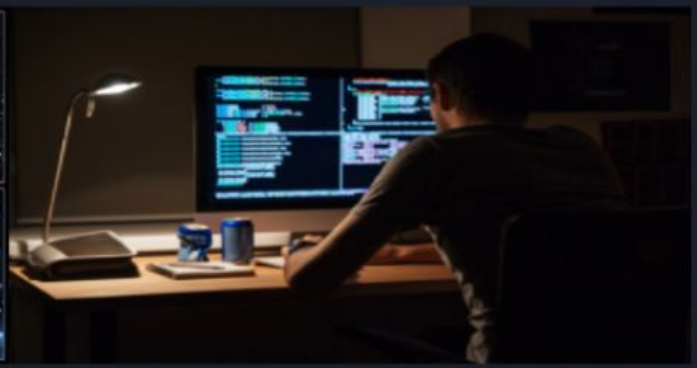
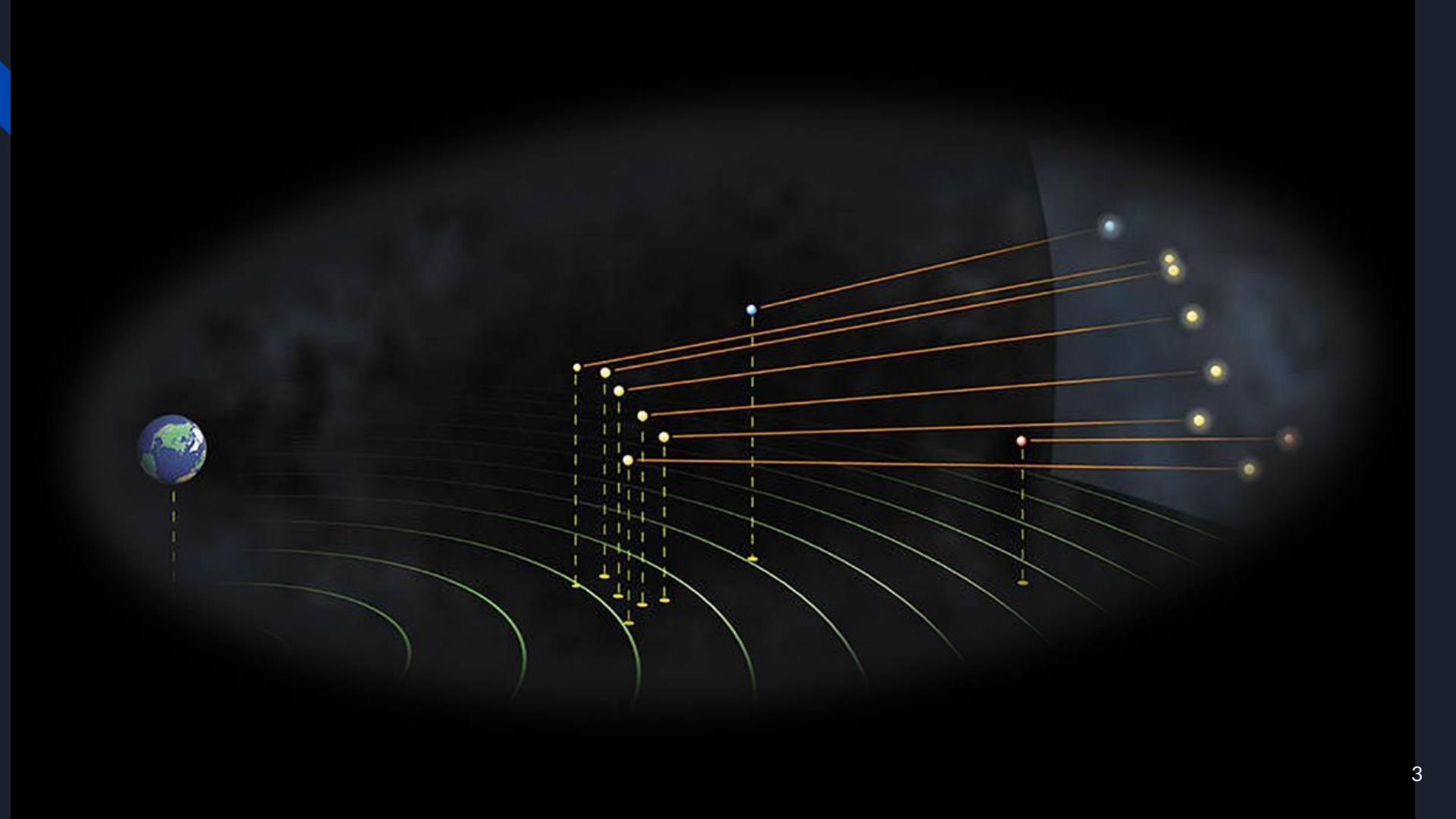
Astronomical Data Science.....



Introduction to astronomy

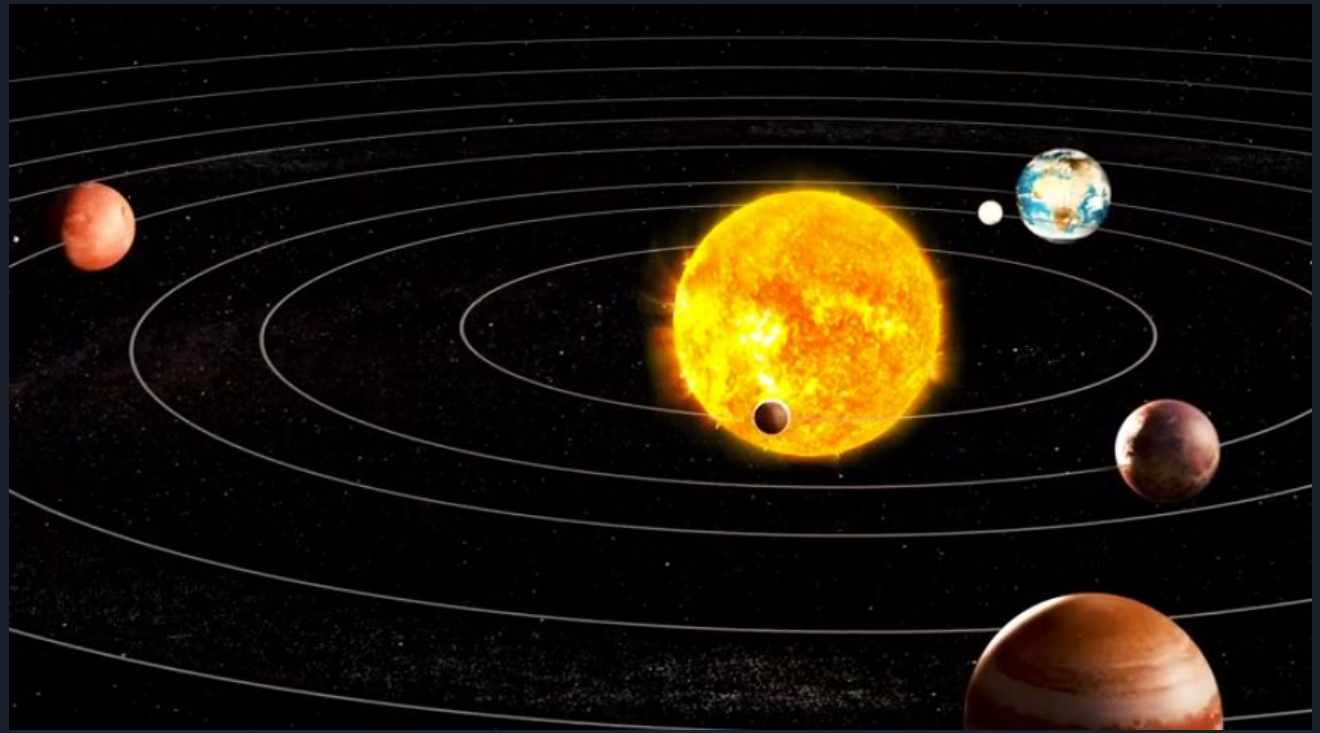
- Astronomy is the study of everything in the universe beyond Earth’s atmosphere.
- That includes objects we can see with our naked eyes, like the Sun , the Moon , the planets, and the stars .
- It also includes objects we can only see with telescopes or other instruments, like faraway galaxies and tiny particles.
- And it even includes questions about things we can't see at all, like dark matter and dark energy .



