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Review of: *Galileo Galilei's notes on motion*

Galileo Galilei's notes on motion, *Paolo Galluzzi (Istituto e Museo di Storia della Scienza), Jürgen Renn (Max Planck Institute for the History of Science), Isabella Truci (Biblioteca Nazionale Centrale), 1998. http://www.imss.fi.it/ms72/INDEX.HTM (Last Accessed: 30.07.2019).*

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Abstract

Galileo Galilei's notes on motion is a diplomatic digital edition most recently updated in 1999 that results from a joint collaboration between the Biblioteca Nazionale Centrale, the Istituto e Museo di Storia della Scienza of Florence and the Max Planck Institute for the History of Science of Berlin. It provides the digital edition of Codex 72, displaying folios from 33 to 196, along with relevant propositions from *Discorsi e dimostrazioni matematiche intorno a due nuove scienze* (1638) related to the manuscript.
The aim of this review is to evaluate the presentation and the contents of the edition, along with its effectiveness related to the academic purpose. In this essay, different assessment measures will be taken into account, all relating to the date in which the edition was published, along with the possible implementations that weren't addressed in order to provide a long-lasting scholarly work on the manuscript. As a result, the review considers the edition groundbreaking for the functionalities and contents offered at the time it was published, but too outdated to be used in the modern digital world.

Keywords: Galileo, manuscript, scholarly digital edition

Introduction

Galileo Galilei's notes on motion is believed to be the first significant scholarly digital edition (hereon SDE) of the history of science (Abbott 1998), dating back to 1998.

The purpose of the project is to innovatively display and analyse Codex Ms. Gal. 72, a collection of Galilean notes more than 300 pages long, physically kept in the archives of the Biblioteca Nazionale Centrale of Florence (BNF). The document is considered of fundamental importance for scientific studies, since it represents the development of a thought process that lasted forty-one years, from around 1600 to 1638.

It was in this time period, in fact, that Galileo changed his view on mechanics, switching his approach from being a follower of Aristotle to the publishing of a groundbreaking work on the subject: the *Discorsi e dimostrazioni matematiche intorno a due nuove scienze* (Galilei 1950). This essay doesn't fully reflect such conceptual shift as much as its related collection of drafts- a detailed study supported by propositions, geometric drawings and calculations-, Codex 72 (Renn 1998, 193). Because of its fragmentary nature, the Codex has been academically neglected for centuries, making it accessible exclusively at the BNF, only in Italian and Latin (Renn 1998, 194).

As evident by the homepage of the website, the project is the outcome of a joint team effort between different institutions- the Biblioteca Nazionale provided the digital images of the manuscript's folio pages, while the Istituto e Museo di Storia della Scienza, based in Florence as well, along with the Max Planck Institute for the History of Science of Berlin, embedded the codex in an appropriate electronic environment, free and easy to use, with respect to the scholarly work that had to be carried out.[1] Unfortunately, contacts of the project representatives have not been made public.

The homepage of the website also mentions the edition winning the Pirelli International Award in 1998, although it is not possible to find any record of the details on the Web.

Main features

The main features of this SDE, as specified on the website,[2] include:

- images of the folio pages in high resolution;

[1] *Galileo Galilei's notes on motion*, "Staff of the project", https://web.archive.org/web/19990424094058/http://www.imss.fi.it/ms72/MAIN/STAFF.HTM.

[2] *Galileo Galilei's notes on motion*, "Description of the main components", https://web.archive.org/web/19990423225544/http://www.imss.fi.it/ms72/MAIN/DESCRIPT.HTM.

- short descriptions of the contents of the folios and their relations to the *Discorsi*;
- transcriptions of the texts including corrected and cancelled versions;
- translations of calculations into modern notation;
- reproductions of drawings;
- information on paper sizes, watermarks, handwriting, and scholarly work on specific folio pages;
- separate Indices for Italian and Latin words, for numbers, for designations of variables, and for the lettering of drawings;
- *Discorsi* theorems with proofs in the original language and in English translation, as well as the results of an analysis of their deductive structure.

Aims and methods

This electronic presentation can be definitely considered a forerunner in the field of digital editions. Although it is 21 years old, it explicitly carries the fundamental message that traditional editorial techniques may not be sufficient to convey an exhaustive interpretation of a text.

