The Virtual Astronomy Classroom: New Frontiers in Science Education

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Abstract

The digital revolution has transformed astronomy education through the Virtual Observatory, creating dynamic, accessible learning environments that transcend traditional classroom limitations. By integrating real-time data, like Gaia, Kepler, TESS, SDSS, virtual astronomy classrooms empower students worldwide to explore the cosmos regardless of geographic or socioeconomic barriers. These tools not only enhance engagement through hands-on experimentation with actual astronomical datasets but also cultivate critical STEM skills like data analysis and computational thinking. As the Virtual Observatory bridges the gap between cutting-edge research and education, it represents a paradigm shift in science pedagogy—democratizing access to the universe while preparing a new generation of learners for data-driven discovery. This innovative approach redefines astronomy education as an immersive, boundaryless experience, where every student can participate in the scientific process under the same "digital sky”.

- We live an era of multi-wavelength astronomy
- Various ground based and space surveys ranging from gamma rays, X-rays, ultraviolet, optical, and infrared to radio bands has brought astronomy into the big data era.
- Astronomical data is already amounting to petabytes and increasing with the advent of new instruments.
- Astronomy has evolved from “hypothesis-driven”, data poor to a data rich science

OUR TEAM

Dr Priya Hasan | Prof S N Hasan

Asst Professor | Professor

(Astronomy /Physics) | (Mathematics/Astronomy)

Maulana Azad National Urdu University, Hyderabad, India


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Results of Extraordinary call for COVID-19 related proposals

In May 2020, the IAU Office of Astronomy for Development issued an Extraordinary Call for Proposals that could use astronomy in any form to help mitigate some of the impacts caused by COVID-19. Together with the African Astronomical Society and African Planetarium Association, more than 800,000 ZAR (about 40,000 Euros) in grants have been awarded to 43 projects around the world that use various aspects of astronomy and the astro community to help communities suffering the negative impacts of COVID-19.

Summaries of projects are listed below (in alphabetical order). For more information on any of the projects, write to *info (at) astro4dev.org*.

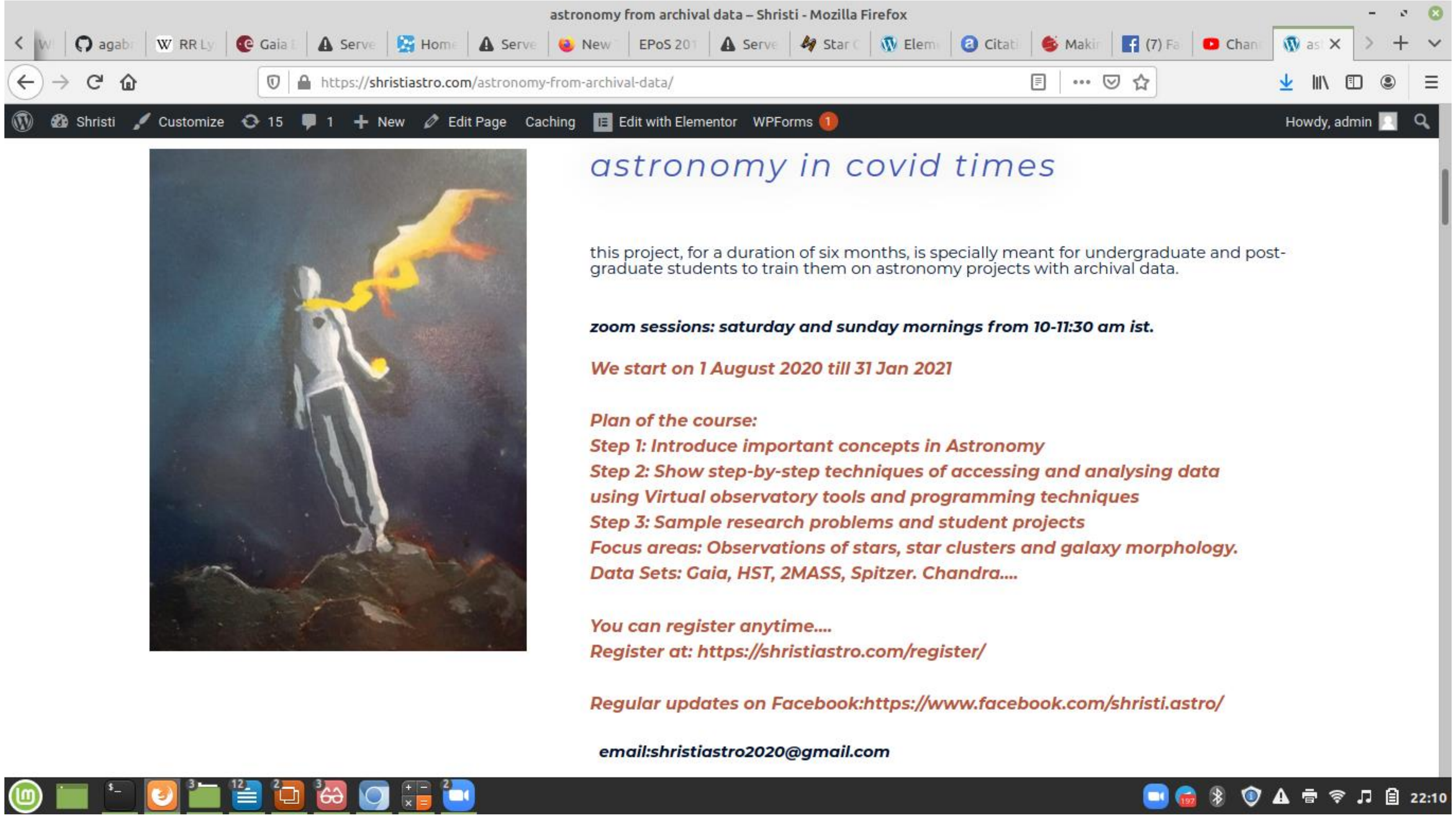
Astronomy from Archival Data	India and all over the world	The project will train students to use the high-quality astronomy data from various facilities. Participants will be shown step-by-step techniques of accessing and analysing astronomy data from the internet, introduced to virtual observatory tools and programmimg techniques, and supported to formulate and develop projects. The training will include special sessions on report writing, publishing and presenting in scientific journals. More info at: https://shristiastro.com/astronomy-from-archival-data/

915 RESPONSES

INDIA, PAKISTAN, BANGLADESH, SRILANKA,NEPAL, GERMANY, ITALY, UK, USA, SA, NIGERIA, BOTSWANA, NAMIBIA, GHANA, COLUMBIA, BRAZIL, MEXICO, PHILIPENES, INDONESIA, THAILAND, MALAYSIA, CHINA, JAPAN...
23..COUNTRIES

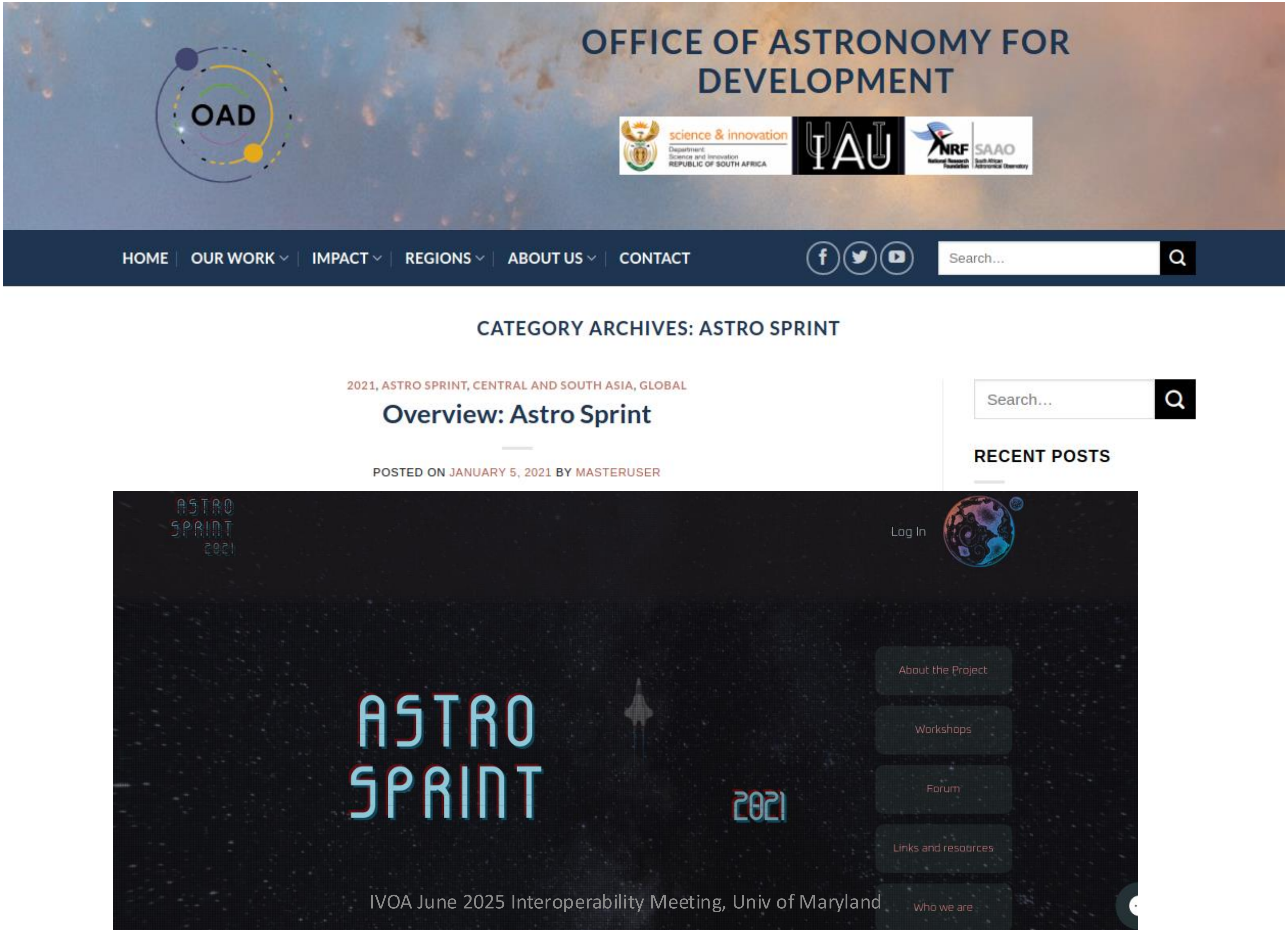
SOMETHING THAT STUDENTS WANT!!!

A TOUR OF OUR WEBSITE.... HTTPS://SHRISTIASTRO.COM/



MODUS OPERANDI

- Virtual teaching has been there for a while..now a serious option to consider
- Website designing and maintenance
- Social Media
- Contact: Telegram, Email
- Feedback: Homework, Quizzes, Polls
- Variety of Speakers: Mark Taylor, Sushan Konar, Luisa Rebull, Bruno Merin, Deborah Baines, Tim Hamilton, Ajit Kembhavi, Avinash Deshpande, Kaustubh Waghmare, Tarun Deep Saini...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2021, ASTRO SPRINT, CENTRAL AND SOUTH ASIA, GLOBAL
Overview: Astro Sprint
POSTED ON JANUARY 5, 2021 BY MASTERUSER
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About the Project
Workshops
Forum
Links and resources
Who we are
ASTRO SPRINT
2021

Schedule and zoom link details...

ENTERPRISE

26th, 27th & 28th March
Online Zoom Sessions.

Warp Drive your way to
Research in Astronomy!

Enter

DISCOVERY (21-31 AUGUST 2021)

Enter

Register

We are planning sessions on weekends & weekdays from 21-31 August to distribute the talks. Most days you have 1, 2 or maximum 3 talks on a day....to not overload u

Here is the schedule
The Zoom link is:Topic: AstroSprint: Discovery
Time: This is a recurring meeting Meet anytime
Join Zoom Meeting
https://us02web.zoom.us/j/5760546150...
Meeting ID: 576 054 6150
Passcode: HAS2020
We will also be live streaming on :
https://www.youtube.com/c/ShristiAstronomy
The registration link is:
https://forms.gle/PZZkaP11BYfY8yiC8

NEXT GENERATION

3-5 June 2022
HYBRID MODE
MAULANA AZAD
NATIONAL URDU
UNIVERSITY,
HYDERABAD

Register

AstroSprint: The Next Generation
3-4 June 2022

Hybrid mode
20 recoded lectures
Stars, pulsars, star clusters, galaxies, AGN….
Projects ongoing
Publications, posters ……..