How can we tell how far away a star is?

- One clue is its brightness.
- Distant stars look dimmer than they would if we were close to them.
- But that clue isn't very reliable, because stars vary a lot in their brightness.
- So astronomers rely on measurements of something called parallax to figure out the distances of stars.
- They look at a nearby star from two different places and compare its position relative to other, much more distant stars.

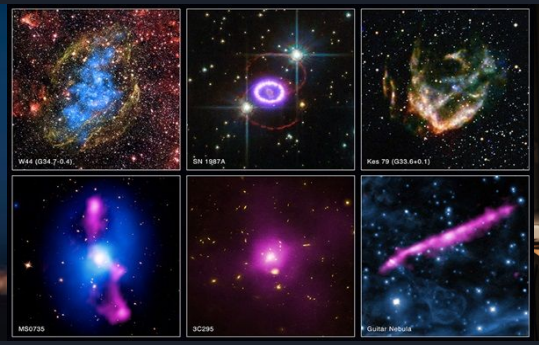
Another challenge - everything is moving



Gravity holds everything together

It takes a team of people working together to study the universe

- When you think of an astronomer, maybe you're imagining someone using a telescope to collect data about objects in the sky.
- Some astronomers do that—they're called observational astronomers.
- But there are lots of other kinds of astronomers too!



How is astronomical data captured ?

Answers please…..

Observational astronomy

Observational astronomy is a division of astronomy that is concerned with recording data about the observable universe

Based on the region of the electromagnetic spectrum observed:

- **Radio astronomy** detects radiation of millimetre to decametre wavelength. The receivers are similar to those used in radio broadcast transmission but much more sensitive.

Based on the region of the electromagnetic spectrum observed:

- Infrared astronomy deals with the detection and analysis of infrared radiation (this typically refers to wavelengths longer than the detection limit of silicon solid-state detectors, about 1 μm wavelength).

The most common tool is the reflecting telescope, but with a detector sensitive to infrared wavelengths. Space telescopes are used at certain wavelengths where the atmosphere is opaque, or to eliminate noise (thermal radiation from the atmosphere).

Based on the region of the electromagnetic spectrum observed:

- Optical astronomy is the part of astronomy that uses optical instruments (mirrors, lenses, and solid-state detectors) to observe light from near-infrared to near-ultraviolet wavelengths.

Visible-light astronomy, using wavelengths detectable with the human eyes (about 400–700 nm), falls in the middle of this spectrum.

Based on the region of the electromagnetic spectrum observed:

- High-energy astronomy includes X-ray astronomy, gamma-ray astronomy, and extreme UV astronomy.

GLIMPSE OF DATASET

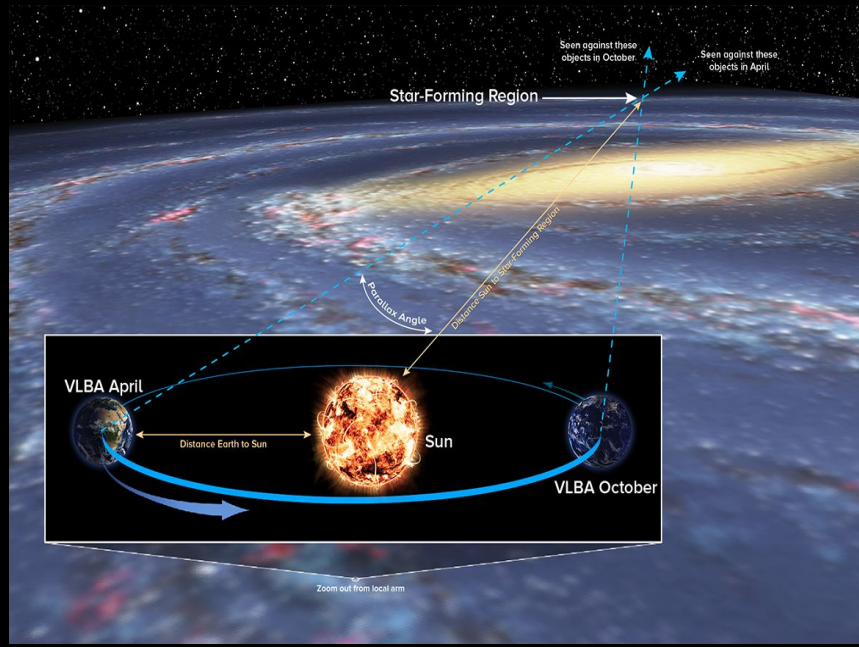
NGC 6946

- Sometimes referred to as the Fireworks Galaxy
- Is a face-on intermediate spiral galaxy with a small bright nucleus

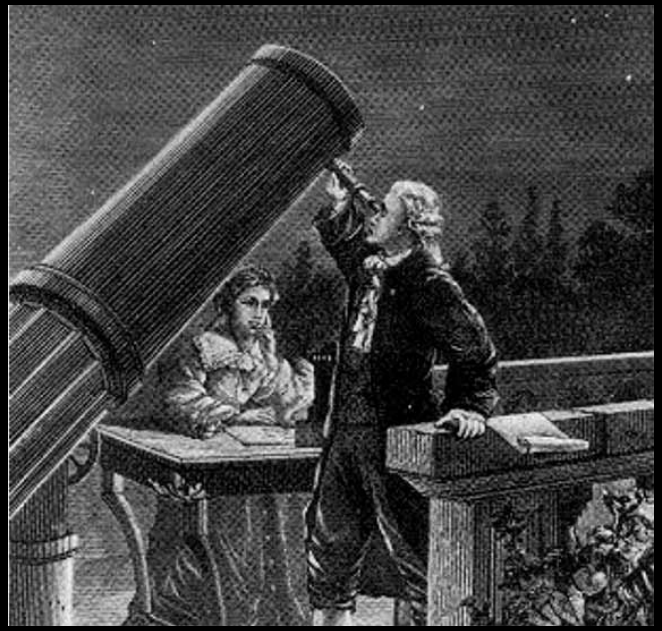
- Its distance from Earth is about 25.2 million light-years or 7.72 megaparsecs,similar to the distance of M101 (NGC 5457) in the constellation Ursa Major.