As it has been pointed out (Renn 1998, 193), previous works on the Codex such as the *National Edition* by Antonio Favaro (Galilei 1909) and the article published by Stillman Drake in *Annali di Storia della Scienza* (Drake 1980), were reductive when compared to their academic scope. In fact, there was the deliberate choice of omitting or correcting parts of the document.

Another issue was that these scholars established an approach that didn't take into consideration the chronological order of the pages, because they didn't have the possibility to see what an integral folio looked like. This made it impossible to make conjectures based on physical information like watermarks, ink, or type of paper. Such a problem is not to underestimate, as it is the actual placement of the notes that proves the conceptual evolution of Galileo's thinking process over time.

The current re-evaluation of the Codex through digital means sheds light on its complexity of content, chaotic and extremely varied, and on the possible ways to address it properly on a brand-new platform. *Galileo's notes on motion* was, in fact, a pilot project connected to the endeavor of BNF to make the Florentine Galileo collection electronically accessible. With that approach in mind, such diverse material clearly needed a thorough work on, so that it could be represented in its entirety as a new tool for further research.[3]

[3] The feasibility study, initially the "Galileo Einstein Electronic Archives" was funded by the US National Science Foundation (NSF). However, the project related to Einstein failed due to copyright issues and the NSF decided to interrupt all research on the matter, as the project was thought to be "unrealistic". At that

The concept of digital edition allows Ms. Gal. 72 to be open to as many interpretative perspectives as possible, involving the scholar to contribute with their own hermeneutics. This idea has become so successful that it still constitutes a metric to define a digital edition in general, as opposed to a digitised one:

"The book is a perfect device for the passive consumption of a limited amount of one-dimensional static information. Digital media, with its complex, multimedia, networked content, is in principle interactive and adaptive […]. A digital edition is more like a workplace or a laboratory where the user is invited to work with the texts and documents more actively" (Sahle 2016, 30).

For this reason, two are the main characteristics of *Galileo Galilei's notes on motion*: easy access and open-endedness. In fact, as Peter Damerow and Jürgen Renn quote:

"[...] Since the manuscript is accessible through the Internet, no scholar is forced anymore to first apply for a travel grant to go to Florence in order to study it. The second element is, however, really new […]. Once the book is printed, there is no longer any possibility of improving the edition except by starting all over again and producing a new edition". [4]

Instead, Galileo's manuscript, makes a "tool for the future",[5] as it would take very little time to produce a new version of the edition. In spite of this purpose, it has to be mentioned the SDE was most recently updated in 1999[6] and it is therefore an insufficient representative of this view. Another important aspect to remark was that this project was meant to be a starting point for further research through an open call invite on the website, in order to develop a joint collaboration among the main

time, the institutions involved in the SDE didn't even exist at the time, but the scholars involved kept on working on the project and made it possible to publish it ten years later.

[4] Damerow, Peter and Jurgen Renn. "Galileo at Work: His Complete Notes on Motion in an Electronic Representation." Accessed 30 July, 2019, https://web.archive.org/web/19990209174712/https://www.mpiwgberlin.mpg.de/texts/Galileo.Nuncius.html.

[5]Damerow, Peter and Jurgen Renn. "Galileo at Work: His Complete Notes on Motion in an Electronic Representation." Accessed 30 July, 2019, https://web.archive.org/web/19990209174712/https://www.mpiwgberlin.mpg.de/texts/Galileo.Nuncius.html.

[6] *Galileo Galilei's notes on motion*, "Homepage", https://web.archive.org/web/19990128203948/http://www.imss.fi.it/ms72/INDEX.HTM.

researchers on Galileo. In fact, two of the founders claim: "The aim was not only to provide easy access to the codex, but also to support further research on it".[7]

As a result, the target audience is made of scholars who may deepen their interest in Galileo's works, but also, and most importantly, researchers who need a complete understanding of the Codex- a consequence of making the document easily accessible, searchable and passive of manipulability. This democratic character has increasingly become fundamental for the definition of a SDE: "social scholarly editions represent a step toward diversifying and democratising knowledge" (Siemens et al. 2016, 155).

Presentation

Galileo Galilei's notes on motion struggles to find an identity since the very first glance- when the user googles the SDE, the results are confusing. Although among the two webpages that are referring to the electronic representation, only the first one directly accesses the website, none of these shows an appropriate URL that can anticipate a preview of their content. Therefore, to begin with, not a good URL has been assigned to the project.

