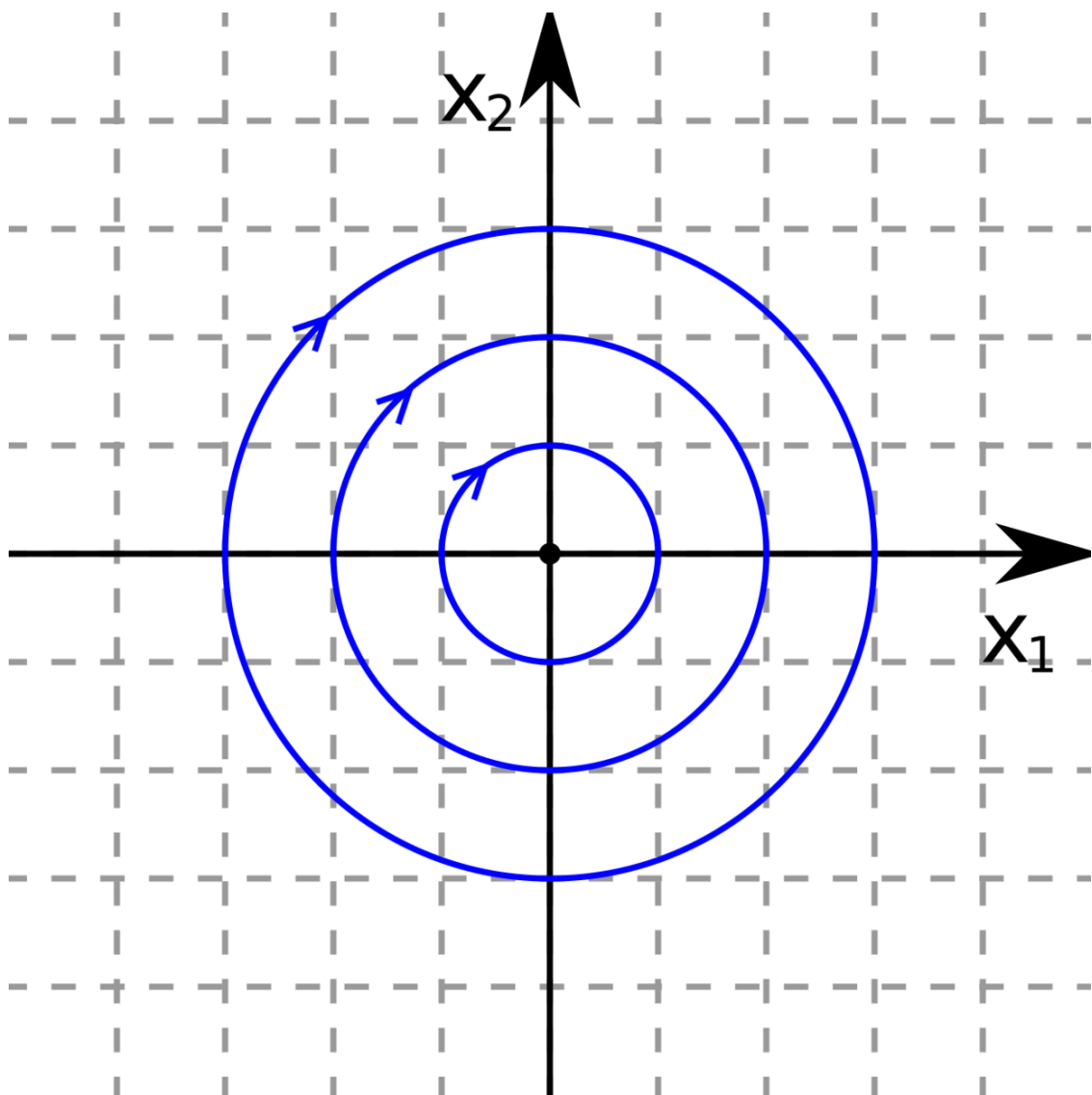


Figure 10 Center

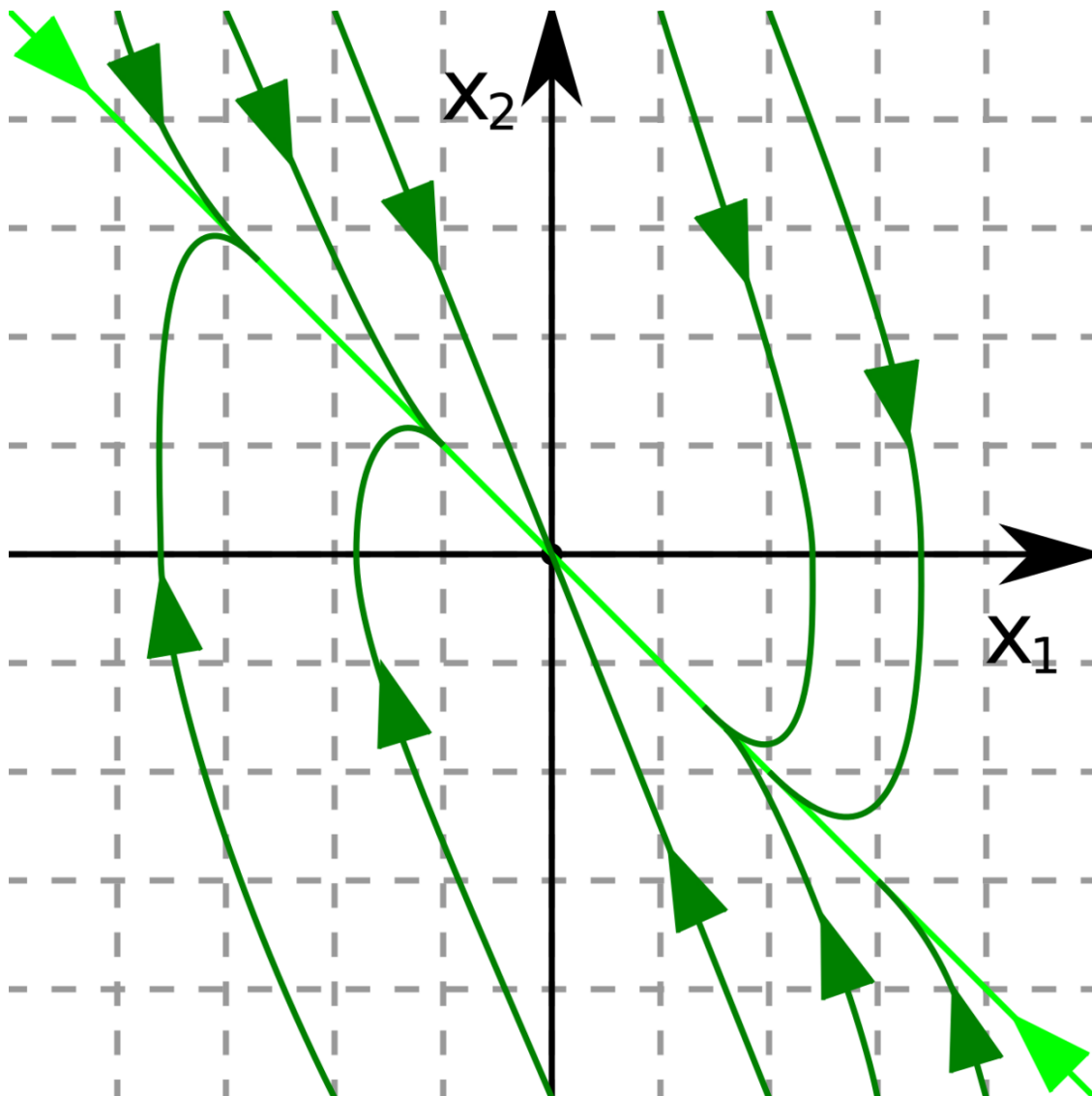


Figure 11 Node

1.3 Character



Figure 12 Photographic portrait of H. Poincaré by Henri Manuel

Poincaré's work habits have been compared to a bee²³² flying from flower to flower. Poincaré was interested in the way his mind²³³ worked; he studied his habits and gave a talk about his observations in 1908 at the Institute of General Psychology in Paris²³⁴. He linked his way of thinking²³⁵ to how he made several discoveries.

²³² <https://en.wikipedia.org/wiki/Bee>

²³³ <https://en.wikipedia.org/wiki/Mind>

²³⁴ <https://en.wikipedia.org/wiki/Paris>

²³⁵ <https://en.wikipedia.org/wiki/Thought>

The mathematician Darboux²³⁶ claimed he was *un intuitif* (an intuitive²³⁷), arguing that this is demonstrated by the fact that he worked so often by visual representation. Jacques Hadamard²³⁸ wrote that Poincaré's research demonstrated marvelous clarity^[62] and Poincaré himself wrote that he believed that logic was not a way to invent but a way to structure ideas and that logic limits ideas.

1.3.1 Toulouse's characterisation

Poincaré's mental organisation was interesting not only to Poincaré himself but also to Édouard Toulouse²³⁹, a psychologist²⁴⁰ of the Psychology Laboratory of the School of Higher Studies in Paris. Toulouse wrote a book entitled *Henri Poincaré* (1910).^{[63][64]} In it, he discussed Poincaré's regular schedule:

- He worked during the same times each day in short periods of time. He undertook mathematical research for four hours a day, between 10 a.m. and noon then again from 5 p.m. to 7 p.m.. He would read articles in journals later in the evening.
- His normal work habit was to solve a problem completely in his head, then commit the completed problem to paper.
- He was ambidextrous²⁴¹ and nearsighted²⁴².
- His ability to visualise what he heard proved particularly useful when he attended lectures, since his eyesight was so poor that he could not see properly what the lecturer wrote on the blackboard.

These abilities were offset to some extent by his shortcomings:

- He was physically clumsy and artistically²⁴³ inept.
- He was always in a rush and disliked going back for changes or corrections.
- He never spent a long time on a problem since he believed that the subconscious²⁴⁴ would continue working on the problem while he consciously worked on another problem²⁴⁵.

In addition, Toulouse stated that most mathematicians worked from principles already established while Poincaré started from basic principles each time (O'Connor et al., 2002).

His method of thinking is well summarised as:

Habitué à négliger les détails et à ne regarder que les cimes, il passait de l'une à l'autre avec une promptitude surprenante et les faits qu'il découvrait se groupant d'eux-mêmes autour de leur centre étaient instantanément et automatiquement classés dans sa mémoire. (Accustomed to neglecting details and to looking only at mountain tops, he went from one peak to another with surprising rapidity, and the facts he discov-

236 https://en.wikipedia.org/wiki/Jean_Gaston_Darboux

237 <https://en.wikipedia.org/wiki/Intuitive>

238 https://en.wikipedia.org/wiki/Jacques_Hadamard

239 https://en.wikipedia.org/wiki/%C3%89douard_Toulouse

240 <https://en.wikipedia.org/wiki/Psychologist>

241 <https://en.wikipedia.org/wiki/Ambidextrous>

242 <https://en.wikipedia.org/wiki/Nearsighted>

243 <https://en.wikipedia.org/wiki/Art>

244 <https://en.wikipedia.org/wiki/Subconscious>

245 https://en.wikipedia.org/wiki/Human_multitasking

ered, clustering around their center, were instantly and automatically pigeonholed in his memory.)

—
BELLIVER (1956)

1.4 Publications

- *Leçons sur la théorie mathématique de la lumière*²⁴⁶ (IN FRENCH). PARIS: CARRÈ. 1889.
- *Solutions periodiques, non-existence des integrales uniformes, solutions asymptotiques*²⁴⁷ (IN FRENCH). VOL. 1. PARIS: GAUTHIER-VILLARS. 1892.
- *Methodes de mm. Newcomb, Gylden, Lindstedt et Bohlin*²⁴⁸ (IN FRENCH). VOL. 2. PARIS: GAUTHIER-VILLARS. 1893.
- *Oscillations électriques*²⁴⁹ (IN FRENCH). PARIS: CARRÈ. 1894.
- *Invariants integraux, solutions periodiques du deuxieme genre, solutions doublement asymptotiques*²⁵⁰ (IN FRENCH). VOL. 3. PARIS: GAUTHIER-VILLARS. 1899.
- *Valeur de la science*²⁵¹ (IN FRENCH). PARIS: FLAMMARION. 1900.
- *Electricité et optique*²⁵² (IN FRENCH). PARIS: CARRÈ & NAUD. 1901.
- *Science et l'hypothèse*²⁵³ (IN FRENCH). PARIS: FLAMMARION. 1905.
- *Thermodynamique*²⁵⁴ (IN FRENCH). PARIS: GAUTHIER-VILLARS. 1908.
- *Dernières pensées*²⁵⁵ (IN FRENCH). PARIS: FLAMMARION. 1913.
- *Science et méthode*²⁵⁶. LONDON: NELSON AND SONS. 1914.

1.5 Honours

Awards

- Oscar II, King of Sweden's mathematical competition (1887)
- Foreign member of the Royal Netherlands Academy of Arts and Sciences²⁵⁷ (1897)^[65]
- American Philosophical Society²⁵⁸ 1899
- Gold Medal of the Royal Astronomical Society²⁵⁹ of London (1900)
- Bolyai Prize²⁶⁰ in 1905

246 <https://gutenberg.beic.it/webclient/DeliveryManager?pid=6569792>

247 <https://gutenberg.beic.it/webclient/DeliveryManager?pid=10996590>

248 <https://gutenberg.beic.it/webclient/DeliveryManager?pid=10997817>

249 <https://gutenberg.beic.it/webclient/DeliveryManager?pid=6571067>

250 <https://gutenberg.beic.it/webclient/DeliveryManager?pid=10999338>

251 <https://gutenberg.beic.it/webclient/DeliveryManager?pid=3901099>

252 <https://gutenberg.beic.it/webclient/DeliveryManager?pid=7156481>

253 <https://gutenberg.beic.it/webclient/DeliveryManager?pid=3901686>

254 <https://gutenberg.beic.it/webclient/DeliveryManager?pid=6568325>

255 <https://gutenberg.beic.it/webclient/DeliveryManager?pid=3902281>

256 <https://gutenberg.beic.it/webclient/DeliveryManager?pid=10947130>

257 https://en.wikipedia.org/wiki/Royal_Netherlands_Academy_of_Arts_and_Sciences

258 https://en.wikipedia.org/wiki/American_Philosophical_Society

259 https://en.wikipedia.org/wiki/Gold_Medal_of_the_Royal_Astronomical_Society

260 https://en.wikipedia.org/wiki/Bolyai_Prize

- Matteucci Medal²⁶¹ 1905
- French Academy of Sciences²⁶² 1906
- Académie française²⁶³ 1909
- Bruce Medal²⁶⁴ (1911)

Named after him

- Institut Henri Poincaré²⁶⁵ (mathematics and theoretical physics center)
- Poincaré Prize²⁶⁶ (Mathematical Physics International Prize)
- Annales Henri Poincaré²⁶⁷ (Scientific Journal)
- Poincaré Seminar (nicknamed "Bourbaphy"²⁶⁸)
- The crater Poincaré²⁶⁹ on the Moon
- Asteroid²⁷⁰ 2021 Poincaré²⁷¹
- List of things named after Henri Poincaré²⁷²

Henri Poincaré did not receive the Nobel Prize in Physics²⁷³, but he had influential advocates like Henri Becquerel²⁷⁴ or committee member Gösta Mittag-Leffler²⁷⁵.^{[66][67]} The nomination archive reveals that Poincaré received a total of 51 nominations between 1904 and 1912, the year of his death.^[68] Of the 58 nominations for the 1910 Nobel Prize, 34 named Poincaré.^[68] Nominators included Nobel laureates Hendrik Lorentz²⁷⁶ and Pieter Zeeman²⁷⁷ (both of 1902), Marie Curie²⁷⁸ (of 1903), Albert Michelson²⁷⁹ (of 1907), Gabriel Lippmann²⁸⁰ (of 1908) and Guglielmo Marconi²⁸¹ (of 1909).^[68]

The fact that renowned theoretical physicists²⁸² like Poincaré, Boltzmann²⁸³ or Gibbs²⁸⁴ were not awarded the Nobel Prize²⁸⁵ is seen as evidence that the Nobel committee had more regard for experimentation than theory.^{[69][70]} In Poincaré's case, several of those who nominated him pointed out that the greatest problem was to name a specific discovery, invention, or technique.^[66]

²⁶¹ https://en.wikipedia.org/wiki/Matteucci_Medal

²⁶² https://en.wikipedia.org/wiki/French_Academy_of_Sciences

²⁶³ https://en.wikipedia.org/wiki/Acad%C3%A9mie_fran%C3%A7aise

²⁶⁴ https://en.wikipedia.org/wiki/Bruce_Medal

²⁶⁵ https://en.wikipedia.org/wiki/Institut_Henri_Poincar%C3%A9

²⁶⁶ https://en.wikipedia.org/wiki/Poincar%C3%A9_Prize

²⁶⁷ https://en.wikipedia.org/wiki/Annales_Henri_Poincar%C3%A9

²⁶⁸ <https://en.wikipedia.org/wiki/Bourbaphy>

²⁶⁹ [https://en.wikipedia.org/wiki/Poincar%C3%A9_\(crater\)](https://en.wikipedia.org/wiki/Poincar%C3%A9_(crater))

²⁷⁰ <https://en.wikipedia.org/wiki/Asteroid>

²⁷¹ https://en.wikipedia.org/wiki/2021_Poincar%C3%A9

²⁷² https://en.wikipedia.org/wiki/List_of_things_named_after_Henri_Poincar%C3%A9

²⁷³ https://en.wikipedia.org/wiki/Nobel_Prize_in_Physics

²⁷⁴ https://en.wikipedia.org/wiki/Henri_Becquerel

²⁷⁵ https://en.wikipedia.org/wiki/G%C3%B6sta_Mittag-Leffler

²⁷⁶ https://en.wikipedia.org/wiki/Hendrik_Lorentz

²⁷⁷ https://en.wikipedia.org/wiki/Pieter_Zeeman

²⁷⁸ https://en.wikipedia.org/wiki/Marie_Curie

²⁷⁹ https://en.wikipedia.org/wiki/Albert_Michelson

²⁸⁰ https://en.wikipedia.org/wiki/Gabriel_Lippmann

²⁸¹ https://en.wikipedia.org/wiki/Guglielmo_Marconi

²⁸² https://en.wikipedia.org/wiki/Theoretical_physics

²⁸³ https://en.wikipedia.org/wiki/Ludwig_Boltzmann

²⁸⁴ https://en.wikipedia.org/wiki/Josiah_Willard_Gibbs

²⁸⁵ https://en.wikipedia.org/wiki/Nobel_Prize_in_Physics

1.6 Philosophy

Poincaré had philosophical²⁸⁶ views opposite to those of Bertrand Russell²⁸⁷ and Gottlob Frege²⁸⁸, who believed that mathematics was a branch of logic²⁸⁹. Poincaré strongly disagreed, claiming that intuition²⁹⁰ was the life of mathematics. Poincaré gives an interesting point of view in his 1902 book *Science and Hypothesis*²⁹¹:

For a superficial observer, scientific truth is beyond the possibility of doubt; the logic of science is infallible, and if the scientists are sometimes mistaken, this is only from their mistaking its rule.

Poincaré believed that arithmetic²⁹² is synthetic²⁹³. He argued that Peano's axioms²⁹⁴ cannot be proven non-circularly with the principle of induction²⁹⁵ (Murzi, 1998), therefore concluding that arithmetic is *a priori*²⁹⁶ synthetic and not analytic²⁹⁷. Poincaré then went on to say that mathematics cannot be deduced from logic since it is not analytic. His views were similar to those of Immanuel Kant²⁹⁸ (Kolak, 2001, Folina 1992). He strongly opposed Cantorian²⁹⁹ set theory³⁰⁰, objecting to its use of impredicative³⁰¹ definitions^[citation needed³⁰²].

However, Poincaré did not share Kantian views³⁰³ in all branches of philosophy and mathematics. For example, in geometry, Poincaré believed that the structure of non-Euclidean space³⁰⁴ can be known analytically. Poincaré held that convention plays an important role in physics. His view (and some later, more extreme versions of it) came to be known as "conventionalism"³⁰⁵.^[71] Poincaré believed that Newton's first law³⁰⁶ was not empirical but is a conventional framework assumption for mechanics³⁰⁷ (Gargani, 2012).^[72] He also believed that the geometry of physical space³⁰⁸ is conventional. He considered examples in which either the geometry of the physical fields or gradients³⁰⁹ of temperature can be changed, either describing a space as non-Euclidean measured by rigid rulers, or as a Euclidean space³¹⁰ where the rulers are expanded or shrunk by a variable³¹¹ heat distribution.

286 <https://en.wikipedia.org/wiki/Philosophical>
 287 https://en.wikipedia.org/wiki/Bertrand_Russell
 288 https://en.wikipedia.org/wiki/Gottlob_Frege
 289 <https://en.wikipedia.org/wiki/Logic>
 290 [https://en.wikipedia.org/wiki/Intuition_\(knowledge\)](https://en.wikipedia.org/wiki/Intuition_(knowledge))
 291 https://en.wikipedia.org/wiki/Science_and_Hypothesis
 292 <https://en.wikipedia.org/wiki/Arithmetic>
 293 https://en.wikipedia.org/wiki/Analytic/synthetic_distinction
 294 https://en.wikipedia.org/wiki/Peano%27s_axioms
 295 https://en.wikipedia.org/wiki/Inductive_reasoning
 296 https://en.wikipedia.org/wiki/A_priori_and_a_posteriori
 297 https://en.wikipedia.org/wiki/Analytic%E2%80%93synthetic_distinction
 298 https://en.wikipedia.org/wiki/Immanuel_Kant
 299 <https://en.wikipedia.org/wiki/Cantorian>
 300 https://en.wikipedia.org/wiki/Set_theory
 301 <https://en.wikipedia.org/wiki/Impredicativity>
 303 <https://en.wikipedia.org/wiki/Kantianism>
 304 https://en.wikipedia.org/wiki/Non-Euclidean_geometry
 305 <https://en.wikipedia.org/wiki/Conventionalism>
 306 https://en.wikipedia.org/wiki/Newton%27s_first_law
 307 <https://en.wikipedia.org/wiki/Mechanics>
 308 https://en.wikipedia.org/wiki/Physical_space
 309 <https://en.wikipedia.org/wiki/Gradients>
 310 https://en.wikipedia.org/wiki/Euclidean_space
 311 [https://en.wikipedia.org/wiki/Variable_\(mathematics\)](https://en.wikipedia.org/wiki/Variable_(mathematics))

However, Poincaré thought that we were so accustomed to Euclidean geometry³¹² that we would prefer to change the physical laws to save Euclidean geometry rather than shift to a non-Euclidean physical geometry.^[73]

1.6.1 Free will

Poincaré's famous lectures before the Société de Psychologie in Paris (published as *Science and Hypothesis*³¹³, *The Value of Science*³¹⁴, and *Science and Method*) were cited by Jacques Hadamard³¹⁵ as the source for the idea that creativity³¹⁶ and invention³¹⁷ consist of two mental stages, first random combinations of possible solutions to a problem, followed by a critical³¹⁸ evaluation³¹⁹.^[74]

Although he most often spoke of a deterministic³²⁰ universe³²¹, Poincaré said that the subconscious³²² generation of new possibilities involves chance³²³.

It is certain that the combinations which present themselves to the mind in a kind of sudden illumination after a somewhat prolonged period of unconscious work are generally useful and fruitful combinations... all the combinations are formed as a result of the automatic action of the subliminal ego, but those only which are interesting find their way into the field of consciousness... A few only are harmonious, and consequently at once useful and beautiful, and they will be capable of affecting the geometrician's special sensibility I have been speaking of; which, once aroused, will direct our attention upon them, and will thus give them the opportunity of becoming conscious... In the subliminal ego, on the contrary, there reigns what I would call liberty, if one could give this name to the mere absence of discipline and to disorder born of chance.^[75]

Poincaré's two stages—random combinations followed by selection—became the basis for Daniel Dennett³²⁴'s two-stage model of free will³²⁵.^[76]

1.7 Bibliography

1.7.1 Poincaré's writings in English translation

Popular writings on the philosophy of science³²⁶:

-
- 312 https://en.wikipedia.org/wiki/Euclidean_geometry
 - 313 https://en.wikipedia.org/wiki/Science_and_Hypothesis
 - 314 https://en.wikipedia.org/wiki/The_Value_of_Science
 - 315 https://en.wikipedia.org/wiki/Jacques_Hadamard
 - 316 <https://en.wikipedia.org/wiki/Creativity>
 - 317 <https://en.wikipedia.org/wiki/Innovation>
 - 318 https://en.wikipedia.org/wiki/Critical_thinking
 - 319 <https://en.wikipedia.org/wiki/Evaluation>
 - 320 <https://en.wikipedia.org/wiki/Deterministic>
 - 321 <https://en.wikipedia.org/wiki/Universe>
 - 322 <https://en.wikipedia.org/wiki/Subconscious>
 - 323 <https://en.wikipedia.org/wiki/Randomness>
 - 324 https://en.wikipedia.org/wiki/Daniel_Dennett
 - 325 https://en.wikipedia.org/wiki/Free_will
 - 326 https://en.wikipedia.org/wiki/Philosophy_of_science

- POINCARÉ, HENRI (1902–1908), *The Foundations of Science*³²⁷, NEW YORK: SCIENCE PRESS; reprinted in 1921; This book includes the English translations of Science and Hypothesis (1902), The Value of Science (1905), Science and Method (1908).
- 1904. *Science and Hypothesis*, The Walter Scott Publishing Co.
- 1913. "The New Mechanics," The Monist, Vol. XXIII.
- 1913. "The Relativity of Space," The Monist, Vol. XXIII.
- 1913.
Last Essays.³²⁸, NEW YORK: DOVER REPRINT, 1963
- 1956. *Chance*. In James R. Newman, ed., The World of Mathematics (4 Vols).
- 1958. *The Value of Science*, New York: Dover.

On algebraic topology³²⁹:

- 1895.
*Analysis Situs*³³⁰ (PDF). The first systematic study of topology³³¹.

On celestial mechanics³³²:

- 1890.
POINCARÉ, HENRI (2017). *The three-body problem and the equations of dynamics : Poincaré's foundational work on dynamical systems theory*. Translated by Popp, Bruce D. Cham, Switzerland: Springer International Publishing. ISBN³³³ 978-3-319-52898-4³³⁴.
- 1892–99. *New Methods of Celestial Mechanics*, 3 vols. English trans., 1967. ISBN³³⁵ 1-56396-117-2³³⁶.
- 1905. "The Capture Hypothesis of J. J. See," The Monist, Vol. XV.
- 1905–10. *Lessons of Celestial Mechanics*.

On the philosophy of mathematics³³⁷:

- Ewald, William B., ed., 1996. *From Kant to Hilbert: A Source Book in the Foundations of Mathematics*, 2 vols. Oxford Univ. Press. Contains the following works by Poincaré:
 - 1894, "On the Nature of Mathematical Reasoning," 972–81.
 - 1898, "On the Foundations of Geometry," 982–1011.
 - 1900, "Intuition and Logic in Mathematics," 1012–20.
 - 1905–06, "Mathematics and Logic, I–III," 1021–70.
 - 1910, "On Transfinite Numbers," 1071–74.
- 1905. "The Principles of Mathematical Physics," The Monist, Vol. XV.
- 1910. "The Future of Mathematics," The Monist, Vol. XX.
- 1910. "Mathematical Creation," The Monist, Vol. XX.