- Both were once considered to be part of the Local Group,but are now known to be among the dozen bright spiral galaxies near the Milky Way but beyond the confines of the Local Group.

- NGC 6946 lies within the Virgo Supercluster.



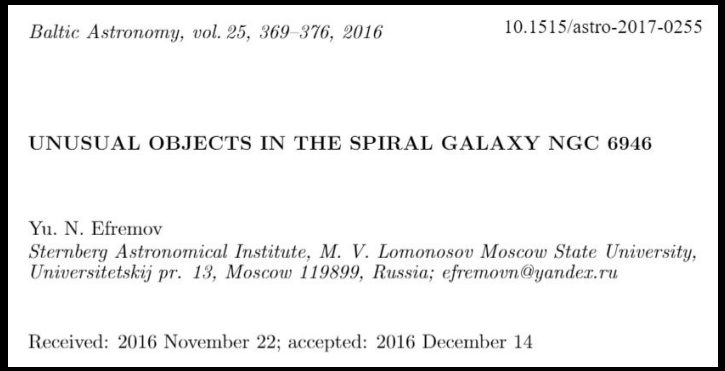
- Discovered by William Herschel on 9 September 1798, this well-studied galaxy has a diameter of approximately 26.7kpc,
- and it contains roughly half the number of stars as the Milky Way
- It is heavily obscured by interstellar matter due to its location close to the galactic plane of the Milky Way.
- Due to its prodigious star formation it has been classified as an active starburst galaxy.



- Various unusual celestial objects have been observed within NGC 6946.
- This includes the so-called 'Red Ellipse' along one of the northern arms that looks like a super-bubble or very large supernova remnant,
- and which may have been formed by an open cluster containing massive stars.

https://ui.adsabs.harvard.edu/abs/2016BaltA..25..369E/abstract

https://www.researchgate.net/publication/314657936_Unusual_Objects_in_the_Spiral_Galaxy_NGC_6946



Baltic Astronomy, vol. 25, 369–376, 2016 10.1515/astro-2017-0255

UNUSUAL OBJECTS IN THE SPIRAL GALAXY NGC 6946

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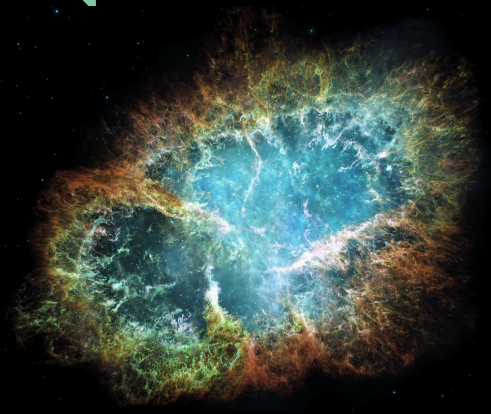
Göran Nilsson &
The Liverpool Telescope

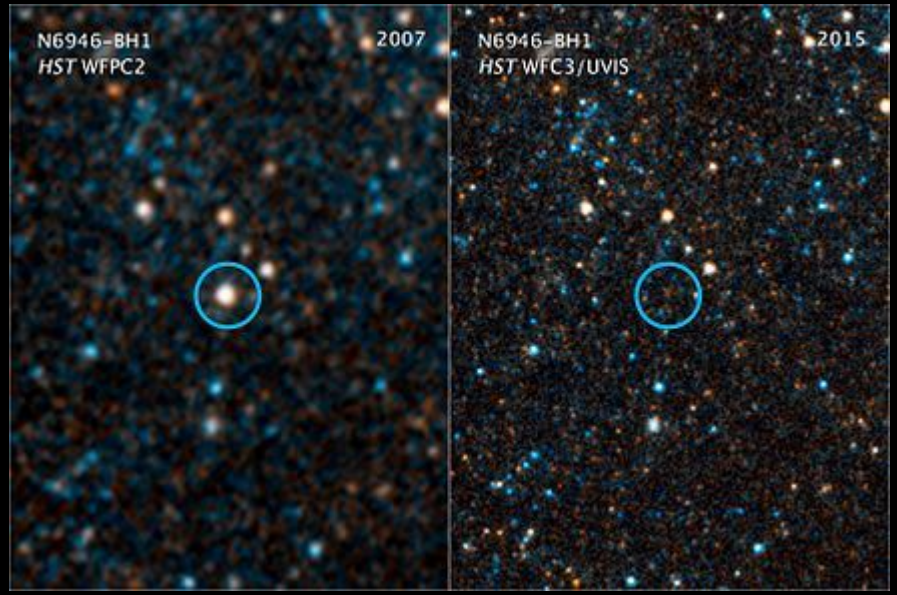
- There are also two regions of unusual dark lanes of nebulosity, while within the spiral arms several regions appear devoid of stars and gaseous hydrogen, some spanning up to two kiloparsecs across.

- A third peculiar object, discovered in 1967, is now known as "Hodge's Complex".

- This was once thought to be a young supergiant cluster, but in 2017 it was conjectured to be an interacting dwarf galaxy superimposed on NGC 6946.[



- Ten supernovae have been observed in NGC 6946 in the 20th and early 21st century: SN 1917A, SN 1939C, SN 1948B, SN 1968D, SN 1969P, SN 1980K, SN 2002hh, SN 2004et, SN 2008S, and SN 2017eaw.
- For this reason NGC 6946 has sometimes been referred to as the "Fireworks Galaxy".
- This is about ten times the rate observed in our Milky Way galaxy,even though the Milky Way has twice as many stars as NGC 6946.

