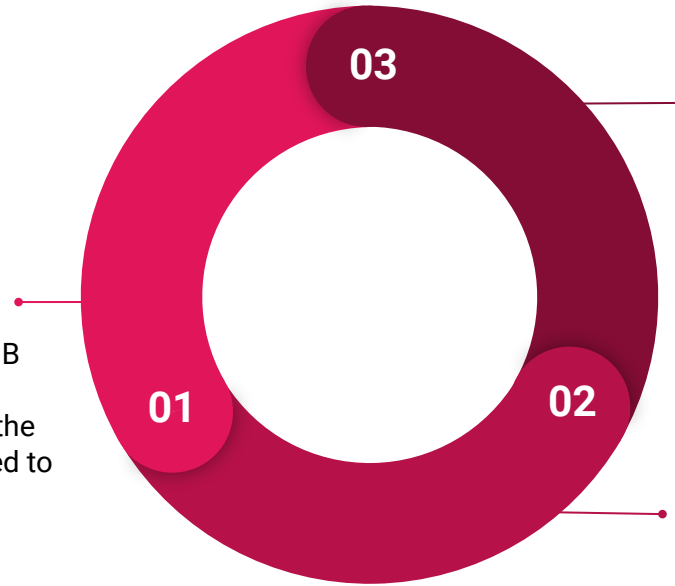
Team: M2_ISR_21

ISRO's Web based Visualization Tool For AstroSat Observations

Data Preprocessing



Conversion of Coordinates

1. The coordinates given in Catalog B were in J2000 RA/DEC.
2. Using the AstroPy Python library the J2000 coordinates were converted to Galactic Longitude and Latitude coordinates.

Matching Catalog C to A

1. All the entities in Catalog A that were observed by the Astrosat were selected.
2. The names of the observed sources were searched for in the titles of Catalog C and the respective publication added to the source's dictionary in the Catalog A json file.

Matching Catalog B to A

1. Compared the Galactic coordinates of Catalog B with A.
2. The matching entries were marked as observations observed by the Astrosat.
3. For the matched entries the data from Catalog B was added to the source's dictionary in the Catalog A json file.

How to use the visualisation tool?

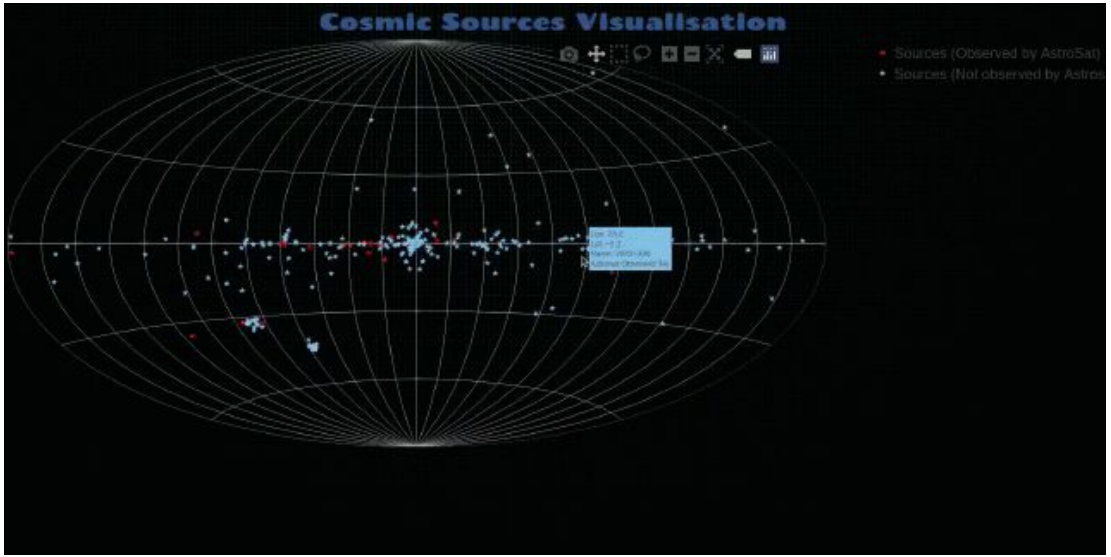
- The web-tool can be served as a website which can be viewed by anyone.

- The executables can be used for desktop applications.