Other:

327 <https://archive.org/details/foundationsscie01poingooq>
 328 <https://archive.org/details/mathematicsandsc001861mbp>
 329 https://en.wikipedia.org/wiki/Algebraic_topology
 330 <http://www.maths.ed.ac.uk/~aar/papers/poincare2009.pdf>
 331 <https://en.wikipedia.org/wiki/Topology>
 332 https://en.wikipedia.org/wiki/Celestial_mechanics
 333 [https://en.wikipedia.org/wiki/ISBN_\(identifier\)](https://en.wikipedia.org/wiki/ISBN_(identifier))
 334 <https://en.wikipedia.org/wiki/Special:BookSources/978-3-319-52898-4>
 335 [https://en.wikipedia.org/wiki/ISBN_\(identifier\)](https://en.wikipedia.org/wiki/ISBN_(identifier))
 336 <https://en.wikipedia.org/wiki/Special:BookSources/1-56396-117-2>
 337 https://en.wikipedia.org/wiki/Philosophy_of_mathematics

- 1904. *Maxwell's Theory and Wireless Telegraphy*, New York, McGraw Publishing Company.
- 1905. "The New Logics," *The Monist*, Vol. XV.
- 1905. "The Latest Efforts of the Logisticians," *The Monist*, Vol. XV.

Exhaustive bibliography of English translations:

- 1892–2017.
*Henri Poincaré Papers*³³⁸[*\[permanent dead link*³³⁹\]](#).

1.8 See also

1.8.1 Concepts

- Poincaré–Andronov–Hopf bifurcation³⁴⁰
- Poincaré complex³⁴¹ – an abstraction of the singular chain complex of a closed, orientable manifold
- Poincaré duality³⁴²
- Poincaré disk model³⁴³
- Poincaré expansion³⁴⁴
- Poincaré gauge³⁴⁵
- Poincaré group³⁴⁶
- Poincaré half-plane model³⁴⁷
- Poincaré homology sphere³⁴⁸
- Poincaré inequality³⁴⁹
- Poincaré lemma³⁵⁰
- Poincaré map³⁵¹
- Poincaré residue³⁵²
- Poincaré series (modular form)³⁵³
- Poincaré space³⁵⁴
- Poincaré metric³⁵⁵
- Poincaré plot³⁵⁶

³³⁸ <http://henripoincarepapers.univ-nantes.fr/bibliohp/index.php?a=on&lang=en&action=Chercher>

³⁴⁰ https://en.wikipedia.org/wiki/Hopf_bifurcation

³⁴¹ https://en.wikipedia.org/wiki/Poincar%C3%A9_complex

³⁴² https://en.wikipedia.org/wiki/Poincar%C3%A9_duality

³⁴³ https://en.wikipedia.org/wiki/Poincar%C3%A9_disk_model

³⁴⁴ https://en.wikipedia.org/wiki/Asymptotic_expansion

³⁴⁵ https://en.wikipedia.org/wiki/Gauge_fixing#Multipolar_gauge

³⁴⁶ https://en.wikipedia.org/wiki/Poincar%C3%A9_group

³⁴⁷ https://en.wikipedia.org/wiki/Poincar%C3%A9_half-plane_model

³⁴⁸ https://en.wikipedia.org/wiki/Homology_sphere#Poincar%C3%A9_homology_sphere

³⁴⁹ https://en.wikipedia.org/wiki/Poincar%C3%A9_inequality

³⁵⁰ https://en.wikipedia.org/wiki/Closed_and_exact_differential_forms#Poincar%C3%A9_lemma

³⁵¹ https://en.wikipedia.org/wiki/Poincar%C3%A9_map

³⁵² https://en.wikipedia.org/wiki/Poincar%C3%A9_residue

³⁵³ [https://en.wikipedia.org/wiki/Poincar%C3%A9_series_\(modular_form\)](https://en.wikipedia.org/wiki/Poincar%C3%A9_series_(modular_form))

³⁵⁴ https://en.wikipedia.org/wiki/Poincar%C3%A9_space

³⁵⁵ https://en.wikipedia.org/wiki/Poincar%C3%A9_metric

³⁵⁶ https://en.wikipedia.org/wiki/Poincar%C3%A9_plot

- Poincaré polynomial³⁵⁷
- Poincaré series³⁵⁸
- Poincaré sphere³⁵⁹
- Poincaré–Einstein synchronisation³⁶⁰
- Poincaré–Lelong equation³⁶¹
- Poincaré–Lindstedt method³⁶²
- Poincaré–Lindstedt perturbation theory³⁶³
- Poincaré–Steklov operator³⁶⁴
- Euler–Poincaré characteristic³⁶⁵
- Neumann–Poincaré operator³⁶⁶
- Reflecting Function³⁶⁷

1.8.2 Theorems

Here is a list of theorems proved by Poincaré:

- Poincaré's recurrence theorem³⁶⁸: certain systems will, after a sufficiently long but finite time, return to a state very close to the initial state.
- Poincaré–Bendixson theorem³⁶⁹: a statement about the long-term behaviour of orbits of continuous dynamical systems on the plane, cylinder, or two-sphere.
- Poincaré–Hopf theorem³⁷⁰: a generalization of the hairy-ball theorem, which states that there is no smooth vector field on a sphere having no sources or sinks.
- Poincaré–Lefschetz duality theorem³⁷¹: a version of Poincaré duality in geometric topology, applying to a manifold with boundary
- Poincaré separation theorem³⁷²: gives the upper and lower bounds of eigenvalues of a real symmetric matrix $B^T A B$ that can be considered as the orthogonal projection of a larger real symmetric matrix A onto a linear subspace spanned by the columns of B .
- Poincaré–Birkhoff theorem³⁷³: every area-preserving, orientation-preserving homeomorphism of an annulus that rotates the two boundaries in opposite directions has at least two fixed points.
- Poincaré–Birkhoff–Witt theorem³⁷⁴: an explicit description of the universal enveloping algebra of a Lie algebra.

357 https://en.wikipedia.org/wiki/Betti_number#Poincar%C3%A9_polynomial

358 https://en.wikipedia.org/wiki/Hilbert%E2%80%93Poincar%C3%A9_series

359 [https://en.wikipedia.org/wiki/Poincar%C3%A9_sphere_\(optics\)](https://en.wikipedia.org/wiki/Poincar%C3%A9_sphere_(optics))

360 https://en.wikipedia.org/wiki/Einstein_synchronisation

361 https://en.wikipedia.org/wiki/Poincar%C3%A9%E2%80%93Lelong_equation

362 https://en.wikipedia.org/wiki/Poincar%C3%A9%E2%80%93Lindstedt_method

363 https://en.wikipedia.org/wiki/Poincar%C3%A9%E2%80%93Lindstedt_perturbation_theory

364 https://en.wikipedia.org/wiki/Poincar%C3%A9%E2%80%93Steklov_operator

365 https://en.wikipedia.org/wiki/Euler_characteristic

366 https://en.wikipedia.org/wiki/Neumann%E2%80%93Poincar%C3%A9_operator

367 https://en.wikipedia.org/wiki/Reflecting_Function

368 https://en.wikipedia.org/wiki/Poincar%C3%A9's_recurrence_theorem

369 https://en.wikipedia.org/wiki/Poincar%C3%A9%E2%80%93Bendixson_theorem

370 https://en.wikipedia.org/wiki/Poincar%C3%A9%E2%80%93Hopf_theorem

371 https://en.wikipedia.org/wiki/Poincar%C3%A9%E2%80%93Lefschetz_duality_theorem

372 https://en.wikipedia.org/wiki/Poincar%C3%A9_separation_theorem

373 https://en.wikipedia.org/wiki/Poincar%C3%A9%E2%80%93Birkhoff_theorem

374 https://en.wikipedia.org/wiki/Poincar%C3%A9%E2%80%93Birkhoff%E2%80%93Witt_theorem

- Poincaré–Bjerknes circulation theorem³⁷⁵: theorem about a conservation of quantity for the rotating frame.
- Poincaré conjecture³⁷⁶ (now a theorem): Every simply connected, closed 3-manifold is homeomorphic to the 3-sphere.
- Poincaré–Miranda theorem³⁷⁷: a generalization of the intermediate value theorem³⁷⁸ to n dimensions.

1.8.3 Other

- French epistemology³⁷⁹
- History of special relativity³⁸⁰
- List of things named after Henri Poincaré³⁸¹
- Institut Henri Poincaré³⁸², Paris
- Brouwer fixed-point theorem³⁸³
- Relativity priority dispute³⁸⁴
- Epistemic structural realism³⁸⁵[77]

1.9 References

1.9.1 Footnotes

1. "Poincaré's Philosophy of Mathematics"³⁸⁶, entry in the Internet Encyclopedia of Philosophy³⁸⁷.
2. "Henri Poincaré"³⁸⁸, entry in the Stanford Encyclopedia of Philosophy³⁸⁹.
3. Einstein's letter to Michele Besso, Princeton, 6 March 1952
4. "POINCARÉ"³⁹⁰. *Oxford English Dictionary*³⁹¹ (ONLINE ED.). OXFORD UNIVERSITY PRESS³⁹². (Subscription or participating institution membership³⁹³ required.)
5. "POINCARÉ PRONUNCIATION: HOW TO PRONOUNCE POINCARÉ IN FRENCH"³⁹⁴. *forvo.com*.

375 https://en.wikipedia.org/wiki/Kelvin%27s_circulation_theorem#Poincar%C3%A9%E2%80%93Bjerknes_circulation_theorem

376 https://en.wikipedia.org/wiki/Poincar%C3%A9_conjecture

377 https://en.wikipedia.org/wiki/Poincar%C3%A9%E2%80%93Miranda_theorem

378 https://en.wikipedia.org/wiki/Intermediate_value_theorem

379 https://en.wikipedia.org/wiki/French_epistemology

380 https://en.wikipedia.org/wiki/History_of_special_relativity

381 https://en.wikipedia.org/wiki/List_of_things_named_after_Henri_Poincar%C3%A9

382 https://en.wikipedia.org/wiki/Institut_Henri_Poincar%C3%A9

383 https://en.wikipedia.org/wiki/Brouwer_fixed-point_theorem

384 https://en.wikipedia.org/wiki/Relativity_priority_dispute

385 https://en.wikipedia.org/wiki/Epistemic_structural_realism

386 <http://www.iep.utm.edu/poi-math/#H3>

387 https://en.wikipedia.org/wiki/Internet_Encyclopedia_of_Philosophy

388 <https://plato.stanford.edu/entries/poincare/>

389 https://en.wikipedia.org/wiki/Stanford_Encyclopedia_of_Philosophy

390 <https://oed.com/search?searchType=dictionary&q=Poincar%C3%A9>

391 https://en.wikipedia.org/wiki/Oxford_English_Dictionary

392 https://en.wikipedia.org/wiki/Oxford_University_Press

393 <https://www.oed.com/public/login/loggingin#withyourlibrary>

394 <http://www.forvo.com/word/poincar%C3%A9/>

6. "HOW TO PRONOUNCE HENRI POINCARÉ"³⁹⁵. *pronouncekiwi.com*.
7. GINOUX, J. M.; GERINI, C. (2013). *Henri Poincaré: A Biography Through the Daily Papers*. World Scientific. doi³⁹⁶:10.1142/8956³⁹⁷. ISBN³⁹⁸ 978-981-4556-61-3³⁹⁹.
8. HADAMARD, JACQUES⁴⁰⁰ (JULY 1922). "THE EARLY SCIENTIFIC WORK OF HENRI POINCARÉ"⁴⁰¹. *The Rice Institute Pamphlet*. **9** (3): 111–183.
9. Belliver, 1956
10. Sagaret, 1911
11. The Internet Encyclopedia of Philosophy⁴⁰² Jules Henri Poincaré article by Mauro Murzi – Retrieved November 2006.
12. O'Connor et al., 2002
13. Carl, 1968
14. F. Verhulst
15. Sageret, 1911
16. MAZLIAK, LAURENT (14 NOVEMBER 2014). "POINCARÉ'S ODDS". IN DUPLANTIER, B.; RIVASSEAU, V. (EDS.). *Poincaré 1912-2012: Poincaré Seminar 2012*⁴⁰³. PROGRESS IN MATHEMATICAL PHYSICS. VOL. 67. BASEL: SPRINGER. P. 150. ISBN⁴⁰⁴ 9783034808347⁴⁰⁵.
17. see Galison 2003
18. "Bulletin de la Société astronomique de France, 1911, vol. 25, pp. 581–586"⁴⁰⁶. 1911.
19. Mathematics Genealogy Project⁴⁰⁷ Archived⁴⁰⁸ 5 October 2007 at the Wayback Machine⁴⁰⁹ North Dakota State University. Retrieved April 2008.
20. "LORENTZ, POINCARÉ ET EINSTEIN"⁴¹⁰. ARCHIVED FROM THE ORIGINAL⁴¹¹ ON 27 NOVEMBER 2004.
21. MCCORMACH, RUSSELL (SPRING 1967), "HENRI POINCARÉ AND THE QUANTUM THEORY", *Isis*, **58** (1): 37–55, doi⁴¹²:10.1086/350182⁴¹³, S2CID⁴¹⁴ 120934561⁴¹⁵

395 <http://www.pronouncekiwi.com/Henri%20Poincar%C3%A9>

396 [https://en.wikipedia.org/wiki/Doi_\(identifiant\)](https://en.wikipedia.org/wiki/Doi_(identifiant))

397 <https://doi.org/10.1142/2F8956>

398 [https://en.wikipedia.org/wiki/ISBN_\(identifiant\)](https://en.wikipedia.org/wiki/ISBN_(identifiant))

399 <https://en.wikipedia.org/wiki/Special:BookSources/978-981-4556-61-3>

400 https://en.wikipedia.org/wiki/Jacques_Hadamard

401 <http://catalog.hathitrust.org/Record/100592035>

402 <http://www.utm.edu/research/iep/p/poincare.htm>

403 <https://books.google.com/books?id=njNpBQAAQBAJ>

404 [https://en.wikipedia.org/wiki/ISBN_\(identifiant\)](https://en.wikipedia.org/wiki/ISBN_(identifiant))

405 <https://en.wikipedia.org/wiki/Special:BookSources/9783034808347>

406 <http://gallica.bnf.fr/ark:/12148/bpt6k9626551q/f616.item>

407 <http://www.genealogy.ams.org/id.php?id=34227>

408 <https://web.archive.org/web/20071005011853/http://www.genealogy.ams.org/id.php?id=34227>

409 https://en.wikipedia.org/wiki/Wayback_Machine

410 <https://web.archive.org/web/20041127160356/http://www.lexpress.fr/idees/tribunes/dossier/allegre/dossier.asp?id=430274>

411 <http://www.lexpress.fr/idees/tribunes/dossier/allegre/dossier.asp?id=430274>

412 [https://en.wikipedia.org/wiki/Doi_\(identifiant\)](https://en.wikipedia.org/wiki/Doi_(identifiant))

413 <https://doi.org/10.1086/2F350182>

414 [https://en.wikipedia.org/wiki/S2CID_\(identifiant\)](https://en.wikipedia.org/wiki/S2CID_(identifiant))

415 <https://api.semanticscholar.org/CorpusID:120934561>

22. IRONS, F. E. (AUGUST 2001), "POINCARÉ'S 1911–12 PROOF OF QUANTUM DISCONTINUITY INTERPRETED AS APPLYING TO ATOMS", *American Journal of Physics*, **69** (8): 879–884, Bibcode⁴¹⁶:2001AmJPh..69..879I⁴¹⁷, doi⁴¹⁸:10.1119/1.1356056⁴¹⁹
23. DIACU, FLORIN (1996), "THE SOLUTION OF THE n -body Problem", *The Mathematical Intelligencer*, **18** (3): 66–70, doi⁴²⁰:10.1007/BF03024313⁴²¹, S2CID⁴²² 119728316⁴²³
24. BARROW-GREEN, JUNE (1997). *Poincaré and the three body problem*⁴²⁴. HISTORY OF MATHEMATICS. VOL. 11. PROVIDENCE, RI: AMERICAN MATHEMATICAL SOCIETY⁴²⁵. ISBN⁴²⁶ 978-0821803677⁴²⁷. OCLC⁴²⁸ 34357985⁴²⁹.
25. POINCARÉ, J. HENRI (2017). *The three-body problem and the equations of dynamics: Poincaré's foundational work on dynamical systems theory*. Popp, Bruce D. (Translator). Cham, Switzerland: Springer International Publishing. ISBN⁴³⁰ 9783319528984⁴³¹. OCLC⁴³² 987302273⁴³³.
26. HSU, JONG-PING; HSU, LEONARDO (2006), *A broader view of relativity: general implications of Lorentz and Poincaré invariance*⁴³⁴, VOL. 10, WORLD SCIENTIFIC, p. 37, ISBN⁴³⁵ 978-981-256-651-5⁴³⁶, Section A5a, p 37⁴³⁷
27. LORENTZ, HENDRIK A.⁴³⁸ (1895), *Versuch einer theorie der electrischen und optischen erscheinungen in bewegten Körpern*⁴³⁹, LEIDEN: E.J. BRILL
28. POINCARÉ, HENRI (1898), "THE MEASURE OF TIME"⁴⁴⁰, *Revue de Métaphysique et de Morale*, **6**: 1–13
29. POINCARÉ, HENRI (1900), "LA THÉORIE DE LORENTZ ET LE PRINCIPE DE RÉACTION"⁴⁴¹, *Archives Néerlandaises des Sciences Exactes et Naturelles*, **5**: 252–278. See also the English translation⁴⁴²

416 [https://en.wikipedia.org/wiki/Bibcode_\(identifiant\)](https://en.wikipedia.org/wiki/Bibcode_(identifiant))

417 <https://ui.adsabs.harvard.edu/abs/2001AmJPh..69..879I>

418 [https://en.wikipedia.org/wiki/Doi_\(identifiant\)](https://en.wikipedia.org/wiki/Doi_(identifiant))

419 <https://doi.org/10.1119%2F1.1356056>

420 [https://en.wikipedia.org/wiki/Doi_\(identifiant\)](https://en.wikipedia.org/wiki/Doi_(identifiant))

421 <https://doi.org/10.1007/2F03024313>

422 [https://en.wikipedia.org/wiki/S2CID_\(identifiant\)](https://en.wikipedia.org/wiki/S2CID_(identifiant))

423 <https://api.semanticscholar.org/CorpusID:119728316>

424 https://en.wikipedia.org/wiki/Poincar%C3%A9_and_the_Three-Body_Problem

425 https://en.wikipedia.org/wiki/American_Mathematical_Society

426 [https://en.wikipedia.org/wiki/ISBN_\(identifiant\)](https://en.wikipedia.org/wiki/ISBN_(identifiant))

427 <https://en.wikipedia.org/wiki/Special:BookSources/978-0821803677>

428 [https://en.wikipedia.org/wiki/OCLC_\(identifiant\)](https://en.wikipedia.org/wiki/OCLC_(identifiant))

429 <http://www.worldcat.org/oclc/34357985>

430 [https://en.wikipedia.org/wiki/ISBN_\(identifiant\)](https://en.wikipedia.org/wiki/ISBN_(identifiant))

431 <https://en.wikipedia.org/wiki/Special:BookSources/9783319528984>

432 [https://en.wikipedia.org/wiki/OCLC_\(identifiant\)](https://en.wikipedia.org/wiki/OCLC_(identifiant))

433 <http://www.worldcat.org/oclc/987302273>

434 <https://books.google.com/books?id=amLqckyrvUwC>

435 [https://en.wikipedia.org/wiki/ISBN_\(identifiant\)](https://en.wikipedia.org/wiki/ISBN_(identifiant))

436 <https://en.wikipedia.org/wiki/Special:BookSources/978-981-256-651-5>

437 <https://books.google.com/books?id=amLqckyrvUwC&pg=PA37>

438 https://en.wikipedia.org/wiki/Hendrik_Lorentz

439 https://en.wikisource.org/wiki/de:Versuch_einer_Theorie_der_electrischen_und_optischen_Erscheinungen_in_bewegten_K%C3%B6rpern

440 https://en.wikisource.org/wiki/The_Measure_of_Time

441 https://en.wikisource.org/wiki/fr:La_th%C3%A9orie_de_Lorentz_et_le_principe_de_r%C3%A9action

442 <http://www.physicsinsights.org/poincare-1900.pdf>

30. POINCARÉ, H. (1881). "SUR LES APPLICATIONS DE LA GÉOMÉTRIE NON-EUCLIDIENNE À LA THÉORIE DES FORMES QUADRATIQUES"⁴⁴³ (PDF). *Association Française Pour l'Avancement des Sciences*. **10**: 132–138.^[permanent dead link⁴⁴⁴]
31. REYNOLDS, W. F. (1993). "HYPERBOLIC GEOMETRY ON A HYPERBOLOID". *The American Mathematical Monthly*. **100** (5): 442–455. doi⁴⁴⁵:10.1080/00029890.1993.11990430⁴⁴⁶. JSTOR⁴⁴⁷ 2324297⁴⁴⁸.
32. POINCARÉ, H. (1892). "CHAPITRE XII: POLARISATION ROTATOIRE"⁴⁴⁹. *Théorie mathématique de la lumière II*. Paris: Georges Carré.
33. TUDOR, T. (2018). "LORENTZ TRANSFORMATION, POINCARÉ VECTORS AND POINCARÉ SPHERE IN VARIOUS BRANCHES OF PHYSICS"⁴⁵⁰. *Symmetry*. **10** (3): 52. Bibcode⁴⁵¹:2018Symm...10...52T⁴⁵². doi⁴⁵³:10.3390/sym10030052⁴⁵⁴.
34. POINCARÉ, H. (1900), "LES RELATIONS ENTRE LA PHYSIQUE EXPÉRIMENTALE ET LA PHYSIQUE MATHÉMATIQUE"⁴⁵⁵, *Revue Générale des Sciences Pures et Appliquées*, **11**: 1163–1175. Reprinted in "Science and Hypothesis", Ch. 9–10.
35. POINCARÉ, HENRI (1913), "THE PRINCIPLES OF MATHEMATICAL PHYSICS"⁴⁵⁶, *The Foundations of Science (The Value of Science)*, New York: Science Press, pp. 297–320; article translated from 1904 original⁴⁵⁷: CS1 maint: postscript (link⁴⁵⁸) available in online chapter from 1913 book⁴⁵⁹
36. POINCARÉ, H. (2007), "38.3, POINCARÉ TO H. A. LORENTZ, MAY 1905"⁴⁶⁰, IN WALTER, S. A. (ED.), *La correspondance entre Henri Poincaré et les physiciens, chimistes, et ingénieurs*, Basel: Birkhäuser, pp. 255–257
37. POINCARÉ, H. (2007), "38.4, POINCARÉ TO H. A. LORENTZ, MAY 1905"⁴⁶¹, IN WALTER, S. A. (ED.), *La correspondance entre Henri Poincaré et les physiciens, chimistes, et ingénieurs*, Basel: Birkhäuser, pp. 257–258
38. [1]⁴⁶² (PDF) Membres de l'Académie des sciences depuis sa création : Henri Poincaré. Sur la dynamique de l' electron. Note de H. Poincaré. C.R. T.140 (1905) 1504–1508.
39. POINCARÉ, H. (1906), "SUR LA DYNAMIQUE DE L'ÉLECTRON (ON THE DYNAMICS OF THE ELECTRON)"⁴⁶³, *Rendiconti del Circolo Matematico Rendiconti*

443 <http://henripoincarepapers.univ-nantes.fr/chp/hp-pdf/hp1881af.pdf>

445 [https://en.wikipedia.org/wiki/Doi_\(identifiant\)](https://en.wikipedia.org/wiki/Doi_(identifiant))

446 <https://doi.org/10.1080%2F00029890.1993.11990430>

447 [https://en.wikipedia.org/wiki/JSTOR_\(identifiant\)](https://en.wikipedia.org/wiki/JSTOR_(identifiant))

448 <http://www.jstor.org/stable/2324297>

449 <https://archive.org/details/thoriemathma00poin>

450 <https://doi.org/10.3390%2Fsym10030052>

451 [https://en.wikipedia.org/wiki/Bibcode_\(identifiant\)](https://en.wikipedia.org/wiki/Bibcode_(identifiant))

452 <https://ui.adsabs.harvard.edu/abs/2018Symm...10...52T>

453 [https://en.wikipedia.org/wiki/Doi_\(identifiant\)](https://en.wikipedia.org/wiki/Doi_(identifiant))

454 <https://doi.org/10.3390%2Fsym10030052>

455 <http://gallica.bnf.fr/ark:/12148/bpt6k17075r/f1167.table>

456 https://en.wikisource.org/wiki/The_Principles_of_Mathematical_Physics

457 <https://en.wikipedia.org/wiki/Template:Citation>

458 https://en.wikipedia.org/wiki/Category:CS1_maint:_postscript

459 https://books.google.com/books/about/The_Foundations_of_Science.html?id=mBvNabP35zoC&pg=PA297

460 <http://henripoincarepapers.univ-nantes.fr/chp/text/lorentz3.html>

461 <http://henripoincarepapers.univ-nantes.fr/chp/text/lorentz4.html>

462 http://www.academie-sciences.fr/pdf/dossiers/Poincare/Poincare_pdf/Poincare_CR1905.pdf

463 <https://zenodo.org/record/1428444>

- del Circolo di Palermo*, **21**: 129–176, Bibcode⁴⁶⁴:1906RCMP...21..129P⁴⁶⁵, doi⁴⁶⁶:10.1007/BF03013466⁴⁶⁷, hdl⁴⁶⁸:2027/uiug.30112063899089⁴⁶⁹, S2CID⁴⁷⁰ 120211823⁴⁷¹ (Wikisource translation)
40. Walter (2007), Secondary sources on relativity
 41. Miller 1981, Secondary sources on relativity
 42. Darrigol 2005, Secondary sources on relativity
 43. EINSTEIN, A. (1905B), "IST DIE TRÄGHEIT EINES KÖRPERS VON DESSEN ENERGIEINHALT ABHÄNGIG?", *Annalen der Physik*, **18** (13): 639–643, Bibcode⁴⁷²:1905AnP...323..639E⁴⁷³, doi⁴⁷⁴:10.1002/andp.19053231314⁴⁷⁵. See also English translation⁴⁷⁶.
 44. EINSTEIN, A. (1906), "DAS PRINZIP VON DER ERHALTUNG DER SCHWERPUNKTSBEWEGUNG UND DIE TRÄGHEIT DER ENERGIE"⁴⁷⁷ (PDF), *Annalen der Physik*, **20** (8): 627–633, Bibcode⁴⁷⁸:1906AnP...325..627E⁴⁷⁹, doi⁴⁸⁰:10.1002/andp.19063250814⁴⁸¹, archived from the original⁴⁸² (PDF) on 18 March 2006
 45. "Il importait d'examiner cette hypothèse de plus près et en particulier de rechercher quelles modifications elle nous obligerait à apporter aux lois de la gravitation. C'est ce que j'ai cherché à déterminer; j'ai été d'abord conduit à supposer que la propagation de la gravitation n'est pas instantanée, mais se fait avec la vitesse de la lumière."
 46. *The Berlin Years: Correspondence, January 1919–April 1920 (English translation supplement)*⁴⁸³. THE COLLECTED PAPERS OF ALBERT EINSTEIN. VOL. 9. PRINCETON U.P. P. 30. See also this letter, with commentary, in SASS, HANS-MARTIN⁴⁸⁴ (1979). "EINSTEIN ÜBER "WAHRE KULTUR" UND DIE STELLUNG DER GEOMETRIE IM WISSENSCHAFTSSYSTEM: EIN BRIEF ALBERT EINSTEINS AN HANS VAHINGER VOM JAHRE 1919". *Zeitschrift für allgemeine Wissenschaft-*