As for what concerns the design, as functional it can be, it surely doesn't show off as the most sophisticated- there is no decorative element other than the logo. As a matter of fact, the data format is deliberately kept simple because of the constant development of markup languages and their relationship with the ever-growing number of different browsers and related updates one has to use them on. This is a questionable choice, since simplicity and minimalism are not necessarily bond to be aesthetically unpleasant. Simple effects like hover for links and textblocks, especially in the "working level" part, would not be difficult to implement, and they could highly improve the SDE's usability. The website is not responsive, but it can still be viewed decently on smartphones and tablets.

The sections concerning the document are immediately clear. In the foreground, the user finds a link on how to use the electronic representation of the manuscript. Beneath it, it is possible to access the text under different levels: as a list of folio pages, through *indices* or via the propositions related to the *Discorsi*.

The papers can be viewed individually or grouped. In the latter case, the webpage shows a survey of folio pages, briefly described and displayed in a small preview. Each page is then visible on four

[7] Damerow, Peter and Jurgen Renn. "Galileo at Work: His Complete Notes on Motion in an Electronic Representation." Accessed 30 July, 2019, https://web.archive.org/web/19990209174712/https://www.mpiwgberlin.mpg.de/texts/Galileo.Nuncius.html.

levels of representation, available for navigation thanks to a bar on the top and on the bottom of the page (Fig. 1).

At a more superficial stage, the user accesses a facsimile of the folio page, as well as the final version of the text. At this overview level, there is also information about the size of the folio page, along with its watermark, a summary of its content, relevant references and, when possible, links to relevant pages of the *Discorsi* that the text refers to.

Clicking on the "working level" menu leads to the display of a better resolution of the folio page, along with the possibility to flip the page, details about its size, a brief comment with references to the *Discorsi* and the text versions that have been worked on. Furthermore, the page is interactive- there are intratextual links for each textblock or drawing, so that the clicked section will show up in another window digitally reconstructed. Otherwise, if a written part is selected, the page will display the editorial markup process, whose accurate reconstruction of orthography makes *Galileo's notes on motion* a diplomatic edition (Fig. 2). The last level is constituted by the best facsimile among all the other levels, in a high resolution for 1999.

There are other sections to browse through on the website. The first one, concerning information about the contents and the context of Codex 72,[8] conveys a detailed but concise summary on the history of the document for each century from the 18th to the 19th. It also addresses the changes that have been made to the manuscript by the different collectors over time,[9] a short list of biographies relevant to the study of the manuscript[10] and, most importantly, the bibliography used.[11] Each of these webpages contains hyperlinks when referring to something that has been explained better in another section, otherwise it points to the bibliographical references.

An immediately noticeable issue about these sections is that there are, at times, missing white spaces between a word and another (Fig. 3).

This is clearly a matter of outdated formatting that has never been solved. Furthermore, a menu on the top of the homepage would have been a much better choice to improve the usability of the website. The user can then find a section that briefly describes the aims, the people and the cultural background behind the electronic archive. Lastly, it is possible to read a note about the system requirements for the website and a call for scholarly participation. This is the only place where we can find a contact

[8] *Galileo Galilei's notes on motion*, "Contents of the Manuscript", https://web.archive.org/web/20181009195535/http://www.imss.fi.it/ms72/MAIN/CONTENTS.HTM.
[9] *Galileo Galilei's notes on motion*, "History of the Manuscript", https://web.archive.org/web/20170329223140/http://www.imss.fi.it/ms72/MAIN/HISTORY.HTM.
[10] *Galileo Galilei's notes on motion*, "Short Biographies", https://web.archive.org/web/20181017064915/http://www.imss.fi.it/ms72/MAIN/BIO.HTM.
[11] *Galileo Galilei's notes on motion*, "Bibliography", https://web.archive.org/web/20081120195111/http://www.imss.fi.it/ms72/MAIN/BIBLIO.HTM.

of some kind- an email address-, but it is unsure whether it could still be valid or not, as it doesn't come up as a hyperlink. It is not possible to come across other ways to contact the staff. Needless to say, there are no existing social media pages about the project or its representatives.

Content

Codex 72 includes 241 folios (numbered from 1-196), written by Galileo or his disciples Mario Guiducci and Niccolò Arrighetti. The first 32 folio pages are not displayed, for unknown reasons. The fragments on motion and mechanics are neither dated nor does their order in the Codex correspond to the chronological sequence of their composition. As a result, the edition aids and encourages scholars to establish their own order basing on their observational skills.