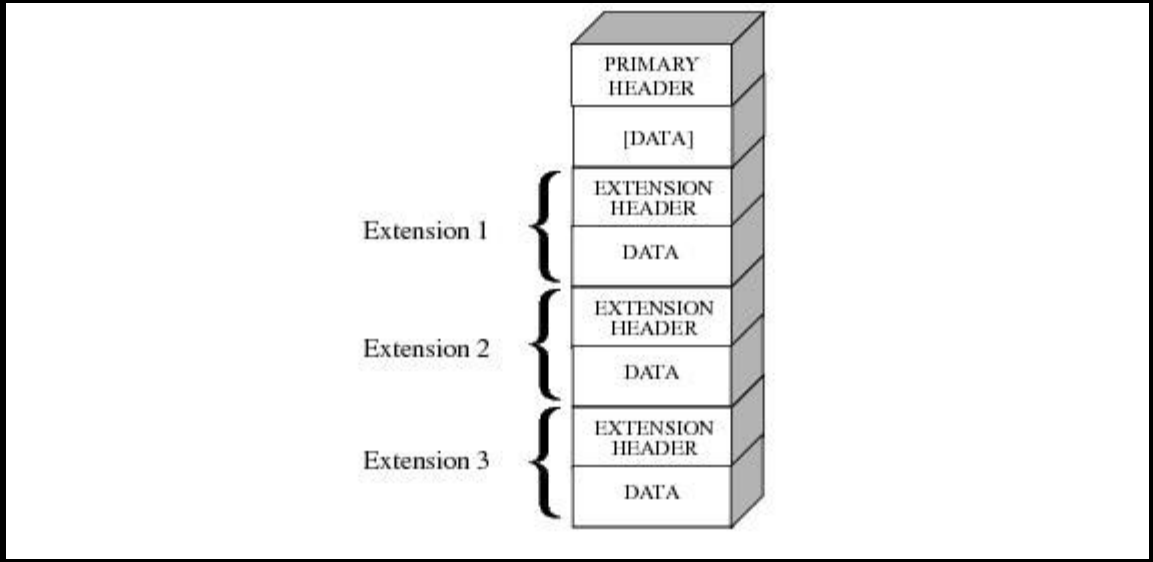


Pair of visible-light and near-infrared photos from the Hubble Space Telescope showing the giant star N6946-BH1 before and after it vanished out of sight by imploding to form a black hole

DATASET

Properties, Images and Spectrals of All Observable Spiral Galaxies

Dataset format



A: Standard FITS Format

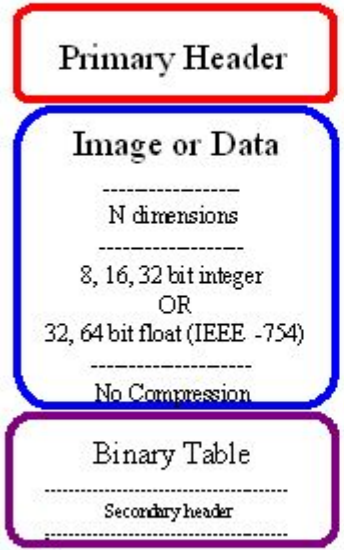


Figure FITS-1

B: Binary Table Extension

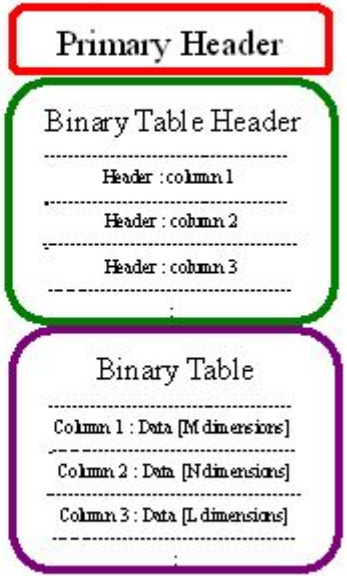


Figure FITS-2

Dataset format

- FITS file format (Flexible Image Transport System (FITS))
- It is an open standard defining a digital file format useful for storage, transmission and processing of data:

  A. formatted as multi-dimensional arrays (for example a 2D image),
  B. non-image data, such as spectra, photon lists, data cubes, or structured data

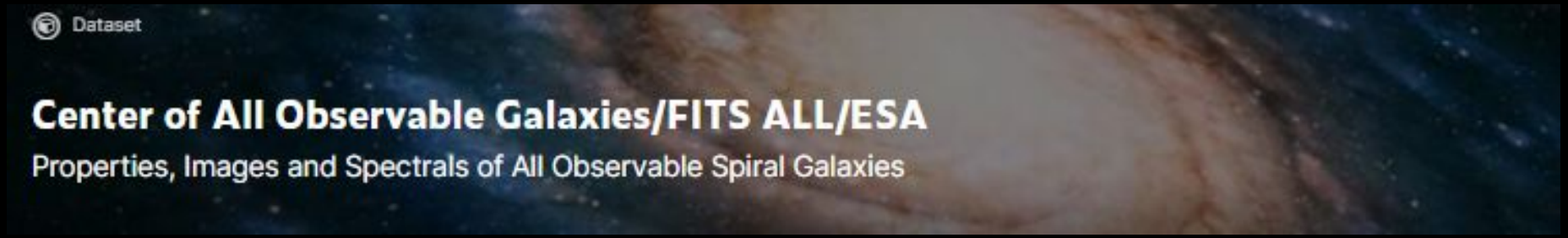
- Image metadata is stored in a human-readable ASCII header that carry keyword/value pairs, interleaved between data blocks.

  (ASCII - American Standard Code for Information Interchange)

- A FITS file may contain several extensions, and each of these may contain a data object
- For example, it is possible to store x-ray and infrared exposures in the same file.

FITS support is available in a variety of programming languages that are used for scientific work, including C, C++, C#, Fortran, IGOR Pro, IDL, Java, Julia, LabVIEW, Mathematica, MATLAB, Perl, Perl Data Language (PDL), Python, R, and Tcl.

The FITS Support Office at NASA/GSFC maintains a list of libraries and platforms that currently support FITS.

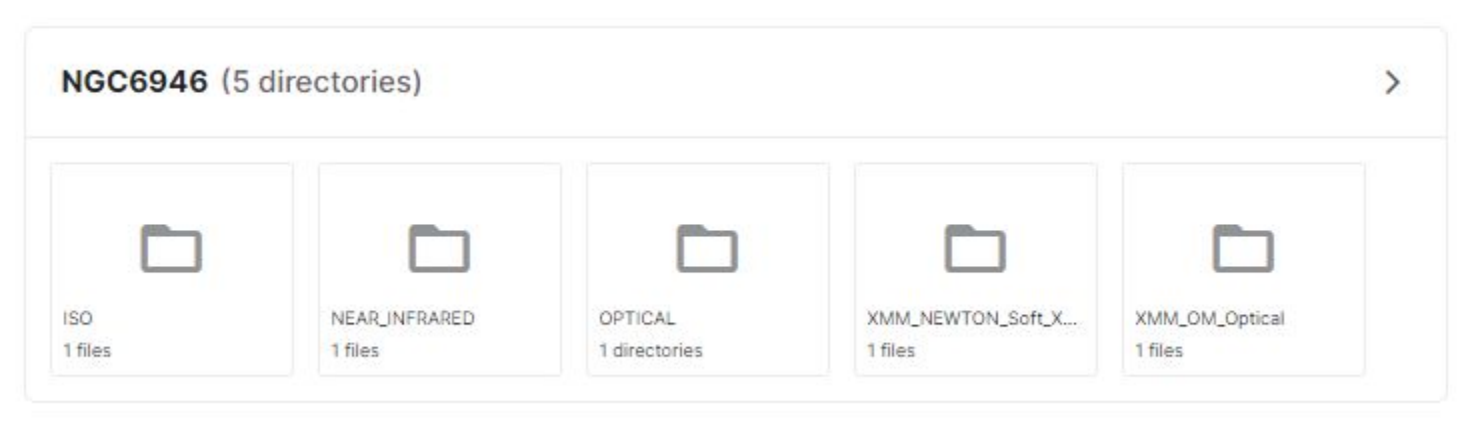

Dataset
Center of All Observable Galaxies/FITS ALL/ESA
Properties, Images and Spectrals of All Observable Spiral Galaxies