464 [https://en.wikipedia.org/wiki/Bibcode_\(identifiant\)](https://en.wikipedia.org/wiki/Bibcode_(identifiant))

465 <https://ui.adsabs.harvard.edu/abs/1906RCMP...21..129P>

466 [https://en.wikipedia.org/wiki/Doi_\(identifiant\)](https://en.wikipedia.org/wiki/Doi_(identifiant))

467 <https://doi.org/10.1007%2FBF03013466>

468 [https://en.wikipedia.org/wiki/Hdl_\(identifiant\)](https://en.wikipedia.org/wiki/Hdl_(identifiant))

469 <http://hdl.handle.net/2027%2Fuig.30112063899089>

470 [https://en.wikipedia.org/wiki/S2CID_\(identifiant\)](https://en.wikipedia.org/wiki/S2CID_(identifiant))

471 <https://api.semanticscholar.org/CorpusID:120211823>

472 [https://en.wikipedia.org/wiki/Bibcode_\(identifiant\)](https://en.wikipedia.org/wiki/Bibcode_(identifiant))

473 <https://ui.adsabs.harvard.edu/abs/1905AnP...323..639E>

474 [https://en.wikipedia.org/wiki/Doi_\(identifiant\)](https://en.wikipedia.org/wiki/Doi_(identifiant))

475 <https://doi.org/10.1002%2Fandp.19053231314>

476 <http://www.fourmilab.ch/etexts/einstein/specrel/www>

477 https://web.archive.org/web/20060318060830/http://www.physik.uni-augsburg.de/annalen/history/papers/1906_20_627-633.pdf

478 [https://en.wikipedia.org/wiki/Bibcode_\(identifiant\)](https://en.wikipedia.org/wiki/Bibcode_(identifiant))

479 <https://ui.adsabs.harvard.edu/abs/1906AnP...325..627E>

480 [https://en.wikipedia.org/wiki/Doi_\(identifiant\)](https://en.wikipedia.org/wiki/Doi_(identifiant))

481 <https://doi.org/10.1002%2Fandp.19063250814>

482 http://www.physik.uni-augsburg.de/annalen/history/papers/1906_20_627-633.pdf

483 <http://einsteinpapers.press.princeton.edu/vol9-trans/52>

484 https://en.wikipedia.org/wiki/Hans-Martin_Sass

- stheorie*⁴⁸⁵ (IN GERMAN). 10 (2): 316–319. doi⁴⁸⁶:10.1007/bf01802352⁴⁸⁷. JSTOR⁴⁸⁸ 25170513⁴⁸⁹. S2CID⁴⁹⁰ 170178963⁴⁹¹.
47. Darrigol 2004, Secondary sources on relativity
48. Galison 2003 and Kragh 1999, Secondary sources on relativity
49. Holton (1988), 196–206
50. Hentschel (1990), 3–13^[full citation needed⁴⁹²]
51. Miller (1981), 216–217
52. Darrigol (2005), 15–18
53. Katzir (2005), 286–288
54. Whittaker 1953, Secondary sources on relativity
55. Poincaré, Selected works in three volumes. page = 682^[full citation needed⁴⁹³]
56. Stillwell 2010⁴⁹⁴, p. 419–435.
57. ALEKSANDROV, PAVEL S.⁴⁹⁵, *Poincaré and topology*, pp. 27–81^[full citation needed⁴⁹⁶]
58. J. Stillwell, Mathematics and its history, page 254⁴⁹⁷
59. A. Kozenko, The theory of planetary figures, pages = 25–26^[full citation needed⁴⁹⁸]
60. French: "Mémoire sur les courbes définies par une équation différentielle"
61. KOLMOGOROV, A.N.; YUSHKEVICH, A.P., EDS. (24 MARCH 1998). *Mathematics of the 19th century*. Vol. 3. pp. 162–174, 283. ISBN⁴⁹⁹ 978-3764358457⁵⁰⁰.
62. J. Hadamard. L'oeuvre de H. Poincaré. Acta Mathematica, 38 (1921), p. 208
63. Toulouse, Édouard, 1910.Henri Poincaré, E. Flammarion, Paris⁵⁰¹. 2005.
64. TOULOUSE, E. (2013). *Henri Poincaré*⁵⁰². MPUBLISHING. ISBN⁵⁰³ 9781418165062⁵⁰⁴. RETRIEVED 10 OCTOBER 2014.
65. "JULES HENRI POINCARÉ (1854–1912)"⁵⁰⁵. ROYAL NETHERLANDS ACADEMY OF ARTS AND SCIENCES. ARCHIVED FROM THE ORIGINAL⁵⁰⁶ ON 5 SEPTEMBER 2015. RETRIEVED 4 AUGUST 2015.
66. GRAY, JEREMY (2013). "THE CAMPAIGN FOR POINCARÉ". *Henri Poincaré: A Scientific Biography*. Princeton University Press. pp. 194–196.
67. CRAWFORD, ELIZABETH (25 NOVEMBER 1987). *The Beginnings of the Nobel Institution: The Science Prizes, 1901–1915*. Cambridge University Press. pp. 141–142.

485 https://en.wikipedia.org/wiki/Zeitschrift_f%C3%BCr_allgemeine_Wissenschaftstheorie

486 [https://en.wikipedia.org/wiki/Doi_\(identifier\)](https://en.wikipedia.org/wiki/Doi_(identifier))

487 <https://doi.org/10.1007/2Fbf01802352>

488 [https://en.wikipedia.org/wiki/JSTOR_\(identifier\)](https://en.wikipedia.org/wiki/JSTOR_(identifier))

489 <http://www.jstor.org/stable/25170513>

490 [https://en.wikipedia.org/wiki/S2CID_\(identifier\)](https://en.wikipedia.org/wiki/S2CID_(identifier))

491 <https://api.semanticscholar.org/CorpusID:170178963>

494 #CITEREFStillwell2010

495 https://en.wikipedia.org/wiki/Pavel_Alexandrov

497 <https://books.google.com/books?id=V7mxZqjs5yUC&pg=PA254>

499 [https://en.wikipedia.org/wiki/ISBN_\(identifier\)](https://en.wikipedia.org/wiki/ISBN_(identifier))

500 <https://en.wikipedia.org/wiki/Special:BookSources/978-3764358457>

501 <http://name.umd.umich.edu/AAS9989.0001.001>

502 <https://books.google.com/books?id=mpjWPQAACAAJ>

503 [https://en.wikipedia.org/wiki/ISBN_\(identifier\)](https://en.wikipedia.org/wiki/ISBN_(identifier))

504 <https://en.wikipedia.org/wiki/Special:BookSources/9781418165062>

505 <https://web.archive.org/web/20150905152142/http://www.dwc.knaw.nl/biografie/pmknaw/?pagetype=authorDetail&aId=PE00002358>

506 <http://www.dwc.knaw.nl/biografie/pmknaw/?pagetype=authorDetail&aId=PE00002358>

68. "NOMINATION DATABASE"⁵⁰⁷. *Nobelprize.org*. Nobel Media AB. Retrieved 24 September 2015.
69. CRAWFORD, ELIZABETH (13 NOVEMBER 1998). "NOBEL: ALWAYS THE WINNERS, NEVER THE LOSERS". *Science*⁵⁰⁸. **282** (5392): 1256–1257. Bibcode⁵⁰⁹:1998Sci...282.1256C⁵¹⁰. doi⁵¹¹:10.1126/science.282.5392.1256⁵¹². S2CID⁵¹³ 153619456⁵¹⁴.^[dead link⁵¹⁵]
70. NASTASI, PIETRO (16 MAY 2013). "A NOBEL PRIZE FOR POINCARÉ?"⁵¹⁶. *Lettera Matematica*. **1** (1–2): 79–82. doi⁵¹⁷:10.1007/s40329-013-0005-1⁵¹⁸.
71. Yemima Ben-Menahem, *Conventionalism: From Poincaré to Quine*, Cambridge University Press, 2006, p. 39.
72. GARGANI JULIEN (2012), *Poincaré, le hasard et l'étude des systèmes complexes*⁵¹⁹, L'HARMATTAN, P. 124, ARCHIVED FROM THE ORIGINAL⁵²⁰ ON 4 MARCH 2016, RETRIEVED 5 JUNE 2015
73. POINCARÉ, HENRI (2007), *Science and Hypothesis*⁵²¹, COSIMO, INC. PRESS, P. 50, ISBN⁵²² 978-1-60206-505-5⁵²³
74. Hadamard, Jacques. *An Essay on the Psychology of Invention in the Mathematical Field*. Princeton Univ Press (1945)
75. POINCARÉ, HENRI (1914). "3: MATHEMATICAL CREATION"⁵²⁴. *Science and Method*. Archived from the original⁵²⁵ on 4 September 2019. Retrieved 4 September 2019.
76. Dennett, Daniel C. 1978. *Brainstorms: Philosophical Essays on Mind and Psychology*. The MIT Press, p.293
77. "Structural Realism"⁵²⁶: entry by James Ladyman in the *Stanford Encyclopedia of Philosophy*⁵²⁷

507 <https://www.nobelprize.org/nomination/archive/list.php>

508 [https://en.wikipedia.org/wiki/Science_\(journal\)](https://en.wikipedia.org/wiki/Science_(journal))

509 [https://en.wikipedia.org/wiki/Bibcode_\(identifiant\)](https://en.wikipedia.org/wiki/Bibcode_(identifiant))

510 <https://ui.adsabs.harvard.edu/abs/1998Sci...282.1256C>

511 [https://en.wikipedia.org/wiki/Doi_\(identifiant\)](https://en.wikipedia.org/wiki/Doi_(identifiant))

512 <https://doi.org/10.1126%2Fscience.282.5392.1256>

513 [https://en.wikipedia.org/wiki/S2CID_\(identifiant\)](https://en.wikipedia.org/wiki/S2CID_(identifiant))

514 <https://api.semanticscholar.org/CorpusID:153619456>

516 <https://doi.org/10.1007%2Fs40329-013-0005-1>

517 [https://en.wikipedia.org/wiki/Doi_\(identifiant\)](https://en.wikipedia.org/wiki/Doi_(identifiant))

518 <https://doi.org/10.1007%2Fs40329-013-0005-1>

519 <https://web.archive.org/web/20160304140554/http://www.editions-harmattan.fr/index.asp?navig=catalogue&obj=livre&no=38754>

520 <http://www.editions-harmattan.fr/index.asp?navig=catalogue&obj=livre&no=38754>

521 <https://books.google.com/books?id=2QXqHaVbkgoC&pg=PA50>

522 [https://en.wikipedia.org/wiki/ISBN_\(identifiant\)](https://en.wikipedia.org/wiki/ISBN_(identifiant))

523 <https://en.wikipedia.org/wiki/Special:BookSources/978-1-60206-505-5>

524 <https://web.archive.org/web/20190904163001/https://ebooks.adelaide.edu.au/p/poincare/henri/science-and-method/book1.3.html>

525 <https://ebooks.adelaide.edu.au/p/poincare/henri/science-and-method/book1.3.html>

526 <http://plato.stanford.edu/entries/structural-realism/#Rel>

527 https://en.wikipedia.org/wiki/Stanford_Encyclopedia_of_Philosophy

1.9.2 Sources

- Bell, Eric Temple⁵²⁸, 1986. *Men of Mathematics* (reissue edition). Touchstone Books. ISBN⁵²⁹ 0-671-62818-6⁵³⁰.
- Belliver, André, 1956. *Henri Poincaré ou la vocation souveraine*. Paris: Gallimard.
- Bernstein, Peter L⁵³¹, 1996. "Against the Gods: A Remarkable Story of Risk". (p. 199–200). John Wiley & Sons.
- Boyer, B. Carl⁵³², 1968. *A History of Mathematics: Henri Poincaré*, John Wiley & Sons.
- Grattan-Guinness, Ivor⁵³³, 2000. *The Search for Mathematical Roots 1870–1940*. Princeton Uni. Press.
- DAUBEN, JOSEPH⁵³⁴ (2004) [1993], "GEORG CANTOR AND THE BATTLE FOR TRANSFINITE SET THEORY"⁵³⁵ (PDF), *Proceedings of the 9th ACMS Conference (Westmont College, Santa Barbara, CA)*, pp. 1–22, archived from the original⁵³⁶ (PDF) on 13 July 2010. Internet version published in Journal of the ACMS 2004.
- Folina, Janet, 1992. *Poincaré and the Philosophy of Mathematics*. Macmillan, New York.
- Gray, Jeremy⁵³⁷, 1986. *Linear differential equations and group theory from Riemann to Poincaré*, Birkhauser ISBN⁵³⁸ 0-8176-3318-9⁵³⁹
- Gray, Jeremy, 2013. *Henri Poincaré: A scientific biography*. Princeton University Press ISBN⁵⁴⁰ 978-0-691-15271-4⁵⁴¹
- JEAN MAWHIN⁵⁴² (OCTOBER 2005), "HENRI POINCARÉ. A LIFE IN THE SERVICE OF SCIENCE"⁵⁴³ (PDF), *Notices of the AMS*, **52** (9): 1036–1044
- Kolak, Daniel, 2001. *Lovers of Wisdom*, 2nd ed. Wadsworth.
- Gargani, Julien, 2012. *Poincaré, le hasard et l'étude des systèmes complexes*, L'Harmattan.
- Murzi, 1998. "Henri Poincaré".
- O'Connor, J. John, and Robertson, F. Edmund, 2002, "Jules Henri Poincaré". University of St. Andrews, Scotland.
- Peterson, Ivars⁵⁴⁴, 1995. *Newton's Clock: Chaos in the Solar System* (reissue edition). W H Freeman & Co. ISBN⁵⁴⁵ 0-7167-2724-2⁵⁴⁶.
- Sageret, Jules, 1911. *Henri Poincaré*. Paris: Mercure de France.

528 https://en.wikipedia.org/wiki/Eric_Temple_Bell

529 [https://en.wikipedia.org/wiki/ISBN_\(identifiant\)](https://en.wikipedia.org/wiki/ISBN_(identifiant))

530 <https://en.wikipedia.org/wiki/Special:BookSources/0-671-62818-6>

531 https://en.wikipedia.org/wiki/Peter_L._Bernstein

532 https://en.wikipedia.org/wiki/Carl_Benjamin_Boyer

533 https://en.wikipedia.org/wiki/Ivor_Grattan-Guinness

534 https://en.wikipedia.org/wiki/Joseph_Dauben

535 <https://web.archive.org/web/20100713115605/http://www.acmsonline.org/journal/2004/Dauben-Cantor.pdf>

536 <http://www.acmsonline.org/journal/2004/Dauben-Cantor.pdf>

537 https://en.wikipedia.org/wiki/Jeremy_Gray

538 [https://en.wikipedia.org/wiki/ISBN_\(identifiant\)](https://en.wikipedia.org/wiki/ISBN_(identifiant))

539 <https://en.wikipedia.org/wiki/Special:BookSources/0-8176-3318-9>

540 [https://en.wikipedia.org/wiki/ISBN_\(identifiant\)](https://en.wikipedia.org/wiki/ISBN_(identifiant))

541 <https://en.wikipedia.org/wiki/Special:BookSources/978-0-691-15271-4>

542 https://en.wikipedia.org/wiki/Jean_Mawhin

543 <https://www.ams.org/notices/200509/comm-mawhin.pdf>

544 https://en.wikipedia.org/wiki/Ivars_Peterson

545 [https://en.wikipedia.org/wiki/ISBN_\(identifiant\)](https://en.wikipedia.org/wiki/ISBN_(identifiant))

546 <https://en.wikipedia.org/wiki/Special:BookSources/0-7167-2724-2>

- Toulouse, E., 1910. *Henri Poincaré*.—(Source biography in French) at University of Michigan Historic Math Collection.
- STILLWELL, JOHN (2010). *Mathematics and Its History*⁵⁴⁷ (3RD, ILLUSTRATED ED.). SPRINGER SCIENCE & BUSINESS MEDIA. ISBN⁵⁴⁸ 978-1-4419-6052-8⁵⁴⁹.
- Verhulst, Ferdinand⁵⁵⁰, 2012 *Henri Poincaré. Impatient Genius*. N.Y.: Springer.
- *Henri Poincaré, l'œuvre scientifique, l'œuvre philosophique*, by Vito Volterra, Jacques Hadamard, Paul Langevin and Pierre Boutroux, Felix Alcan, 1914.
 - *Henri Poincaré, l'œuvre mathématique*, by Vito Volterra⁵⁵¹.
 - *Henri Poincaré, le problème des trois corps*, by Jacques Hadamard⁵⁵².
 - *Henri Poincaré, le physicien*, by Paul Langevin⁵⁵³.
 - *Henri Poincaré, l'œuvre philosophique*, by Pierre Boutroux⁵⁵⁴.
- *This article incorporates material from Jules Henri Poincaré on PlanetMath*⁵⁵⁵, which is licensed under the Creative Commons Attribution/Share-Alike License⁵⁵⁶.

1.10 Further reading

1.10.1 Secondary sources to work on relativity

- CUAJ, CAMILLO (1969), "HENRI POINCARÉ'S MATHEMATICAL CONTRIBUTIONS TO RELATIVITY AND THE POINCARÉ STRESSES", *American Journal of Physics*, **36** (12): 1102–1113, Bibcode⁵⁵⁷:1968AmJPh..36.1102C⁵⁵⁸, doi⁵⁵⁹:10.1119/1.1974373⁵⁶⁰
- DARRIGOL, O. (1995), "HENRI POINCARÉ'S CRITICISM OF FIN DE SIÈCLE ELECTRODYNAMICS", *Studies in History and Philosophy of Science*, **26** (1): 1–44, Bibcode⁵⁶¹:1995SHPMP..26....1D⁵⁶², doi⁵⁶³:10.1016/1355-2198(95)00003-C⁵⁶⁴
- DARRIGOL, O. (2000), *Electrodynamics from Ampère to Einstein*⁵⁶⁵, OXFORD: CLARENDON PRESS, ISBN⁵⁶⁶ 978-0-19-850594-5⁵⁶⁷

⁵⁴⁷ <https://books.google.com/books?id=V7mxZqjs5yUC>

⁵⁴⁸ [https://en.wikipedia.org/wiki/ISBN_\(identifier\)](https://en.wikipedia.org/wiki/ISBN_(identifier))

⁵⁴⁹ <https://en.wikipedia.org/wiki/Special:BookSources/978-1-4419-6052-8>

⁵⁵⁰ https://en.wikipedia.org/w/index.php?title=F._Verhulst&action=edit&redlink=1

⁵⁵¹ https://en.wikipedia.org/wiki/Vito_Volterra

⁵⁵² https://en.wikipedia.org/wiki/Jacques_Hadamard

⁵⁵³ https://en.wikipedia.org/wiki/Paul_Langevin

⁵⁵⁴ https://en.wikipedia.org/wiki/Pierre_Boutroux

⁵⁵⁵ <https://en.wikipedia.org/wiki/PlanetMath>

⁵⁵⁶ <https://en.wikipedia.org/wiki/Wikipedia:CC-BY-SA>

⁵⁵⁷ [https://en.wikipedia.org/wiki/Bibcode_\(identifier\)](https://en.wikipedia.org/wiki/Bibcode_(identifier))

⁵⁵⁸ <https://ui.adsabs.harvard.edu/abs/1968AmJPh..36.1102C>

⁵⁵⁹ [https://en.wikipedia.org/wiki/Doi_\(identifier\)](https://en.wikipedia.org/wiki/Doi_(identifier))

⁵⁶⁰ <https://doi.org/10.1119/2F1.1974373>

⁵⁶¹ [https://en.wikipedia.org/wiki/Bibcode_\(identifier\)](https://en.wikipedia.org/wiki/Bibcode_(identifier))

⁵⁶² <https://ui.adsabs.harvard.edu/abs/1995SHPMP..26....1D>

⁵⁶³ [https://en.wikipedia.org/wiki/Doi_\(identifier\)](https://en.wikipedia.org/wiki/Doi_(identifier))

⁵⁶⁴ <https://doi.org/10.1016%2F1355-2198%2895%2900003-C>

⁵⁶⁵ <https://archive.org/details/electrodynamicsf0000darr>

⁵⁶⁶ [https://en.wikipedia.org/wiki/ISBN_\(identifier\)](https://en.wikipedia.org/wiki/ISBN_(identifier))

⁵⁶⁷ <https://en.wikipedia.org/wiki/Special:BookSources/978-0-19-850594-5>

- DARRIGOL, O. (2004), "THE MYSTERY OF THE EINSTEIN-POINCARÉ CONNECTION", *Isis*, **95** (4): 614–626, Bibcode⁵⁶⁸:2004Isis...95..614D⁵⁶⁹, doi⁵⁷⁰:10.1086/430652⁵⁷¹, PMID⁵⁷² 16011297⁵⁷³, S2CID⁵⁷⁴ 26997100⁵⁷⁵
- DARRIGOL, O. (2005), "THE GENESIS OF THE THEORY OF RELATIVITY"⁵⁷⁶ (PDF), *Séminaire Poincaré*, **1**: 1–22, Bibcode⁵⁷⁷:2006eins.book....1D⁵⁷⁸, doi⁵⁷⁹:10.1007/3-7643-7436-5_1⁵⁸⁰, ISBN⁵⁸¹ 978-3-7643-7435-8⁵⁸²
- GALISON, P. (2003), *Einstein's Clocks, Poincaré's Maps: Empires of Time*, New York: W.W. Norton, ISBN⁵⁸³ 978-0-393-32604-8⁵⁸⁴
- GIANNETTO, E. (1998), "THE RISE OF SPECIAL RELATIVITY: HENRI POINCARÉ'S WORKS BEFORE EINSTEIN", *Atti del XVIII Congresso di Storia della Fisica e dell'astronomia*: 171–207
- GIEDYMIN, J.⁵⁸⁵ (1982), *Science and Convention: Essays on Henri Poincaré's Philosophy of Science and the Conventionalist Tradition*, Oxford: Pergamon Press, ISBN⁵⁸⁶ 978-0-08-025790-7⁵⁸⁷
- GOLDBERG, S. (1967), "HENRI POINCARÉ AND EINSTEIN'S THEORY OF RELATIVITY", *American Journal of Physics*, **35** (10): 934–944, Bibcode⁵⁸⁸:1967AmJPh..35..934G⁵⁸⁹, doi⁵⁹⁰:10.1119/1.1973643⁵⁹¹
- GOLDBERG, S. (1970), "POINCARÉ'S SILENCE AND EINSTEIN'S RELATIVITY", *British Journal for the History of Science*, **5**: 73–84, doi⁵⁹²:10.1017/S0007087400010633⁵⁹³, S2CID⁵⁹⁴ 123766991⁵⁹⁵

568 [https://en.wikipedia.org/wiki/Bibcode_\(identifier\)](https://en.wikipedia.org/wiki/Bibcode_(identifier))
569 <https://ui.adsabs.harvard.edu/abs/2004Isis...95..614D>
570 [https://en.wikipedia.org/wiki/Doi_\(identifier\)](https://en.wikipedia.org/wiki/Doi_(identifier))
571 <https://doi.org/10.1086%2F430652>
572 [https://en.wikipedia.org/wiki/PMID_\(identifier\)](https://en.wikipedia.org/wiki/PMID_(identifier))
573 <http://pubmed.ncbi.nlm.nih.gov/16011297>
574 [https://en.wikipedia.org/wiki/S2CID_\(identifier\)](https://en.wikipedia.org/wiki/S2CID_(identifier))
575 <https://api.semanticscholar.org/CorpusID:26997100>
576 <http://www.bourbaphy.fr/darrigol2.pdf>
577 [https://en.wikipedia.org/wiki/Bibcode_\(identifier\)](https://en.wikipedia.org/wiki/Bibcode_(identifier))
578 <https://ui.adsabs.harvard.edu/abs/2006eins.book....1D>
579 [https://en.wikipedia.org/wiki/Doi_\(identifier\)](https://en.wikipedia.org/wiki/Doi_(identifier))
580 https://doi.org/10.1007%2F3-7643-7436-5_1
581 [https://en.wikipedia.org/wiki/ISBN_\(identifier\)](https://en.wikipedia.org/wiki/ISBN_(identifier))
582 <https://en.wikipedia.org/wiki/Special:BookSources/978-3-7643-7435-8>
583 [https://en.wikipedia.org/wiki/ISBN_\(identifier\)](https://en.wikipedia.org/wiki/ISBN_(identifier))
584 <https://en.wikipedia.org/wiki/Special:BookSources/978-0-393-32604-8>
585 https://en.wikipedia.org/wiki/Jerzy_Giedymin
586 [https://en.wikipedia.org/wiki/ISBN_\(identifier\)](https://en.wikipedia.org/wiki/ISBN_(identifier))
587 <https://en.wikipedia.org/wiki/Special:BookSources/978-0-08-025790-7>
588 [https://en.wikipedia.org/wiki/Bibcode_\(identifier\)](https://en.wikipedia.org/wiki/Bibcode_(identifier))
589 <https://ui.adsabs.harvard.edu/abs/1967AmJPh..35..934G>
590 [https://en.wikipedia.org/wiki/Doi_\(identifier\)](https://en.wikipedia.org/wiki/Doi_(identifier))
591 <https://doi.org/10.1119%2F1.1973643>
592 [https://en.wikipedia.org/wiki/Doi_\(identifier\)](https://en.wikipedia.org/wiki/Doi_(identifier))
593 <https://doi.org/10.1017%2FS0007087400010633>
594 [https://en.wikipedia.org/wiki/S2CID_\(identifier\)](https://en.wikipedia.org/wiki/S2CID_(identifier))
595 <https://api.semanticscholar.org/CorpusID:123766991>

- HOLTON, G. (1988) [1973], "POINCARÉ AND RELATIVITY", *Thematic Origins of Scientific Thought: Kepler to Einstein*⁵⁹⁶, HARVARD UNIVERSITY PRESS, ISBN⁵⁹⁷ 978-0-674-87747-4⁵⁹⁸
- KATZIR, S. (2005), "POINCARÉ'S RELATIVISTIC PHYSICS: ITS ORIGINS AND NATURE", *Phys. Perspect.*, **7** (3): 268–292, Bibcode⁵⁹⁹:2005PhP.....7..268K⁶⁰⁰, doi⁶⁰¹:10.1007/s00016-004-0234-y⁶⁰², S2CID⁶⁰³ 14751280⁶⁰⁴
- KESWANI, G.H., KILMISTER, C.W. (1983), "INTIMATIONS OF RELATIVITY: RELATIVITY BEFORE EINSTEIN"⁶⁰⁵, *Br. J. Philos. Sci.*, **34** (4): 343–354, doi⁶⁰⁶:10.1093/bjps/34.4.343⁶⁰⁷, S2CID⁶⁰⁸ 65257414⁶⁰⁹, archived from the original⁶¹⁰ on 26 March 2009⁶¹¹: CS1 maint: multiple names: authors list (link⁶¹²)
- KESWANI, G.H. (1965), "ORIGIN AND CONCEPT OF RELATIVITY, PART I", *Br. J. Philos. Sci.*, **15** (60): 286–306, doi⁶¹³:10.1093/bjps/XV.60.286⁶¹⁴, S2CID⁶¹⁵ 229320737⁶¹⁶
- KESWANI, G.H. (1965), "ORIGIN AND CONCEPT OF RELATIVITY, PART II", *Br. J. Philos. Sci.*, **16** (61): 19–32, doi⁶¹⁷:10.1093/bjps/XVI.61.19⁶¹⁸, S2CID⁶¹⁹ 229320603⁶²⁰
- KESWANI, G.H. (1966), "ORIGIN AND CONCEPT OF RELATIVITY, PART III", *Br. J. Philos. Sci.*, **16** (64): 273–294, doi⁶²¹:10.1093/bjps/XVI.64.273⁶²², S2CID⁶²³ 122596290⁶²⁴
- KRAGH, H. (1999), *Quantum Generations: A History of Physics in the Twentieth Century*, Princeton University Press, ISBN⁶²⁵ 978-0-691-09552-3⁶²⁶