For each folio page, it is possible to read any kind of contextual information, along with a look at the transcriptional variants of the text, highlighted in different colours, carried out by the research team. Although for this level there is no translation from Latin, to have a look at the different text versions it is still of high scholarly interest. At the same time, the quality of the facsimile nowadays is not sufficient to make a proper comparison between the final given transcription and the original manuscript. Therefore, it is should be a necessary improvement to insert a zoom tool on the vectorised folio page, in order to search through the text word-by-word. Under "Editorial and technical principles"[12] there is a selection of general bullet points remarking how the digital edition is different from a traditional copy one. Although the source for the scholarly work is clear- the manuscript-, it is not explicit here what the exact editorial principles are.

Because the display of the manuscript facsimile makes it quite easy to read it, the text is immediately provided with the final version of the transcription, while the whole process of editorial markup can be looked at in the "working level" of the document. In this part of the SDE, it is possible to recognise editorial interventions such as additions and deletions, but no TEI encoding principles have been used to the SDE's data modelling. While this is understandable because of the time the platform was published, it still remains something to be fixed to improve not only usability, but also the scholarly content itself.[13]

Drawings and geometric calculations are represented in modern notation and reproduced in such a way that it is impossible to interpret their meaning as ambiguous. In this perspective, each text of the

[12] *Galileo Galilei's notes on motion*, "Editorial and technical principles", https://web.archive.org/web/20081120195413/http://www.imss.fi.it/ms72/MAIN/EDITOR.HTM.

[13] Such information has been confirmed via e-mail by Prof. Paolo Galluzzi, who I thank here for his availability to answer my questions on the technical details of the SDE that were not disclosed on the website.

propositions has been translated. A very interesting aspect of the SDE is, therefore, its strive for transparency, which allows the user to make positive considerations on its reliability.

Another strength of the edition concerns the intratextual and intertextual links, which make it easy to navigate through the respective internal and external references of the manuscript. This feature allows the user to deeply understand Galileo's mindset, as opposed to the previous printed editions that dealt with the manuscript. Such a modularised structure provides the user with a "fluid publication", process defined as the possibility to "connect various forms of representation with editorial knowledge and contextual material" (Sahle 2016, 29).

On the other hand, though, it would be interesting to implement this environment with a function that makes it possible to compare two folia and the related markup on the same webpage, so that the scholar wouldn't have to go back and forth between different links and pages.

The first and main issue that comes with the edition is that it hasn't been updated since 1999. Because the reason behind it is unknown, the problem concerns sustainability. A possible explanation is that, since the website of the Istituto e Museo di Storia della Scienza of Florence changed domain, the maintenance of *Galileo Galilei's notes on motion* has become of secondary importance, remaining a pilot project. This event clearly constitutes a loss, since the new website carried out its goal to make the Florentine Galileo collection an online database accessible to anyone having an Internet collection.[14] It is possible to witness the extent of such problem in Fig. 4 and Fig. 5: the project has very few mentions by other researchers.

"While the electronic representation may appear odd compared with the sophisticated transcription systems of traditional critical editions, its unprecedented opportunities for further scholarly work justify the deviation from traditional editorial standards. The new medium combines a powerful intelligent working environment for scholarly work with a flexible and open-ended account of its results."[15]

This claim is true to some extent. In fact, not only the user has access to *indices* that are fundamental tools to the scholarly work, but also to the list of propositions of Galileo's *Discorsi* for further possibilities of comparison between the two documents. At the same time, however, the graphic is so minimal and outdated that it is visually difficult to browse through all the pages for a long period of

[14] Istituto e Museo di Storia della Scienza, "Museo Galileo", https://web.archive.org/web/20190607090234/https://www.museogalileo.it/en/library-and-research-institute/projects/databases-and-bibliographies.html.

[15] Paolo Galluzzi, Truci, Isabella, Renn, Jurgen. "Galileo Galilei's Notes on motion." Accessed July 30, 2019, http://web.archive.org/web/2018*/http://www.imss.fi.it/ms72/INDEX.HTM.

time, especially when it comes to reproductions of drawings and formulas. Furthermore, real open-ended access should come in multiple languages. Despite the choice of using English as the main language is perfectly understandable, it would have been useful to gradually include more languages, such as Italian, in order to make the SDE available to a larger number of geographic contexts. If this edition was to be renewed, only the conceptual apparatus of the website would have to be maintained. Lastly, what is missing in this SDE is the desired scholarly participation. The choice of keeping the edition simple did not take into account the fact that with no scholarly participation, the opportunities of including other interesting features and comments on the Codex 72 are ruled down to zero. For instance, a work on the lexical choice of traditional scientific terms such as "*casus*" would enrich the interpretation of the manuscript.