GALAXIES_CENTER (19 directories)

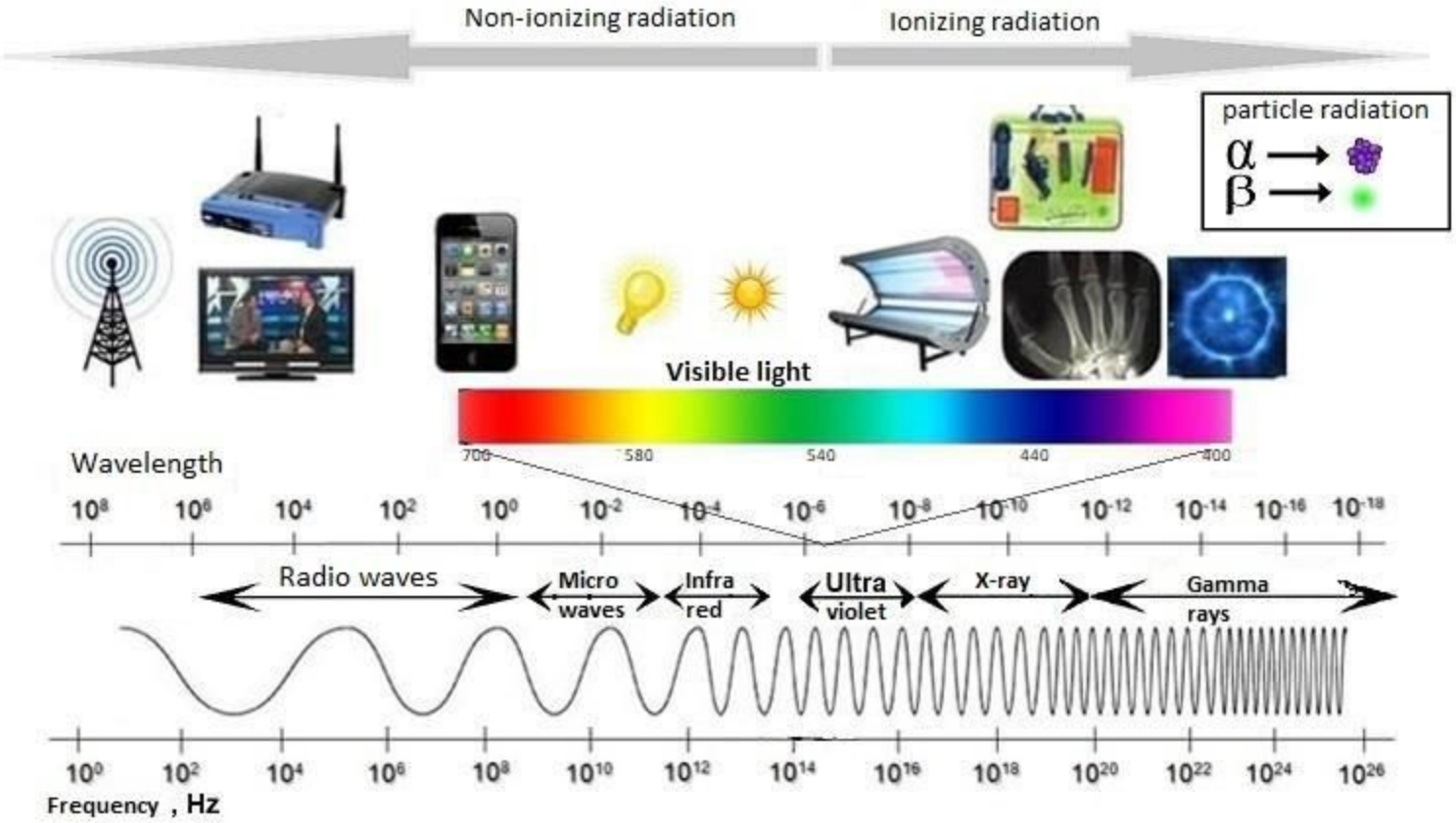
About this directory

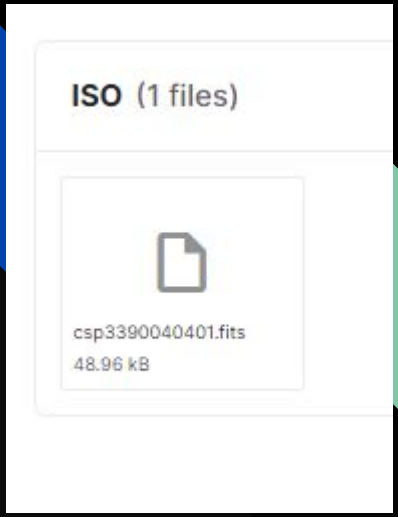
Properties, Images and Spectrals of All Observable Spiral Galaxies

M100 5 directories	M101 5 directories	M31 5 directories	M33 5 directories	M51 5 directories
M83 5 directories	M91 2 directories	M95 2 directories	M99 3 directories	NGC1300 2 directories
NGC1365 5 directories	NGC2997 1 directories	NGC300 4 directories	NGC3184 4 directories	NGC4013 4 directories
NGC4725 5 directories	NGC6744 3 directories	NGC6946 5 directories	NGC7479 5 directories	


NGC6946 (5 directories)
ISO
1 files
NEAR_INFRARED
1 files
OPTICAL
1 directories
XMM_NEWTON_Soft_X...
1 files
XMM_OM_Optical
1 files

The electromagnetic spectrum





The Infrared Space Observatory was a space telescope for infrared light designed and operated by the European Space Agency, in cooperation with ISAS and NASA.

The ISO was designed to study infrared light at wavelengths of 2.5 to 240 micrometres and operated from 1995 to 1998.