596 https://en.wikipedia.org/wiki/Thematic_Origins_of_Scientific_Thought:_Kepler_to_Einstein
 597 [https://en.wikipedia.org/wiki/ISBN_\(identifier\)](https://en.wikipedia.org/wiki/ISBN_(identifier))
 598 <https://en.wikipedia.org/wiki/Special:BookSources/978-0-674-87747-4>
 599 [https://en.wikipedia.org/wiki/Bibcode_\(identifier\)](https://en.wikipedia.org/wiki/Bibcode_(identifier))
 600 <https://ui.adsabs.harvard.edu/abs/2005PhP.....7..268K>
 601 [https://en.wikipedia.org/wiki/Doi_\(identifier\)](https://en.wikipedia.org/wiki/Doi_(identifier))
 602 <https://doi.org/10.1007/2Fs00016-004-0234-y>
 603 [https://en.wikipedia.org/wiki/S2CID_\(identifier\)](https://en.wikipedia.org/wiki/S2CID_(identifier))
 604 <https://api.semanticscholar.org/CorpusID:14751280>
 605 https://web.archive.org/web/20090326084436/http://osiris.sunderland.ac.uk/webedit/allweb/news/Philosophy_of_Science/PIRT2002/Intimations%20of%20Relativity.doc
 606 [https://en.wikipedia.org/wiki/Doi_\(identifier\)](https://en.wikipedia.org/wiki/Doi_(identifier))
 607 <https://doi.org/10.1093/2Fbjps%2F34.4.343>
 608 [https://en.wikipedia.org/wiki/S2CID_\(identifier\)](https://en.wikipedia.org/wiki/S2CID_(identifier))
 609 <https://api.semanticscholar.org/CorpusID:65257414>
 610 http://osiris.sunderland.ac.uk/webedit/allweb/news/Philosophy_of_Science/PIRT2002/Intimations%20of%20Relativity.doc
 611 <https://en.wikipedia.org/wiki/Template:Citation>
 612 https://en.wikipedia.org/wiki/Category:CS1_maint:_multiple_names:_authors_list
 613 [https://en.wikipedia.org/wiki/Doi_\(identifier\)](https://en.wikipedia.org/wiki/Doi_(identifier))
 614 <https://doi.org/10.1093/2Fbjps%2FXV.60.286>
 615 [https://en.wikipedia.org/wiki/S2CID_\(identifier\)](https://en.wikipedia.org/wiki/S2CID_(identifier))
 616 <https://api.semanticscholar.org/CorpusID:229320737>
 617 [https://en.wikipedia.org/wiki/Doi_\(identifier\)](https://en.wikipedia.org/wiki/Doi_(identifier))
 618 <https://doi.org/10.1093/2Fbjps%2FXVI.61.19>
 619 [https://en.wikipedia.org/wiki/S2CID_\(identifier\)](https://en.wikipedia.org/wiki/S2CID_(identifier))
 620 <https://api.semanticscholar.org/CorpusID:229320603>
 621 [https://en.wikipedia.org/wiki/Doi_\(identifier\)](https://en.wikipedia.org/wiki/Doi_(identifier))
 622 <https://doi.org/10.1093/2Fbjps%2FXVI.64.273>
 623 [https://en.wikipedia.org/wiki/S2CID_\(identifier\)](https://en.wikipedia.org/wiki/S2CID_(identifier))
 624 <https://api.semanticscholar.org/CorpusID:122596290>
 625 [https://en.wikipedia.org/wiki/ISBN_\(identifier\)](https://en.wikipedia.org/wiki/ISBN_(identifier))
 626 <https://en.wikipedia.org/wiki/Special:BookSources/978-0-691-09552-3>

- LANGEVIN, P. (1913), "L'ŒUVRE D'HENRI POINCARÉ: LE PHYSICIEN"⁶²⁷, *Revue de Métaphysique et de Morale*, **21**: 703
- MACROSSAN, M. N. (1986), "A NOTE ON RELATIVITY BEFORE EINSTEIN"⁶²⁸, *Br. J. Philos. Sci.*, **37** (2): 232–234, CiteSeerX⁶²⁹ 10.1.1.679.5898⁶³⁰, doi⁶³¹:10.1093/bjps/37.2.232⁶³², S2CID⁶³³ 121973100⁶³⁴, archived from the original⁶³⁵ on 29 October 2013, retrieved 27 March 2007
- MILLER, A.I. (1973), "A STUDY OF HENRI POINCARÉ'S "SUR LA DYNAMIQUE DE L'ELECTRON", *Arch. Hist. Exact Sci.*, **10** (3–5): 207–328, doi⁶³⁶:10.1007/BF00412332⁶³⁷, S2CID⁶³⁸ 189790975⁶³⁹
- MILLER, A.I. (1981), *Albert Einstein's special theory of relativity. Emergence (1905) and early interpretation (1905–1911)*⁶⁴⁰, READING: ADDISON–WESLEY, ISBN⁶⁴¹ 978-0-201-04679-3⁶⁴²
- MILLER, A.I. (1996), "WHY DID POINCARÉ NOT FORMULATE SPECIAL RELATIVITY IN 1905?", IN JEAN-LOUIS GREFFE; GERHARD HEINZMANN; KUNO LORENZ (EDS.), *Henri Poincaré : science et philosophie*, Berlin, pp. 69–100
- POPP, B.D. (2020), *Henri Poincaré: Electrons to Special Relativity*, Cham: Springer Nature, ISBN⁶⁴³ 978-3-030-48038-7⁶⁴⁴
- SCHWARTZ, H. M. (1971), "POINCARÉ'S RENDICONTI PAPER ON RELATIVITY. PART I", *American Journal of Physics*, **39** (7): 1287–1294, Bibcode⁶⁴⁵:1971AmJPh..39.1287S⁶⁴⁶, doi⁶⁴⁷:10.1119/1.1976641⁶⁴⁸
- SCHWARTZ, H. M. (1972), "POINCARÉ'S RENDICONTI PAPER ON RELATIVITY. PART II", *American Journal of Physics*, **40** (6): 862–872, Bibcode⁶⁴⁹:1972AmJPh..40..862S⁶⁵⁰, doi⁶⁵¹:10.1119/1.1986684⁶⁵²

627 <http://gallica.bnf.fr/ark:/12148/bpt6k111418/f93.chemindefer>

628 <https://web.archive.org/web/20131029203003/http://espace.library.uq.edu.au/view.php?pid=UQ:9560>

629 [https://en.wikipedia.org/wiki/CiteSeerX_\(identifiant\)](https://en.wikipedia.org/wiki/CiteSeerX_(identifiant))

630 <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.679.5898>

631 [https://en.wikipedia.org/wiki/Doi_\(identifiant\)](https://en.wikipedia.org/wiki/Doi_(identifiant))

632 <https://doi.org/10.1093%2Fbjps%2F37.2.232>

633 [https://en.wikipedia.org/wiki/S2CID_\(identifiant\)](https://en.wikipedia.org/wiki/S2CID_(identifiant))

634 <https://api.semanticscholar.org/CorpusID:121973100>

635 <http://espace.library.uq.edu.au/view.php?pid=UQ:9560>

636 [https://en.wikipedia.org/wiki/Doi_\(identifiant\)](https://en.wikipedia.org/wiki/Doi_(identifiant))

637 <https://doi.org/10.1007%2FBF00412332>

638 [https://en.wikipedia.org/wiki/S2CID_\(identifiant\)](https://en.wikipedia.org/wiki/S2CID_(identifiant))

639 <https://api.semanticscholar.org/CorpusID:189790975>

640 <https://archive.org/details/alberteinsteinss0000mill>

641 [https://en.wikipedia.org/wiki/ISBN_\(identifiant\)](https://en.wikipedia.org/wiki/ISBN_(identifiant))

642 <https://en.wikipedia.org/wiki/Special:BookSources/978-0-201-04679-3>

643 [https://en.wikipedia.org/wiki/ISBN_\(identifiant\)](https://en.wikipedia.org/wiki/ISBN_(identifiant))

644 <https://en.wikipedia.org/wiki/Special:BookSources/978-3-030-48038-7>

645 [https://en.wikipedia.org/wiki/Bibcode_\(identifiant\)](https://en.wikipedia.org/wiki/Bibcode_(identifiant))

646 <https://ui.adsabs.harvard.edu/abs/1971AmJPh..39.1287S>

647 [https://en.wikipedia.org/wiki/Doi_\(identifiant\)](https://en.wikipedia.org/wiki/Doi_(identifiant))

648 <https://doi.org/10.1119%2F1.1976641>

649 [https://en.wikipedia.org/wiki/Bibcode_\(identifiant\)](https://en.wikipedia.org/wiki/Bibcode_(identifiant))

650 <https://ui.adsabs.harvard.edu/abs/1972AmJPh..40..862S>

651 [https://en.wikipedia.org/wiki/Doi_\(identifiant\)](https://en.wikipedia.org/wiki/Doi_(identifiant))

652 <https://doi.org/10.1119%2F1.1986684>

- SCHWARTZ, H. M. (1972), "POINCARÉ'S RENDICONTI PAPER ON RELATIVITY. PART III", *American Journal of Physics*, **40** (9): 1282–1287, Bibcode⁶⁵³:1972AmJPh..40.1282S⁶⁵⁴, doi⁶⁵⁵:10.1119/1.1986815⁶⁵⁶
- SCRIBNER, C. (1964), "HENRI POINCARÉ AND THE PRINCIPLE OF RELATIVITY", *American Journal of Physics*, **32** (9): 672–678, Bibcode⁶⁵⁷:1964AmJPh..32..672S⁶⁵⁸, doi⁶⁵⁹:10.1119/1.1970936⁶⁶⁰
- WALTER, S. (2005), "HENRI POINCARÉ AND THE THEORY OF RELATIVITY"⁶⁶¹, IN RENN, J. (ED.), *Albert Einstein, Chief Engineer of the Universe: 100 Authors for Einstein*, Berlin: Wiley-VCH, pp. 162–165
- WALTER, S. (2007), "BREAKING IN THE 4-VECTORS: THE FOUR-DIMENSIONAL MOVEMENT IN GRAVITATION, 1905–1910"⁶⁶², IN RENN, J. (ED.), *The Genesis of General Relativity*, vol. 3, Berlin: Springer, pp. 193–252
- WHITTAKER, E.T.⁶⁶³ (1953), "THE RELATIVITY THEORY OF POINCARÉ AND LORENTZ", *A History of the Theories of Aether and Electricity: The Modern Theories 1900–1926*⁶⁶⁴, LONDON: NELSON
- ZAHAR, E. (2001), *Poincaré's Philosophy: From Conventionalism to Phenomenology*, Chicago: Open Court Pub Co, ISBN⁶⁶⁵ 978-0-8126-9435-2⁶⁶⁶

1.10.2 Non-mainstream sources

- LEVEUGLE, J. (2004), *La Relativité et Einstein, Planck, Hilbert—Histoire véridique de la Théorie de la Relativité*, Pars: L'Harmattan
- LOGUNOV, A.A. (2004), *Henri Poincaré and relativity theory*, arXiv⁶⁶⁷:physics/0408077⁶⁶⁸, Bibcode⁶⁶⁹:2004physics...8077L⁶⁷⁰, ISBN⁶⁷¹ 978-5-02-033964-4⁶⁷²

1.11 External links

Wikimedia Commons has media related to Henri Poincaré⁶⁷³.

⁶⁵³ [https://en.wikipedia.org/wiki/Bibcode_\(identifier\)](https://en.wikipedia.org/wiki/Bibcode_(identifier))
⁶⁵⁴ <https://ui.adsabs.harvard.edu/abs/1972AmJPh..40.1282S>
⁶⁵⁵ [https://en.wikipedia.org/wiki/Doi_\(identifier\)](https://en.wikipedia.org/wiki/Doi_(identifier))
⁶⁵⁶ <https://doi.org/10.1119/2F1.1986815>
⁶⁵⁷ [https://en.wikipedia.org/wiki/Bibcode_\(identifier\)](https://en.wikipedia.org/wiki/Bibcode_(identifier))
⁶⁵⁸ <https://ui.adsabs.harvard.edu/abs/1964AmJPh..32..672S>
⁶⁵⁹ [https://en.wikipedia.org/wiki/Doi_\(identifier\)](https://en.wikipedia.org/wiki/Doi_(identifier))
⁶⁶⁰ <https://doi.org/10.1119/2F1.1970936>
⁶⁶¹ <http://scottwalter.free.fr/papers/2005-100authors-poincare-einstein-walter.html>
⁶⁶² <http://scottwalter.free.fr/papers/2007-genesis-walter.html>
⁶⁶³ https://en.wikipedia.org/wiki/E._T._Whittaker
⁶⁶⁴ https://en.wikipedia.org/wiki/A_History_of_the_Theories_of_Aether_and_Electricity
⁶⁶⁵ [https://en.wikipedia.org/wiki/ISBN_\(identifier\)](https://en.wikipedia.org/wiki/ISBN_(identifier))
⁶⁶⁶ <https://en.wikipedia.org/wiki/Special:BookSources/978-0-8126-9435-2>
⁶⁶⁷ [https://en.wikipedia.org/wiki/ArXiv_\(identifier\)](https://en.wikipedia.org/wiki/ArXiv_(identifier))
⁶⁶⁸ <http://arxiv.org/abs/physics/0408077>
⁶⁶⁹ [https://en.wikipedia.org/wiki/Bibcode_\(identifier\)](https://en.wikipedia.org/wiki/Bibcode_(identifier))
⁶⁷⁰ <https://ui.adsabs.harvard.edu/abs/2004physics...8077L>
⁶⁷¹ [https://en.wikipedia.org/wiki/ISBN_\(identifier\)](https://en.wikipedia.org/wiki/ISBN_(identifier))
⁶⁷² <https://en.wikipedia.org/wiki/Special:BookSources/978-5-02-033964-4>
⁶⁷³ https://commons.wikimedia.org/wiki/Category:Henri_Poincar%C3%A9

Wikiquote has quotations related to: *Henri Poincaré*⁶⁷⁴

Wikisource⁶⁷⁵ has original works written by or about:
*Henri Poincaré*⁶⁷⁶

- Works by Henri Poincaré⁶⁷⁷ at Project Gutenberg⁶⁷⁸
- Works by or about Henri Poincaré⁶⁷⁹ at Internet Archive⁶⁸⁰
- Works by Henri Poincaré⁶⁸¹ at LibriVox⁶⁸² (public domain audiobooks)
- Henri Poincaré's Bibliography⁶⁸³
- Internet Encyclopedia of Philosophy⁶⁸⁴: "Henri Poincaré⁶⁸⁵"—by Mauro Murzi.
- Internet Encyclopedia of Philosophy⁶⁸⁶: "Poincaré's Philosophy of Mathematics⁶⁸⁷"—by Janet Folina.
- Henri Poincaré⁶⁸⁸ at the Mathematics Genealogy Project⁶⁸⁹
- Henri Poincaré on Information Philosopher⁶⁹⁰
- O'CONNOR, JOHN J.⁶⁹¹; ROBERTSON, EDMUND F.⁶⁹², "HENRI POINCARÉ"⁶⁹³, *MacTutor History of Mathematics archive*⁶⁹⁴, UNIVERSITY OF ST ANDREWS⁶⁹⁵
- A timeline of Poincaré's life⁶⁹⁶ University of Nantes (in French).
- Henri Poincaré Papers⁶⁹⁷ University of Nantes (in French).
- Bruce Medal page⁶⁹⁸

674 https://en.wikiquote.org/wiki/Special:Search/Henri_Poincar%C3%A9

675 <https://en.wikipedia.org/wiki/Wikisource>

676 https://en.wikisource.org/wiki/Author:Henri_Poincar%C3%A9

677 <https://www.gutenberg.org/author/Poincar%C3%A9,+Henri>

678 https://en.wikipedia.org/wiki/Project_Gutenberg
<https://archive.org/search.php?query=%28%28subject%3A%22Poincar%C3%A9%2C%20Henri%22%20OR%20subject%3A%22Henri%20Poincar%C3%A9%22%20OR%20creator%3A%22Poincar%C3%A9%2C%20Henri%22%20OR%20creator%3A%22Henri%20Poincar%C3%A9%22%20OR%20creator%3A%22Poincar%C3%A9%2C%20H%2E%22%20OR%20title%3A%22Henri%20Poincar%C3%A9%22%20OR%20description%3A%22Poincar%C3%A9%2C%20Henri%22%20OR%20description%3A%22Henri%20Poincar%C3%A9%22%20OR%20%28Henri+Poincar%2A%29%29%20OR%20%28%221854-1912%22%20AND%20%28%22Poincar%C3%A9%22%20OR%20Poincar%C3%A9%29%29%29%20AND%20%28-mediatype:software%29>

680 https://en.wikipedia.org/wiki/Internet_Archive

681 <https://librivox.org/author/4281>

682 <https://en.wikipedia.org/wiki/LibriVox>

683 <http://henripoincarepapers.univ-nantes.fr/en/bibliohp/>

684 https://en.wikipedia.org/wiki/Internet_Encyclopedia_of_Philosophy

685 <http://www.utm.edu/research/iep/p/poincare.htm>

686 https://en.wikipedia.org/wiki/Internet_Encyclopedia_of_Philosophy

687 <http://www.iep.utm.edu/poi-math/>

688 <https://mathgenealogy.org/id.php?id=34227>

689 https://en.wikipedia.org/wiki/Mathematics_Genealogy_Project

690 <https://web.archive.org/web/20090930005045/https://www.informationphilosopher.com/solutions/scientists/poincare/>

691 [https://en.wikipedia.org/wiki/John_J._O%27Connor_\(mathematician\)](https://en.wikipedia.org/wiki/John_J._O%27Connor_(mathematician))

692 https://en.wikipedia.org/wiki/Edmund_F._Robertson

693 <https://mathshistory.st-andrews.ac.uk/Biographies/Poincare.html>

694 https://en.wikipedia.org/wiki/MacTutor_History_of_Mathematics_archive

695 https://en.wikipedia.org/wiki/University_of_St_Andrews

696 <http://henripoincarepapers.univ-nantes.fr/chronos.php>

697 <http://henripoincarepapers.univ-nantes.fr>

698 <https://web.archive.org/web/20060627062431/https://www.phys-astro.sonoma.edu/BruceMedalists/Poincare/index.html>

- Collins, Graham P., "Henri Poincaré, His Conjecture, Copacabana and Higher Dimensions⁶⁹⁹," *Scientific American*⁷⁰⁰, 9 June 2004.
- BBC in Our Time, "Discussion of the Poincaré conjecture⁷⁰¹," 2 November 2006, hosted by Melvynn Bragg⁷⁰².
- Poincare Contemplates Copernicus⁷⁰³ at MathPages
- High Anxieties – The Mathematics of Chaos⁷⁰⁴ (2008) BBC documentary directed by David Malone⁷⁰⁵ looking at the influence of Poincaré's discoveries on 20th Century mathematics.

Cultural offices
Preceded by Sully Prudhomme⁷⁰⁶

Seat 24⁷⁰⁷
Académie française⁷⁰⁸
1908-1912

Succeeded by Alfred Capus⁷⁰⁹

Philosophy of science

Dynamical systems

Relativity

Authority control

- 699 https://web.archive.org/web/20071017055831/http://www.sciam.com/print_version.cfm?articleID=0003848D-1C61-10C7-9C6183414B7F0000
- 700 https://en.wikipedia.org/wiki/Scientific_American
- 701 <https://web.archive.org/web/20090424054425/http://www.bbc.co.uk/radio4/history/inourtime/inourtime.shtml>
- 702 https://en.wikipedia.org/w/index.php?title=Melvynn_Bragg&action=edit&redlink=1
- 703 <https://web.archive.org/web/20070927190224/http://www.mathpages.com/home/kmath305/kmath305.htm>
- 704 <https://www.youtube.com/user/thedebtgeneration?feature=mhum#p/u/8/5pKrKdNclYs0>
- 705 [https://en.wikipedia.org/wiki/David_Malone_\(independent_filmmaker\)](https://en.wikipedia.org/wiki/David_Malone_(independent_filmmaker))
- 706 https://en.wikipedia.org/wiki/Sully_Prudhomme
- 707 https://en.wikipedia.org/wiki/List_of_members_of_the_Acad%C3%A9mie_fran%C3%A7aise#Seat_24
- 708 https://en.wikipedia.org/wiki/Acad%C3%A9mie_fran%C3%A7aise
- 709 https://en.wikipedia.org/wiki/Alfred_Capus

Authority control

- This page was last edited on 17 March 2022, at 19:24 (UTC).
- Text is available under the Creative Commons Attribution-ShareAlike License 3.0⁷¹⁰⁷¹¹; additional terms may apply. By using this site, you agree to the Terms of Use⁷¹² and Privacy Policy⁷¹³. Wikipedia® is a registered trademark of the Wikimedia Foundation, Inc.⁷¹⁴, a non-profit organization.

⁷¹⁰ http://en.wikipedia.org/wiki/Wikipedia:Text_of_Creative_Commons_Attribution-ShareAlike_3.0_Unported_License

⁷¹¹ <http://creativecommons.org/licenses/by-sa/3.0/>

⁷¹² http://foundation.wikimedia.org/wiki/Terms_of_Use

⁷¹³ http://foundation.wikimedia.org/wiki/Privacy_policy

⁷¹⁴ <http://www.wikimediafoundation.org/>

2 Contributors

Edits	User
1	.anacondabot ¹
1	19.168 ²
3	2015.ww ³
1	345Kai ⁴
1	777sms ⁵
4	Acegikmo1 ⁶
2	Adam annaben ⁷
1	Adam37 ⁸
1	Addbot ⁹
1	Ahmedronaldo321 ¹⁰
1	Ahoerstemeier ¹¹
1	Akasseb ¹²
1	Akrokerama ¹³
1	Alba ¹⁴
2	Albert Yi tao su ¹⁵
2	Albrecht ¹⁶
1	Alfred Noble 3141 ¹⁷
1	Alice M. Lubes ¹⁸
1	Aliotra ¹⁹
1	AlleborgoBot ²⁰

1 <https://en.wikipedia.org/wiki/User:.anacondabot>
2 <https://en.wikipedia.org/w/index.php%3ftitle=User:19.168&action=edit&redlink=1>
3 <https://en.wikipedia.org/w/index.php%3ftitle=User:2015.ww&action=edit&redlink=1>
4 <https://en.wikipedia.org/wiki/User:345Kai>
5 <https://en.wikipedia.org/wiki/User:777sms>
6 <https://en.wikipedia.org/wiki/User:Acegikmo1>
7 https://en.wikipedia.org/wiki/User:Adam_annaben
8 <https://en.wikipedia.org/wiki/User:Adam37>
9 <https://en.wikipedia.org/wiki/User:Addbot>
10 <https://en.wikipedia.org/w/index.php%3ftitle=User:Ahmedronaldo321&action=edit&redlink=1>
11 <https://en.wikipedia.org/wiki/User:Ahoerstemeier>
12 <https://en.wikipedia.org/wiki/User:Akasseb>
13 <https://en.wikipedia.org/w/index.php%3ftitle=User:Akrokerama&action=edit&redlink=1>
14 <https://en.wikipedia.org/wiki/User:Alba>
15 https://en.wikipedia.org/w/index.php%3ftitle=User:Albert_Yi_tao_su&action=edit&redlink=1
16 <https://en.wikipedia.org/wiki/User:Albrecht>
17 https://en.wikipedia.org/wiki/User:Alfred_Noble_3141
18 https://en.wikipedia.org/wiki/User:Alice_M._Lubes
19 <https://en.wikipedia.org/wiki/User:Aliotra>
20 <https://en.wikipedia.org/wiki/User:AlleborgoBot>

1 Allissonn²¹
1 AlnoktaBOT²²
1 Alphachimp²³
2 Altaïr²⁴
10 Alvestrand²⁵
1 Andonic²⁶
1 Angela²⁷
1 Angusmclellan²⁸
6 AnomieBOT²⁹
1 Anotherwikipedian³⁰
1 Antandrus³¹
1 Ardehali³²
1 Armend³³
1 ArthurBot³⁴
1 AsalKadal³⁵
1 Attic Salt³⁶
1 Aubreybardo³⁷
1 Augustus Leonhardus Cartesius³⁸
1 Avaya1³⁹
1 Avian⁴⁰
1 Avicennasis⁴¹
2 B7582⁴²
2 BD2412⁴³
3 BG19bot⁴⁴
2 Badger M.⁴⁵

21 <https://en.wikipedia.org/wiki/User:Allissonn>
22 <https://en.wikipedia.org/wiki/User:AlnoktaBOT>
23 <https://en.wikipedia.org/wiki/User:Alphachimp>
24 <https://en.wikipedia.org/wiki/User:Alta%25C3%25AFr>
25 <https://en.wikipedia.org/wiki/User:Alvestrand>
26 <https://en.wikipedia.org/wiki/User:Andonic>
27 <https://en.wikipedia.org/wiki/User:Angela>
28 <https://en.wikipedia.org/wiki/User:Angusmclellan>
29 <https://en.wikipedia.org/wiki/User:AnomieBOT>
30 <https://en.wikipedia.org/wiki/User:Anotherwikipedian>
31 <https://en.wikipedia.org/wiki/User:Antandrus>
32 <https://en.wikipedia.org/w/index.php%3ftitle=User:Ardehali&action=edit&redlink=1>
33 <https://en.wikipedia.org/wiki/User:Armend>
34 <https://en.wikipedia.org/wiki/User:ArthurBot>
35 <https://en.wikipedia.org/w/index.php%3ftitle=User:AsalKadal&action=edit&redlink=1>
36 https://en.wikipedia.org/wiki/User:Attic_Salt
37 <https://en.wikipedia.org/w/index.php%3ftitle=User:Aubreybardo&action=edit&redlink=1>
38 https://en.wikipedia.org/wiki/User:Augustus_Leonhardus_Cartesius
39 <https://en.wikipedia.org/wiki/User:Avaya1>
40 <https://en.wikipedia.org/wiki/User:Avian>
41 <https://en.wikipedia.org/wiki/User:Avicennasis>
42 <https://en.wikipedia.org/w/index.php%3ftitle=User:B7582&action=edit&redlink=1>
43 <https://en.wikipedia.org/wiki/User:BD2412>
44 <https://en.wikipedia.org/wiki/User:BG19bot>
45 https://en.wikipedia.org/wiki/User:Badger_M.