Very good response

Aims: Educational

Fundamentals of observing
Planning observations
Photometry
Standardisation

Star Clusters
HR Diagrams
Using Gaia and other datasets
Science with HR diagrams

Global Sky Partners

Shristi Astronomy

Back to Global Sky Partners

About

Shristi Astronomy has been using LCO as an Educational Tool to help participants understand how observations are made, how to plan observations, exposure times, filters, and analyse data. We hope that the experience will train students to analyse data and obtain results. We have conducted various online and offline workshops on stellar photometry, plotting HR diagrams, study of star clusters, the BANZAI pipeline, etc. We propose to extend our activities with our Global Sky Partners.

Audience Region

- Asia

Organizers:	Priya Hasan, SN Hasan
Affiliation:	Maulana Azad National Urdu University, Hyderabad, India
Partner website:	For more information
Active:	Aug 2021 → present
Audience:	In-person workshops/training/mentoring Online workshops/training/mentoring

NEWS
Researchers Discover Cosmic Dust Storms from a Type Ia Supernova

NEWS
A Double Detonation Supernova

NEWS
LCO detects planetary collision in distant solar system, revealing new cosmic object

NEWS
LCO Scientists Share the Secrets of an Important Supernova

NEWS
Alan Hale Recovers Comet with LCO Telescopes

Education

- Activities at Home
- Education Homepage
- Global Sky Partners
- Observing Info
- Resources

ASIA
EUROPE
NORTH AMERICA
Atlantic Ocean
AFRICA
SOUTH AMERICA
Indian Ocean

The HR diagram with LCO
(2 -3 October 2021)
We plan a two-day online workshop on observations with the Las Cumbres Observatory to observe Star Clusters and plot their HR diagrams. This program is planned for serious amateur and young aspiring professional astronomers. We shall have detailed presentations on magnitude scales, extinction, photometry and HR diagrams. There will be hands-on sessions on using the Aperture Photometry Tool (APT) and TopCat and participants will learn how to plot HR diagrams for Star Clusters.
The registration link is:
https://forms.gle/bR2jkZfZGbVVkPef6
Youtube:https://www.youtube.com/c/shristiastronomy
Contact us at +91 9866619519 or priya.hasan@gmail.com .
More details at: https://shristiastro.wordpress.com/the-hr-diagram-with-lco/
Contact: Priya Hasan, S N Hasan, MANUU, Hyd
+91 9866619519, priya.hasan@gmail.com
Twenty-five telescopes at seven sites around the world working together as a single instrument

The HR diagram with LCO-2
30 October 2021
10-12 am IST
We plan a short online workshop on observations with the Las Cumbres Observatory to observe Star Clusters and plot their HR diagrams. This program is planned for serious amateur and young aspiring professional astronomers.
This is a follow-up of the earlier workshop held. Participants will learn how to plot HR diagrams for Star Clusters.
The registration link is:
https://forms.gle/npXuri4HYBheo4Fc6
Youtube:https://www.youtube.com/c/shristiastronomy
Contact us at +91 9866619519 or priya.hasan@gmail.com .
More details at: https://shristiastro.wordpress.com/the-hr-diagram-with-lco/
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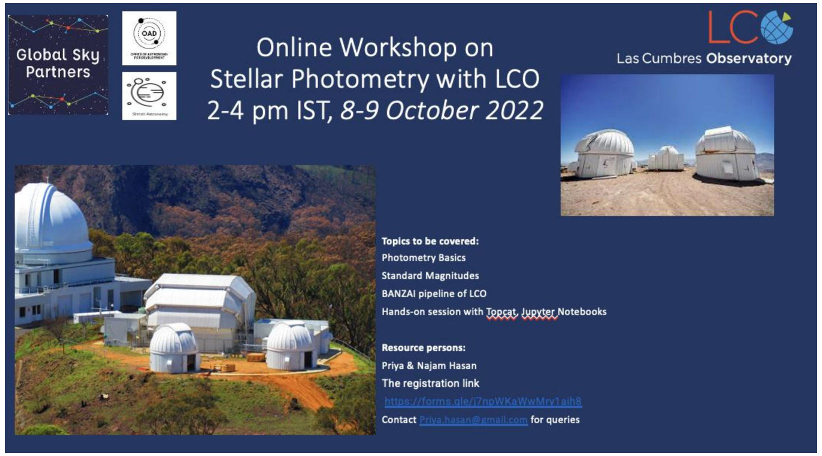
Twenty-five telescopes at seven sites around the world working together as a single instrument



Global Sky Partners
Online Workshop on
Stellar Photometry with LCO
2-4 pm IST, 8-9 October 2022
Las Cumbres Observatory
Topics to be covered:
Photometry Basics
Standard Magnitudes
BANZAI pipeline of LCO
Hands-on session with Topcat, Jupyter Notebooks
Resource persons:
Priya & Najam Hasan
The registration link
https://forms.gle/j7npWKaWwMry1aih8
Contact Priya.hasan@gmail.com for queries

University of Sharjah

Dec 2022

Workshops

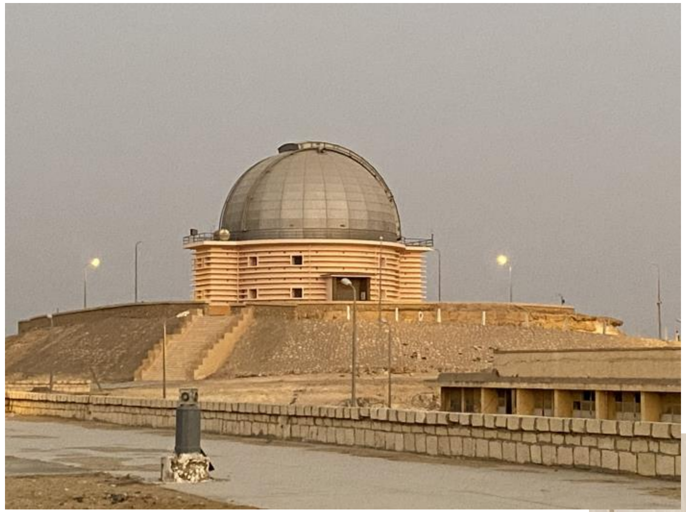
- May 24, 2022, “Stars and HR Diagram”, The Bush School, Seattle, Washington, USA. Online Workshop by Priya Hasan

- **2 -3 October 2021,** The HR diagram with LCO. Online Workshop by Priya Hasan and S N Hasan.
- **30 October 2021,** The HR diagram with LCO-2. Online Workshop by Priya Hasan and S N Hasan.
- **8 - 9 October 2022:** Stellar photometry with LCO. Online Workshop by Priya Hasan and S N Hasan.

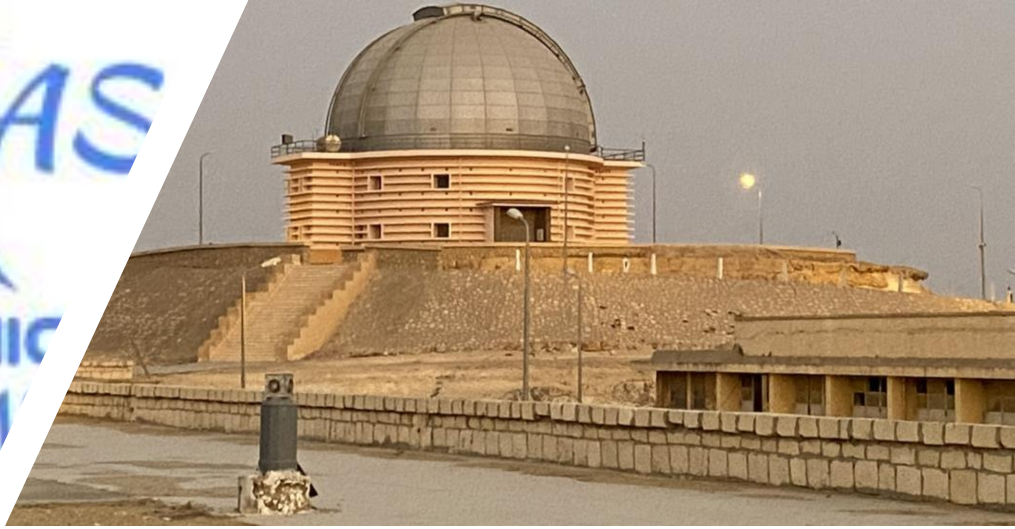
- **STELLAR PHOTOMETRY AND HR DIAGRAMS WITH SOO and LCO, Wed. 21 to Fri. 23 Dec. 2022**

Sharjah Academy for Astronomy, Space Sciences and Technology, UoS, UAE

- May 2023, AstroEdu, Workshop on LCO Observations



Third Advanced ArAS School for Astrophysics in the **Kottamia Astronomical Observatory, Egypt**, on **September 15-22, 2023**.



- The 2nd International Science Conference "Science and Industry", which will be held during October 14-15, 2024 in Culture and Arts Building, Helwan University, Egypt.

- Third Advanced ArAS School for Astrophysics in the Kottamia Astronomical Observatory, Egypt, October 18-24, 2024.

No	ACTIVITY	DATE	TIME
1	Courtesy call on the administration: Dean, HOD, Faculty	23 October 2023	09:00 – 10:00
2	Postgraduate workshop in astronomy	25-27 October 2023	09:00 – 17:00
3	Staff workshop: Hands on training	30 October to 01 November 2023	09:00 – 17:00
4	Public lecture: Machine learning based on Gaia	3 November 2023	10:00 – 11:00
5	Workshop3: Open mode development of MSc resources	4 – 9 November 2023	10:00 – 17:00
6	Public lecture: Quantifying Galaxy Morphology	8 November 2023	10:00 – 11:00
7	Departure of experts	10 November 2023	08:00

OAD

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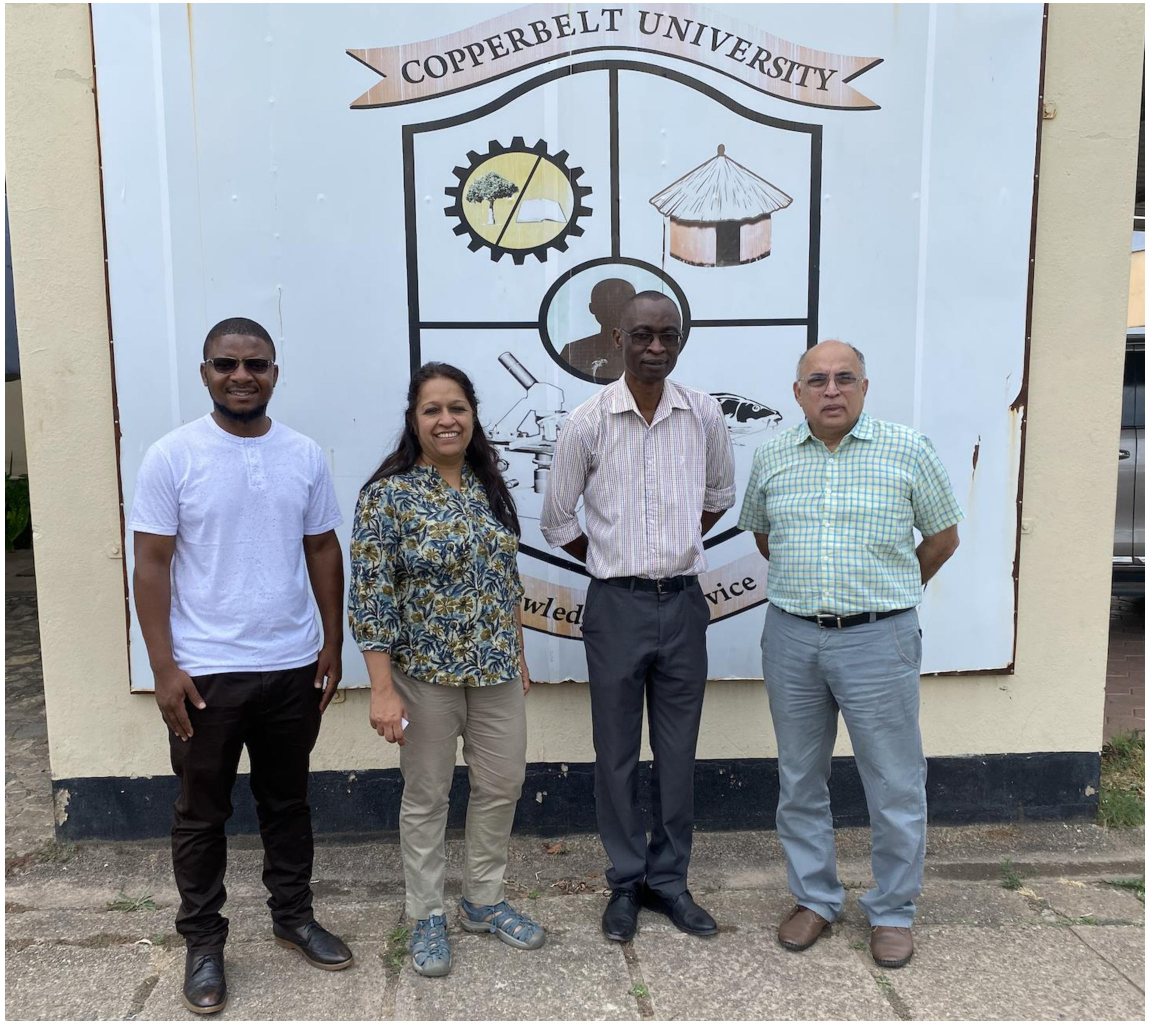
Virtual Observatory – Office of Astronomy for Development Special Grant



INTRO2ASTRO WORKSHOP

ABOUT THE COURSE

Intro2Astro (Introduction to Astronomy Research) is a free summer workshop designed for undergraduate students aspiring to become professional astronomers. Intro2Astro 2025 will run from **July 1 to August 19, 2025** (8 weeks). We will meet every Tuesday from 6:00–7:00 PM UTC to discuss the following topics:

- Coding in Python
- How to read and write scientific papers
- Data analysis of real astronomical data
- Research Websites and CVs
- Funded Research Opportunities
- Graduate School Application
- Citizen Scientists Projects

REGISTRATION

REGISTRATION

Students: First, second-year undergraduate students, and advanced high school students who are interested in astronomy. **You don't have to be an astronomy major either. No prior experience required-just curiosity and motivation!**

SIGN UP

Mentors: Graduate students and postdoctoral researchers who are doing research in astronomy are welcomed to join as mentors.