NEAR_INFRARED (1 files)

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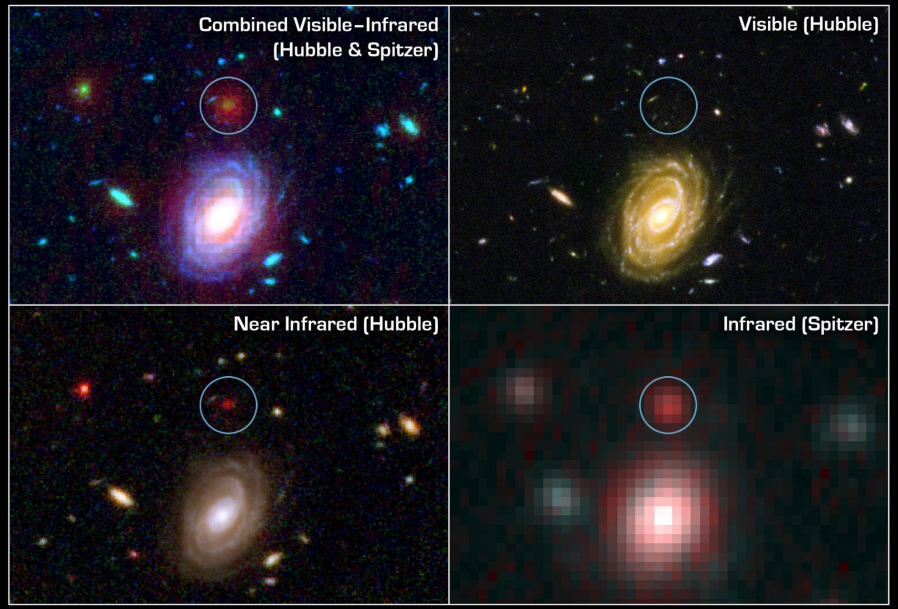
1.12 MB



Distant Galaxy in the Hubble Ultra Deep Field

Spitzer Space Telescope • IRAC
Hubble Space Telescope • ACS • NICMOS

NASA, ESA / JPL-Caltech / B. Mobasher (STScI/ESA)

ssc2005-19a

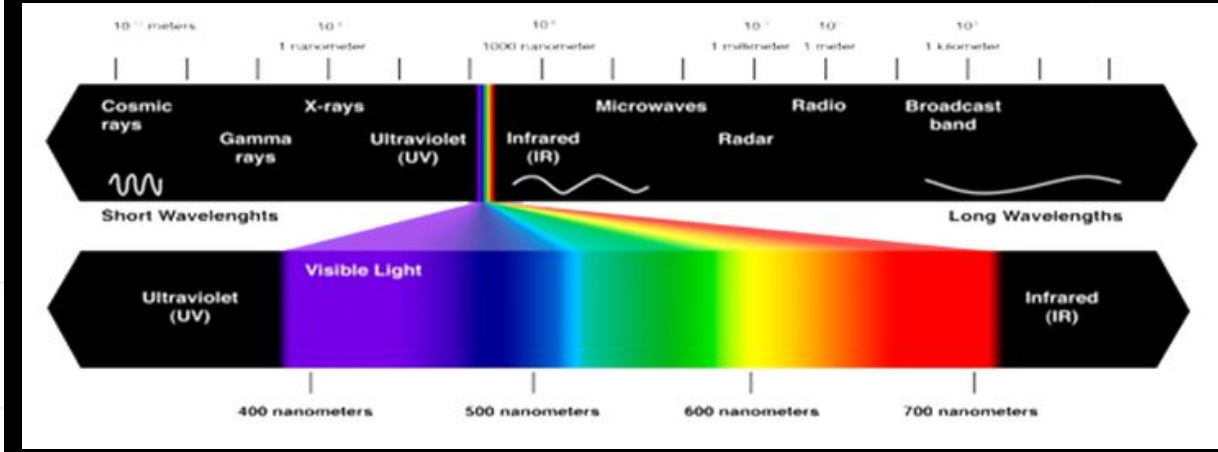
OPTICAL (1 directories)

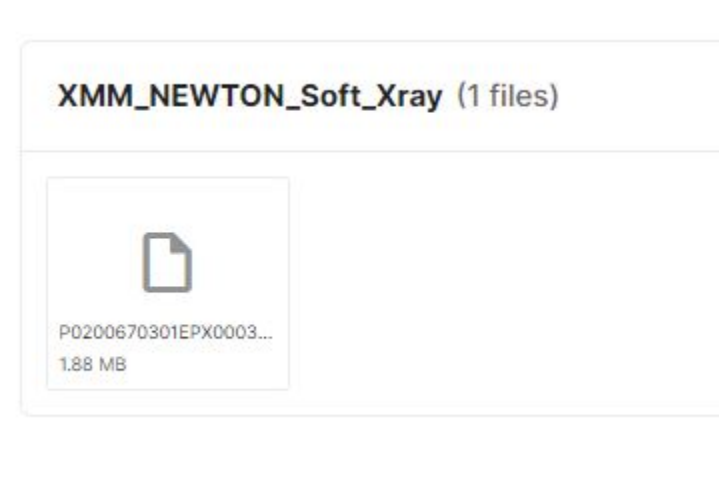
HST
1 directories

idk404050 (2 files)