- 1 Badgettrg⁴⁶
- 3 BattyBot⁴⁷
- 1 Bazzargh⁴⁸
- 1 Ben Kidwell⁴⁹
- 2 Bender the Bot⁵⁰
- 5 Bender235⁵¹
- 1 Benzband⁵²
- 5 Bibcode Bot⁵³
- 1 Bidabadi~enwiki⁵⁴
- 1 Bigturtle⁵⁵
- 1 Bilaurent⁵⁶
- 1 BillFlis⁵⁷
- 1 Billinghamurst⁵⁸
- 2 Biruitorul⁵⁹
- 1 Bkell⁶⁰
- 1 Bluebot⁶¹
- 1 Bm gub⁶²
- 1 BotMultichill⁶³
- 1 Bota47⁶⁴
- 1 Brandon97⁶⁵
- 1 Breno⁶⁶
- 1 Brookie⁶⁷
- 1 BrownHairedGirl⁶⁸
- 2 Bunzil⁶⁹
- 1 C. A. Russell⁷⁰

- 46 <https://en.wikipedia.org/wiki/User:Badgettrg>
- 47 <https://en.wikipedia.org/wiki/User:BattyBot>
- 48 <https://en.wikipedia.org/wiki/User:Bazzargh>
- 49 https://en.wikipedia.org/wiki/User:Ben_Kidwell
- 50 https://en.wikipedia.org/wiki/User:Bender_the_Bot
- 51 <https://en.wikipedia.org/wiki/User:Bender235>
- 52 <https://en.wikipedia.org/wiki/User:Benzband>
- 53 https://en.wikipedia.org/wiki/User:Bibcode_Bot
- 54 <https://en.wikipedia.org/w/index.php?3ftitle=User:Bidabadi~enwiki&action=edit&redlink=1>
- 55 <https://en.wikipedia.org/wiki/User:Bigturtle>
- 56 <https://en.wikipedia.org/w/index.php?3ftitle=User:Bilaurent&action=edit&redlink=1>
- 57 <https://en.wikipedia.org/wiki/User:BillFlis>
- 58 <https://en.wikipedia.org/wiki/User:Billinghamurst>
- 59 <https://en.wikipedia.org/wiki/User:Biruitorul>
- 60 <https://en.wikipedia.org/wiki/User:Bkell>
- 61 <https://en.wikipedia.org/wiki/User:Bluebot>
- 62 https://en.wikipedia.org/wiki/User:Bm_gub
- 63 <https://en.wikipedia.org/wiki/User:BotMultichill>
- 64 <https://en.wikipedia.org/wiki/User:Bota47>
- 65 <https://en.wikipedia.org/w/index.php?3ftitle=User:Brandon97&action=edit&redlink=1>
- 66 <https://en.wikipedia.org/wiki/User:Breno>
- 67 <https://en.wikipedia.org/wiki/User:Brookie>
- 68 <https://en.wikipedia.org/wiki/User:BrownHairedGirl>
- 69 <https://en.wikipedia.org/wiki/User:Bunzil>
- 70 https://en.wikipedia.org/wiki/User:C._A._Russell

5 CA2MI⁷¹
2 CLCStudent⁷²
1 CRGreathouse⁷³
1 Capricorn42⁷⁴
1 Captain Wacky⁷⁵
1 Carl Logan⁷⁶
1 Cewbot⁷⁷
2 Charles Matthews⁷⁸
1 CharlesGillingham⁷⁹
1 ChazYork⁸⁰
1 Chenopodiaceous⁸¹
1 ChenzwBot⁸²
2 Chobot⁸³
1 Choor monster⁸⁴
1 ChrisGualtieri⁸⁵
2 Christophe1946⁸⁶
1 CiTrusD⁸⁷
17 Citation bot⁸⁸
3 Citation bot 1⁸⁹
1 CitationCleanerBot⁹⁰
1 Cjfsyntropy⁹¹
1 ClaesWallin⁹²
1 Cloudswrest⁹³
4 ClueBot⁹⁴
25 ClueBot NG⁹⁵

71 <https://en.wikipedia.org/w/index.php?ftitle=User:CA2MI&action=edit&redlink=1>
72 <https://en.wikipedia.org/wiki/User:CLCStudent>
73 <https://en.wikipedia.org/wiki/User:CRGreathouse>
74 <https://en.wikipedia.org/wiki/User:Capricorn42>
75 https://en.wikipedia.org/wiki/User:Captain_Wacky
76 https://en.wikipedia.org/wiki/User:Carl_Logan
77 <https://en.wikipedia.org/wiki/User:Cewbot>
78 https://en.wikipedia.org/wiki/User:Charles_Matthews
79 <https://en.wikipedia.org/wiki/User:CharlesGillingham>
80 <https://en.wikipedia.org/w/index.php?ftitle=User:ChazYork&action=edit&redlink=1>
81 <https://en.wikipedia.org/wiki/User:Chenopodiaceous>
82 <https://en.wikipedia.org/wiki/User:ChenzwBot>
83 <https://en.wikipedia.org/wiki/User:Chobot>
84 https://en.wikipedia.org/w/index.php?ftitle=User:Choor_monster&action=edit&redlink=1
85 <https://en.wikipedia.org/wiki/User:ChrisGualtieri>
86 <https://en.wikipedia.org/w/index.php?ftitle=User:Christophe1946&action=edit&redlink=1>
87 <https://en.wikipedia.org/wiki/User:CiTrusD>
88 https://en.wikipedia.org/wiki/User:Citation_bot
89 https://en.wikipedia.org/wiki/User:Citation_bot_1
90 <https://en.wikipedia.org/wiki/User:CitationCleanerBot>
91 <https://en.wikipedia.org/wiki/User:Cjfsyntropy>
92 <https://en.wikipedia.org/wiki/User:ClaesWallin>
93 <https://en.wikipedia.org/wiki/User:Cloudswrest>
94 <https://en.wikipedia.org/wiki/User:ClueBot>
95 https://en.wikipedia.org/wiki/User:ClueBot_NG

- 1 CmdrObot⁹⁶
- 1 Cmdrjameson⁹⁷
- 5 Cmsreview⁹⁸
- 1 Cnbr15⁹⁹
- 14 Coldcreation¹⁰⁰
- 1 CommonsDelinker¹⁰¹
- 1 Confusionreigns¹⁰²
- 2 Connormah¹⁰³
- 1 Crispulop¹⁰⁴
- 1 Crowsnest¹⁰⁵
- 1 Csblack¹⁰⁶
- 1 Css¹⁰⁷
- 5 Curps¹⁰⁸
- 1 Curpsbot-unicodify¹⁰⁹
- 1 Cvalente¹¹⁰
- 1 Cy7caersek¹¹¹
- 1 Cybercobra¹¹²
- 1 Cybermax~enwiki¹¹³
- 9 Cydebot¹¹⁴
- 55 D.H¹¹⁵
- 2 D6¹¹⁶
- 1 DHR¹¹⁷
- 39 DVdm¹¹⁸
- 1 Dabsent¹¹⁹
- 1 DadaNeem¹²⁰

- 96 <https://en.wikipedia.org/wiki/User:CmdrObot>
- 97 <https://en.wikipedia.org/wiki/User:Cmdrjameson>
- 98 <https://en.wikipedia.org/w/index.php?3ftitle=User:Cmsreview&action=edit&redlink=1>
- 99 <https://en.wikipedia.org/wiki/User:Cnbr15>
- 100 <https://en.wikipedia.org/wiki/User:Coldcreation>
- 101 <https://en.wikipedia.org/wiki/User:CommonsDelinker>
- 102 <https://en.wikipedia.org/w/index.php?3ftitle=User:Confusionreigns&action=edit&redlink=1>
- 103 <https://en.wikipedia.org/wiki/User:Connormah>
- 104 <https://en.wikipedia.org/wiki/User:Crispulop>
- 105 <https://en.wikipedia.org/wiki/User:Crowsnest>
- 106 <https://en.wikipedia.org/w/index.php?3ftitle=User:Csblack&action=edit&redlink=1>
- 107 <https://en.wikipedia.org/wiki/User:Css>
- 108 <https://en.wikipedia.org/wiki/User:Curps>
- 109 <https://en.wikipedia.org/wiki/User:Curpsbot-unicodify>
- 110 <https://en.wikipedia.org/wiki/User:Cvalente>
- 111 <https://en.wikipedia.org/wiki/User:Cy7caersek>
- 112 <https://en.wikipedia.org/wiki/User:Cybercobra>
- 113 <https://en.wikipedia.org/wiki/User:Cybermax~enwiki>
- 114 <https://en.wikipedia.org/wiki/User:Cydebot>
- 115 <https://en.wikipedia.org/wiki/User:D.H>
- 116 <https://en.wikipedia.org/wiki/User:D6>
- 117 <https://en.wikipedia.org/wiki/User:DHR>
- 118 <https://en.wikipedia.org/wiki/User:DVdm>
- 119 <https://en.wikipedia.org/wiki/User:Dabsent>
- 120 <https://en.wikipedia.org/wiki/User:DadaNeem>

5 DanielCD¹²¹
2 Danny lost¹²²
1 Daqu¹²³
1 David Eppstein¹²⁴
1 David Haslam¹²⁵
1 David.Monniaux¹²⁶
1 Davshul¹²⁷
1 Dcirovic¹²⁸
1 DenisRS¹²⁹
1 Desmond71¹³⁰
5 DeusNova00¹³¹
3 DeusNovo00¹³²
1 Dexbot¹³³
1 Diannaa¹³⁴
2 DipiDuck¹³⁵
1 Dirac1933¹³⁶
5 Dkuratko2¹³⁷
2 Doczilla¹³⁸
1 Donner60¹³⁹
1 Dougthebug¹⁴⁰
1 Dr. Sunglasses¹⁴¹
1 Dr. Universe¹⁴²
1 Dreamy Jazz¹⁴³
1 Droid5.5¹⁴⁴
2 DumZiBoT¹⁴⁵

121 <https://en.wikipedia.org/wiki/User:DanielCD>
122 https://en.wikipedia.org/wiki/User:Danny_lost
123 <https://en.wikipedia.org/wiki/User:Daqu>
124 https://en.wikipedia.org/wiki/User:David_Eppstein
125 https://en.wikipedia.org/wiki/User:David_Haslam
126 <https://en.wikipedia.org/wiki/User:David.Monniaux>
127 <https://en.wikipedia.org/wiki/User:Davshul>
128 <https://en.wikipedia.org/wiki/User:Dcirovic>
129 <https://en.wikipedia.org/wiki/User:DenisRS>
130 <https://en.wikipedia.org/w/index.php?ftitle=User:Desmond71&action=edit&redlink=1>
131 <https://en.wikipedia.org/w/index.php?ftitle=User:DeusNova00&action=edit&redlink=1>
132 <https://en.wikipedia.org/wiki/User:DeusNovo00>
133 <https://en.wikipedia.org/wiki/User:Dexbot>
134 <https://en.wikipedia.org/wiki/User:Diannaa>
135 <https://en.wikipedia.org/w/index.php?ftitle=User:DipiDuck&action=edit&redlink=1>
136 <https://en.wikipedia.org/w/index.php?ftitle=User:Dirac1933&action=edit&redlink=1>
137 <https://en.wikipedia.org/w/index.php?ftitle=User:Dkuratko2&action=edit&redlink=1>
138 <https://en.wikipedia.org/wiki/User:Doczilla>
139 <https://en.wikipedia.org/wiki/User:Donner60>
140 <https://en.wikipedia.org/wiki/User:Dougthebug>
141 https://en.wikipedia.org/wiki/User:Dr._Sunglasses
142 https://en.wikipedia.org/wiki/User:Dr._Universe
143 https://en.wikipedia.org/wiki/User:Dreamy_Jazz
144 <https://en.wikipedia.org/w/index.php?ftitle=User:Droid5.5&action=edit&redlink=1>
145 <https://en.wikipedia.org/wiki/User:DumZiBoT>

1	Dysepsion ¹⁴⁶
1	Dzordzm ¹⁴⁷
236	E4mmacro ¹⁴⁸
1	ESkog ¹⁴⁹
5	Earthandmoon ¹⁵⁰
1	Edgars2007 ¹⁵¹
3	Edinborgarstefan ¹⁵²
1	EduardoPoyonga ¹⁵³
1	Edward ¹⁵⁴
1	Ellywa ¹⁵⁵
3	EmausBot ¹⁵⁶
12	EmilJ ¹⁵⁷
1	Ems57fcva ¹⁵⁸
1	Enviroboy ¹⁵⁹
1	Equinox ¹⁶⁰
3	Erel Segal ¹⁶¹
1	Erianna ¹⁶²
1	Ericross ¹⁶³
8	Errantius ¹⁶⁴
1	Escarbot ¹⁶⁵
1	Etacar11 ¹⁶⁶
1	Euroflux ¹⁶⁷
1	Everyking ¹⁶⁸
2	Excirial ¹⁶⁹
1	Eyer ¹⁷⁰

146	https://en.wikipedia.org/wiki/User:Dysepsion
147	https://en.wikipedia.org/wiki/User:Dzordzm
148	https://en.wikipedia.org/wiki/User:E4mmacro
149	https://en.wikipedia.org/wiki/User:ESkog
150	https://en.wikipedia.org/wiki/User:Earthandmoon
151	https://en.wikipedia.org/wiki/User:Edgars2007
152	https://en.wikipedia.org/wiki/User:Edinborgarstefan
153	https://en.wikipedia.org/w/index.php?3ftitle=User:EduardoPoyonga&action=edit&redlink=1
154	https://en.wikipedia.org/wiki/User:Edward
155	https://en.wikipedia.org/wiki/User:Ellywa
156	https://en.wikipedia.org/wiki/User:EmausBot
157	https://en.wikipedia.org/wiki/User:EmilJ
158	https://en.wikipedia.org/w/index.php?3ftitle=User:Ems57fcva&action=edit&redlink=1
159	https://en.wikipedia.org/wiki/User:Enviroboy
160	https://en.wikipedia.org/wiki/User:Equinox
161	https://en.wikipedia.org/wiki/User:Erel_Segal
162	https://en.wikipedia.org/wiki/User:Erianna
163	https://en.wikipedia.org/wiki/User:Ericross
164	https://en.wikipedia.org/wiki/User:Errantius
165	https://en.wikipedia.org/wiki/User:Escarbot
166	https://en.wikipedia.org/wiki/User:Etacar11
167	https://en.wikipedia.org/wiki/User:Euroflux
168	https://en.wikipedia.org/wiki/User:Everyking
169	https://en.wikipedia.org/wiki/User:Excirial
170	https://en.wikipedia.org/wiki/User:Eyer

1 Fandecaisses¹⁷¹
13 Fastfission¹⁷²
1 FeanorStar¹⁷³
3 FeatherPluma¹⁷⁴
2 Fiddlefofum¹⁷⁵
1 FidgeyB¹⁷⁶
2 Filipe fazanaro¹⁷⁷
3 FlaBot¹⁷⁸
2 Footlessmouse¹⁷⁹
1 Fraggles81¹⁸⁰
1 Francis Ocoma¹⁸¹
1 Frank Shearar¹⁸²
1 FranksValli¹⁸³
2 Fre3831¹⁸⁴
3 Fredrik¹⁸⁵
1 FreplySpang¹⁸⁶
2 FrescoBot¹⁸⁷
1 Funandtrvl¹⁸⁸
1 Gabbe¹⁸⁹
1 Gadfium¹⁹⁰
2 Gaius Cornelius¹⁹¹
1 Gareth Griffith-Jones¹⁹²
1 Garion96¹⁹³
1 Garuda0001¹⁹⁴
1 Gatta¹⁹⁵

171 <https://en.wikipedia.org/wiki/User:Fandecaisses>
172 <https://en.wikipedia.org/wiki/User:Fastfission>
173 <https://en.wikipedia.org/wiki/User:FeanorStar7>
174 <https://en.wikipedia.org/wiki/User:FeatherPluma>
175 <https://en.wikipedia.org/w/index.php%3ftitle=User:Fiddlefofum&action=edit&redlink=1>
176 <https://en.wikipedia.org/wiki/User:FidgeyB>
177 https://en.wikipedia.org/w/index.php%3ftitle=User:Filipe_fazanaro&action=edit&redlink=1
178 <https://en.wikipedia.org/wiki/User:FlaBot>
179 <https://en.wikipedia.org/wiki/User:Footlessmouse>
180 <https://en.wikipedia.org/wiki/User:Fraggles81>
181 https://en.wikipedia.org/wiki/User:Francis_Ocoma
182 https://en.wikipedia.org/wiki/User:Frank_Shearar
183 <https://en.wikipedia.org/wiki/User:FranksValli>
184 <https://en.wikipedia.org/w/index.php%3ftitle=User:Fre3831&action=edit&redlink=1>
185 <https://en.wikipedia.org/wiki/User:Fredrik>
186 <https://en.wikipedia.org/wiki/User:FreplySpang>
187 <https://en.wikipedia.org/wiki/User:FrescoBot>
188 <https://en.wikipedia.org/wiki/User:Funandtrvl>
189 <https://en.wikipedia.org/wiki/User:Gabbe>
190 <https://en.wikipedia.org/wiki/User:Gadfium>
191 https://en.wikipedia.org/wiki/User:Gaius_Cornelius
192 https://en.wikipedia.org/wiki/User:Gareth_Griffith-Jones
193 <https://en.wikipedia.org/wiki/User:Garion96>
194 <https://en.wikipedia.org/w/index.php%3ftitle=User:Garuda0001&action=edit&redlink=1>
195 <https://en.wikipedia.org/wiki/User:Gatta>

- 1 GcSwRhIc¹⁹⁶
- 1 Gene Nygaard¹⁹⁷
- 2 GeometryJim¹⁹⁸
- 1 GiantSnowman¹⁹⁹
- 12 Giftlite²⁰⁰
- 1 Gilderien²⁰¹
- 1 Goingstuckey²⁰²
- 1 Graham87²⁰³
- 1 GrahamHardy²⁰⁴
- 3 GreenC²⁰⁵
- 3 GreenC bot²⁰⁶
- 1 GregVolk²⁰⁷
- 2 Gregbard²⁰⁸
- 2 GrouchoBot²⁰⁹
- 1 Gwern²¹⁰
- 1 Hairy Dude²¹¹
- 1 HarDNox²¹²
- 88 Harald88²¹³
- 1 Harold f²¹⁴
- 10 Headbomb²¹⁵
- 2 Hebrides²¹⁶
- 1 Hektor²¹⁷
- 1 Helpful Pixie Bot²¹⁸
- 1 Heron²¹⁹
- 1 Hkyriazi²²⁰

196 <https://en.wikipedia.org/wiki/User:GcSwRhIc>
 197 https://en.wikipedia.org/wiki/User:Gene_Nygaard
 198 <https://en.wikipedia.org/wiki/User:GeometryJim>
 199 <https://en.wikipedia.org/wiki/User:GiantSnowman>
 200 <https://en.wikipedia.org/wiki/User:Giftlite>
 201 <https://en.wikipedia.org/wiki/User:Gilderien>
 202 <https://en.wikipedia.org/wiki/User:Goingstuckey>
 203 <https://en.wikipedia.org/wiki/User:Graham87>
 204 <https://en.wikipedia.org/wiki/User:GrahamHardy>
 205 <https://en.wikipedia.org/wiki/User:GreenC>
 206 https://en.wikipedia.org/wiki/User:GreenC_bot
 207 <https://en.wikipedia.org/w/index.php%3ftitle=User:GregVolk&action=edit&redlink=1>
 208 <https://en.wikipedia.org/wiki/User:Gregbard>
 209 <https://en.wikipedia.org/wiki/User:GrouchoBot>
 210 <https://en.wikipedia.org/wiki/User:Gwern>
 211 https://en.wikipedia.org/wiki/User:Hairy_Dude
 212 <https://en.wikipedia.org/wiki/User:HarDNox>
 213 <https://en.wikipedia.org/wiki/User:Harald88>
 214 https://en.wikipedia.org/wiki/User:Harold_f
 215 <https://en.wikipedia.org/wiki/User:Headbomb>
 216 <https://en.wikipedia.org/wiki/User:Hebrides>
 217 <https://en.wikipedia.org/wiki/User:Hektor>
 218 https://en.wikipedia.org/wiki/User:Helpful_Pixie_Bot
 219 <https://en.wikipedia.org/wiki/User:Heron>
 220 <https://en.wikipedia.org/w/index.php%3ftitle=User:Hkyriazi&action=edit&redlink=1>

1 Hmains²²¹
1 Hmainsbot1²²²
1 Hmxhmx²²³
1 Holon²²⁴
1 Hongooi²²⁵
8 Hrodvarsson²²⁶
1 Husond²²⁷
1 I dream of horses²²⁸
1 Iamthisguy7²²⁹
1 Ideyal²³⁰
1 Igloo of the South²³¹
2 IllaZilla²³²
5 Illuminus Knight²³³
2 Ilya Voyager²³⁴
11 InternetArchiveBot²³⁵
10 InverseHypercube²³⁶
1 Itzcuahtli²³⁷
1 IvanScrooge98²³⁸
1 JAnDbot²³⁹
2 JCW-CleanerBot²⁴⁰
1 JJMC89 bot III²⁴¹
1 JKlug81²⁴²
1 JRSpriggs²⁴³
1 JTBurman²⁴⁴
1 JYBot²⁴⁵

221 <https://en.wikipedia.org/wiki/User:Hmains>
222 <https://en.wikipedia.org/wiki/User:Hmainsbot1>
223 <https://en.wikipedia.org/wiki/User:Hmxhmx>
224 <https://en.wikipedia.org/wiki/User:Holon>
225 <https://en.wikipedia.org/wiki/User:Hongooi>
226 <https://en.wikipedia.org/wiki/User:Hrodvarsson>
227 <https://en.wikipedia.org/wiki/User:Husond>
228 https://en.wikipedia.org/wiki/User:I_dream_of_horses
229 <https://en.wikipedia.org/w/index.php%3ftitle=User:Iamthisguy7&action=edit&redlink=1>
230 <https://en.wikipedia.org/wiki/User:Ideyal>
231 https://en.wikipedia.org/w/index.php%3ftitle=User:Igloo_of_the_South&action=edit&redlink=1
232 <https://en.wikipedia.org/wiki/User:Illazilla>
233 https://en.wikipedia.org/wiki/User:Illuminus_Knight
234 https://en.wikipedia.org/wiki/User:Ilya_Voyager
235 <https://en.wikipedia.org/wiki/User:InternetArchiveBot>
236 <https://en.wikipedia.org/wiki/User:InverseHypercube>
237 <https://en.wikipedia.org/wiki/User:Itzcuahtli>
238 <https://en.wikipedia.org/wiki/User:IvanScrooge98>
239 <https://en.wikipedia.org/wiki/User:JAnDbot>
240 <https://en.wikipedia.org/wiki/User:JCW-CleanerBot>
241 https://en.wikipedia.org/wiki/User:JJMC89_bot_III
242 <https://en.wikipedia.org/wiki/User:JKlug81>
243 <https://en.wikipedia.org/wiki/User:JRSpriggs>
244 <https://en.wikipedia.org/wiki/User:JTBurman>
245 <https://en.wikipedia.org/wiki/User:JYBot>

- 3 Jabot the Scrob²⁴⁶
- 2 Jacknote²⁴⁷
- 1 Jacona²⁴⁸
- 1 James086²⁴⁹
- 1 Jaredwf²⁵⁰
- 2 Jasperdoomen²⁵¹
- 1 Jayarathina²⁵²
- 1 JeanneMish²⁵³
- 1 Jerzy²⁵⁴
- 1 Jheald²⁵⁵
- 1 Jim1138²⁵⁶
- 1 Jochen Burghardt²⁵⁷
- 2 JohnBlackburne²⁵⁸
- 1 Johnpacklambert²⁵⁹
- 2 Joke137²⁶⁰
- 1 Jon Awbrey²⁶¹
- 3 Jonesey95²⁶²
- 3 Josve05a²⁶³
- 1 Josvebot²⁶⁴
- 5 Julian Felsenburgh²⁶⁵
- 1 Jumbuck²⁶⁶
- 1 Just Another Dan²⁶⁷
- 1 JustDiploid²⁶⁸
- 12 Jwy²⁶⁹
- 1 Kaiwhakahaere²⁷⁰

- 246 https://en.wikipedia.org/wiki/User:Jabot_the_Scrob
- 247 <https://en.wikipedia.org/wiki/User:Jacknote>
- 248 <https://en.wikipedia.org/wiki/User:Jacona>
- 249 <https://en.wikipedia.org/wiki/User:James086>
- 250 <https://en.wikipedia.org/wiki/User:Jaredwf>
- 251 <https://en.wikipedia.org/wiki/User:Jasperdoomen>
- 252 <https://en.wikipedia.org/wiki/User:Jayarathina>
- 253 <https://en.wikipedia.org/wiki/User:JeanneMish>
- 254 <https://en.wikipedia.org/wiki/User:Jerzy>
- 255 <https://en.wikipedia.org/wiki/User:Jheald>
- 256 <https://en.wikipedia.org/wiki/User:Jim1138>
- 257 https://en.wikipedia.org/wiki/User:Jochen_Burghardt
- 258 <https://en.wikipedia.org/wiki/User:JohnBlackburne>
- 259 <https://en.wikipedia.org/wiki/User:Johnpacklambert>
- 260 <https://en.wikipedia.org/wiki/User:Joke137>
- 261 https://en.wikipedia.org/wiki/User:Jon_Awbrey
- 262 <https://en.wikipedia.org/wiki/User:Jonesey95>
- 263 <https://en.wikipedia.org/wiki/User:Josve05a>
- 264 <https://en.wikipedia.org/wiki/User:Josvebot>
- 265 https://en.wikipedia.org/wiki/User:Julian_Felsenburgh
- 266 <https://en.wikipedia.org/wiki/User:Jumbuck>
- 267 https://en.wikipedia.org/w/index.php?3ftitle=User:Just_Another_Dan&action=edit&redlink=1
- 268 <https://en.wikipedia.org/w/index.php?3ftitle=User:JustDiploid&action=edit&redlink=1>
- 269 <https://en.wikipedia.org/wiki/User:Jwy>
- 270 <https://en.wikipedia.org/wiki/User:Kaiwhakahaere>

7	Karada ²⁷¹
1	Karol Langner ²⁷²
1	Karpada ²⁷³
2	KasparBot ²⁷⁴
1	Katieh5584 ²⁷⁵
1	Kbdankbot ²⁷⁶
2	Kbh3rd ²⁷⁷
1	Kesac ²⁷⁸
1	Khazar2 ²⁷⁹
1	Kingbird1 ²⁸⁰
1	Kintetsubuffalo ²⁸¹
1	Kj cheetham ²⁸²
1	Kkm010 ²⁸³
1	KolbertBot ²⁸⁴
1	KrazeIke ²⁸⁵
4	Kwamikagami ²⁸⁶
1	Kylu ²⁸⁷
1	Lakinekaki ²⁸⁸
1	Laura N. Åkerman ²⁸⁹
1	Legobot ²⁹⁰
1	Lenthe ²⁹¹
2	Lestrade ²⁹²
33	Licorne ²⁹³
1	Liface ²⁹⁴
1	Liftarn ²⁹⁵