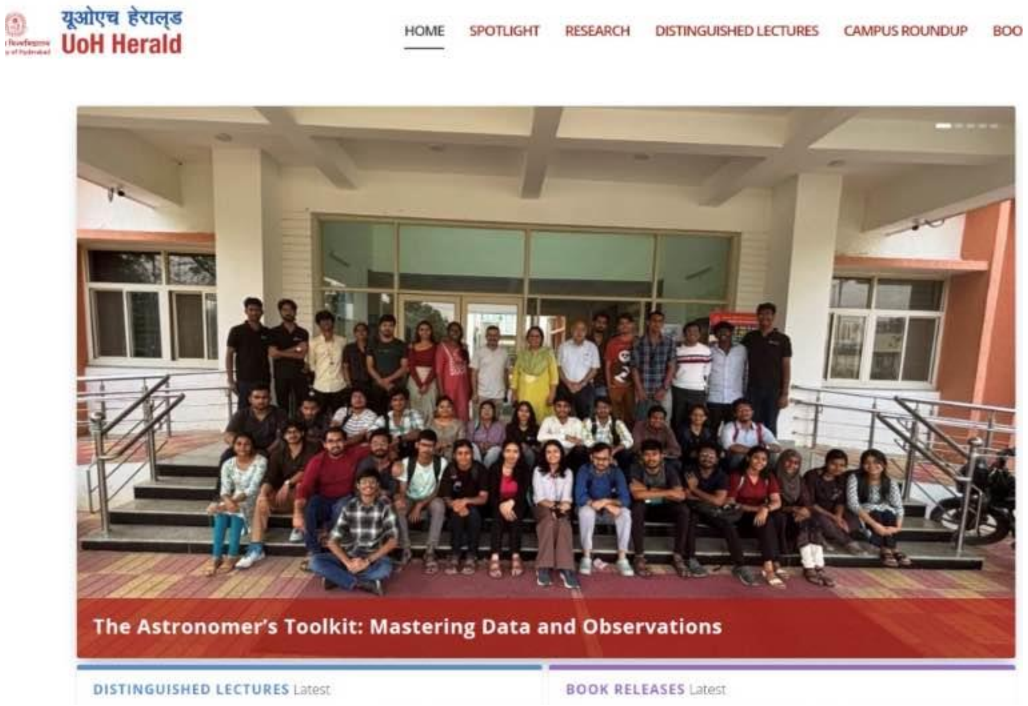
LEARN MORE

You can learn more about the workshop through our website, Github Repo, and Youtube Channel:

- https://sites.google.com/view/intro-2-astro
- https://github.com/howardisaacson/Intro-to-Astro2025
- https://www.youtube.com/@intro2astro

Organizers:

- Dr. Fei Dai (University of Hawai`i) fdai@hawaii.edu
- Dr. Howard Isaacson (Berkeley) hisaacson@berkeley.edu
- Chetan Chawla (ZS, ASIAA) chetanchawlacc4@gmail.com



Training program series for Women in Astronomy

Essential Skills for Astronomy Research

TP3-Day1

TP3-Day2

TP3-Day3

TP3-Day4

Other Workshops

IAU GA, ***Virtual Observatory Tools for Students and Educators*** workshop

M. Allen**,** M. Baumann, B. Berriman, **P. Hasan**, M. Marchand, P. Sharma, P. Whitelock, 2024

IAU GA**, Remote Telescopes** FM 10

Nagpur, India, 2023, 2024

Mathura, 2023

SPPU University, Anand, India 2024

Nehru Planetarium, Delhi, April 2025

Science Cases

Exoplanets: Kepler and TESS data

Star Clusters: HR diagrams with Gaia

1D Galaxy Morphology: Isophotes

Observations with LCO

CCD Data Analysis with astropy

Analyzing interstellar reddening and calculating synthetic photometry with astropy

Computing Galactic Orbits of Stars with Gala https://archive.stsci.edu/prepds/kepler_hlsp/

Accessing Data:

Barbara A. MIKULSKI ARCHIVE FOR SPACE TELESCOPES

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Kepler HLSP

Below are README files describing version 1.0 HLSP data:

README_dtr.txt describing the files containing time series of detrended, normalized stellar fluxes of individual target stars as observed by NASA's Kepler Mission.

README_rvb.txt describing the files containing time series of radial velocity and spectral line bisector span for ground-based spectroscopic observations of individual target stars that have been observed by NASA's Kepler Mission.

Click on the target name to see more information and a quick-look plot. Click on the filenames to download txt files. You may also download via anonymous ftp from archive.stsci.edu. cd /pub/hlsp/kepler_hlsp/

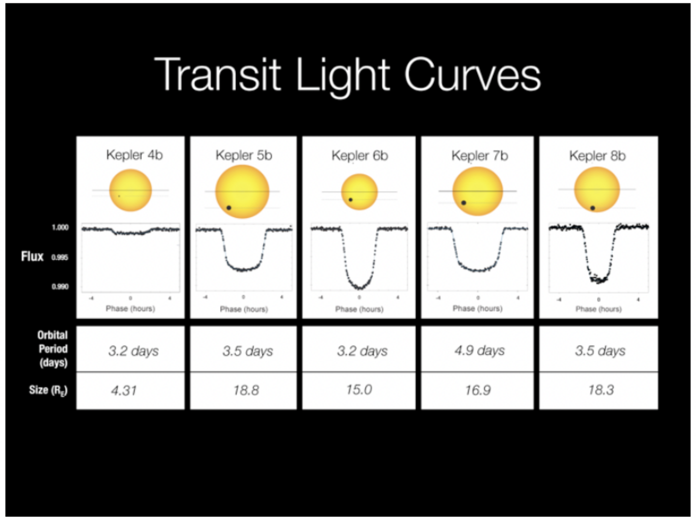


Illustration from Bill Borucki's Jan 2010 AAS Presentation

The First Five Targets

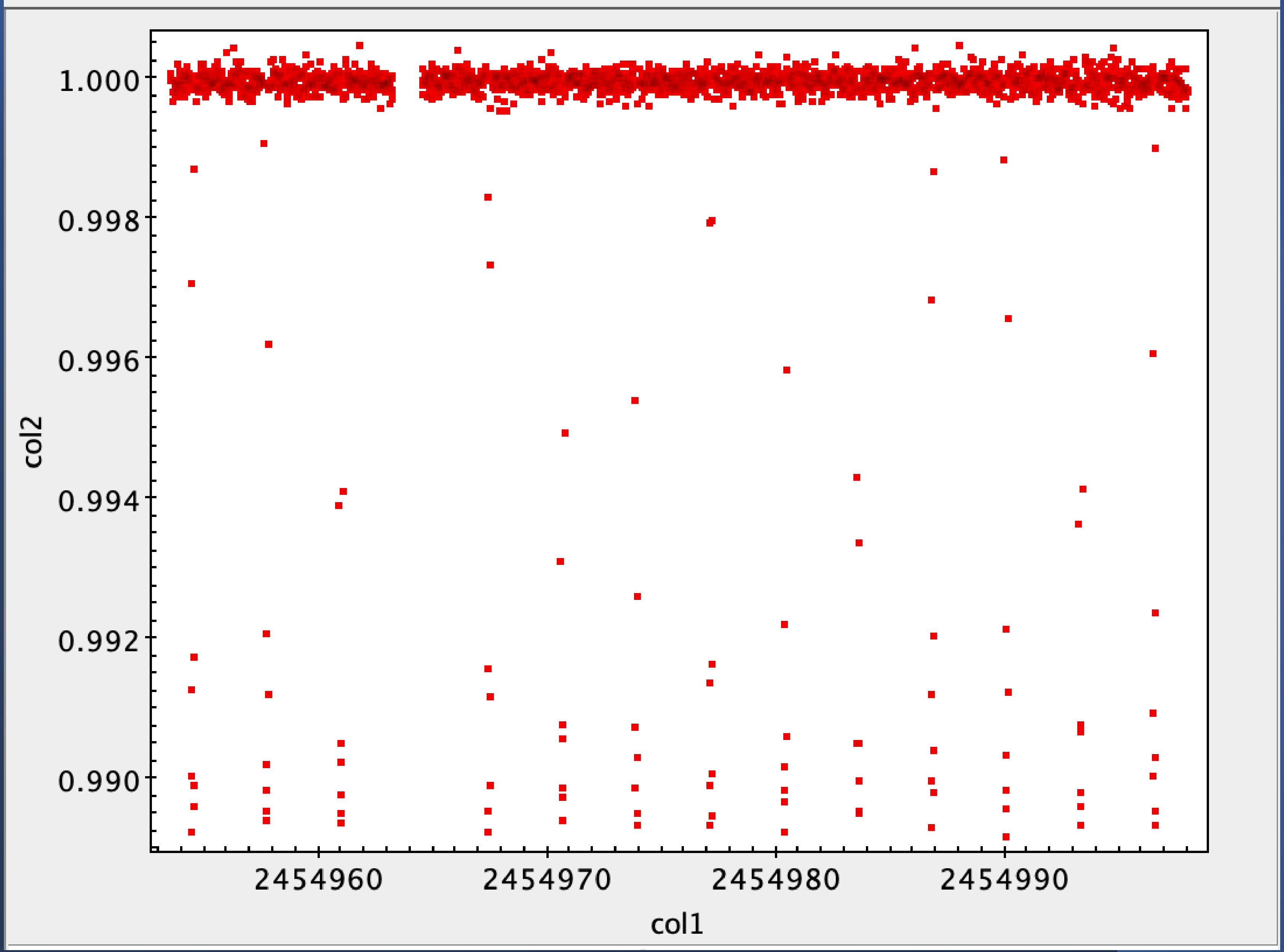
Target	Kepler Time Series	Ground Based Time Series
KPLR10874614 Kepler-6b	hlsp_exo_kepler_phot_KPLR10874614_kep_v1.0_dtr.txt	hlsp_exo_kepler_spec_KPLR10874614_wide_v1.0_rvb.txt
KPLR11853905 Kepler-4b	hlsp_exo_kepler_phot_KPLR11853905_kep_v1.0_dtr.txt	hlsp_exo_kepler_spec_KPLR11853905_wide_v1.0_rvb.txt
KPLR5780885		

Open in Topcat

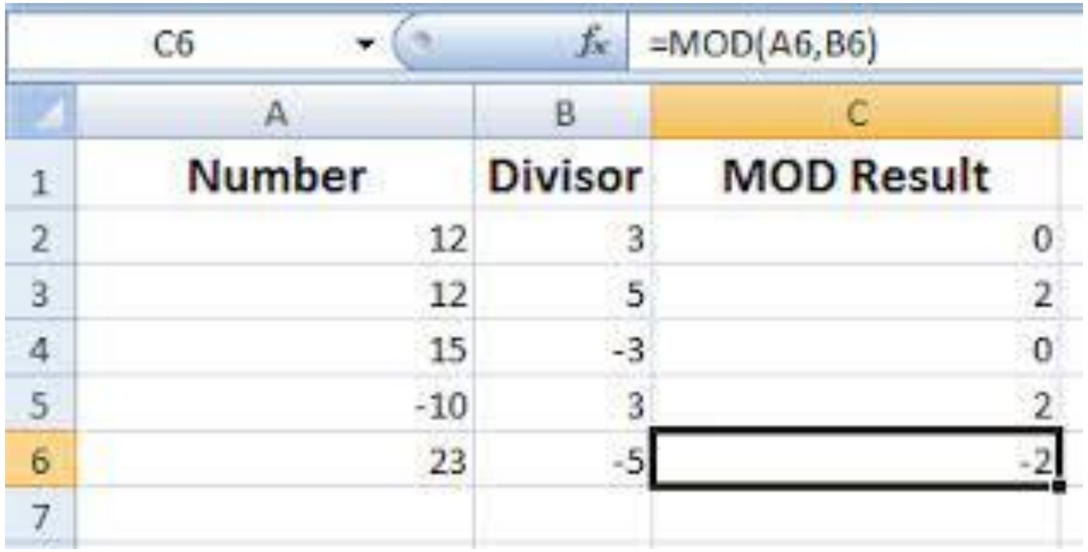
- Julian Date
- Flux

- The **Julian day number** (JDN) is the integer assigned to a whole solar day in the Julian day count starting from noon Universal Time, with Julian day number 0 assigned to the day starting at noon on Monday, January 1, 4713 BC, proleptic Julian calendar (November 24, 4714 BC, in the proleptic Gregorian calendar), a date at which three multi-year cycles started (which are: Indiction, Solar, and Lunar cycles) and which preceded any dates in recorded history.[a]
- For example, the Julian day number for the day starting at 12:00 UT (noon) on January 1, 2000, was 2 451 545.