Conclusion

Galileo Galilei's notes on motion constitutes a groundbreaking scholarly digital edition whose editorial principles and aims highly overlap with the contemporary ones. The study of Codex 72 is "fluid" in a sense that it has the possibility to be updated at any moment and, at the same time, that the connections among its contents are modelled by a neat, but complex network of intertextual and intratextual links. The digital paradigm developed in 1998 already considered the target audience of the project so that it could actively participate in the conceptual product provided, not only with their own considerations for personal use, but also with the aim to exploit their academic experience for the making of the website.

The website presents, however, many issues- the lack of a data modelling based on TEI, the graphic is definitely outdated and too ineffective for Web 3.0, no scholarly participation has been actually involved, there is too little information about contacts, the SDE is not included on the institutions' collection of scientific projects, and most importantly, it hasn't been updated since 1999. Despite these problems, it is fundamental to remember which were the initial purposes and methods of the institutions involved in the SDE, in order to be able to compare them to the ones we use nowadays. Furthermore, keeping track of the possible directions leading to the improvement of this edition, in order to cater to a larger audience, means to have found the real way to treasure open access and open-endedness.

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Renn, Jurgen. “Galileo’s manuscript on mechanics. The project of an edition with full critical apparatus of Mss. Gal. Codex 72”. *Nuncius*, no. 3 (1998): 193-241. WorldCat.

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Siemens Ray, Constance Crompton, Daniel Powell, Alyssa Arbuckle, Maggie Shirley. “Building A Social Edition of the Devonshire Manuscript”, in *Digital Scholarly Editing. Theories and practices*, edited by James Driscoll and Elena Pierazzo 137-160. Cambridge: Open Book Publishers, 2016.

Appendix

Fig. 1: Menu bar on top and on the bottom of the page.

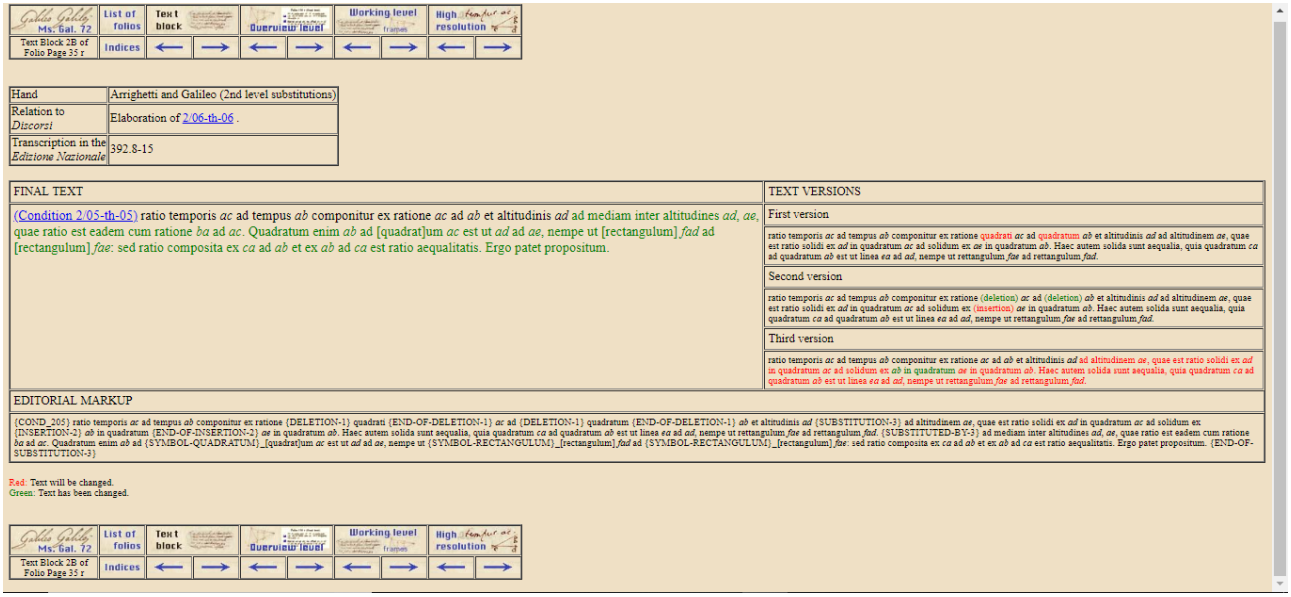

Fig. 2: “Working level” for text, with different text versions, final text and editorial markup.