271	https://en.wikipedia.org/wiki/User:Karada
272	https://en.wikipedia.org/wiki/User:Karol_Langner
273	https://en.wikipedia.org/wiki/User:Karpada
274	https://en.wikipedia.org/wiki/User:KasparBot
275	https://en.wikipedia.org/wiki/User:Katieh5584
276	https://en.wikipedia.org/wiki/User:Kbdankbot
277	https://en.wikipedia.org/wiki/User:Kbh3rd
278	https://en.wikipedia.org/wiki/User:Kesac
279	https://en.wikipedia.org/wiki/User:Khazar2
280	https://en.wikipedia.org/wiki/User:Kingbird1
281	https://en.wikipedia.org/wiki/User:Kintetsubuffalo
282	https://en.wikipedia.org/wiki/User:Kj_cheetham
283	https://en.wikipedia.org/wiki/User:Kkm010
284	https://en.wikipedia.org/wiki/User:KolbertBot
285	https://en.wikipedia.org/w/index.php%3ftitle=User:KrazeIke&action=edit&redlink=1
286	https://en.wikipedia.org/wiki/User:Kwamikagami
287	https://en.wikipedia.org/wiki/User:Kylu
288	https://en.wikipedia.org/wiki/User:Lakinekaki
289	https://en.wikipedia.org/wiki/User:Laura_N._%25C3%2585kerman
290	https://en.wikipedia.org/wiki/User:Legobot
291	https://en.wikipedia.org/wiki/User:Lenthe
292	https://en.wikipedia.org/wiki/User:Lestrade
293	https://en.wikipedia.org/wiki/User:Licorne
294	https://en.wikipedia.org/wiki/User:Liface
295	https://en.wikipedia.org/wiki/User:Liftarn

- 1 LinkFA-Bot²⁹⁶
- 1 Lisa Longhi (BEIC)²⁹⁷
- 4 Lockley²⁹⁸
- 1 Looxix~enwiki²⁹⁹
- 1 Lord Emsworth³⁰⁰
- 1 Lt-wiki-bot³⁰¹
- 1 Lucidish³⁰²
- 1 Luckas-bot³⁰³
- 2 Lugia2453³⁰⁴
- 1 Lumidek³⁰⁵
- 103 Lumos3³⁰⁶
- 1 Luna Santin³⁰⁷
- 1 MTSbot~enwiki³⁰⁸
- 1 Mad Madsonian³⁰⁹
- 1 Magnus Manske³¹⁰
- 1 Makecat³¹¹
- 1 MalafayaBot³¹²
- 2 Marcocapelle³¹³
- 2 Mark Arsten³¹⁴
- 2 Markhurd³¹⁵
- 1 Marriex³¹⁶
- 1 Martinkugler³¹⁷
- 1 Materialschemist³¹⁸
- 1 MathKeduor7³¹⁹
- 3 MathMartin³²⁰

- 296 <https://en.wikipedia.org/wiki/User:LinkFA-Bot>
- 297 [https://en.wikipedia.org/wiki/User:Lisa_Longhi_\(BEIC\)](https://en.wikipedia.org/wiki/User:Lisa_Longhi_(BEIC))
- 298 <https://en.wikipedia.org/wiki/User:Lockley>
- 299 <https://en.wikipedia.org/wiki/User:Looxix~enwiki>
- 300 https://en.wikipedia.org/wiki/User:Lord_Emsworth
- 301 <https://en.wikipedia.org/wiki/User:Lt-wiki-bot>
- 302 <https://en.wikipedia.org/wiki/User:Lucidish>
- 303 <https://en.wikipedia.org/wiki/User:Luckas-bot>
- 304 <https://en.wikipedia.org/wiki/User:Lugia2453>
- 305 <https://en.wikipedia.org/wiki/User:Lumidek>
- 306 <https://en.wikipedia.org/wiki/User:Lumos3>
- 307 https://en.wikipedia.org/wiki/User:Luna_Santin
- 308 <https://en.wikipedia.org/wiki/User:MTSbot~enwiki>
- 309 https://en.wikipedia.org/wiki/User:Mad_Madsonian
- 310 https://en.wikipedia.org/wiki/User:Magnus_Manske
- 311 <https://en.wikipedia.org/wiki/User:Makecat>
- 312 <https://en.wikipedia.org/wiki/User:MalafayaBot>
- 313 <https://en.wikipedia.org/wiki/User:Marcocapelle>
- 314 https://en.wikipedia.org/wiki/User:Mark_Arsten
- 315 <https://en.wikipedia.org/wiki/User:Markhurd>
- 316 <https://en.wikipedia.org/wiki/User:Marriex>
- 317 <https://en.wikipedia.org/wiki/User:Martinkugler>
- 318 <https://en.wikipedia.org/wiki/User:Materialschemist>
- 319 <https://en.wikipedia.org/wiki/User:MathKeduor7>
- 320 <https://en.wikipedia.org/wiki/User:MathMartin>

1 Mawfive³²¹
1 Maximilianklein³²²
1 Mcewan³²³
1 Mdd³²⁴
1 Merope³²⁵
4 Mhym³²⁶
3 Michael C Price³²⁷
34 Michael Hardy³²⁸
3 Michael Slone³²⁹
1 Mike Schwartz³³⁰
1 Mirwin³³¹
1 Monegasque³³²
5 Monkbot³³³
1 Mortense³³⁴
1 Moskvax³³⁵
1 Mr Schneebly³³⁶
1 Mr. Stradivarius³³⁷
5 Murzim³³⁸
2 MusikAnimal³³⁹
1 Mxjwo³⁴⁰
19 Myasuda³⁴¹
2 NSH001³⁴²
2 Nardog³⁴³
1 Nealmcb³⁴⁴
1 Nerd271³⁴⁵

321 <https://en.wikipedia.org/wiki/User:Mawfive>
322 <https://en.wikipedia.org/wiki/User:Maximilianklein>
323 <https://en.wikipedia.org/wiki/User:Mcewan>
324 <https://en.wikipedia.org/wiki/User:Mdd>
325 <https://en.wikipedia.org/wiki/User:Merope>
326 <https://en.wikipedia.org/wiki/User:Mhym>
327 https://en.wikipedia.org/wiki/User:Michael_C_Price
328 https://en.wikipedia.org/wiki/User:Michael_Hardy
329 https://en.wikipedia.org/wiki/User:Michael_Slone
330 https://en.wikipedia.org/wiki/User:Mike_Schwartz
331 <https://en.wikipedia.org/wiki/User:Mirwin>
332 <https://en.wikipedia.org/wiki/User:Monegasque>
333 <https://en.wikipedia.org/wiki/User:Monkbot>
334 <https://en.wikipedia.org/wiki/User:Mortense>
335 <https://en.wikipedia.org/wiki/User:Moskvax>
336 https://en.wikipedia.org/w/index.php%3ftitle=User:Mr_Schneebly&action=edit&redlink=1
337 https://en.wikipedia.org/wiki/User:Mr._Stradivarius
338 <https://en.wikipedia.org/wiki/User:Murzim>
339 <https://en.wikipedia.org/wiki/User:MusikAnimal>
340 <https://en.wikipedia.org/w/index.php%3ftitle=User:Mxjwo&action=edit&redlink=1>
341 <https://en.wikipedia.org/wiki/User:Myasuda>
342 <https://en.wikipedia.org/wiki/User:NSH001>
343 <https://en.wikipedia.org/wiki/User:Nardog>
344 <https://en.wikipedia.org/wiki/User:Nealmcb>
345 <https://en.wikipedia.org/wiki/User:Nerd271>

- 1 Newbyguesses³⁴⁶
- 3 Niceguyedc³⁴⁷
- 1 Nickshanks³⁴⁸
- 2 Nihil novi³⁴⁹
- 1 Nimetapoeg³⁵⁰
- 1 Ninly³⁵¹
- 5 Ninmacer20³⁵²
- 1 NottNott³⁵³
- 1 Numbo3-bot³⁵⁴
- 1 Nutfortuna³⁵⁵
- 1 Nwbeeson³⁵⁶
- 3 OAbot³⁵⁷
- 1 Ocolon³⁵⁸
- 2 Ohconfucius³⁵⁹
- 1 Olavo Belavan³⁶⁰
- 2 Oleg Alexandrov³⁶¹
- 3 Olivier³⁶²
- 2 Omcnew³⁶³
- 2 Omicron18³⁶⁴
- 26 Omnipaedista³⁶⁵
- 1 OnePt618³⁶⁶
- 2 Opus88888³⁶⁷
- 1 Oracleofottawa³⁶⁸
- 1 Orenburg1³⁶⁹
- 1 Orphan Wiki³⁷⁰

³⁴⁶ <https://en.wikipedia.org/wiki/User:Newbyguesses>
³⁴⁷ <https://en.wikipedia.org/wiki/User:Niceguyedc>
³⁴⁸ <https://en.wikipedia.org/wiki/User:Nickshanks>
³⁴⁹ https://en.wikipedia.org/wiki/User:Nihil_novi
³⁵⁰ <https://en.wikipedia.org/wiki/User:Nimetapoeg>
³⁵¹ <https://en.wikipedia.org/wiki/User:Ninly>
³⁵² <https://en.wikipedia.org/wiki/User:Ninmacer20>
³⁵³ <https://en.wikipedia.org/wiki/User:NottNott>
³⁵⁴ <https://en.wikipedia.org/wiki/User:Numbo3-bot>
³⁵⁵ <https://en.wikipedia.org/w/index.php%3ftitle=User:Nutfortuna&action=edit&redlink=1>
³⁵⁶ <https://en.wikipedia.org/wiki/User:Nwbeeson>
³⁵⁷ <https://en.wikipedia.org/wiki/User:OAbot>
³⁵⁸ <https://en.wikipedia.org/wiki/User:Ocolon>
³⁵⁹ <https://en.wikipedia.org/wiki/User:Ohconfucius>
³⁶⁰ https://en.wikipedia.org/w/index.php%3ftitle=User:Olavo_Belavan&action=edit&redlink=1
³⁶¹ https://en.wikipedia.org/wiki/User:Oleg_Alexandrov
³⁶² <https://en.wikipedia.org/wiki/User:Olivier>
³⁶³ <https://en.wikipedia.org/w/index.php%3ftitle=User:Omcnew&action=edit&redlink=1>
³⁶⁴ <https://en.wikipedia.org/wiki/User:Omicron18>
³⁶⁵ <https://en.wikipedia.org/wiki/User:Omnipaedista>
³⁶⁶ <https://en.wikipedia.org/wiki/User:OnePt618>
³⁶⁷ <https://en.wikipedia.org/wiki/User:Opus88888>
³⁶⁸ <https://en.wikipedia.org/wiki/User:Oracleofottawa>
³⁶⁹ <https://en.wikipedia.org/wiki/User:Orenburg1>
³⁷⁰ https://en.wikipedia.org/wiki/User:Orphan_Wiki

1 Ospalh³⁷¹
1 Oub³⁷²
1 Palica³⁷³
2 Pallen³⁷⁴
27 Paul August³⁷⁵
2 Paul-Eric Langevin³⁷⁶
1 Pax:Vobiscum³⁷⁷
1 PedjaNbg³⁷⁸
1 Perseus25³⁷⁹
1 Philip Stevens³⁸⁰
1 Phoebe³⁸¹
2 Pjacobi³⁸²
2 PointOfPresence³⁸³
1 Poppy³⁸⁴
1 Prajaman³⁸⁵
1 Pruneau³⁸⁶
1 Putsari³⁸⁷
1 Qrystal³⁸⁸
1 Quadell³⁸⁹
1 Quant08³⁹⁰
1 Queen4thewin³⁹¹
1 Qutezuce³⁹²
1 R.e.b.³⁹³
1 REL1870³⁹⁴
1 RJHall³⁹⁵

371 <https://en.wikipedia.org/wiki/User:Ospalh>
372 <https://en.wikipedia.org/wiki/User:Oub>
373 <https://en.wikipedia.org/wiki/User:Palica>
374 <https://en.wikipedia.org/wiki/User:Pallen>
375 https://en.wikipedia.org/wiki/User:Paul_August
376 https://en.wikipedia.org/w/index.php?ftitle=User:Paul-Eric_Langevin&action=edit&redlink=1
377 <https://en.wikipedia.org/wiki/User:Pax:Vobiscum>
378 <https://en.wikipedia.org/wiki/User:PedjaNbg>
379 <https://en.wikipedia.org/wiki/User:Perseus25>
380 https://en.wikipedia.org/wiki/User:Philip_Stevens
381 <https://en.wikipedia.org/wiki/User:Phoebe>
382 <https://en.wikipedia.org/wiki/User:Pjacobi>
383 <https://en.wikipedia.org/wiki/User:PointOfPresence>
384 <https://en.wikipedia.org/wiki/User:Poppy>
385 <https://en.wikipedia.org/w/index.php?ftitle=User:Prajaman&action=edit&redlink=1>
386 <https://en.wikipedia.org/wiki/User:Pruneau>
387 <https://en.wikipedia.org/wiki/User:Putsari>
388 <https://en.wikipedia.org/wiki/User:Qrystal>
389 <https://en.wikipedia.org/wiki/User:Quadell>
390 <https://en.wikipedia.org/w/index.php?ftitle=User:Quant08&action=edit&redlink=1>
391 <https://en.wikipedia.org/w/index.php?ftitle=User:Queen4thewin&action=edit&redlink=1>
392 <https://en.wikipedia.org/wiki/User:Qutezuce>
393 <https://en.wikipedia.org/wiki/User:R.e.b.>
394 <https://en.wikipedia.org/wiki/User:REL1870>
395 <https://en.wikipedia.org/wiki/User:RJHall>

- 3 Randy Kryn³⁹⁶
- 5 Ranicki³⁹⁷
- 1 RaphaelQS³⁹⁸
- 1 Rathfelder³⁹⁹
- 1 Rbh00⁴⁰⁰
- 1 ReconditeRodent⁴⁰¹
- 1 Renamed user 943a06d1c3⁴⁰²
- 8 Renata500⁴⁰³
- 1 RexNL⁴⁰⁴
- 1 Rgdboer⁴⁰⁵
- 2 RibotBOT⁴⁰⁶
- 1 Rich Farmbrough⁴⁰⁷
- 1 Richard Harvey⁴⁰⁸
- 5 Rivasseau⁴⁰⁹
- 1 Rjknkr⁴¹⁰
- 7 Rjwilmsi⁴¹¹
- 1 RjwilmsiBot⁴¹²
- 1 Rlink2⁴¹³
- 2 Robbot⁴¹⁴
- 2 Robby.is.on⁴¹⁵
- 5 Rober1236jua⁴¹⁶
- 1 Robert K S⁴¹⁷
- 1 Roberto.catini⁴¹⁸
- 1 RobinK⁴¹⁹
- 1 Rock69~enwiki⁴²⁰

396 https://en.wikipedia.org/wiki/User:Randy_Kryn
 397 <https://en.wikipedia.org/wiki/User:Ranicki>
 398 <https://en.wikipedia.org/wiki/User:RaphaelQS>
 399 <https://en.wikipedia.org/wiki/User:Rathfelder>
 400 <https://en.wikipedia.org/w/index.php?3ftitle=User:Rbh00&action=edit&redlink=1>
 401 <https://en.wikipedia.org/wiki/User:ReconditeRodent>
 402 https://en.wikipedia.org/w/index.php?3ftitle=User:Renamed_user_943a06d1c3&action=edit&redlink=1
 403 <https://en.wikipedia.org/w/index.php?3ftitle=User:Renata500&action=edit&redlink=1>
 404 <https://en.wikipedia.org/wiki/User:RexNL>
 405 <https://en.wikipedia.org/wiki/User:Rgdboer>
 406 <https://en.wikipedia.org/wiki/User:RibotBOT>
 407 https://en.wikipedia.org/wiki/User:Rich_Farmbrough
 408 https://en.wikipedia.org/wiki/User:Richard_Harvey
 409 <https://en.wikipedia.org/w/index.php?3ftitle=User:Rivasseau&action=edit&redlink=1>
 410 <https://en.wikipedia.org/w/index.php?3ftitle=User:Rjknkr&action=edit&redlink=1>
 411 <https://en.wikipedia.org/wiki/User:Rjwilmsi>
 412 <https://en.wikipedia.org/wiki/User:RjwilmsiBot>
 413 <https://en.wikipedia.org/wiki/User:Rlink2>
 414 <https://en.wikipedia.org/wiki/User:Robbot>
 415 <https://en.wikipedia.org/wiki/User:Robby.is.on>
 416 <https://en.wikipedia.org/wiki/User:Rober1236jua>
 417 https://en.wikipedia.org/wiki/User:Robert_K_S
 418 <https://en.wikipedia.org/w/index.php?3ftitle=User:Roberto.catini&action=edit&redlink=1>
 419 <https://en.wikipedia.org/wiki/User:RobinK>
 420 <https://en.wikipedia.org/w/index.php?3ftitle=User:Rock69~enwiki&action=edit&redlink=1>

1 Rose Garden⁴²¹
1 RoyBoy⁴²²
1 Royalguard11⁴²³
1 Rror⁴²⁴
1 Rsrikanth05⁴²⁵
1 Rubinbot⁴²⁶
3 RussBot⁴²⁷
1 RussellBell⁴²⁸
1 ST47⁴²⁹
1 Sabbe⁴³⁰
1 Sadi Carnot⁴³¹
1 Samuelabaker1⁴³²
1 SashatoBot⁴³³
8 Schlafly⁴³⁴
1 SchreiberBike⁴³⁵
1 Seaphoto⁴³⁶
5 Ser Amantio di Nicolao⁴³⁷
1 Shizhao⁴³⁸
2 SieBot⁴³⁹
1 Siim⁴⁴⁰
1 Sjö⁴⁴¹
1 Skeptic2⁴⁴²
1 SkerHawx⁴⁴³
1 Snobot⁴⁴⁴
1 Snori⁴⁴⁵

421 https://en.wikipedia.org/wiki/User:Rose_Garden
422 <https://en.wikipedia.org/wiki/User:RoyBoy>
423 <https://en.wikipedia.org/wiki/User:Royalguard11>
424 <https://en.wikipedia.org/wiki/User:Rror>
425 <https://en.wikipedia.org/wiki/User:Rsrikanth05>
426 <https://en.wikipedia.org/wiki/User:Rubinbot>
427 <https://en.wikipedia.org/wiki/User:RussBot>
428 <https://en.wikipedia.org/w/index.php?ftitle=User:RussellBell&action=edit&redlink=1>
429 <https://en.wikipedia.org/wiki/User:ST47>
430 <https://en.wikipedia.org/wiki/User:Sabbe>
431 https://en.wikipedia.org/wiki/User:Sadi_Carnot
432 <https://en.wikipedia.org/w/index.php?ftitle=User:Samuelabaker1&action=edit&redlink=1>
433 <https://en.wikipedia.org/wiki/User:SashatoBot>
434 <https://en.wikipedia.org/wiki/User:Schlafly>
435 <https://en.wikipedia.org/wiki/User:SchreiberBike>
436 <https://en.wikipedia.org/wiki/User:Seaphoto>
437 https://en.wikipedia.org/wiki/User:Ser_Amantio_di_Nicolao
438 <https://en.wikipedia.org/wiki/User:Shizhao>
439 <https://en.wikipedia.org/wiki/User:SieBot>
440 <https://en.wikipedia.org/wiki/User:Siim>
441 <https://en.wikipedia.org/wiki/User:Sj%25C3%25B6>
442 <https://en.wikipedia.org/w/index.php?ftitle=User:Skeptic2&action=edit&redlink=1>
443 <https://en.wikipedia.org/wiki/User:SkerHawx>
444 <https://en.wikipedia.org/w/index.php?ftitle=User:Snobot&action=edit&redlink=1>
445 <https://en.wikipedia.org/wiki/User:Snori>

- 1 Snotbot⁴⁴⁶
- 1 Snoyes⁴⁴⁷
- 2 SoSivr⁴⁴⁸
- 1 Solomonfromfinland⁴⁴⁹
- 3 Spicemix⁴⁵⁰
- 1 Spiff~enwiki⁴⁵¹
- 1 Splash⁴⁵²
- 1 SporkBot⁴⁵³
- 1 Srleffler⁴⁵⁴
- 1 Stephen⁴⁵⁵
- 1 Stephen Bain⁴⁵⁶
- 2 StewartMH⁴⁵⁷
- 1 Stymphal⁴⁵⁸
- 1 Sunlitsky⁴⁵⁹
- 6 SureFire⁴⁶⁰
- 1 Surfscoter⁴⁶¹
- 3 Suslindisambiguator⁴⁶²
- 1 Sv1xv⁴⁶³
- 1 Symane⁴⁶⁴
- 1 TAnthony⁴⁶⁵
- 1 TXiKiBoT⁴⁶⁶
- 1 Tabletop⁴⁶⁷
- 2 TakuyaMurata⁴⁶⁸
- 2 Tarnoob⁴⁶⁹
- 1 Tesseract⁴⁷⁰

446 <https://en.wikipedia.org/wiki/User:Snotbot>
 447 <https://en.wikipedia.org/wiki/User:Snoyes>
 448 <https://en.wikipedia.org/wiki/User:SoSivr>
 449 <https://en.wikipedia.org/wiki/User:Solomonfromfinland>
 450 <https://en.wikipedia.org/wiki/User:Spicemix>
 451 <https://en.wikipedia.org/wiki/User:Spiff~enwiki>
 452 <https://en.wikipedia.org/wiki/User:Splash>
 453 <https://en.wikipedia.org/wiki/User:SporkBot>
 454 <https://en.wikipedia.org/wiki/User:Srleffler>
 455 <https://en.wikipedia.org/wiki/User:Stephen>
 456 https://en.wikipedia.org/wiki/User:Stephen_Bain
 457 <https://en.wikipedia.org/wiki/User:StewartMH>
 458 <https://en.wikipedia.org/wiki/User:Stymphal>
 459 <https://en.wikipedia.org/wiki/User:Sunlitsky>
 460 <https://en.wikipedia.org/wiki/User:SureFire>
 461 <https://en.wikipedia.org/wiki/User:Surfscoter>
 462 <https://en.wikipedia.org/wiki/User:Suslindisambiguator>
 463 <https://en.wikipedia.org/wiki/User:Sv1xv>
 464 <https://en.wikipedia.org/wiki/User:Symane>
 465 <https://en.wikipedia.org/wiki/User:TAnthony>
 466 <https://en.wikipedia.org/wiki/User:TXiKiBoT>
 467 <https://en.wikipedia.org/wiki/User:Tabletop>
 468 <https://en.wikipedia.org/wiki/User:TakuyaMurata>
 469 <https://en.wikipedia.org/wiki/User:Tarnoob>
 470 <https://en.wikipedia.org/wiki/User:Tesseract>

6 TestPilot⁴⁷¹
1 Thanatos666⁴⁷²
1 That Guy, From That Show!⁴⁷³
1 The Font⁴⁷⁴
1 The Transhumanist⁴⁷⁵
1 TheMathCat⁴⁷⁶
10 Thepalerider2012⁴⁷⁷
1 Thijs!bot⁴⁷⁸
1 Thismightbezach⁴⁷⁹
1 TimBentley⁴⁸⁰
1 Timrollpickering⁴⁸¹
1 Timwi⁴⁸²
1 Tito-⁴⁸³
1 Tom.Reding⁴⁸⁴
1 Tomerbot⁴⁸⁵
1 Tommy2010⁴⁸⁶
1 Tomruen⁴⁸⁷
1 Tony Sidaway⁴⁸⁸
1 Tony1⁴⁸⁹
1 TonySever⁴⁹⁰
1 Trappist the monk⁴⁹¹
1 Trebor⁴⁹²
5 Turgidson⁴⁹³
4 Twas Now⁴⁹⁴
1 UDScott⁴⁹⁵

471 <https://en.wikipedia.org/wiki/User:TestPilot>
472 <https://en.wikipedia.org/wiki/User:Thanatos666>
473 https://en.wikipedia.org/wiki/User:That_Guy,_From_That_Show!
474 https://en.wikipedia.org/w/index.php%3ftitle=User:The_Font&action=edit&redlink=1
475 https://en.wikipedia.org/wiki/User:The_Transhumanist
476 <https://en.wikipedia.org/wiki/User:TheMathCat>
477 <https://en.wikipedia.org/w/index.php%3ftitle=User:Thepalerider2012&action=edit&redlink=1>
478 <https://en.wikipedia.org/wiki/User:Thijs!bot>
479 <https://en.wikipedia.org/wiki/User:Thismightbezach>
480 <https://en.wikipedia.org/wiki/User:TimBentley>
481 <https://en.wikipedia.org/wiki/User:Timrollpickering>
482 <https://en.wikipedia.org/wiki/User:Timwi>
483 <https://en.wikipedia.org/w/index.php%3ftitle=User:Tito-&action=edit&redlink=1>
484 <https://en.wikipedia.org/wiki/User:Tom.Reding>
485 <https://en.wikipedia.org/wiki/User:Tomerbot>
486 <https://en.wikipedia.org/wiki/User:Tommy2010>
487 <https://en.wikipedia.org/wiki/User:Tomruen>
488 https://en.wikipedia.org/wiki/User:Tony_Sidaway
489 <https://en.wikipedia.org/wiki/User:Tony1>
490 <https://en.wikipedia.org/wiki/User:TonySever>
491 https://en.wikipedia.org/w/index.php%3ftitle=User:Trappist_the_monk&action=edit&redlink=1
492 <https://en.wikipedia.org/wiki/User:Trebor>
493 <https://en.wikipedia.org/wiki/User:Turgidson>
494 https://en.wikipedia.org/wiki/User:Twas_Now
495 <https://en.wikipedia.org/wiki/User:UDScott>

- 8 Utternutter⁴⁹⁶
- 1 VAL THE FACTS⁴⁹⁷
- 1 VIAFbot⁴⁹⁸
- 2 Valerius Tygart⁴⁹⁹
- 1 Vijeth⁵⁰⁰
- 1 Vladimirdx⁵⁰¹
- 2 VorerstGescheitert⁵⁰²
- 4 Vsmith⁵⁰³
- 1 WOSlinker⁵⁰⁴
- 1 Wabbit98⁵⁰⁵
- 1 Wachholder0⁵⁰⁶
- 1 WeißwurstJon⁵⁰⁷
- 1 Wesino⁵⁰⁸
- 1 Whenthedaycomes⁵⁰⁹
- 4 WhiteBeard120⁵¹⁰
- 1 WikiCleanerBot⁵¹¹
- 2 WikiCrisis⁵¹²
- 1 WikiDao⁵¹³
- 1 WikiTatik⁵¹⁴
- 1 Wikiain⁵¹⁵
- 1 Wikimandia⁵¹⁶
- 1 WikitanvirBot⁵¹⁷
- 1 Wild rabbit⁵¹⁸
- 1 WildBot⁵¹⁹
- 1 William Avery⁵²⁰

⁴⁹⁶ <https://en.wikipedia.org/wiki/User:Utternutter>

⁴⁹⁷ https://en.wikipedia.org/w/index.php?title=User:VAL_THE_FACTS&action=edit&redlink=1

⁴⁹⁸ <https://en.wikipedia.org/wiki/User:VIAFbot>

⁴⁹⁹ https://en.wikipedia.org/wiki/User:Valerius_Tygart

⁵⁰⁰ <https://en.wikipedia.org/wiki/User:Vijeth>

⁵⁰¹ <https://en.wikipedia.org/wiki/User:Vladimirdx>

⁵⁰² <https://en.wikipedia.org/wiki/User:VorerstGescheitert>

⁵⁰³ <https://en.wikipedia.org/wiki/User:Vsmith>

⁵⁰⁴ <https://en.wikipedia.org/wiki/User:WOSlinker>

⁵⁰⁵ <https://en.wikipedia.org/wiki/User:Wabbit98>

⁵⁰⁶ <https://en.wikipedia.org/wiki/User:Wachholder0>

⁵⁰⁷ <https://en.wikipedia.org/w/index.php?title=User:Wei%25C3%259FwurstJon&action=edit&redlink=1>