	col1	col2	r
1	2.454954E6	1.00007	
2	2.454954E6	0.99999	
3	2.454954E6	0.99998	
4	2.454954E6	0.99983	
5	2.454954E6	0.99982	
6	2.454954E6	0.99969	
7	2.454954E6	0.99998	
8	2.454954E6	0.99987	
9	2.454954E6	0.99994	
10	2.454954E6	0.99978	
11	2.454954E6	0.99993	
12	2.454954E6	0.99988	
13	2.454954E6	1.00023	
14	2.454954E6	0.99999	
15	2.454954E6	0.99974	
16	[illegible]	[illegible]	

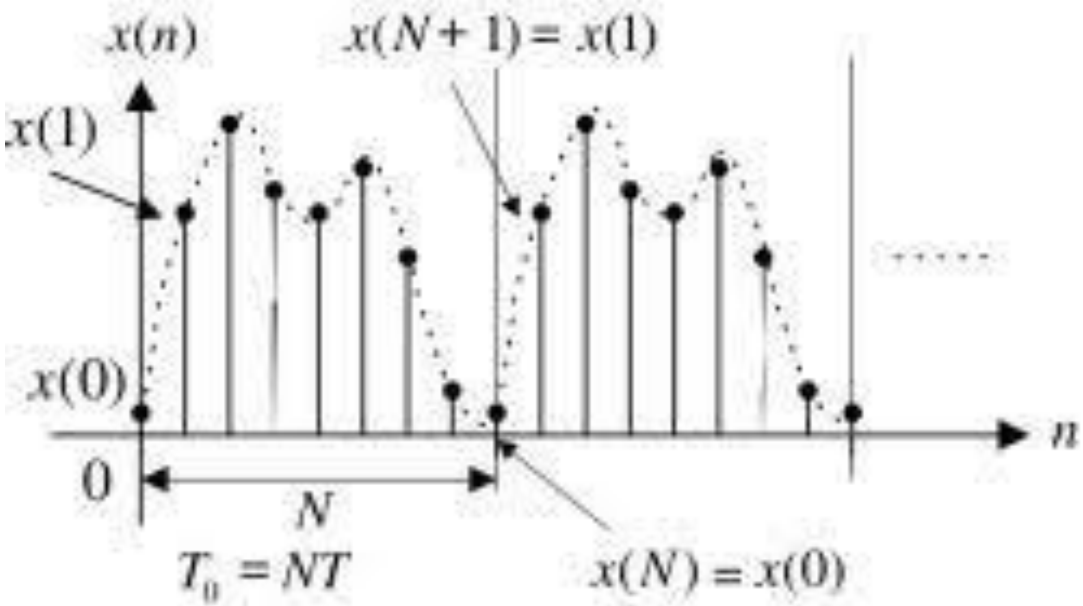

1.000
0.998
0.996
0.994
0.992
0.990
col2
2454960
2454970
2454980
2454990
col1

# Folding functions
mod(y,P)

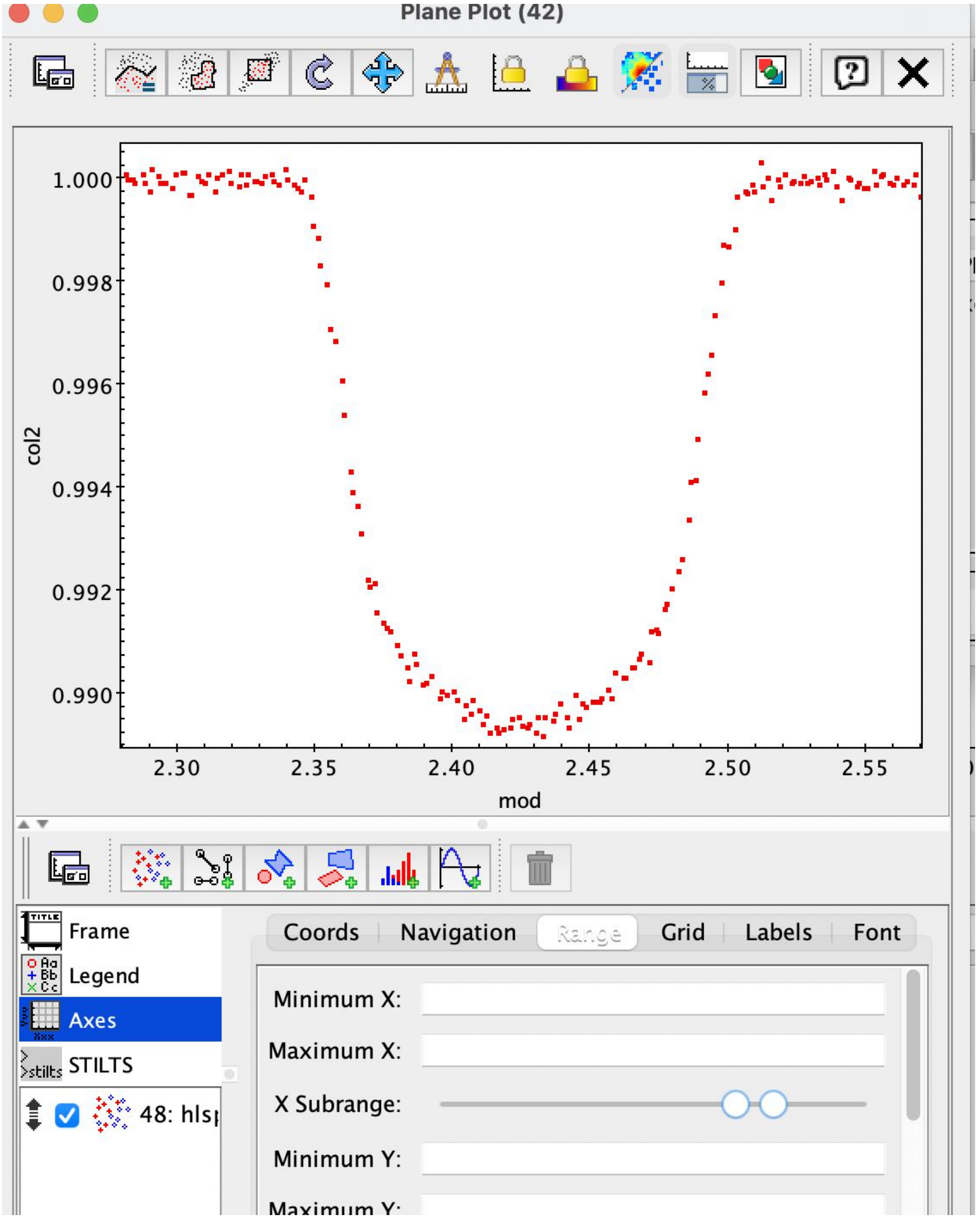


C6 =MOD(A6,B6)

	A	B	C
1	Number	Divisor	MOD Result
2	12	3	0
3	12	5	2
4	15	-3	0
5	-10	3	2
6	23	-5	-2
7			



Light curve (folded)
P=3.2346
mod(col1,3.2346)



Measuring the Distance from the Star to the Planet

$$\boxed{a = \left[G\mathcal{M}_* \left(\frac{P}{2\pi}\right)^2\right]^{\frac{1}{3}}}$$

Recall Kepler's Third Law,

$$P^2 \propto a^3,$$

where P is the planet's orbital period, and a is its semi-major axis (for a circular orbit, this will be the orbital radius).

$$\frac{a^3}{P^2} = \frac{G(\mathcal{M}_* + \mathcal{M}_\mathrm{p})}{4\pi^2},$$

where $\mathcal{M}_*$ is the mass of the host star, $\mathcal{M}_\mathrm{p}$ is the mass of the planet, and G is Newton's gravitational constant.

If $\mathcal{M}_\mathrm{p} << \mathcal{M}_*$ (the star is much more massive than the planet), then $\mathcal{M}_* + \mathcal{M}_\mathrm{p} \approx \mathcal{M}_*$, and

$$\frac{a^3}{P^2} = \frac{G\mathcal{M}_*}{4\pi^2}$$

$$a^3 = G\mathcal{M}_* \frac{P^2}{4\pi^2}$$

$$a^3 = G\mathcal{M}_* \left(\frac{P}{2\pi}\right)^2$$

For M_*: The Extrasolar Planets Encyclopaedia

http://exoplanet.eu/

Exoplanet.eu

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Catalog

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Status | Detection | "Kepler-6 b" IN name | Filter

Showing 4988 planets / 3676 planetary systems / 816 multiple planet systems

All fields

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Planet Search

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Planet	Mass (M_{Jup})	Radius (R_{Jup})	Period (day)	*a* (AU)	*e*	*i* (deg)	Ang. dist. (arcsec)	Discovery	Update
GJ 367 b	0.00047	0.0526	0.3219659	0.0069	—	—	—	2021	2022-04-07
WASP-178 b	1.41	1.94	3.3448285	0.0558	0	85.7	—	2019	2022-04-06
KMT-2019-BLG-2974 b	0.28	—	—	2	—	—	—	2022	2022-04-06
KMT-2019-BLG-1552 b	4.05	—	—	2.6	—	—	—	2022	2022-04-06
KMT-2019-BLG-1042 b	0.19	—	—	1.7	—	—	—	2022	2022-04-06
WASP-5 b	1.637	1.171	1.6284246	0.02729	0	85.8	0.000092	2007	2022-04-05
AB Aur b	9	—	—	93.9	0.4	42.6	0.708333	2008	2022-04-04
GJ 9066 c	—	—	772.05	0.88	0.49	—	—	2020	2022-04-04
Kepler-1656 c	0.3977	—	1919	3.053	0.527	89.31	—	2022	2022-04-04
Kepler-1656 b	0.1504	0.448	31.562	0.1974	0.838	89.31	—	2018	2022-04-04
K2-2016-BLG-0005L b	1.1	—	—	4.18	—	—	—	2022	2022-04-01
KMT-2021-BLG-1077L c	0.25	—	—	0.93	—	—	—	2022	2022-04-01
KMT-2021-BLG-1077L b	0.22	—	—	1.26	—	—	—	2022	2022-04-01

Star data

Star

Kepler-6

Name	**Kepler-6**
Distance	**597.14 ($_{-5.16}^{+5.16}$) pc**
Spectral type	—
Apparent magnitude V	—
Mass	**1.21 ($_{-0.04}^{+0.04}$) M_{Sun}**
Age	**3.8 (± 1.0) Gyr**
Effective temperature	**5647.0 (± 44.0) K**
Radius	**1.39 ($_{-0.03}^{+0.02}$) R_{Sun}**
Metallicity [Fe/H]	**0.34 (± 0.04)**