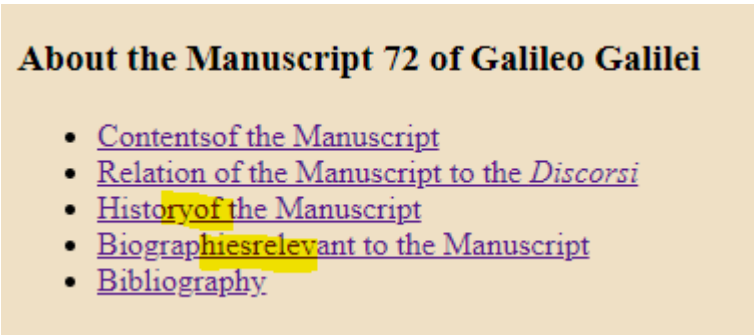

Fig. 3: Example of missing white spaces.

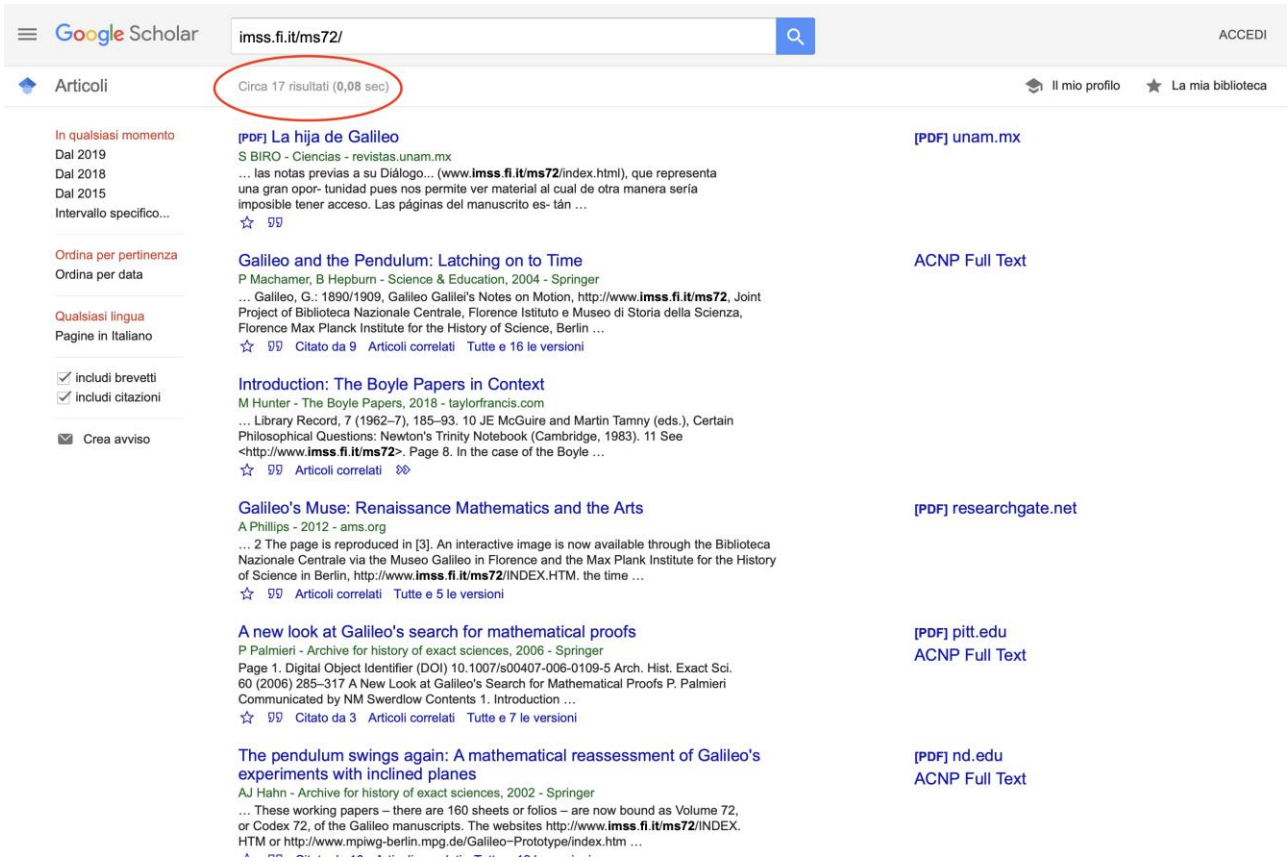

Fig. 4: Number of works that cite *Galileo Galilei's notes on motion* (Domain of