⁵⁰⁸ <https://en.wikipedia.org/wiki/User:Wesino>

⁵⁰⁹ <https://en.wikipedia.org/wiki/User:Whenthedaycomes>

⁵¹⁰ <https://en.wikipedia.org/wiki/User:WhiteBeard120>

⁵¹¹ <https://en.wikipedia.org/wiki/User:WikiCleanerBot>

⁵¹² <https://en.wikipedia.org/wiki/User:WikiCrisis>

⁵¹³ <https://en.wikipedia.org/wiki/User:WikiDao>

⁵¹⁴ <https://en.wikipedia.org/wiki/User:WikiTatik>

⁵¹⁵ <https://en.wikipedia.org/wiki/User:Wikiain>

⁵¹⁶ <https://en.wikipedia.org/wiki/User:Wikimandia>

⁵¹⁷ <https://en.wikipedia.org/wiki/User:WikitanvirBot>

⁵¹⁸ https://en.wikipedia.org/wiki/User:Wild_rabbit

⁵¹⁹ <https://en.wikipedia.org/wiki/User:WildBot>

⁵²⁰ https://en.wikipedia.org/wiki/User:William_Avery

1 Woggly⁵²¹
6 WolfmanSF⁵²²
3 Woohookitty⁵²³
1 Wwannsda⁵²⁴
1 Wybot⁵²⁵
1 XJaM⁵²⁶
1 Xindeho⁵²⁷
3 Xqbot⁵²⁸
2 Yamamoto Ichiro⁵²⁹
2 Yikkayaya⁵³⁰
5 Yobot⁵³¹
2 YurikBot⁵³²
1 Zen611⁵³³
1 Zorrobot⁵³⁴
1 Zundark⁵³⁵
2 ZéroBot⁵³⁶
1 Гармонический Мир⁵³⁷
1 ██████████ ██████████⁵³⁸
2 ████████████████████ ████████████████████⁵³⁹
1 ██████⁵⁴⁰

521 <https://en.wikipedia.org/w/index.php?ftitle=User:Woggly&action=edit&redlink=1>
522 <https://en.wikipedia.org/wiki/User:WolfmanSF>
523 <https://en.wikipedia.org/wiki/User:Woohookitty>
524 <https://en.wikipedia.org/wiki/User:Wwannsda>
525 <https://en.wikipedia.org/wiki/User:Wybot>
526 <https://en.wikipedia.org/wiki/User:XJaM>
527 <https://en.wikipedia.org/wiki/User:Xindeho>
528 <https://en.wikipedia.org/wiki/User:Xqbot>
529 https://en.wikipedia.org/wiki/User:Yamamoto_Ichiro
530 <https://en.wikipedia.org/wiki/User:Yikkayaya>
531 <https://en.wikipedia.org/wiki/User:Yobot>
532 <https://en.wikipedia.org/wiki/User:YurikBot>
533 <https://en.wikipedia.org/wiki/User:Zen611>
534 <https://en.wikipedia.org/wiki/User:Zorrobot>
535 <https://en.wikipedia.org/wiki/User:Zundark>
536 <https://en.wikipedia.org/wiki/User:Z%25C3%25A9roBot>
https://en.wikipedia.org/wiki/User:%25D0%2593%25D0%25B0%25D1%2580%25D0%25BC%25D0%25BE%25D0%25BD%25D0%25B8%25D1%2587%25D0%25B5%25D1%2581%25D0%25BA%25D0%25B8%25D0%25B9_%25D0%259C%25D0%25B8%25D1%2580
537 https://en.wikipedia.org/w/index.php?ftitle=User:%25D8%25B4%25D8%25A7%25D9%25BE%25D9%2588%25D8%25B1_%25D9%25BE%25D8%25A7%25D8%25B1%25D8%25B3%25DB%258C&action=edit&redlink=1
538 https://en.wikipedia.org/wiki/User:%25E0%25B2%25AE%25E0%25B2%25B2%25E0%25B3%258D%25E0%25B2%25A8%25E0%25B2%25BE%25E0%25B2%25A1%25E0%25B2%25BE%25E0%25B2%259A%25E0%25B3%258D_%25E0%25B2%2595%25E0%25B3%258A%25E0%25B2%2582%25E0%25B2%2595%25E0%25B3%258D%25E0%25B2%25A3%25E0%25B3%258A
539 <https://en.wikipedia.org/wiki/User:%25E0%25B6%25A2%25E0%25B6%25B4%25E0%25B7%2583>
540

List of Figures

- GFDL: Gnu Free Documentation License. <http://www.gnu.org/licenses/fdl.html>
- cc-by-sa-3.0: Creative Commons Attribution ShareAlike 3.0 License. <http://creativecommons.org/licenses/by-sa/3.0/>
- cc-by-sa-2.5: Creative Commons Attribution ShareAlike 2.5 License. <http://creativecommons.org/licenses/by-sa/2.5/>
- cc-by-sa-2.0: Creative Commons Attribution ShareAlike 2.0 License. <http://creativecommons.org/licenses/by-sa/2.0/>
- cc-by-sa-1.0: Creative Commons Attribution ShareAlike 1.0 License. <http://creativecommons.org/licenses/by-sa/1.0/>
- cc-by-2.0: Creative Commons Attribution 2.0 License. <http://creativecommons.org/licenses/by/2.0/>
- cc-by-2.0: Creative Commons Attribution 2.0 License. <http://creativecommons.org/licenses/by/2.0/deed.en>
- cc-by-2.5: Creative Commons Attribution 2.5 License. <http://creativecommons.org/licenses/by/2.5/deed.en>
- cc-by-3.0: Creative Commons Attribution 3.0 License. <http://creativecommons.org/licenses/by/3.0/deed.en>
- GPL: GNU General Public License. <http://www.gnu.org/licenses/gpl-2.0.txt>
- LGPL: GNU Lesser General Public License. <http://www.gnu.org/licenses/lgpl.html>
- PD: This image is in the public domain.
- ATTR: The copyright holder of this file allows anyone to use it for any purpose, provided that the copyright holder is properly attributed. Redistribution, derivative work, commercial use, and all other use is permitted.
- EURO: This is the common (reverse) face of a euro coin. The copyright on the design of the common face of the euro coins belongs to the European Commission. Authorised is reproduction in a format without relief (drawings, paintings, films) provided they are not detrimental to the image of the euro.
- LFK: Lizenz Freie Kunst. <http://artlibre.org/licence/lal/de>
- CFR: Copyright free use.

- EPL: Eclipse Public License. <http://www.eclipse.org/org/documents/epl-v10.php>

Copies of the GPL, the LGPL as well as a GFDL are included in chapter Licenses⁵⁴¹. Please note that images in the public domain do not require attribution. You may click on the image numbers in the following table to open the webpage of the images in your webbrowser.

⁵⁴¹ Chapter 3 on page 81

1	en:User:Saranphat.cha ⁵⁴² , Anomie, J.delanoy, JJMC89, Jo-Jo Eumerus, John M Wolfson, Kimchi.sg, Luk, MSGJ, PeterSymonds, Redrose64, Salvidrim!, ToBeFree, Topbanana	
2	Marek BLAHUŠ ⁵⁴³ , Marek BLAHUŠ ⁵⁴⁴	
3	Eugène Pirou (1841–1909) ⁵⁴⁵ [1] ⁵⁴⁶	
4	EmilJ ⁵⁴⁷ , EmilJ ⁵⁴⁸	
5	Donarreiskoffer, Drdoht, Fastfission commonswiki, Jarekt-Bot, Jarould, JdH, Mu	
6	Lucas Vieira ⁵⁴⁹ , Lucas Vieira ⁵⁵⁰	
7	User:Joris_Gillis~ commonswiki	
8	Podshumok ⁵⁵¹ ⁵⁵² This <i>W3C-unspecified</i> vector image ⁵⁵³ was created with Inkscape ⁵⁵⁴ ., Podshumok ⁵⁵⁵ ⁵⁵⁶ This <i>W3C-unspecified</i> vector image ⁵⁵⁷ was created with Inkscape ⁵⁵⁸ .	
9	Podshumok ⁵⁵⁹ ⁵⁶⁰ This <i>W3C-unspecified</i> vector image ⁵⁶¹ was created with Inkscape ⁵⁶² ., Podshumok ⁵⁶³ ⁵⁶⁴ This <i>W3C-unspecified</i> vector image ⁵⁶⁵ was created with Inkscape ⁵⁶⁶ .	

⁵⁴² <https://en.wikipedia.org/wiki/User:Saranphat.cha>

⁵⁴³ <http://commons.wikimedia.org/wiki/User:Blahma>

⁵⁴⁴ <https://commons.wikimedia.org/wiki/User:Blahma>

⁵⁴⁵ https://fr.wikipedia.org/wiki/Eug%C3%A8ne_Pirou

⁵⁴⁶ <https://www.europeana.eu/portal/record/03903/3C346EEF27532312811FE9573220FDB9617D9DF7.html?start=9&query=Henri+Poincar%C3%A9&qf=TYPE:IMAGE>

⁵⁴⁷ <http://commons.wikimedia.org/wiki/User:EmilJ>

⁵⁴⁸ <https://commons.wikimedia.org/wiki/User:EmilJ>

⁵⁴⁹ <http://commons.wikimedia.org/wiki/User:LucasVB>

⁵⁵⁰ <https://commons.wikimedia.org/wiki/User:LucasVB>

⁵⁵¹ <http://commons.wikimedia.org/w/index.php?title=User:Podshumok&action=edit&redlink=1>

⁵⁵² <http://commons.wikimedia.org/wiki/File:Inkscape-ws.svg>

⁵⁵³ https://en.wikipedia.org/wiki/Vector_images

⁵⁵⁴ <https://en.wikipedia.org/wiki/Inkscape>

⁵⁵⁵ <https://commons.wikimedia.org/w/index.php?title=User:Podshumok&action=edit&redlink=1>

⁵⁵⁶ <https://commons.wikimedia.org/wiki/File:Inkscape-ws.svg>

⁵⁵⁷ https://en.wikipedia.org/wiki/Vector_images

⁵⁵⁸ <https://en.wikipedia.org/wiki/Inkscape>

⁵⁵⁹ <http://commons.wikimedia.org/w/index.php?title=User:Podshumok&action=edit&redlink=1>

⁵⁶⁰ <http://commons.wikimedia.org/wiki/File:Inkscape-ws.svg>

⁵⁶¹ https://en.wikipedia.org/wiki/Vector_images

⁵⁶² <https://en.wikipedia.org/wiki/Inkscape>

⁵⁶³ <https://commons.wikimedia.org/w/index.php?title=User:Podshumok&action=edit&redlink=1>

⁵⁶⁴ <https://commons.wikimedia.org/wiki/File:Inkscape-ws.svg>

⁵⁶⁵ https://en.wikipedia.org/wiki/Vector_images

⁵⁶⁶ <https://en.wikipedia.org/wiki/Inkscape>

10	Podshumok ⁵⁶⁷ ⁵⁶⁸ This <i>W3C-unspecified</i> vector image ⁵⁶⁹ was created with Inkscape ⁵⁷⁰ ., Podshumok ⁵⁷¹ ⁵⁷² This <i>W3C-unspecified</i> vector image ⁵⁷³ was created with Inkscape ⁵⁷⁴ .	
11	Podshumok ⁵⁷⁵ ⁵⁷⁶ This <i>W3C-unspecified</i> vector image ⁵⁷⁷ was created with Inkscape ⁵⁷⁸ ., Podshumok ⁵⁷⁹ ⁵⁸⁰ This <i>W3C-unspecified</i> vector image ⁵⁸¹ was created with Inkscape ⁵⁸² .	
12	Clpo13, KolbertBot, Selket, Sv1xv	

567 <http://commons.wikimedia.org/w/index.php?title=User:Podshumok&action=edit&redlink=1>
568 <http://commons.wikimedia.org/wiki/File:Inkscape-ws.svg>
569 https://en.wikipedia.org/wiki/Vector_images
570 <https://en.wikipedia.org/wiki/Inkscape>
571 <https://commons.wikimedia.org/w/index.php?title=User:Podshumok&action=edit&redlink=1>
572 <https://commons.wikimedia.org/wiki/File:Inkscape-ws.svg>
573 https://en.wikipedia.org/wiki/Vector_images
574 <https://en.wikipedia.org/wiki/Inkscape>
575 <http://commons.wikimedia.org/w/index.php?title=User:Podshumok&action=edit&redlink=1>
576 <http://commons.wikimedia.org/wiki/File:Inkscape-ws.svg>
577 https://en.wikipedia.org/wiki/Vector_images
578 <https://en.wikipedia.org/wiki/Inkscape>
579 <https://commons.wikimedia.org/w/index.php?title=User:Podshumok&action=edit&redlink=1>
580 <https://commons.wikimedia.org/wiki/File:Inkscape-ws.svg>
581 https://en.wikipedia.org/wiki/Vector_images
582 <https://en.wikipedia.org/wiki/Inkscape>

3 Licenses

3.1 GNU GENERAL PUBLIC LICENSE

Version 3, 29 June 2007

Copyright © 2007 Free Software Foundation, Inc. <<http://fsf.org/>>

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed. Preamble

The GNU General Public License is a free, copyleft license for software and other kinds of works.

The licenses for most software and other practical works are designed to take away your freedom to share and change the works. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change all versions of a program—to make sure it remains free software for all its users. We, the Free Software Foundation, use the GNU General Public License for most of our software; it applies also to any other work released this way by its authors. You can apply it to your programs, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for them if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs, and that you know you can do these things.

To protect your rights, we need to prevent others from denying you these rights or asking you to surrender the rights. Therefore, you have certain responsibilities if you distribute copies of the software, or if you modify it: responsibilities to respect the freedom of others.

For example, if you distribute copies of such a program, whether gratis or for a fee, you must pass on to the recipients the same freedoms that you received. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

Developers that use the GNU GPL protect your rights with two steps: (1) assert copyright on the software, and (2) offer you this License giving you legal permission to copy, distribute and/or modify it.

For the developers' and authors' protection, the GPL clearly explains that there is no warranty for this free software. For both users' and authors' sake, the GPL requires that modified versions be marked as changed, so that their problems will not be attributed erroneously to authors of previous versions.

Some devices are designed to deny users access to install or run modified versions of the software inside them, although the manufacturer can do so. This is fundamentally incompatible with the aim of protecting users' freedom to change the software. The systematic pattern of such abuse occurs in the area of products for individuals to use, which is precisely where it is most unacceptable. Therefore, we have designed this version of the GPL to prohibit the practice for those products. If such problems arise substantially in other domains, we stand ready to extend this provision to those domains in future versions of the GPL, as needed to protect the freedom of users.

Finally, every program is threatened constantly by software patents. States should not allow patents to restrict development and use of software on general-purpose computers, but in those that do, we wish to avoid the special danger that patents applied to a free program could make it effectively proprietary. To prevent this, the GPL assures that patents cannot be used to render the program non-free.

The precise terms and conditions for copying, distribution and modification follow. TERMS AND CONDITIONS 0. Definitions.

"This License" refers to version 3 of the GNU General Public License.

"Copyright" also means copyright-like laws that apply to other kinds of works, such as semiconductor masks.

"The Program" refers to any copyrightable work licensed under this License. Each licensee is addressed as "you". "Licensees" and "recipients" may be individuals or organizations.

To "modify" a work means to copy from or adapt all or part of the work in a fashion requiring copyright permission, other than the making of an exact copy. The resulting work is called a "modified version" of the earlier work or a work "based on" the earlier work.

A "covered work" means either the unmodified Program or a work based on the Program.

To "propagate" a work means to do anything with it that, without permission, would make you directly or secondarily liable for infringement under applicable copyright law, except executing it on a computer or using a private copy. Propagation includes copying, distribution (with or without modification), making available to the public, and in some countries other activities as well.

To "convey" a work means any kind of propagation that enables other parties to make or receive copies. Mere interaction with a user through a computer network, with no transfer of a copy, is not conveying.

An interactive user interface displays "Appropriate Legal Notices" to the extent that it includes a convenient and prominently visible feature that (1) displays an appropriate copyright notice, and (2) tells the user that there is no warranty for the work (except to the extent that warranties are provided), that licensees may convey the work under this License, and how to view a copy of this License. If the interface presents a list of user commands or options, such as a menu, a prominent item in the list meets this criterion. 1. Source Code.

The "source code" for a work means the preferred form of the work for making modifications to it. "Object code" means any non-source form of a work.

A "Standard Interface" means an interface that either is an official standard defined by a recognized standards body, or, in the case of interfaces specified for a particular programming language, one that is widely used among developers working in that language.

The "System Libraries" of an executable work include anything, other than the work as a whole, that (a) is included in the normal form of packaging a Major Component, but which is not part of that Major Component, and (b) serves only to enable use of the work with that Major Component, or to implement a Standard Interface for which an implementation is available to the public in source code form. A "Major Component", in this context, means a major operating component (kernel, window system, and so on) of the specific essential system (if any) on which the executable work runs, or a compiler used to produce the work, or an object code interpreter used to run it.

The "Corresponding Source" for a work in object code form means all the source code needed to generate, install, and (for an executable work) run the object code and to modify the work, including scripts to control those activities. However, it does not include the work's System Libraries, or general-purpose tools or generally available free programs which are used unmodified in performing those activities but which are not part of the work. For example, Corresponding Source includes interface definition files associated with source files for the work, and the source code for shared libraries and dynamically linked subprograms that the work is specifically designed to require, such as by intimate data communication or control flow between those subprograms and other parts of the work.

The Corresponding Source need not include anything that users can regenerate automatically from other parts of the Corresponding Source.

The Corresponding Source for a work in source code form is that same work. 2. Basic Permissions.

All rights granted under this License are granted for the term of copyright on the Program, and are irrevocable provided the stated conditions are met. This License explicitly affirms your unlimited permission to run the unmodified Program. The output from running a covered work is covered by this License only if the output, given its content, constitutes a covered work. This License acknowledges your rights of fair use or other equivalent, as provided by copyright law.

You may make, run and propagate covered works that you do not convey, without conditions so long as your license otherwise remains in force. You may convey covered works to others for the sole purpose of having them make modifications exclusively for you, or provide you with facilities for running those works, provided that you comply with the terms of this License in conveying all material for which you do not control copyright. Those thus making or running the covered works for you must do so exclusively on your behalf, under your direction and control, on terms that prohibit them from making any copies of your copyrighted material outside their relationship with you.

Conveying under any other circumstances is permitted solely under the conditions stated below. Sublicensing is not allowed; section 10 makes it unnecessary. 3. Protecting Users' Legal Rights From Anti-Circumvention Law.

No covered work shall be deemed part of an effective technological measure under any applicable law fulfilling obligations under article 11 of the WIPO copyright treaty adopted on 20 December 1996, or similar laws prohibiting or restricting circumvention of such measures.

When you convey a covered work, you waive any legal power to forbid circumvention of technological measures to the extent such circumvention is effected by exercising rights under this License with respect to the covered work, and you disclaim any intention to limit operation or modification of the work as a means of enforcing, against the work's users, your or third parties' legal rights to forbid circumvention of technological measures. 4. Conveying Verbatim Copies.

You may convey verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice; keep intact all notices stating that this License and any non-permissive terms added in accord with section 7 apply to the code; keep intact all notices of the absence of any warranty; and give all recipients a copy of this License along with the Program.

You may charge any price or no price for each copy that you convey, and you may offer support or warranty protection for a fee. 5. Conveying Modified Source Versions.

You may convey a work based on the Program, or the modifications to produce it from the Program, in the form of source code under the terms of section 4, provided that you also meet all of these conditions:

* a) The work must carry prominent notices stating that you modified it, and giving a relevant date. * b) The work must carry prominent notices stating that it is released under this License and any conditions added under section 7. This requirement modifies the requirement in section 4 to "keep intact all notices". * c) You must license the entire work, as a whole, under this License to anyone who comes into possession of a copy. This License will therefore apply, along with any applicable section 7 additional terms, to the whole of the work, and all its parts, regardless of how they are packaged. This License gives no permission to license the work in any other way, but it does not invalidate such permission if you have separately received it. * d) If the work has interactive user interfaces, each must display Appropriate Legal Notices; however, if the Program has interactive interfaces that do not display Appropriate Legal Notices, your work need not make them do so.

A compilation of a covered work with other separate and independent works, which are not by their nature extensions of the covered work, and which are not combined with it such as to form a larger program, in or on a volume of a storage or distribution medium, is called an "aggregate" if the compilation and its resulting copyright are not used to limit the access or legal rights of the compilation's users beyond what the individual works permit. Inclusion of a covered work in an aggregate does not cause this License to apply to the other parts of the aggregate. 6. Conveying Non-Source Forms.

You may convey a covered work in object code form under the terms of sections 4 and 5, provided that you also convey the machine-readable Corresponding Source under the terms of this License, in one of these ways:

* a) Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by the Corresponding Source fixed on a durable physical medium customarily used for software interchange. * b) Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by a written offer, valid for at least three years and valid for as long as you offer spare parts or customer support for that product model, to give anyone who possesses the object code either (1) a copy of the Corresponding Source for all the software in the product that is covered by this License, on a durable physical medium customarily used for software interchange, for a price no more than your reasonable cost of physically performing this conveying of source, or (2) access to copy the Corresponding Source from a network server at no charge. * c) Convey individual copies of the object code with a copy of the written offer to provide the Corresponding Source. This alternative is allowed only occasionally and noncommercially, and only if you received the object code with such an offer, in accord with subsection 6b. * d) Convey the object code by offering access from a designated place (gratis or for a charge), and offer equivalent access to the Corresponding Source in the same way through the same place at no further charge. You need not require recipients to copy the Corresponding Source along with the object code. If the place to copy the object code is a network server, the Corresponding Source may be on a

different server (operated by you or a third party) that supports equivalent copying facilities, provided you maintain clear directions next to the object code saying where to find the Corresponding Source. Regardless of what server hosts the Corresponding Source, you remain obligated to ensure that it is available for as long as needed to satisfy these requirements. * e) Convey the object code using peer-to-peer transmission, provided you inform other peers where the object code and Corresponding Source of the work are being offered to the general public at no charge under subsection 6d.

A separable portion of the object code, whose source code is excluded from the Corresponding Source as a System Library, need not be included in conveying the object code work.

A "User Product" is either (1) a "consumer product", which means any tangible personal property which is normally used for personal, family, or household purposes, or (2) anything designed or sold for incorporation into a dwelling. In determining whether a product is a consumer product, doubtful cases shall be resolved in favor of coverage. For a particular product received by a particular user, "normally used" refers to a typical or common use of that class of product, regardless of the status of the particular user or of the way in which the particular user actually uses, or expects to be expected to use, the product. A product is a consumer product regardless of whether the product has substantial commercial, industrial or non-consumer uses, unless such uses represent the only significant mode of use of the product.

"Installation Information" for a User Product means any methods, procedures, authorization keys, or other information required to install and execute modified versions of a covered work in that User Product from a modified version of its Corresponding Source. The information must suffice to ensure that the continued functioning of the modified object code is in no case prevented or interfered with solely because modification has been made.

If you convey an object code work under this section in, or with, or specifically for use in, a User Product, and the conveying occurs as part of a transaction in which the right of possession and use of the User Product is transferred to the recipient in perpetuity or for a fixed term (regardless of how the transaction is characterized), the Corresponding Source conveyed under this section must be accompanied by the Installation Information. But this requirement does not apply if neither you nor any third party retains the ability to install modified object code on the User Product (for example, the work has been installed in ROM).

The requirement to provide Installation Information does not include a requirement to continue to provide support service, warranty, or updates for a work that has been modified or installed by the recipient, or for the User Product in which it has been modified or installed. Access to a network may be denied when the modification itself materially and adversely affects the operation of the network or violates the rules and protocols for communication across the network.

Corresponding Source conveyed, and Installation Information provided, in accord with this section must be in a format that is publicly documented (and with an implementation available to the public in source code form), and must require no special password or key for unpacking, reading or copying. 7. Additional Terms.

"Additional permissions" are terms that supplement the terms of this License by making exceptions from one or more of its conditions. Additional permissions that are applicable to the entire Program shall be treated as though they were included in this License, to the extent that they are valid under applicable law. If additional permissions apply only to part of the Program, that part may be used separately under those permissions, but the entire Program remains governed by this License without regard to the additional permissions.

When you convey a copy of a covered work, you may at your option remove additional permissions from that copy, or from any part of it. (Additional permissions may be written to require their own removal in certain cases when you modify the work.) You may place additional permissions on material, added by you to a covered work, for which you have or can give appropriate copyright permission.

Notwithstanding any other provision of this License, for material you add to a covered work, you may (if authorized by the copyright holders of that material) supplement the terms of this License with terms:

* a) Disclaiming warranty or limiting liability differently from the terms of sections 15 and 16 of this License; or * b) Requiring preservation of specified reasonable legal notices or author attributions in that material or in the Appropriate Legal Notices displayed by works containing it; or * c) Prohibiting misrepresentation of the origin of that material, or requiring that modified versions of such material be marked in reasonable ways as different from the original version; or * d) Limiting the use for publicity purposes of names of licensors or authors of the material; or * e) Declining to grant rights under trademark law for use of some trade names, trademarks, or service marks; or * f) Requiring indemnification of licensors and authors of that material by anyone who conveys the material (or modified versions of it) with contractual assumptions of liability to the recipient, for any liability that these contractual assumptions directly impose on those licensors and authors.

All other non-permissive additional terms are considered "further restrictions" within the meaning of section 10. If the Program as you received it, or any part of it, contains a notice stating that it is governed by this License along with a term that is a further restriction, you may remove that term. If a license document contains a further restriction but permits relicensing or conveying under this License, you may add to a covered work material governed by the terms of that license document, provided that the further restriction does not survive such relicensing or conveying.

If you add terms to a covered work in accord with this section, you must place, in the relevant source files, a statement of the additional terms that apply to those files, or a notice indicating where to find the applicable terms.

Additional terms, permissive or non-permissive, may be stated in the form of a separately written license, or stated as exceptions; the above requirements apply either way. 8. Termination.

You may not propagate or modify a covered work except as expressly provided under this License. Any attempt otherwise to propagate or modify it is void, and will automatically terminate your rights under this License (including any patent licenses granted under the third paragraph of section 11).

However, if you cease all violation of this License, then your license from a particular copyright holder is reinstated (a) provisionally, unless and until the copyright holder explicitly and finally terminates

your license, and (b) permanently, if the copyright holder fails to notify you of the violation by some reasonable means prior to 60 days after the cessation.

Moreover, your license from a particular copyright holder is reinstated permanently if the copyright holder notifies you of the violation by some reasonable means, this is the first time you have received notice of violation of this License (for any work) from that copyright holder, and you cure the violation prior to 30 days after your receipt of the notice.

Termination of your rights under this section does not terminate the licenses of parties who have received copies or rights from you under this License. If your rights have been terminated and not permanently reinstated, you do not qualify to receive new licenses for the same material under section 10. 9. Acceptance Not Required for Having Copies.

You are not required to accept this License in order to receive or run a copy of the Program. Ancillary propagation of a covered work occurring solely as a consequence of using peer-to-peer transmission to receive a copy likewise does not require acceptance. However, nothing other than this License grants you permission to propagate or modify any covered work. These actions infringe copyright if you do not accept this License. Therefore, by modifying or propagating a covered work, you indicate your acceptance of this License to do so. 10. Automatic Licensing of Downstream Recipients.

Each time you convey a covered work, the recipient automatically receives a license from the original licensors, to run, modify and propagate that work, subject to this License. You are not responsible for enforcing compliance by third parties with this License.