Measuring the Size of the Planet

R_p=factor * R_*

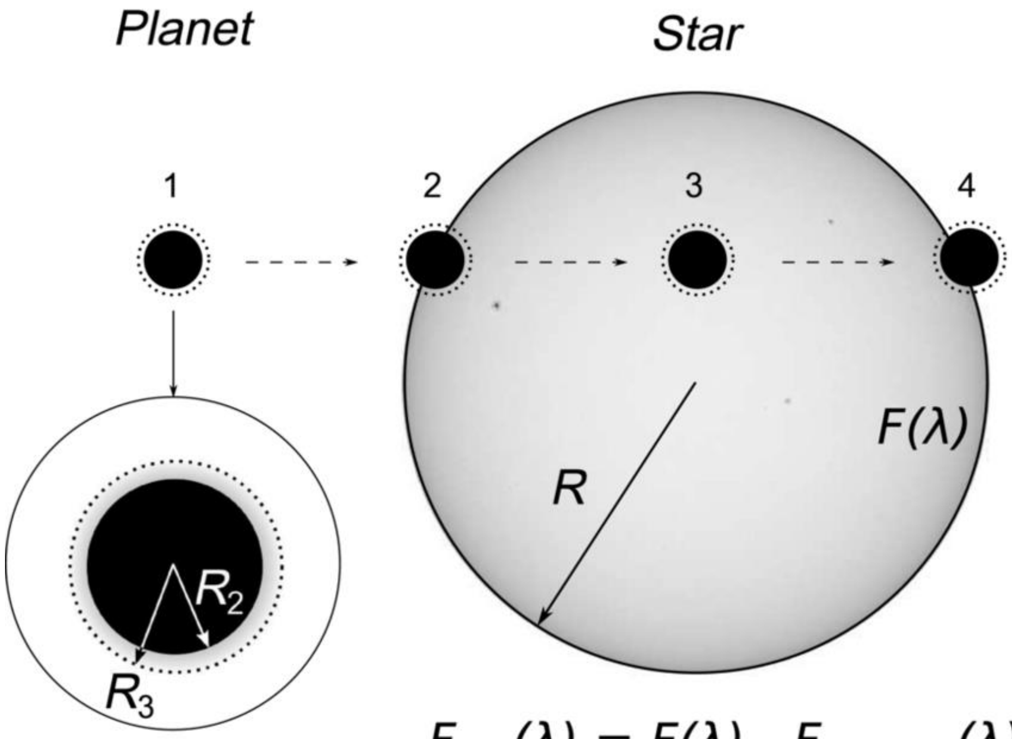
$$\frac{F_{\rm tot} - F_{\rm trans}}{F_{\rm tot}} = \frac{A_{\rm p}}{A_*}.$$

Since both the star and the planet are circular, we can write their area in terms of radius, $A = \pi r^2$. Substituting this in and simplifying the left hand side,

$$1 - \frac{F_{\rm trans}}{F_{\rm tot}} = \frac{\pi R_{\rm p}^2}{\pi R_*^2}$$

$$\boxed{R_{\rm p} = R_* \sqrt{1 - \frac{F_{\rm trans}}{F_{\rm tot}}}}$$

Calculating the Temperature of the Planet



$F_{obs}(\lambda) = F(\lambda) - F_{occulted}(\lambda)$

$$L_{\rm em} = \sigma T_{\rm p}^4 \; 4\pi R_{\rm p}^2.$$

$$L_{\rm abs} = (1-\alpha)\sigma T_*^4 \frac{R_*^2}{a^2}\,\pi R_{\rm p}^2$$

$$L_{\rm abs} = (\text{absorption coefficient}) \times F_{\rm inc} A_{\rm cross}$$

$$L_{\rm em} = L_{\rm abs}$$

$$\sigma T_{\rm p}^4 \; 4\pi R_{\rm p}^2 = (1-\alpha)\,\sigma T_*^4 \,\frac{R_*^2}{a^2}\pi R_{\rm p}^2$$

The σ and $\pi R_{\rm p}^2$ cancel out on both sides.

$$T_{\rm p}^4 = \frac{1}{4}(1-\alpha) T_*^4 \,\frac{R_*^2}{a^2}$$

Solving for $T_{\rm p}$,

$$\boxed{T_{\rm p} = T_* \left[(1-\alpha)\,\frac{R_*^2}{a^2}\right]^{\frac{1}{4}}},$$

Getting the Planet's Mass and density From Radial Velocity

$$\mathcal{M}_p = \frac{v_{*,\ \max}}{\sin i}\sqrt{\frac{a\,\mathcal{M}_*}{G}}$$

$$P^2 = \frac{4\pi^2}{GM_*}a^3$$

from P, we get a and (knowing M_*) V_p:

$$V_p = \sqrt{\frac{GM_*}{a}}$$

then, conservation of momentum:

$$M_pV_p = M_*V_*$$

we can get M_p

$$M_p = M_*\left(\frac{V_*}{V_p}\right)$$

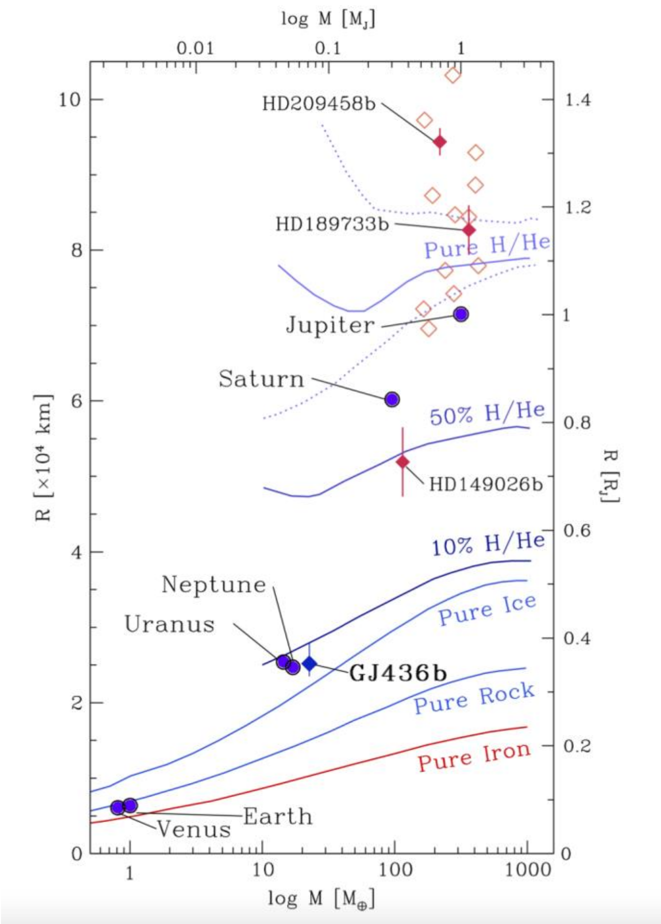
but we really get $M_p$sin(i)

$$M_p \sin i = M_*\left(\frac{V_* \sin i}{V_p}\right)$$

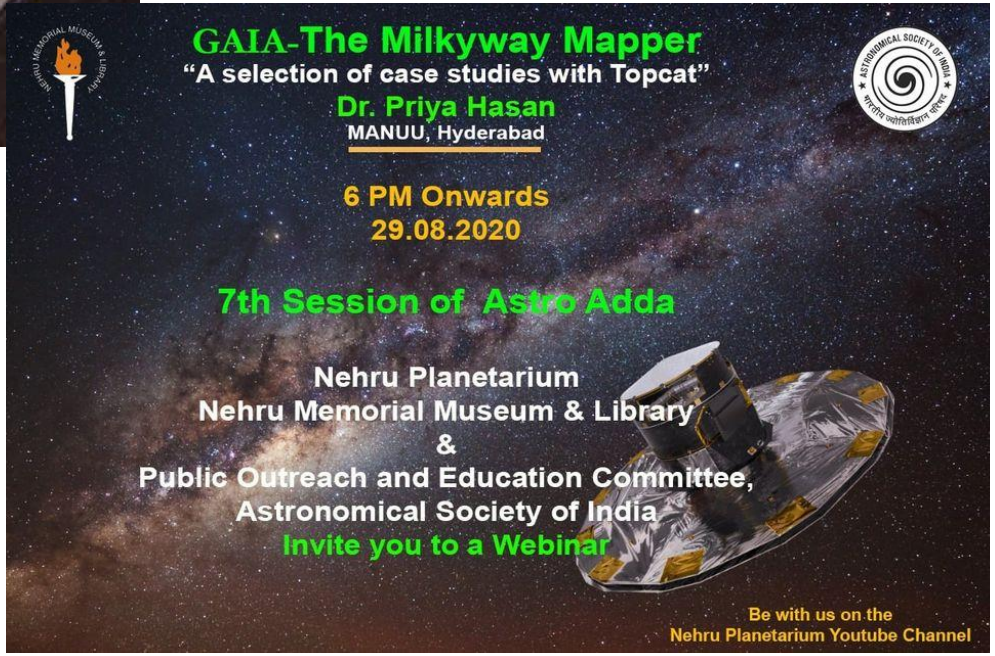
Density

$$\rho_p = \frac{\mathcal{M}_p}{(4/3)\,\pi\, r_p^3}.$$

Planet composition
Gillon 2007



Plotting HR Diagrams with Gaia



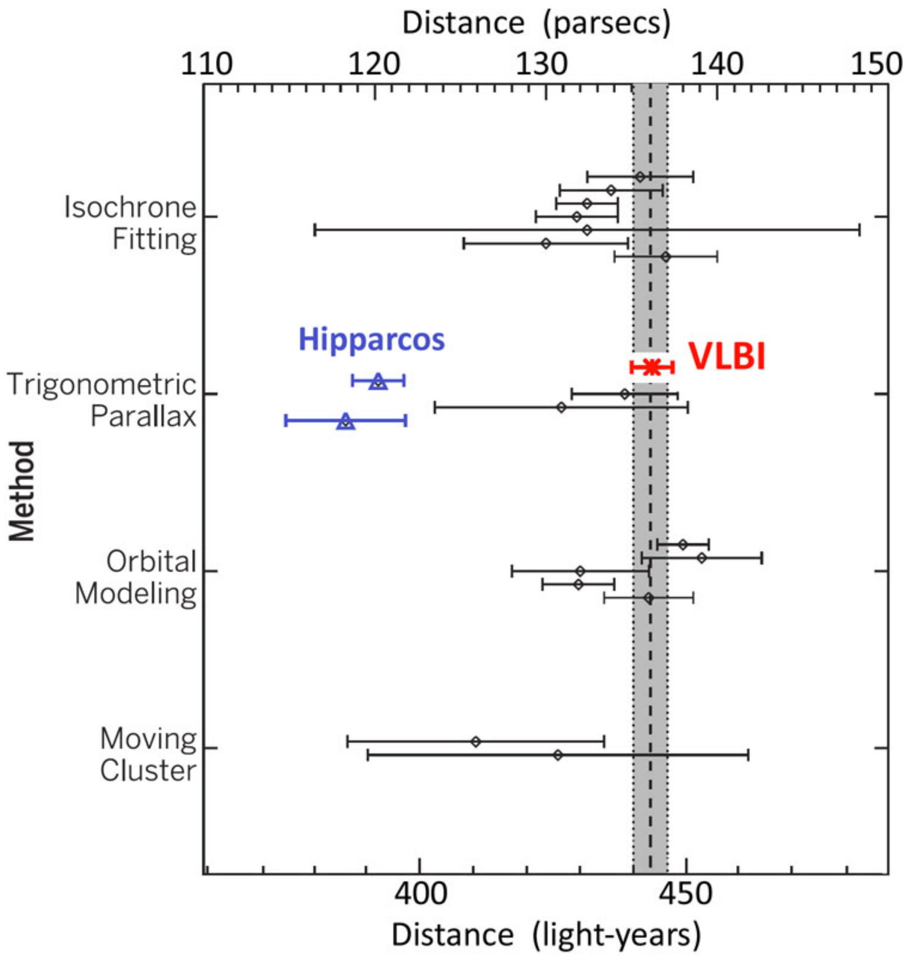
Pleiades distance problem (M45)

-

- Ground-based methods had consistently shown that the Pleiades lie about 435 light-years (133 parsecs) away.

According to Hipparcos, the cluster has a distance of just 392 light-years (120.2 parsecs), supposedly with an error of less than 1%

Courtsey: Mark Taylor, TOPCAT and how to use it for Gaia, Gaia DR1 Workshop, ESAC, Madrid.