Istituto e Museo di Storia della Scienza).

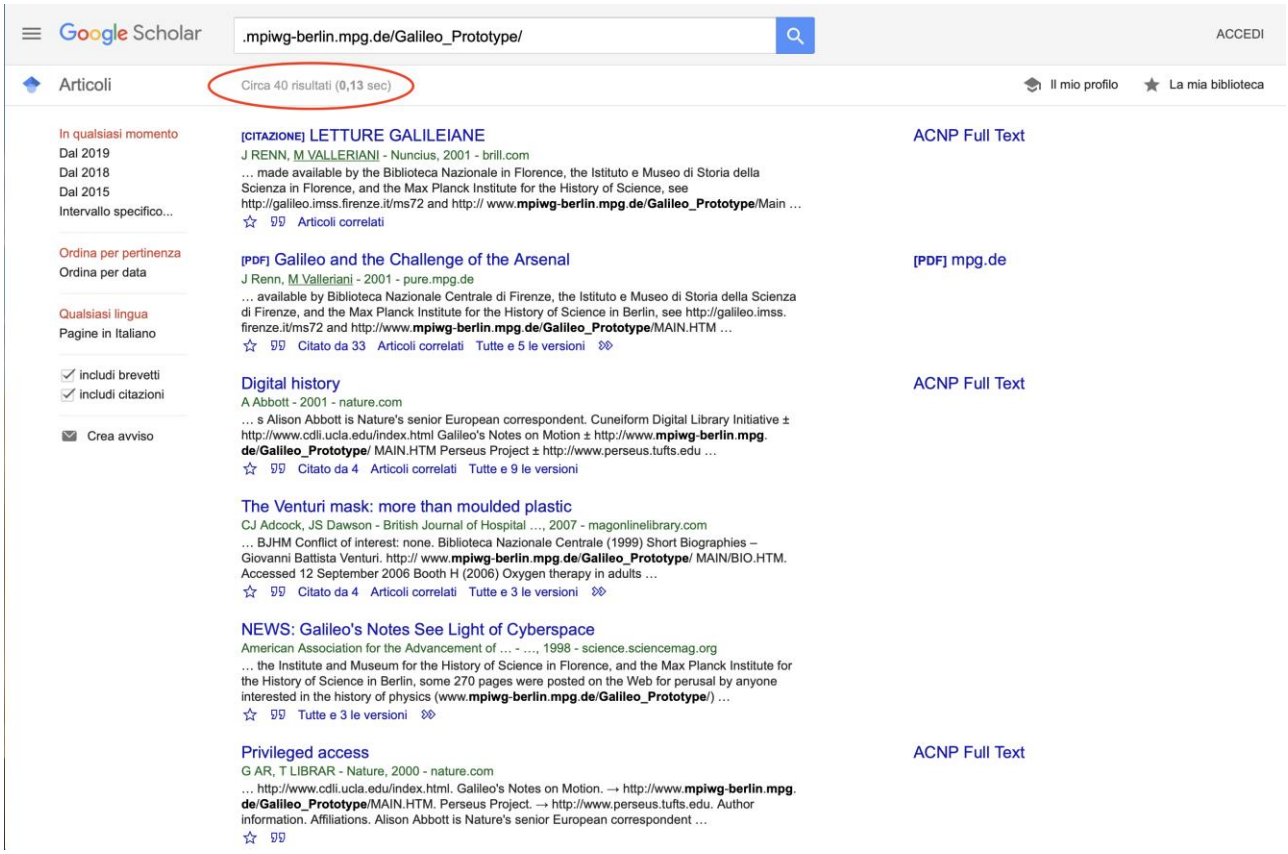

Fig. 5: Number of works that cite *Galileo Galilei's notes on motion* (domain of Max Planck Institute for History of Science).