An "entity transaction" is a transaction transferring control of an organization, or substantially all assets of one, or subdividing an organization, or merging organizations. If propagation of a covered work results from an entity transaction, each party to that transaction who receives a copy of the work also receives whatever licenses to the work the party's predecessor in interest had or could give under the previous paragraph, plus a right to possession of the Corresponding Source of the work from the predecessor in interest, if the predecessor has it or can get it with reasonable efforts.

You may not impose any further restrictions on the exercise of the rights granted or affirmed under this License. For example, you may not impose a license fee, royalty, or other charge for exercise of rights granted under this License, and you may not initiate litigation (including a cross-claim or counterclaim in a lawsuit) alleging that any patent claim is infringed by making, using, selling, offering for sale, or importing the Program or any portion of it. 11. Patents.

A "contributor" is a copyright holder who authorizes use under this License of the Program or a work on which the Program is based. The work thus licensed is called the contributor's "contributor version".

A contributor's "essential patent claims" are all patent claims owned or controlled by the contributor, whether already acquired or hereafter acquired, that would be infringed by some manner, permitted by this License, of making, using, or selling its contributor version, but do not include claims that would be infringed only as a consequence of further modification of the contributor version. For purposes of this definition, "control" includes the right to grant patent sublicenses in a manner consistent with the requirements of this License.

Each contributor grants you a non-exclusive, worldwide, royalty-free patent license under the contributor's essential patent claims, to make, use, sell, offer for sale, import and otherwise run, modify and propagate the contents of its contributor version.

In the following three paragraphs, a "patent license" is any express agreement or commitment, however denominated, not to enforce a patent (such as an express permission to practice a patent or covenant not to sue for patent infringement). To "grant" such a patent license to a party means to make such an agreement or commitment not to enforce a patent against the party.

If you convey a covered work, knowingly relying on a patent license, and the Corresponding Source of the work is not available for anyone to copy, free of charge and under the terms of this License, through a publicly available network server or other readily accessible means, then you must either (1) cause the Corresponding Source to be so available, or (2) arrange to deprive yourself of the benefit of the patent license for this particular work, or (3) arrange, in a manner consistent with the requirements of this License, to extend the patent license to downstream recipients. "Knowingly relying" means you have actual knowledge that, but for the patent license, your conveying the covered work in a country, or your recipient's use of the covered work in a country, would infringe one or more identifiable patents in that country that you have reason to believe are valid.

If, pursuant to or in connection with a single transaction or arrangement, you convey, or propagate by procuring conveyance of, a covered work, and grant a patent license to some of the parties receiving the covered work authorizing them to use, propagate, modify or convey a specific copy of the covered work, then the patent license you grant is automatically extended to all recipients of the covered work and works based on it.

A patent license is "discriminatory" if it does not include within the scope of its coverage, prohibits the exercise of, or is conditioned on the non-exercise of one or more of the rights that are specifically granted under this License. You may not convey a covered work if you are a party to an arrangement with a third party that is in the business of distributing software, under which you make payment to the third party based on the extent of your activity of conveying the work, and under which the third party grants, to any of the parties who would receive the covered work from you, a discriminatory patent license (a) in connection with copies of the covered work conveyed by you (or copies made from those copies), or (b) primarily for and in connection with specific products or compilations that contain the covered work, unless you entered into that arrangement, or that patent license was granted, prior to 28 March 2007.

Nothing in this License shall be construed as excluding or limiting any implied license or other defenses to infringement that may otherwise be available to you under applicable patent law. 12. No Surrender of Others' Freedom.

If conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot convey a covered work so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not convey it at all. For example, if you agree to terms that obligate you to collect a royalty for further conveying from those to whom you convey the Program, the only way you could satisfy

both those terms and this License would be to refrain entirely from conveying the Program. 13. Use with the GNU Affero General Public License.

Notwithstanding any other provision of this License, you have permission to link or combine any covered work with a work licensed under version 3 of the GNU Affero General Public License into a single combined work, and to convey the resulting work. The terms of this License will continue to apply to the part which is the covered work, but the special requirements of the GNU Affero General Public License, section 13, concerning interaction through a network will apply to the combination as such. 14. Revised Versions of this License.

The Free Software Foundation may publish revised and/or new versions of the GNU General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Program specifies that a certain numbered version of the GNU General Public License "or any later version" applies to it, you have the option of following the terms and conditions either of that numbered version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of the GNU General Public License, you may choose any version ever published by the Free Software Foundation.

If the Program specifies that a proxy can decide which future versions of the GNU General Public License can be used, that proxy's public statement of acceptance of a version permanently authorizes you to choose that version for the Program.

3.2 GNU Free Documentation License

Version 1.3, 3 November 2008

Copyright (c) 2000, 2001, 2002, 2007, 2008 Free Software Foundation, Inc. <<http://fsf.org/>>

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed. 0. PREAMBLE

The purpose of this License is to make a manual, textbook, or other functional and useful document "free" in the sense of freedom: to assure everyone the effective freedom to copy and redistribute it, with or without modifying it, either commercially or noncommercially. Secondly, this License preserves for the author and publisher a way to get credit for their work, while not being considered responsible for modifications made by others.

This License is a kind of "copyleft", which means that derivative works of the document must themselves be free in the same sense. It complements the GNU General Public License, which is a copyleft license designed for free software.

We have designed this License in order to use it for manuals for free software, because free software needs free documentation: a free program should come with manuals providing the same freedoms that the software does. But this License is not limited to software manuals; it can be used for any textual work, regardless of subject matter or whether it is published as a printed book. We recommend this License principally for works whose purpose is instruction or reference. 1. APPLICABILITY AND DEFINITIONS

This License applies to any manual or other work, in any medium, that contains a notice placed by the copyright holder saying it can be distributed under the terms of this License. Such a notice grants a world-wide, royalty-free license, unlimited in duration, to use that work under the conditions stated herein. The "Document", below, refers to any such manual or work. Any member of the public is a licensee, and is addressed as "you". You accept the license if you copy, modify or distribute the work in a way requiring permission under copyright law.

A "Modified Version" of the Document means any work containing the Document or a portion of it, either copied verbatim, or with modifications and/or translated into another language.

A "Secondary Section" is a named appendix or a front-matter section of the Document that deals exclusively with the relationship of the publishers or authors of the Document to the Document's overall subject (or to related matters) and contains nothing that could fall directly within that overall subject. (Thus, if the Document is in part a textbook of mathematics, a Secondary Section may not explain any mathematics.) The relationship could be a matter of historical connection with the subject or with related matters, or of legal, commercial, philosophical, ethical or political position regarding them.

The "Invariant Sections" are certain Secondary Sections whose titles are designated, as being those of Invariant Sections, in the notice that says that the Document is released under this License. If a section does not fit the above definition of Secondary then it is not allowed to be designated as Invariant. The Document may contain zero Invariant Sections. If the Document does not identify any Invariant Sections then there are none.

The "Cover Texts" are certain short passages of text that are listed, as Front-Cover Texts or Back-Cover Texts, in the notice that says that the Document is released under this License. A Front-Cover Text may be at most 5 words, and a Back-Cover Text may be at most 25 words.

A "Transparent" copy of the Document means a machine-readable copy, represented in a format whose specification is available to the general public, that is suitable for revising the document straightforwardly with generic text editors or (for images composed of pixels) generic paint programs or (for drawings) some widely available drawing editor, and that is suitable for input to text formatters or for automatic translation to a variety of formats suitable for input to text formatters. A copy made in an otherwise Transparent file format whose markup, or absence of markup, has been arranged to thwart or discourage subsequent modification by readers is not Transparent. An image format is not Transparent if used for any substantial amount of text. A copy that is not "Transparent" is called "Opaque".

Examples of suitable formats for Transparent copies include plain ASCII without markup, Texinfo input format, LaTeX input format, SGML or XML using a publicly available DTD, and standard-conforming simple HTML, PostScript or PDF designed for human modification. Examples of transparent image formats include PNG, XCF and JPG. Opaque formats include proprietary formats that can be read and edited only by proprietary word processors, SGML or XML for which the DTD and/or processing tools are not generally available, and the machine-generated HTML, PostScript or PDF produced by some word processors for output purposes only.

The "Title Page" means, for a printed book, the title page itself, plus such following pages as are needed to hold, legibly, the material this License requires to appear in the title page. For works in formats which do not have any title page as such, "Title Page" means the text near the most prominent appearance of the work's title, preceding the beginning of the body of the text.

The "publisher" means any person or entity that distributes copies of the Document to the public.

A section "Entitled XYZ" means a named subunit of the Document whose title either is precisely XYZ or contains XYZ in parentheses

Later license versions may give you additional or different permissions. However, no additional obligations are imposed on any author or copyright holder as a result of your choosing to follow a later version. 15. Disclaimer of Warranty.

THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION. 16. Limitation of Liability.

IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MODIFIES AND/OR CONVEYS THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. 17. Interpretation of Sections 15 and 16.

following text that translates XYZ in another language. (Here XYZ stands for a specific section name mentioned below, such as "Acknowledgements", "Dedications", "Endorsements", or "History"). To "Preserve the Title" of such a section when you modify the Document means that it remains a section "Entitled XYZ" according to this definition.

The Document may include Warranty Disclaimers next to the notice which states that this License applies to the Document. These Warranty Disclaimers are considered to be included by reference in this License, but only as regards disclaiming warranties; any other implication that these Warranty Disclaimers may have is void and has no effect on the meaning of this License. 2. VERBATIM COPYING

You may copy and distribute the Document in any medium, either commercially or noncommercially, provided that this License, the copyright notices, and the license notice saying this License applies to the Document are reproduced in all copies, and that you add no other conditions whatsoever to those of this License. You may not use technical measures to obstruct or control the reading or further copying of the copies you make or distribute. However, you may accept compensation in exchange for copies. If you distribute a large enough number of copies you must also follow the conditions in section 3.

You may also lend copies, under the same conditions stated above, and you may publicly display copies. 3. COPYING IN QUANTITY

If you publish printed copies (or copies in media that commonly have printed covers) of the Document, numbering more than 100, and the Document's license notice requires Cover Texts, you must enclose the copies in covers that carry, clearly and legibly, all these Cover Texts: Front-Cover Texts on the front cover, and Back-Cover Texts on the back cover. Both covers must also clearly and legibly identify you as the publisher of these copies. The front cover must present the full title with all words of the title equally prominent and visible. You may add other material on the covers in addition. Copying with changes limited to the covers, as long as they preserve the title of the Document and satisfy these conditions, can be treated as verbatim copying in other respects.

If the required texts for either cover are too voluminous to fit legibly, you should put the first one listed (as many as fit reasonably) on the actual cover, and continue the rest onto adjacent pages.

If you publish or distribute Opaque copies of the Document numbering more than 100, you must either include a machine-readable Transparent copy along with each Opaque copy, or state in or with each Opaque copy a computer-network location from which the general network-using public has access to download using public-standard network protocols a complete Transparent copy of the Document, free of added material. If you use the latter option, you must take reasonably prudent steps, when you begin distribution of Opaque copies in quantity, to ensure that this Transparent copy will remain thus accessible at the stated location until at least one year after the last time you distribute an Opaque copy (directly or through your agents or retailers) of that edition to the public.

It is requested, but not required, that you contact the authors of the Document well before redistributing any large number of copies, to give them a chance to provide you with an updated version of the Document. 4. MODIFICATIONS

You may copy and distribute a Modified Version of the Document under the conditions of section 2 above, provided that you release the Modified Version under precisely this License, with the Modified Version filling the role of the Document, this licensing distribution and modification of the Modified Version to whoever possesses a copy of it. In addition, you must do these things in the Modified Version:

* A. Use in the Title Page (and on the covers, if any) a title distinct from that of the Document, and from those of previous versions (which should, if there were any, be listed in the History section of the Document). You may use the same title as a previous version if the original publisher of that version gives permission. * B. List on the Title Page, as authors, one or more persons or entities responsible for authorship of the modifications in the Modified Version, together with at least five of the principal authors of the Document (all of its principal authors, if it has fewer than five), unless they release you from this requirement. * C. State on the Title page the name of the publisher of the Modified Version, as the publisher. * D. Preserve all the copyright notices of the Document. * E. Add an appropriate copyright notice for your modifications adjacent to the other copyright notices. * F. Include, immediately after the copyright notices, a license notice giving the public permission to use the Modified Version under the terms of this license, in the form shown below. * G. Preserve in the license notice the full list of Invariant Sections and required Cover Texts given in the Document's license notice. * H. Include an unaltered copy of this License. * I. Preserve the section entitled "History", Preserve its Title, and add to it an item stating at least the title, year, new authors, and publisher of the Modified Version as given on the Title Page. If there is no section entitled "History" in the Document, create one stating the title, year, authors, and publisher of the Document as given on its Title Page, then add an item describing the Modified Version as stated in the previous sentence. * J. Preserve the network location, if any, given in the Document for public access to a Transparent copy of the Document, and likewise the network locations given in the Document for previous versions it was based on. These may be placed in the "History" section. You may omit a network location for work that was published at least four years before the Document itself, or if the original publisher of the version it refers to gives permission. * K. For one section entitled "Acknowledgements" or "Dedications", Preserve the Title of the section, and preserve in the section all the substance and tone of each of the contributor acknowledgements and/or dedications given therein. * L. Preserve all the Invariant Sections of the Document, unaltered in their text and

If the disclaimer of warranty and limitation of liability provided above cannot be given local legal effect according to their terms, reviewing courts shall apply local law that most closely approximates an absolute waiver of all civil liability in connection with the Program, unless a warranty or assumption of liability accompanies a copy of the Program in return for a fee.

END OF TERMS AND CONDITIONS How to Apply These Terms to Your New Programs

If you develop a new program, and you want it to be of the greatest possible use to the public, the best way to achieve this is to make it free software which everyone can redistribute and change under these terms.

To do so, attach the following notices to the program. It is safest to attach them to the start of each source file to most effectively state the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

<one line to give the program's name and a brief idea of what it does.>
Copyright (C) <year> <name of author>

This program is free software: you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation, either version 3 of the License, or (at your option) any later version.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

in their titles. Section numbers or the equivalent are not considered part of the section titles. * M. Delete any section Entitled "Endorsements". Such a section may not be included in the Modified Version. * N. Do not retitle any existing section to be Entitled "Endorsements" or to conflict in title with any Invariant Section. * O. Preserve any Warranty Disclaimers.

If the Modified Version includes new front-matter sections or appendices that qualify as Secondary Sections and contain no material copied from the Document, you may at your option designate some or all of these sections as invariant. To do this, add their titles to the list of Invariant Sections in the Modified Version's license notice. These titles must be distinct from any other section titles.

You may add a section Entitled "Endorsements", provided it contains nothing but endorsements of your Modified Version by various parties—for example, statements of peer review or of the text has been approved by an organization as the authoritative definition of a standard.

You may add a passage of up to five words as a Front-Cover Text, and a passage of up to 25 words as a Back-Cover Text, to the end of the list of Cover Texts in the Modified Version. Only one passage of Front-Cover Text and one of Back-Cover Text may be added by (or through arrangements made by) any one entity. If the Document already includes a cover text for the same cover, previously added by you or by arrangement made by the same entity you are acting on behalf of, you may not add another; but you may replace the old one, on explicit permission from the previous publisher that added the old one.

The author(s) and publisher(s) of the Document do not by this License give permission to use their names for publicity for or to assert or imply endorsement of any Modified Version. 5. COMBINING DOCUMENTS

You may combine the Document with other documents released under this License, under the terms defined in section 4 above for modified versions, provided that you include in the combination all of the Invariant Sections of all of the original documents, unmodified, and list them all as Invariant Sections of your combined work in its license notice, and that you preserve all their Warranty Disclaimers.

The combined work need only contain one copy of this License, and multiple identical Invariant Sections may be replaced with a single copy. If there are multiple Invariant Sections with the same name but different contents, make the title of each such section unique by adding at the end of it, in parentheses, the name of the original author or publisher of that section if known, or else a unique number. Make the same adjustment to the section titles in the list of Invariant Sections in the license notice of the combined work.

In the combination, you must combine any sections Entitled "History" in the various original documents, forming one section Entitled "History"; likewise combine any sections Entitled "Acknowledgements", and any sections Entitled "Dedications". You must delete all sections Entitled "Endorsements". 6. COLLECTIONS OF DOCUMENTS

You may make a collection consisting of the Document and other documents released under this License, and replace the individual copies of this License in the various documents with a single copy that is included in the collection, provided that you follow the rules of this License for verbatim copying of each of the documents in all other respects.

You may extract a single document from such a collection, and distribute it individually under this License, provided you insert a copy of this License into the extracted document, and follow this License in all other respects regarding verbatim copying of that document. 7. AGGREGATION WITH INDEPENDENT WORKS

A compilation of the Document or its derivatives with other separate and independent documents or works, in or on a volume of a storage or distribution medium, is called an "aggregate" if the copyright resulting from the compilation is not used to limit the legal rights of the compilation's users beyond what the individual works permit. When the Document is included in an aggregate, this License does not apply to the other works in the aggregate which are not themselves derivative works of the Document.

If the Cover Text requirement of section 3 is applicable to these copies of the Document, then if the Document is less than one half of the entire aggregate, the Document's Cover Texts may be placed on covers that bracket the Document within the aggregate, or the electronic equivalent of covers if the Document is in electronic form. Otherwise they must appear on printed covers that bracket the whole aggregate. 8. TRANSLATION

Translation is considered a kind of modification, so you may distribute translations of the Document under the terms of section 4. Replacing Invariant Sections with translations requires special permission from their copyright holders, but you may include translations of some or all Invariant Sections in addition to the original versions of these Invariant Sections. You may include a translation of this License, and all the license notices in the Document, and any Warranty Disclaimers, provided that you also include the original English version of this License and the original versions of those notices and disclaimers. In case of a disagreement between the translation and the original version of this License or a notice or disclaimer, the original version will prevail.

If a section in the Document is Entitled "Acknowledgements", "Dedications", or "History", the requirement (section 4) to Preserve its Title

You should have received a copy of the GNU General Public License along with this program. If not, see <<http://www.gnu.org/licenses/>>.

Also add information on how to contact you by electronic and paper mail.

If the program does terminal interaction, make it output a short notice like this when it starts in an interactive mode:

<program> Copyright (C) <year> <name of author> This program comes with ABSOLUTELY NO WARRANTY; for details type 'show w'. This is free software, and you are welcome to redistribute it under certain conditions; type 'show c' for details.

The hypothetical commands 'show w' and 'show c' should show the appropriate parts of the General Public License. Of course, your program's commands might be different; for a GUI interface, you would use an "about box".

You should also get your employer (if you work as a programmer) or school, if any, to sign a "copyright disclaimer" for the program, if necessary. For more information on this, and how to apply and follow the GNU GPL, see <<http://www.gnu.org/licenses/>>.

The GNU General Public License does not permit incorporating your program into proprietary programs. If your program is a subroutine library, you may consider it more useful to permit linking proprietary applications with the library. If this is what you want to do, use the GNU Lesser General Public License instead of this License. But first, please read <<http://www.gnu.org/philosophy/why-not-lgpl.html>>.

(section 1) will typically require changing the actual title. 9. TERMINATION

You may not copy, modify, sublicense, or distribute the Document except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense, or distribute it is void, and will automatically terminate your rights under this License.

However, if you cease all violation of this License, then your license from a particular copyright holder is reinstated (a) provisionally, unless and until the copyright holder explicitly and finally terminates your license, and (b) permanently, if the copyright holder fails to notify you of the violation by some reasonable means prior to 60 days after the cessation.

Moreover, your license from a particular copyright holder is reinstated permanently if the copyright holder notifies you of the violation by some reasonable means, this is the first time you have received notice of violation of this License (for any work) from that copyright holder, and you cure the violation prior to 30 days after your receipt of the notice.

Termination of your rights under this section does not terminate the licenses of parties who have received copies or rights from you under this License. If your rights have been terminated and not permanently reinstated, receipt of a copy of some or all of the same material does not give you any rights to use it. 10. FUTURE REVISIONS OF THIS LICENSE

The Free Software Foundation may publish new, revised versions of the GNU Free Documentation License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns. See <<http://www.gnu.org/copyleft/>>.

Each version of the License is given a distinguishing version number. If the Document specifies that a particular numbered version of this License "or any later version" applies to it, you have the option of following the terms and conditions either of that specified version or of any later version that has been published (not as a draft) by the Free Software Foundation. If the Document does not specify a version number of this License, you may choose any version ever published (not as a draft) by the Free Software Foundation. If the Document specifies that a proxy can decide which future versions of this License can be used, that proxy's public statement of acceptance of a version permanently authorizes you to choose that version for the Document. 11. RELICENSING

"Massive Multiauthor Collaboration Site" (or "MMC Site") means any World Wide Web server that publishes copyrightable works and also provides prominent facilities for anybody to edit those works. A public webkit that anybody can edit is an example of such a server. A "Massive Multiauthor Collaboration" (or "MMC") contained in the site means any set of copyrightable works thus published on the MMC site.

"CC-BY-SA" means the Creative Commons Attribution-Share Alike 3.0 license published by Creative Commons Corporation, a not-for-profit corporation with a principal place of business in San Francisco, California, as well as future copyleft versions of that license published by that same organization.

"Incorporate" means to publish or republish a Document, in whole or in part, as part of another Document.

An MMC is "eligible for relicensing" if it is licensed under this License, and if all works that were first published under this License somewhere other than this MMC, and subsequently incorporated in whole or in part into the MMC, (1) had no cover texts or invariant sections, and (2) were thus incorporated prior to November 1, 2008.

The operator of an MMC Site may republish an MMC contained in the site under CC-BY-SA on the same site at any time before August 1, 2009, provided the MMC is eligible for relicensing. ADDENDUM: How to use this License for your documents

To use this License in a document you have written, include a copy of the License in the document and put the following copyright and license notices just after the title page:

Copyright (C) YEAR YOUR NAME. Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.3 or any later version published by the Free Software Foundation; with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts. A copy of the License is included in the section entitled "GNU Free Documentation License".

If you have Invariant Sections, Front-Cover Texts and Back-Cover Texts, replace the "with ... Texts." line with this:

with the Invariant Sections being LIST THEIR TITLES, with the Front-Cover Texts being LIST, and with the Back-Cover Texts being LIST.

If you have Invariant Sections without Cover Texts, or some other combination of the three, merge those two alternatives to suit the situation.

If your document contains nontrivial examples of program code, we recommend releasing these examples in parallel under your choice of free software license, such as the GNU General Public License, to permit their use in free software.

3.3 GNU Lesser General Public License

GNU LESSER GENERAL PUBLIC LICENSE

Version 3, 29 June 2007

Copyright © 2007 Free Software Foundation, Inc. <<http://fsf.org/>>

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

This version of the GNU Lesser General Public License incorporates the terms and conditions of version 3 of the GNU General Public License, supplemented by the additional permissions listed below.

0. Additional Definitions.

As used herein, “this License” refers to version 3 of the GNU Lesser General Public License, and the “GNU GPL” refers to version 3 of the GNU General Public License.

“The Library” refers to a covered work governed by this License, other than an Application or a Combined Work as defined below.

An “Application” is any work that makes use of an interface provided by the Library, but which is not otherwise based on the Library. Defining a subclass of a class defined by the Library is deemed a mode of using an interface provided by the Library.

A “Combined Work” is a work produced by combining or linking an Application with the Library. The particular version of the Library with which the Combined Work was made is also called the “Linked Version”.

The “Minimal Corresponding Source” for a Combined Work means the Corresponding Source for the Combined Work, excluding any source code for portions of the Combined Work that, considered in isolation, are based on the Application, and not on the Linked Version.

The “Corresponding Application Code” for a Combined Work means the object code and/or source code for the Application, including any data and utility programs needed for reproducing the Combined Work from the Application, but excluding the System Libraries of the Combined Work.

1. Exception to Section 3 of the GNU GPL.

You may convey a covered work under sections 3 and 4 of this License without being bound by section 3 of the GNU GPL.

2. Conveying Modified Versions.

If you modify a copy of the Library, and, in your modifications, a facility refers to a function or data to be supplied by an Application that uses the facility (other than as an argument passed when the facility is invoked), then you may convey a copy of the modified version:

* a) under this License, provided that you make a good faith effort to ensure that, in the event an Application does not supply the function or data, the facility still operates, and performs whatever part of its purpose remains meaningful, or

* b) under the GNU GPL, with none of the additional permissions of this License applicable to that copy.

3. Object Code Incorporating Material from Library Header Files.

The object code form of an Application may incorporate material from a header file that is part of the Library. You may convey such object code under terms of your choice, provided that, if the incorporated material is not limited to numerical parameters, data structure layouts and accessors, or small macros, inline functions and templates (ten or fewer lines in length), you do both of the following:

* a) Give prominent notice with each copy of the object code that the Library is used in it and that the Library and its use are covered by this License.

* b) Accompany the object code with a copy of the GNU GPL and this license document.

4. Combined Works.

You may convey a Combined Work under terms of your choice that, taken together, effectively do not restrict modification of the portions of the Library contained in the Combined Work and reverse engineering for debugging such modifications, if you also do each of the following:

* a) Give prominent notice with each copy of the Combined Work that the Library is used in it and that the Library and its use are covered by this License.

* b) Accompany the Combined Work with a copy of the GNU GPL and this license document.

* c) For a Combined Work that displays copyright notices during execution, include the copyright notice for the Library among these notices, as well as a reference directing the user to the copies of the GNU GPL and this license document.

* d) Do one of the following:

- o 0) Convey the Minimal Corresponding Source under the terms of this License, and the Corresponding Application Code in a form suitable for, and under terms that permit, the user to recombine or relink the Application with a modified version of the Linked Version to produce a modified Combined Work, in the manner specified by section 6 of the GNU GPL for conveying Corresponding Source.
- o 1) Use a suitable shared library mechanism for linking with the Library. A suitable mechanism is one that (a) uses at run time a copy of the Library already present on the user’s computer system, and (b) will operate properly with a modified version of the Library that is interface-compatible with the Linked Version.
- * e) Provide Installation Information, but only if you would otherwise be required to provide such information under section 6 of the GNU GPL, and only to the extent that such information is necessary to install and execute a modified version of the Combined Work produced by recombining or relinking the Application with a modified version of the Linked Version. (If you use option 4d0, the Installation Information must accompany the Minimal Corresponding Source and Corresponding Application Code. If you use option 4d1, you must provide the Installation Information in the manner specified by section 6 of the GNU GPL for conveying Corresponding Source.)

5. Combined Libraries.

You may place library facilities that are a work based on the Library side by side in a single library together with other library facilities that are not Applications and are not covered by this License, and convey such a combined library under terms of your choice, if you do both of the following:

* a) Accompany the combined library with a copy of the same work based on the Library, uncombined with any other library facilities, conveyed under the terms of this License.

* b) Give prominent notice with the combined library that part of it is a work based on the Library, and explaining where to find the accompanying uncombined form of the same work.

6. Revised Versions of the GNU Lesser General Public License.

The Free Software Foundation may publish revised and/or new versions of the GNU Lesser General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Library as you received it specifies that a certain numbered version of the GNU Lesser General Public License “or any later version” applies to it, you have the option of following the terms and conditions either of that published version or of any later version published by the Free Software Foundation. If the Library as you received it does not specify a version number of the GNU Lesser General Public License, you may choose any version of the GNU Lesser General Public License ever published by the Free Software Foundation.

If the Library as you received it specifies that a proxy can decide whether future versions of the GNU Lesser General Public License shall apply, that proxy’s public statement of acceptance of any version is permanent authorization for you to choose that version for the Library.