Pleiades Distance

TOPCAT

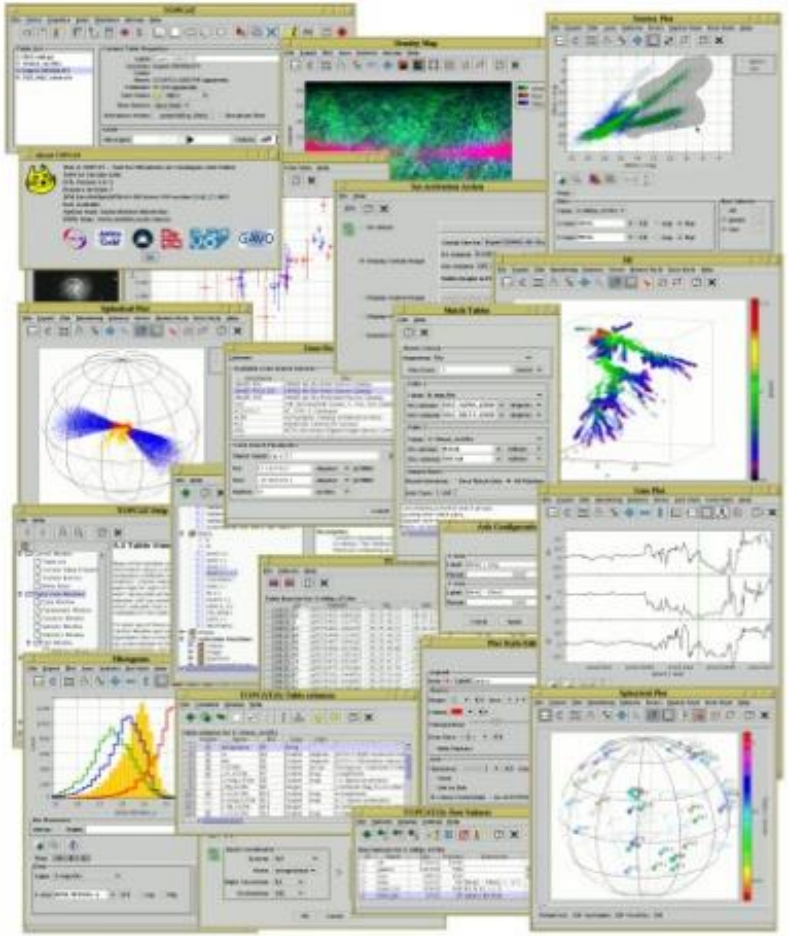
TOPCAT = Tool for OPerations on Catalogues And Tables

Capabilities:

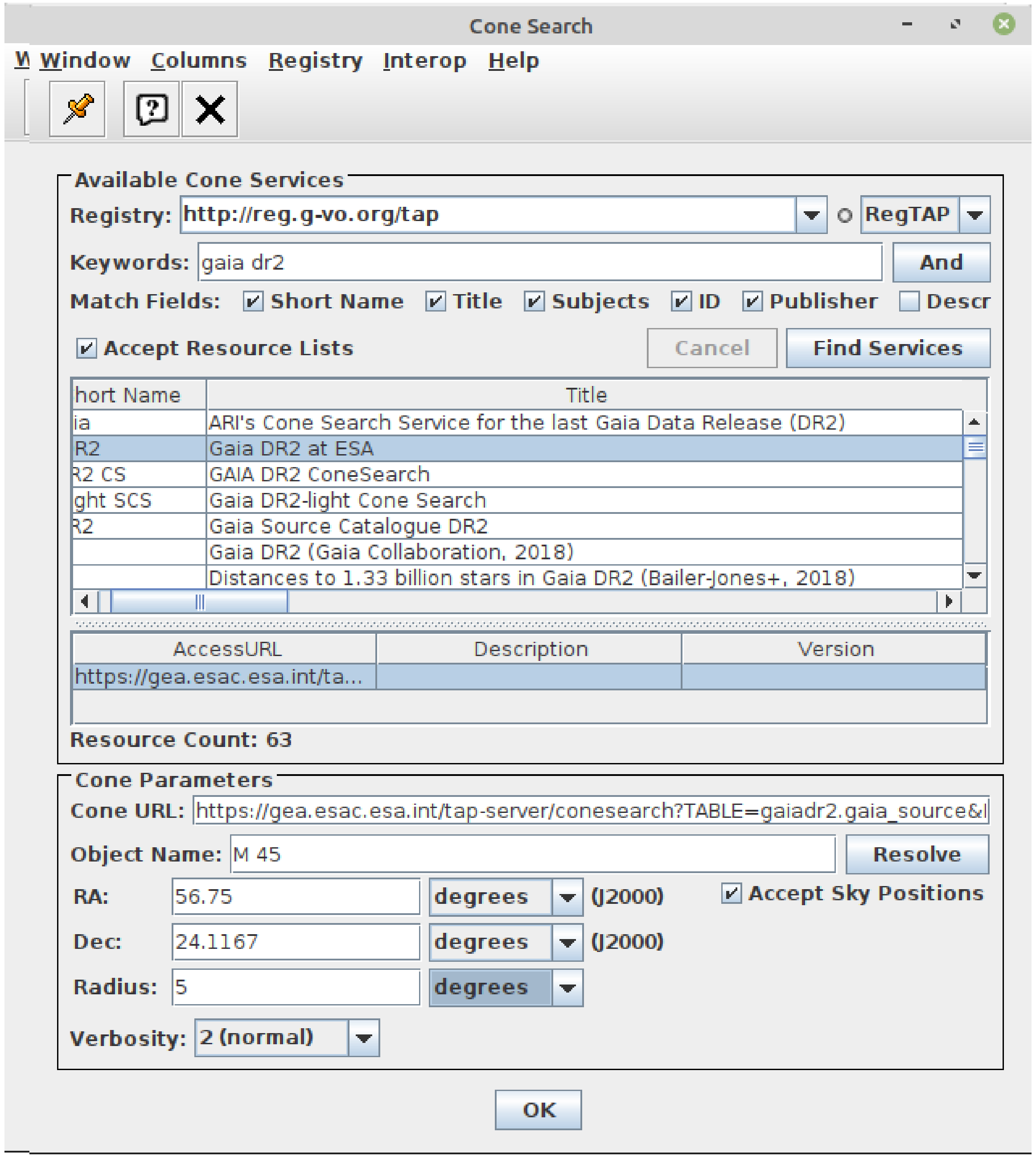
- Does stuff with tables
- Talks to the *Virtual Observatory*

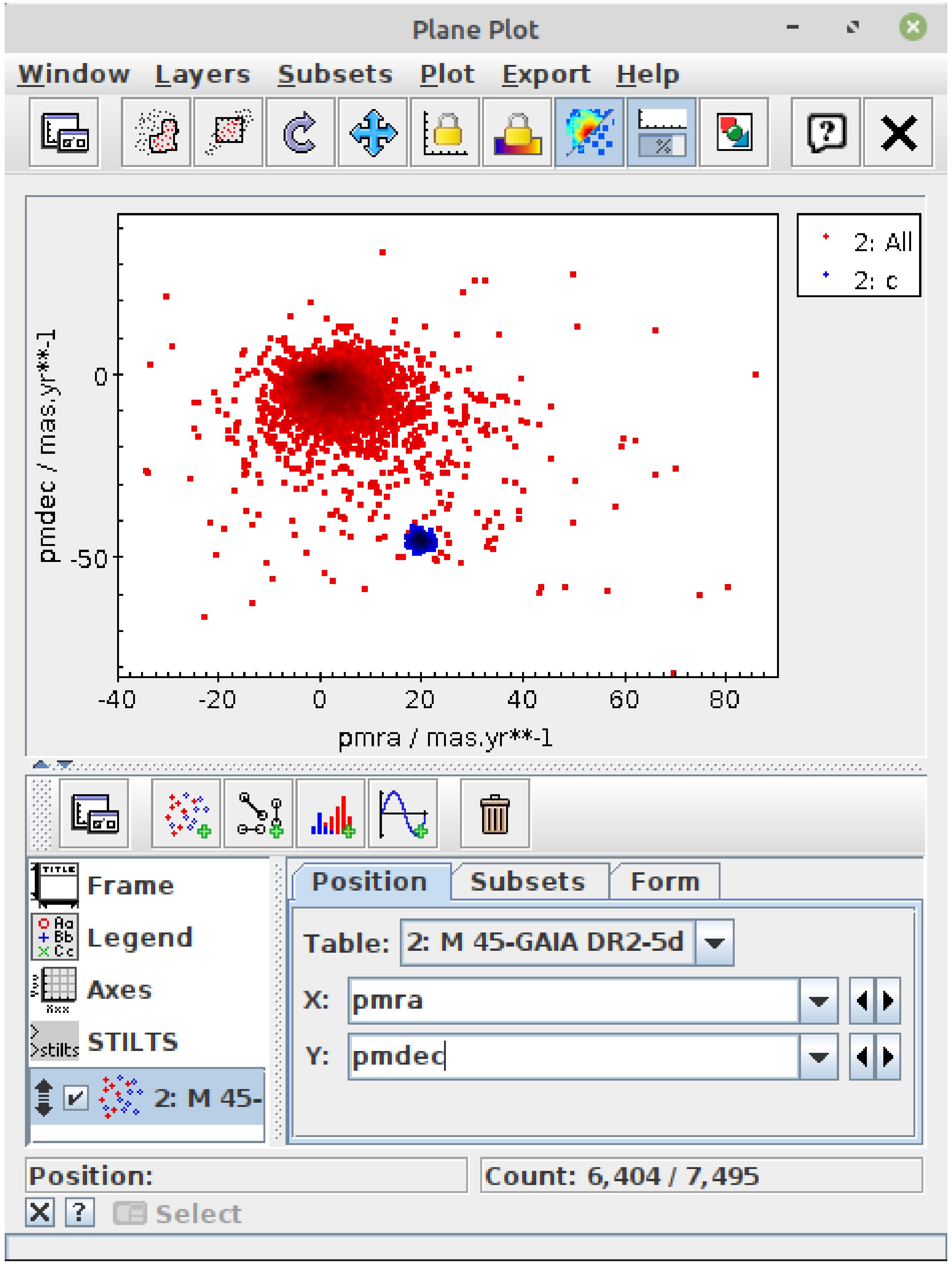
Help is available:

- Comprehensive HTML / PDF user manual
- **Help for Window** [?] button on every window
- Email support:
  - ▷ on list: topcat-user@bristol.ac.uk
  - ▷ in person: m.b.taylor@bristol.ac.uk
- Acknowledgement: 2005ASPC..347...29T