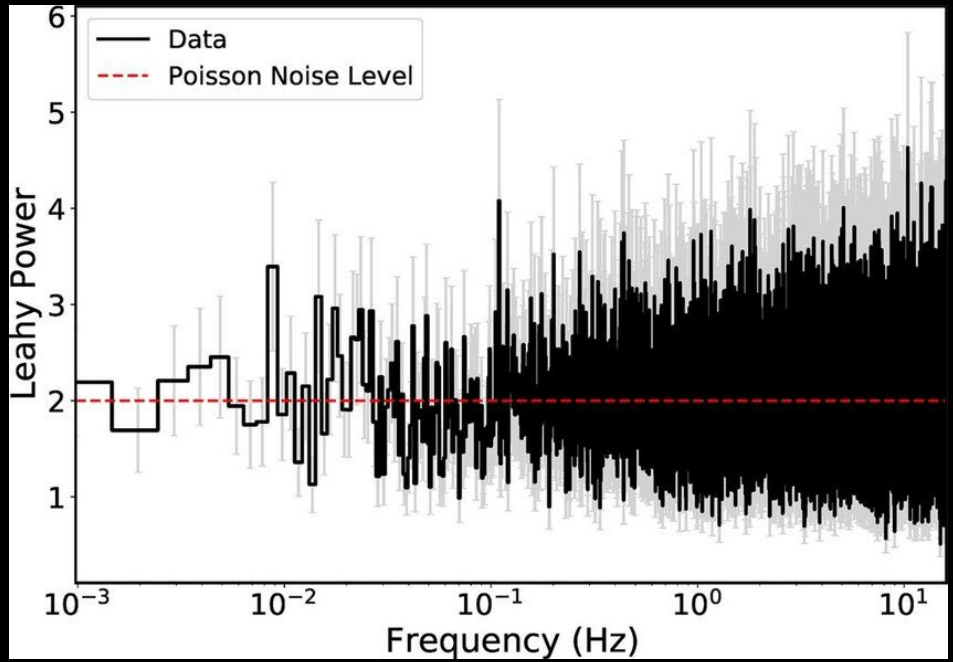
idk404050_drc.fits
221.44 MB

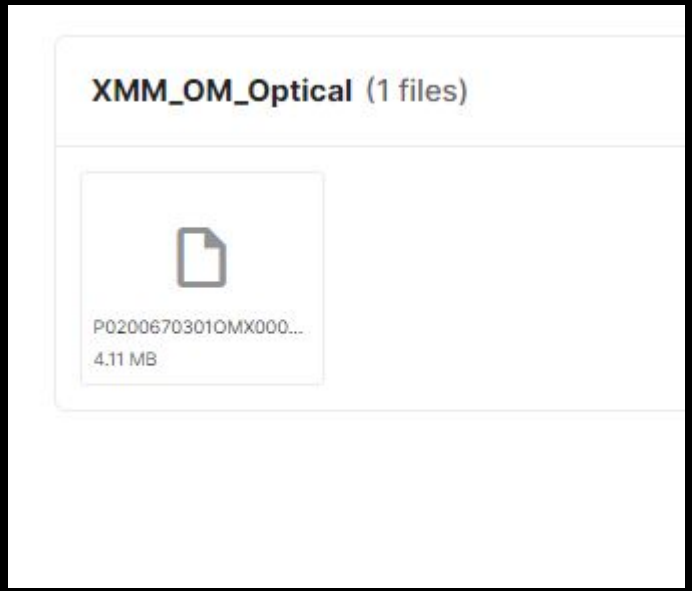
idk404050_drz.fits
221.44 MB





XMM-Newton, also known as the **High Throughput X-ray Spectroscopy Mission** and the X-ray Multi-Mirror Mission, is an X-ray space observatory launched by the European Space Agency in December 1999





The XMM-Newton Optical Monitor
The **Optical/UV Monitor Telescope** (XMM-OM) is mounted on the mirror support platform of XMM-Newton alongside the X-ray mirror modules

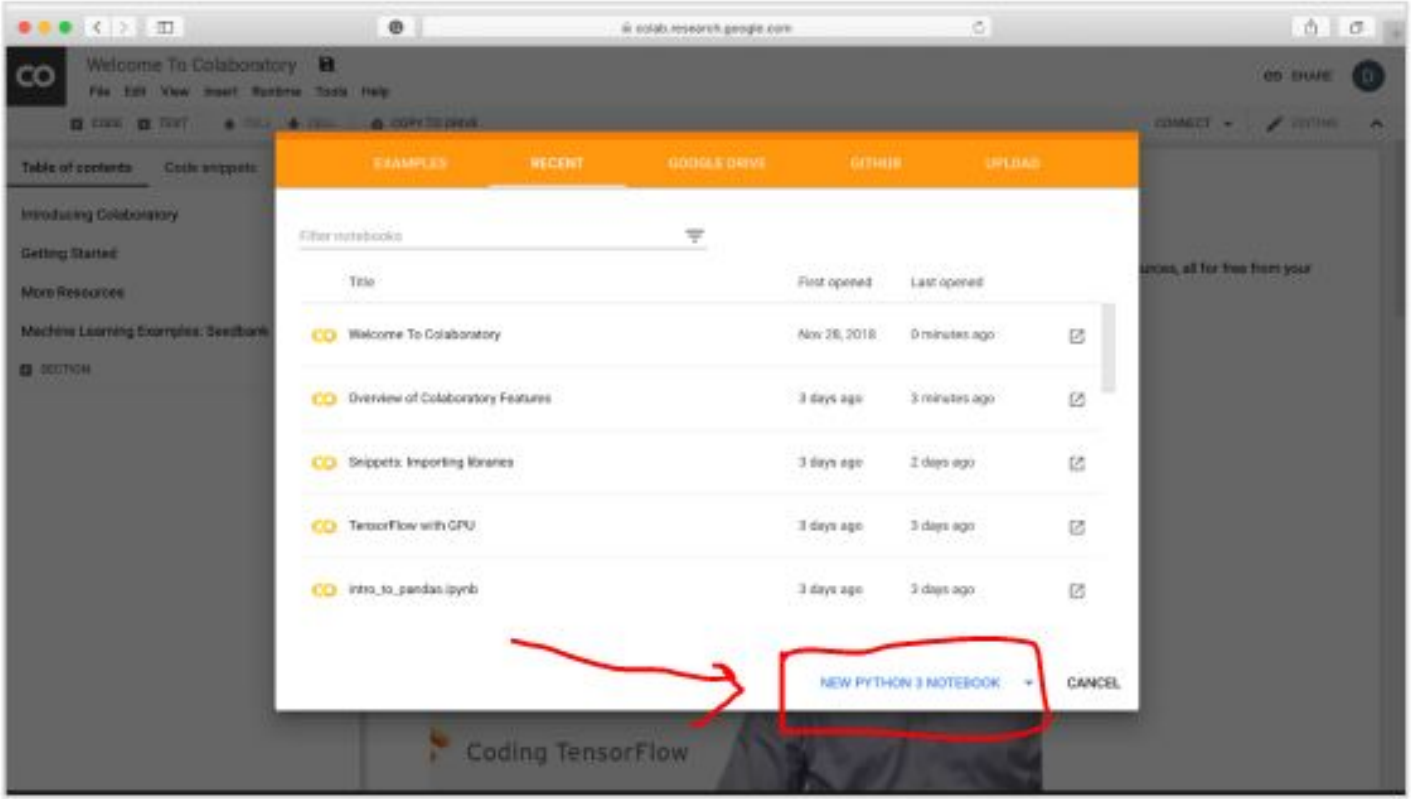
Google Colab – Introduction

What Colab Offers You?

As a programmer, you can perform the following using Google Colab.

- Write and execute code in Python
- Document your code that supports mathematical equations
- Create/Upload/Share notebooks
- Import/Save notebooks from/to Google Drive
- Import/Publish notebooks from GitHub
- Import external datasets e.g. from Kaggle
- Integrate PyTorch, TensorFlow, Keras, OpenCV
- Free Cloud service with free GPU