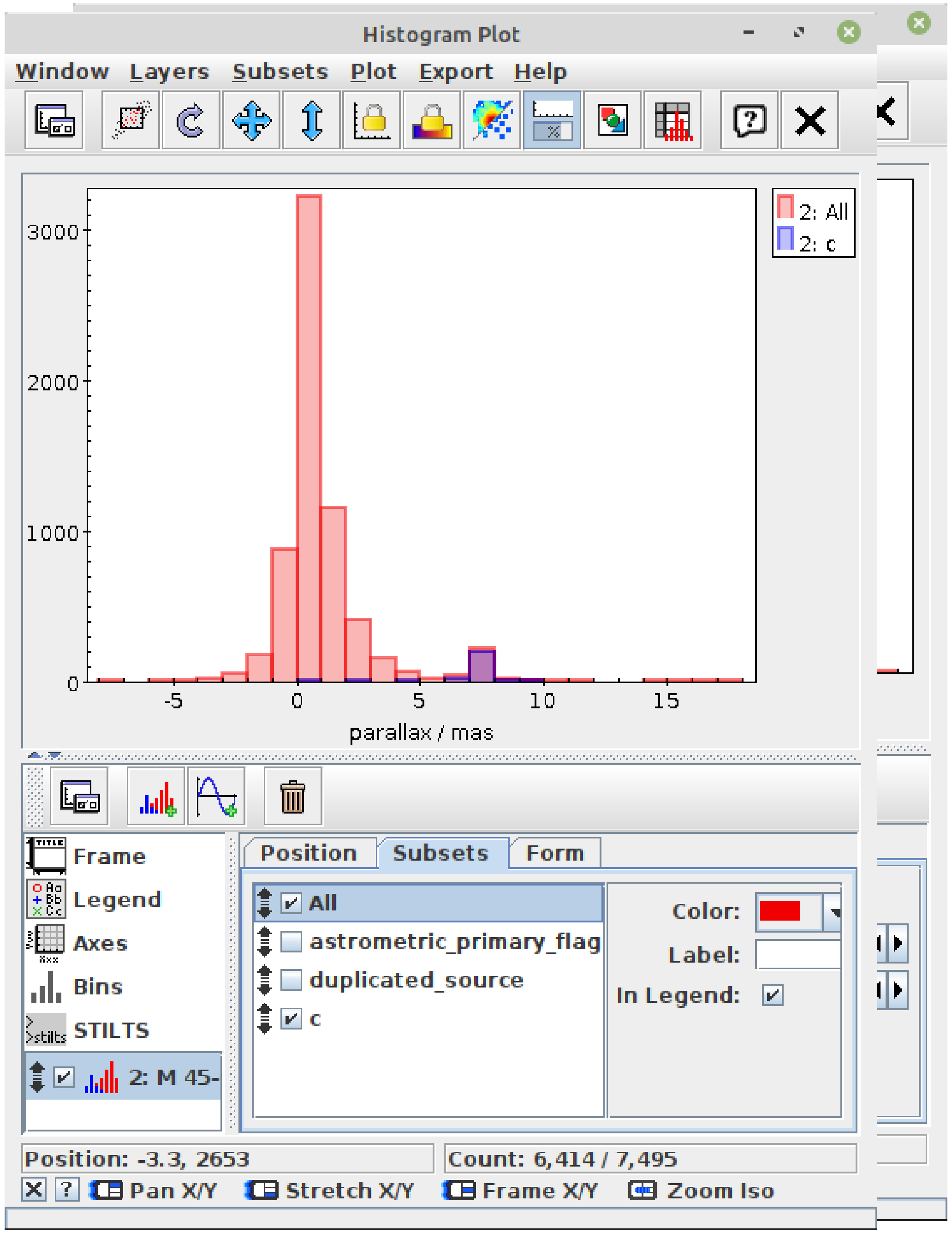


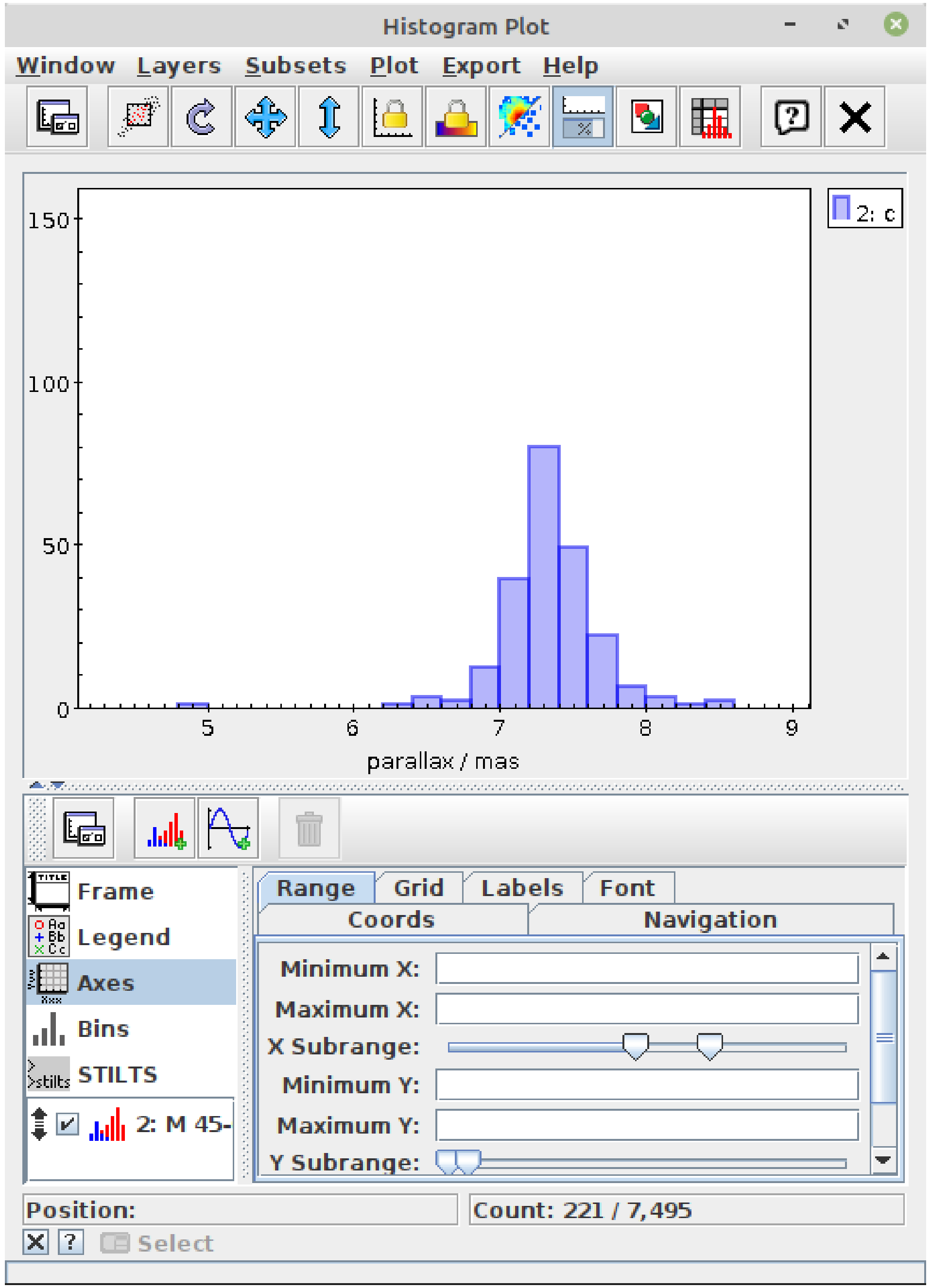
http:/www.starlink.ac.uk/topcat/

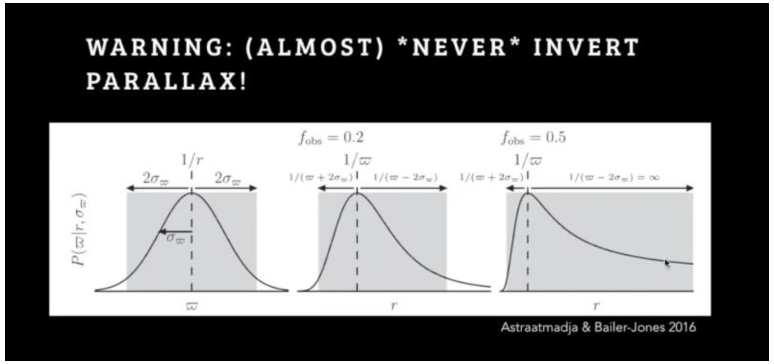

Cone Search
Window Columns Registry Interop Help
Available Cone Services
Registry: http://reg.g-vo.org/tap
RegTAP
Keywords: gaia dr2
And
Match Fields: Short Name Title Subjects ID Publisher Descr
Accept Resource Lists
Cancel
Find Services
hort Name
Title
ia
ARI's Cone Search Service for the last Gaia Data Release (DR2)
R2
Gaia DR2 at ESA
R2 CS
GAIA DR2 ConeSearch
ght SCS
Gaia DR2-light Cone Search
R2
Gaia Source Catalogue DR2
Gaia DR2 (Gaia Collaboration, 2018)
Distances to 1.33 billion stars in Gaia DR2 (Bailer-Jones+, 2018)
AccessURL
Description
Version
https://gea.esac.esa.int/ta...
Resource Count: 63
Cone Parameters
Cone URL: https://gea.esac.esa.int/tap-server/conesearch?TABLE=gaiadr2.gaia_source&
Object Name: M 45
Resolve
RA: 56.75 degrees (J2000)
Accept Sky Positions
Dec: 24.1167 degrees (J2000)
Radius: 5 degrees
Verbosity: 2 (normal)
OK

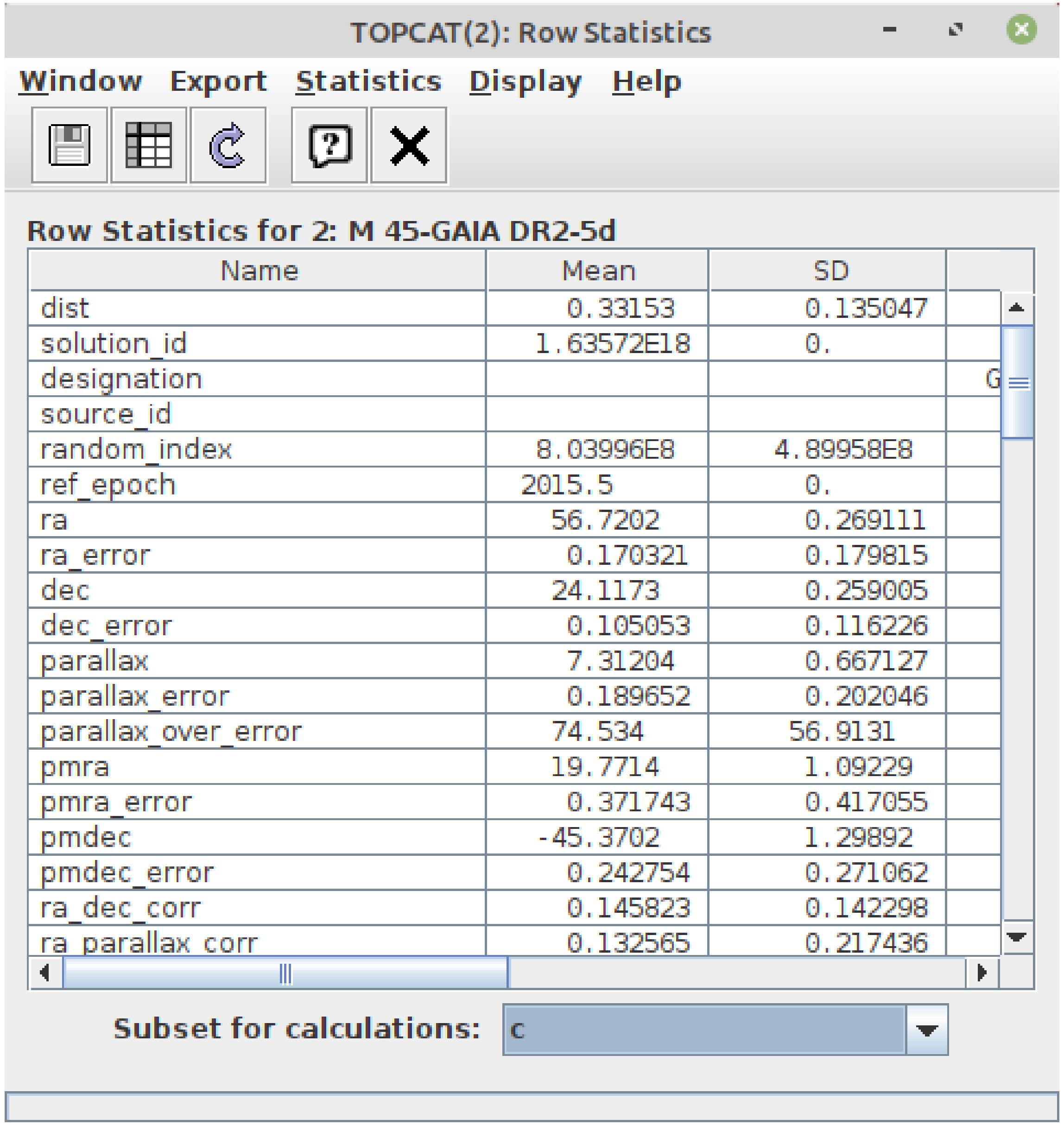


Plane Plot
Window
Layers
Subsets
Plot
Export
Help
2: All
2: c
0
-50
pmdec / mas.yr**-1
-40
-20
0
20
40
60
80
pmra / mas.yr**-1
Frame
Legend
Axes
STILTS
2: M 45-
Position
Subsets
Form
Table: 2: M 45-GAIA DR2-5d
X: pmra
Y: pmdec
Position:
Count: 6,404 / 7,495
Select


Histogram Plot
Window Layers Subsets Plot Export Help
3000
2000
1000
0
-5
0
5
10
15
parallax / mas
2: All
2: c
Frame
Legend
Axes
Bins
STILTS
2: M 45-
Position
Subsets
Form
All
astrometric_primary_flag
duplicated_source
c
Color:
Label:
In Legend:
Position: -3.3, 2653
Count: 6,414 / 7,495
Pan X/Y
Stretch X/Y
Frame X/Y
Zoom Iso


Histogram Plot
Window Layers Subsets Plot Export Help
2: c
150
100
50
0
5
6
7
8
9
parallax / mas
Frame
Legend
Axes
Bins
STILTS
2: M 45-
Range Grid Labels Font
Coords Navigation
Minimum X:
Maximum X:
X Subrange:
Minimum Y:
Maximum Y:
Y Subrange:
Position:
Count: 221 / 7,495
Select


WARNING: (ALMOST) *NEVER* INVERT PARALLAX!
Astraatmadja & Bailer-Jones 2016



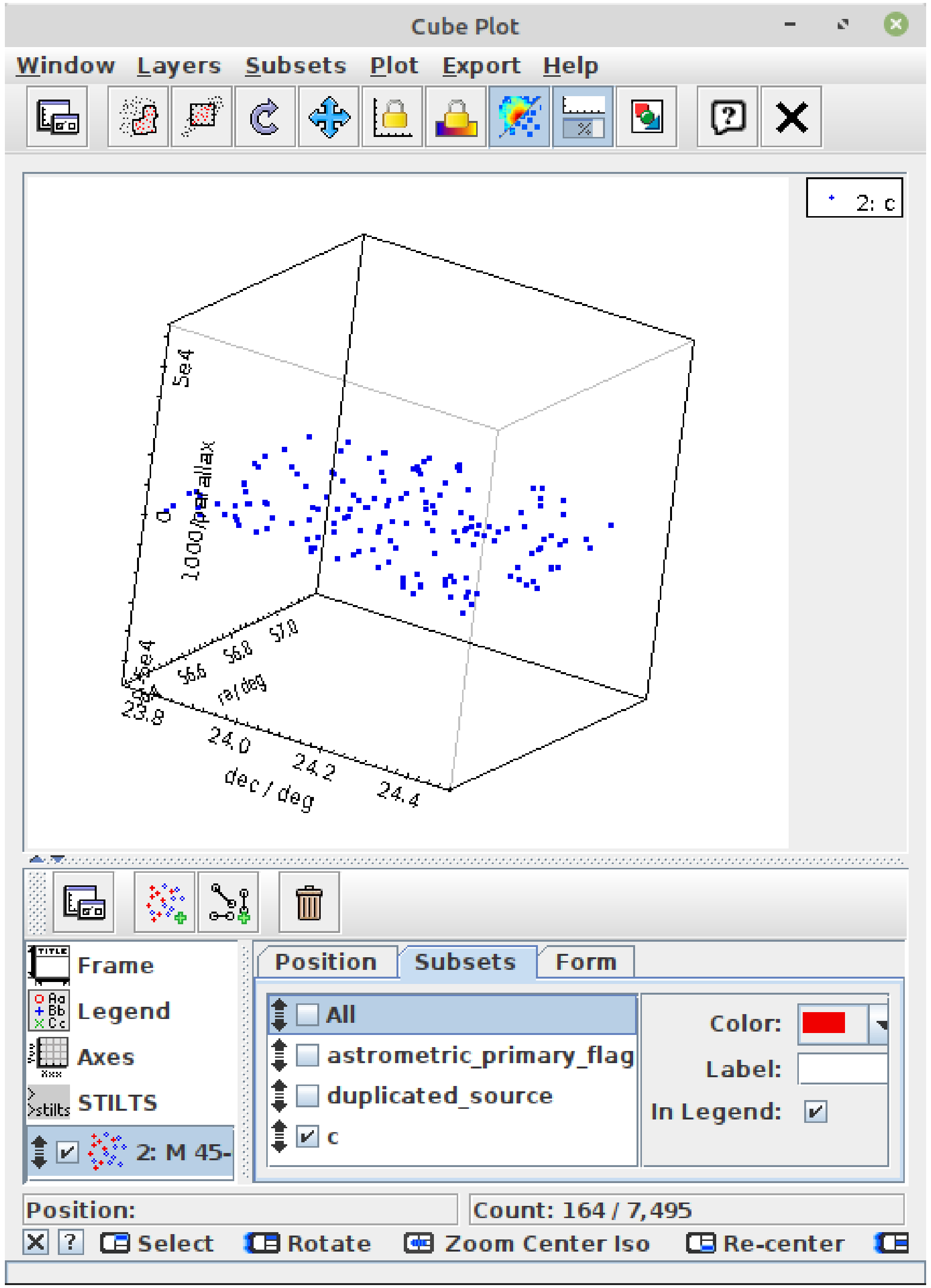
TOPCAT(2): Row Statistics

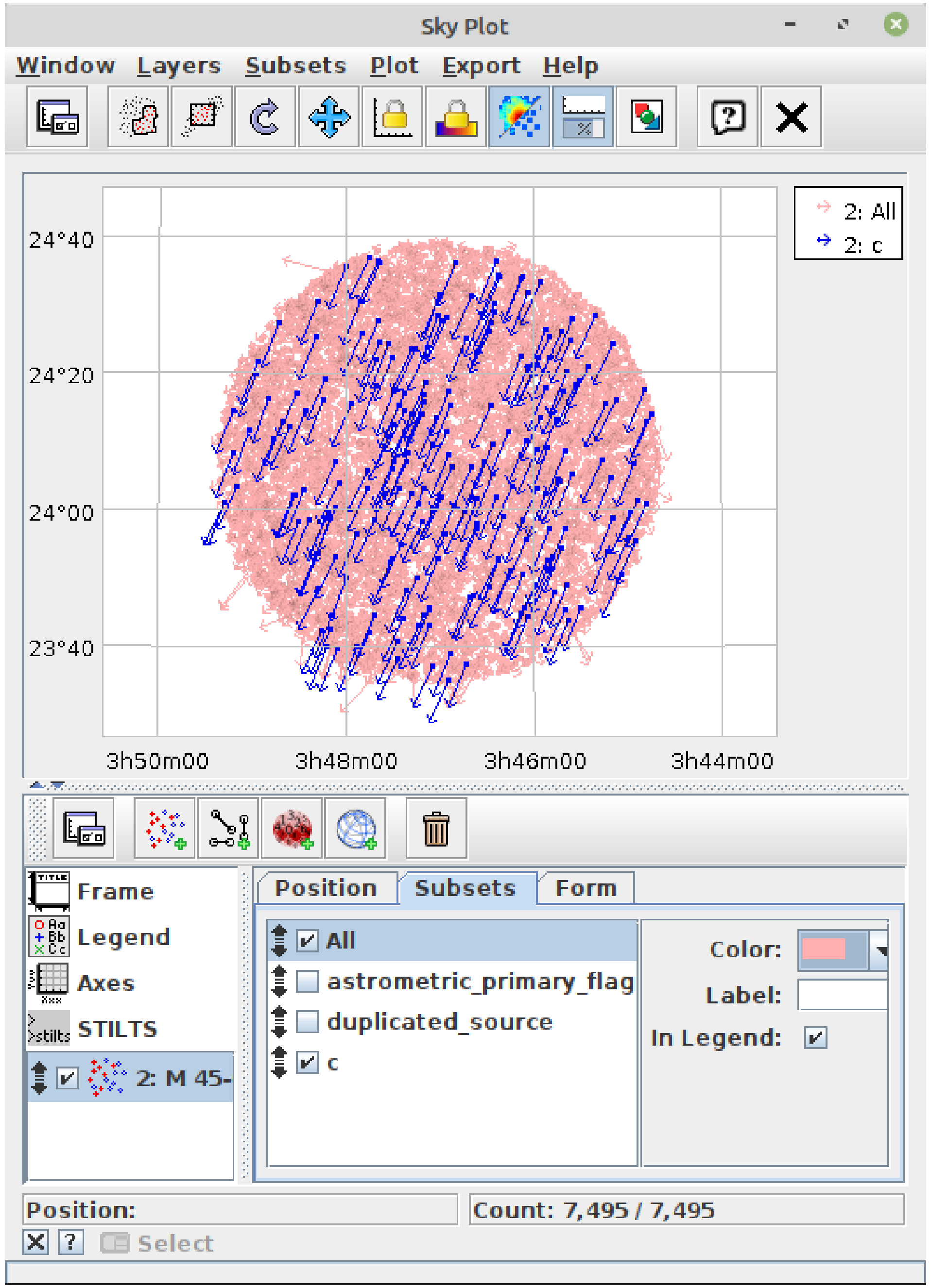
Window Export Statistics Display Help

Row Statistics for 2: M 45-GAIA DR2-5d

Name	Mean	SD	
dist	0.33153	0.135047	
solution_id	1.63572E18	0.	
designation			G
source_id			
random_index	8.03996E8	4.89958E8	
ref_epoch	2015.5	0.	
ra	56.7202	0.269111	
ra_error	0.170321	0.179815	
dec	24.1173	0.259005	
dec_error	0.105053	0.116226	
parallax	7.31204	0.667127	
parallax_error	0.189652	0.202046	
parallax_over_error	74.534	56.9131	
pmra	19.7714	1.09229	
pmra_error	0.371743	0.417055	
pmdec	-45.3702	1.29892	
pmdec_error	0.242754	0.271062	
ra_dec_corr	0.145823	0.142298	
ra_parallax_corr	0.132565	0.217436	

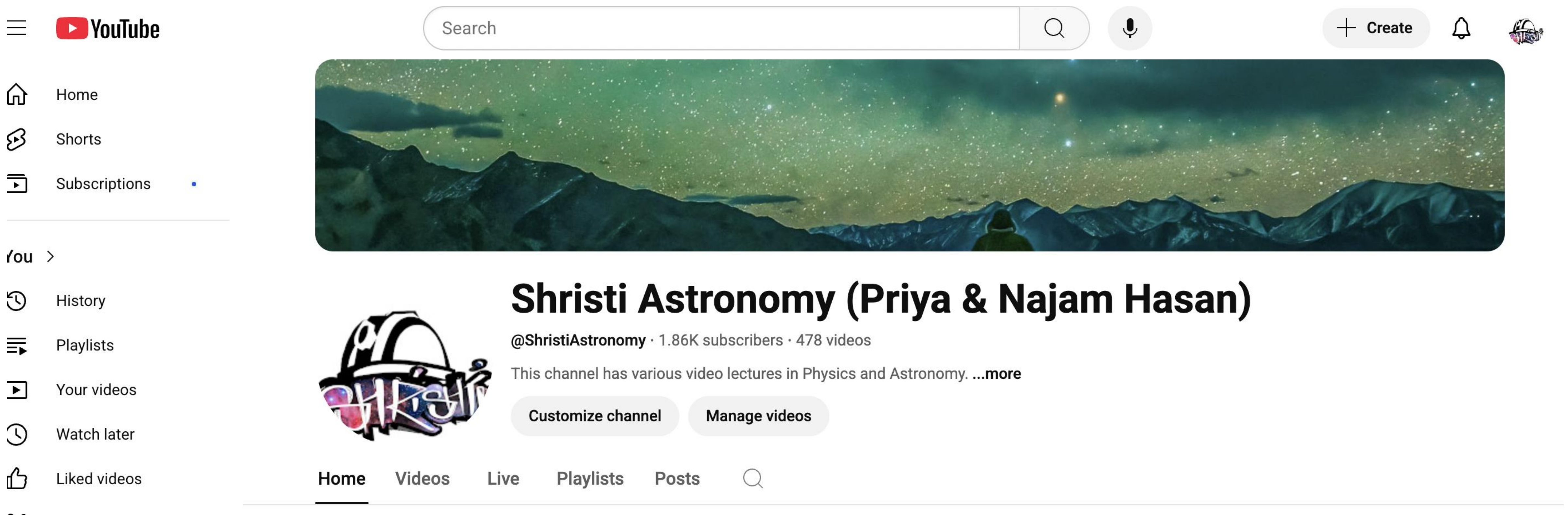
Subset for calculations: c


Cube Plot
Window Layers Subsets Plot Export Help
2: c
5e4
0
1000/parallax
5e4
56.6
56.8
57.0
ra / deg
23.8
24.0
24.2
24.4
dec / deg
Frame
Legend
Axes
STILTS
2: M 45-
Position
Subsets
Form
All
astrometric_primary_flag
duplicated_source
c
Color:
Label:
In Legend:
Position:
Count: 164 / 7,495
Select
Rotate
Zoom Center Iso
Re-center


Sky Plot
Window Layers Subsets Plot Export Help
2: All
2: c
24°40
24°20
24°00
23°40
3h50m00
3h48m00
3h46m00
3h44m00
Frame
Legend
Axes
STILTS
2: M 45-
Position
Subsets
Form
All
astrometric_primary_flag
duplicated_source
c
Color:
Label:
In Legend:
Position:
Count: 7,495 / 7,495
Select

….And many more

with Jupyter Notebooks too



https://shristiastro.com/

Dr Priya Hasan

Dr Priya Hasan did her Integrated Masters in Physics specialising in Astrophysics from the Moscow State University, Moscow, Russia in 1996. She did her PhD in Astronomy at Osmania University, Hyderabad in 2004. She did post-doctoral research in France and IUCAA, Pune. She was awarded the Women Scientist Award by Department of Science and Technology, New Delhi in 2006. The US Consulate, Hyderabad selected her for the International Visitors Leadership Program in 2011 to visit and deliver lectures at select universities in the US like MIT, Harvard, CalTech, etc. She has presented her work in various conferences in India, Europe and US and in the United Nations, Vienna. Her research interests are in observational astronomy, star formation, star clusters and galaxies. At present she collaborates with groups in India, Europe, US and Egypt. Priya recently visited The Harvard Smithsonian Center for Astrophysics, Cambridge, USA on a Summer Internship Program of the International Astronomical Union. She is a member of the International Science Driven Team of the Thirty Meter Telescope. Priya is actively involved in olympiads, public outreach and science popularization programs for children and adults and has worked on various projects with the IAU-OAD, US Consulate Hyderabad, etc. At present she is an Asst Professor in Physics at the Maulana Azad National Urdu University, Hyderabad. She is the co-Chair of the Women in Astronomy Working Group of the International Astronomical Union. She was the Secretary of the Public Outreach and Education Committee, Astronomical Society of India. She is a Regional Astronomy Education Coordinator of the IAU Office of Astronomy for Education.

Prof S N Hasan

Prof S N Hasan is the Dean, Alumni and Foreign Affairs, Maulana Azad National Urdu University. Before joining MANUU he was Head Dept. of Astronomy, Osmania University, Hyderabad and Director Japal-Rangapur Observatories.
He completed his MSc and M Phil at the University of Hyderabad and PhD at the Moscow State University, Moscow, Russia.
He was recipient of National Merit Scholarship, University Merit Scholarship for his Master's program and Ministry of Human Resource Development (MHRD), Government of India scholarship for Doctoral Studies.
His research interests are Celestial Mechanics and Dynamical Astronomy. He has published his research in national and international journals and has more than 25 years of teaching experience. He is actively involved in Olympiads, public outreach and science popularization programs for children and adults. He has lead the Indian team in International Olympiads.
He has published in National and International Journals and delivered lectures at both National International Universities.

Astrophysics Handbook