Google Colab – Your First Colab Notebook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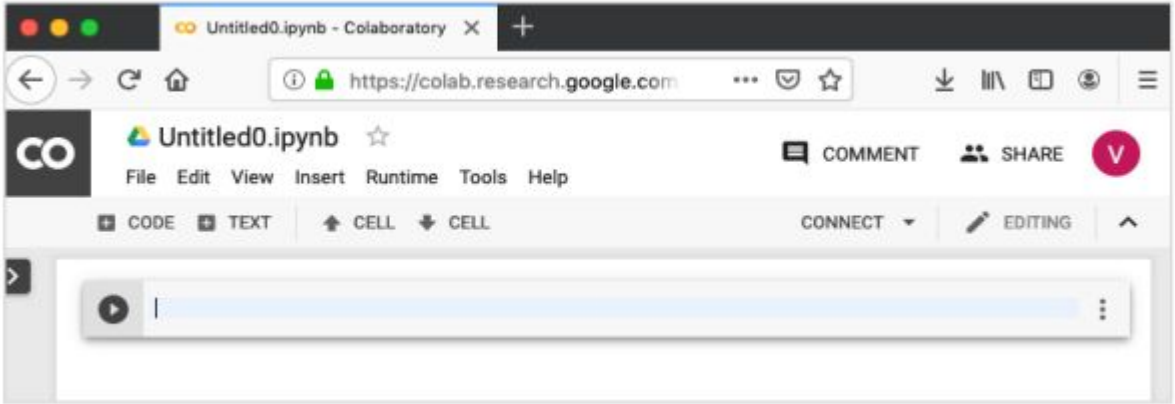
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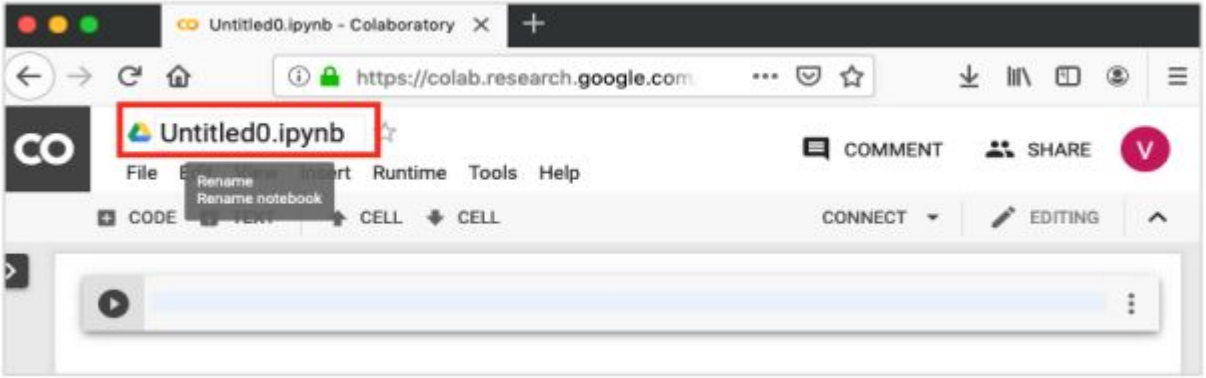
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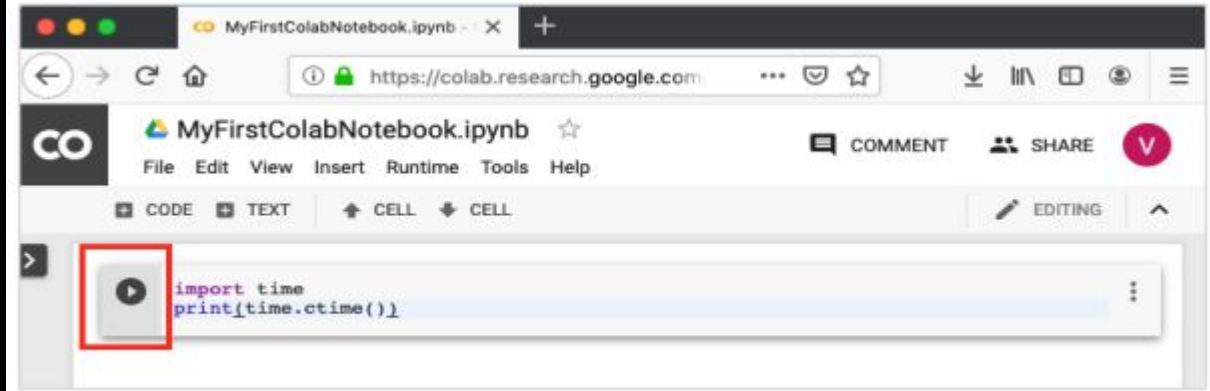
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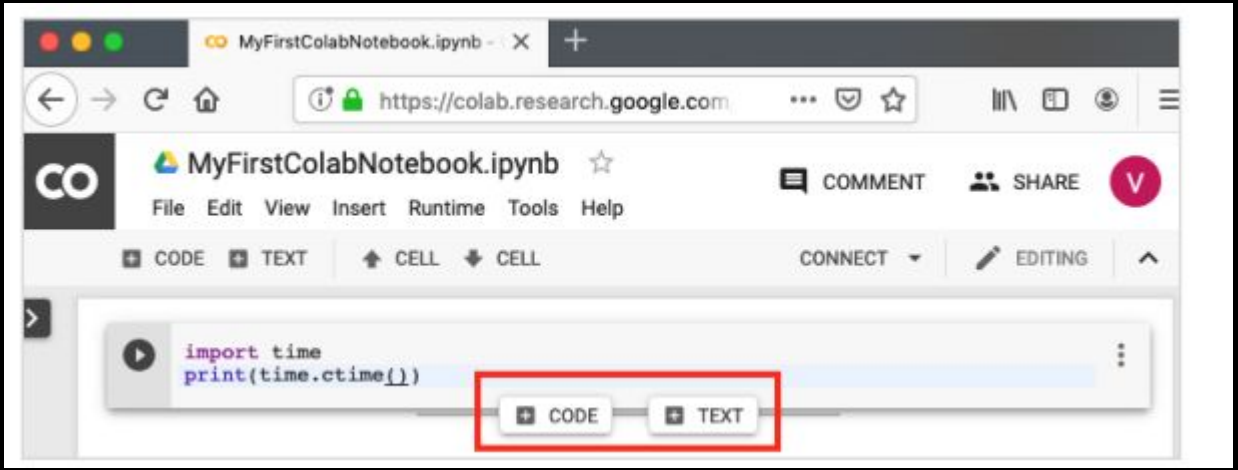
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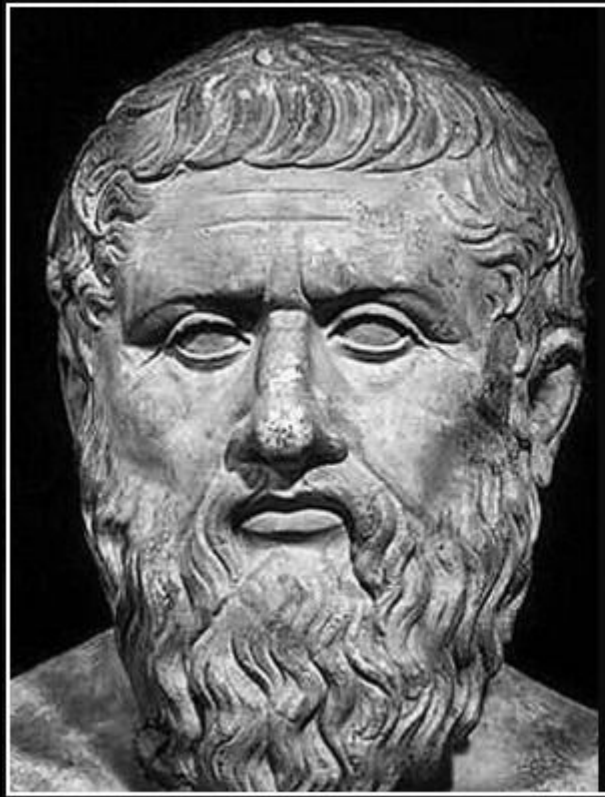

Astronomy compels the soul to look upwards and leads us from this world to another.

— Plato —

AZ QUOTES