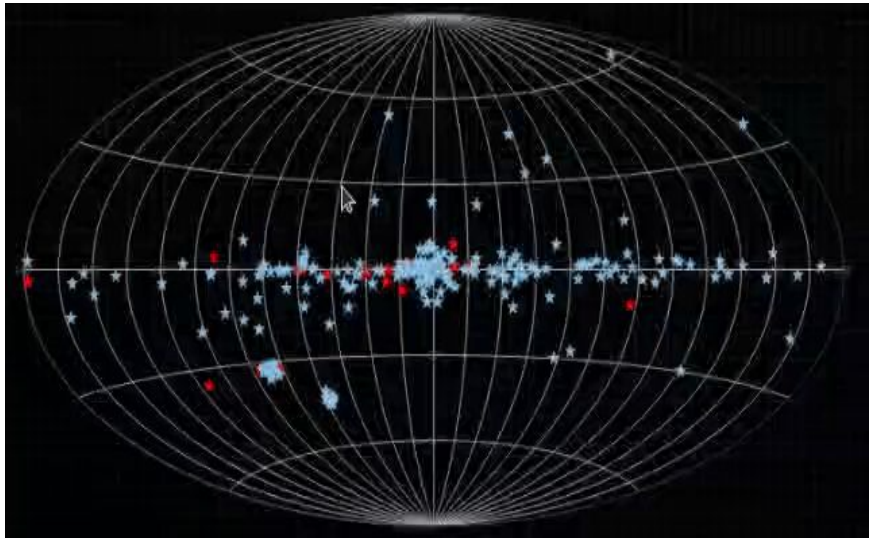
Web Application

- **Technology stack**

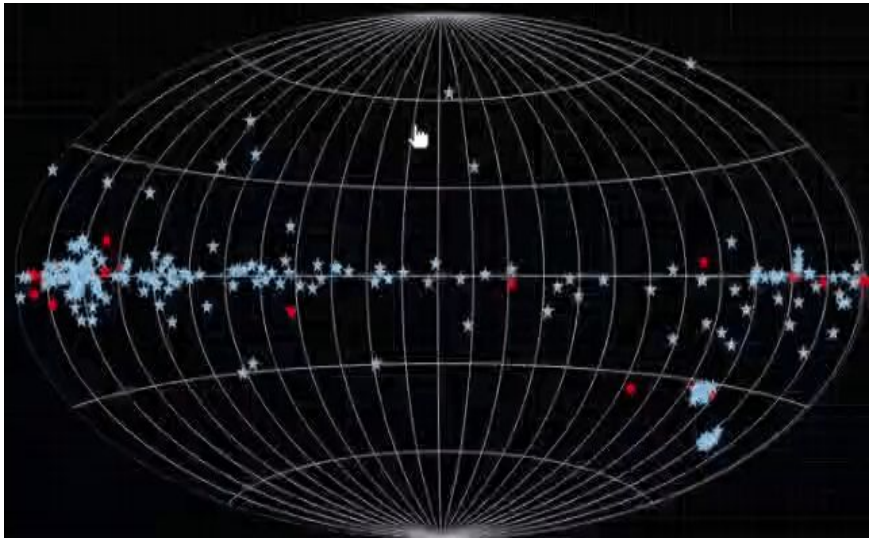
  Open source JavaScript Frameworks
  - **Backend**
    - NodeJS
    - ExpressJS APIs
  - **Frontend**
    - HTML, CSS, JavaScript
    - Bootstrap
    - PlotlyJS



Features

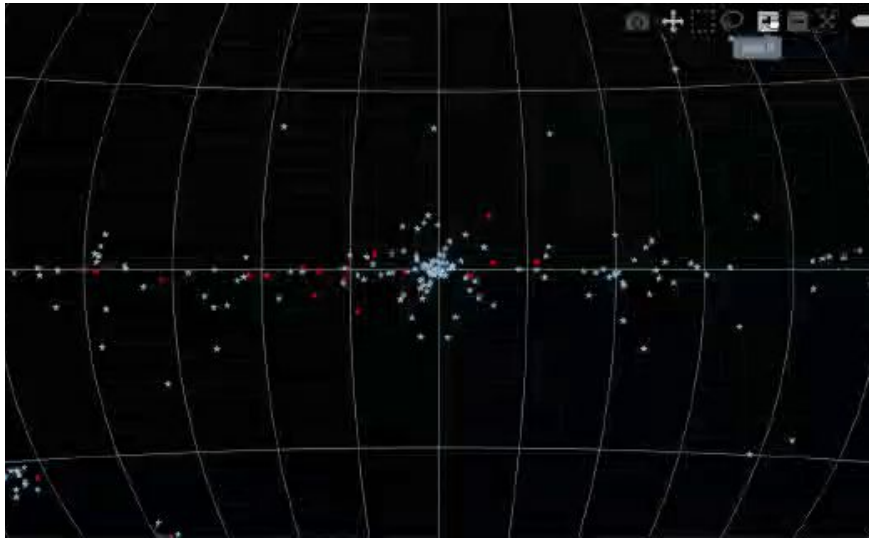


Hover

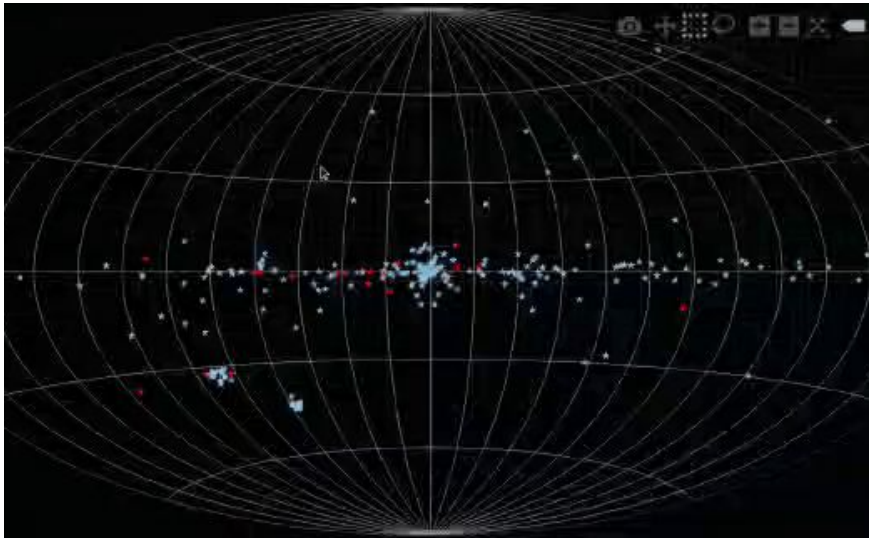


Pan

Features

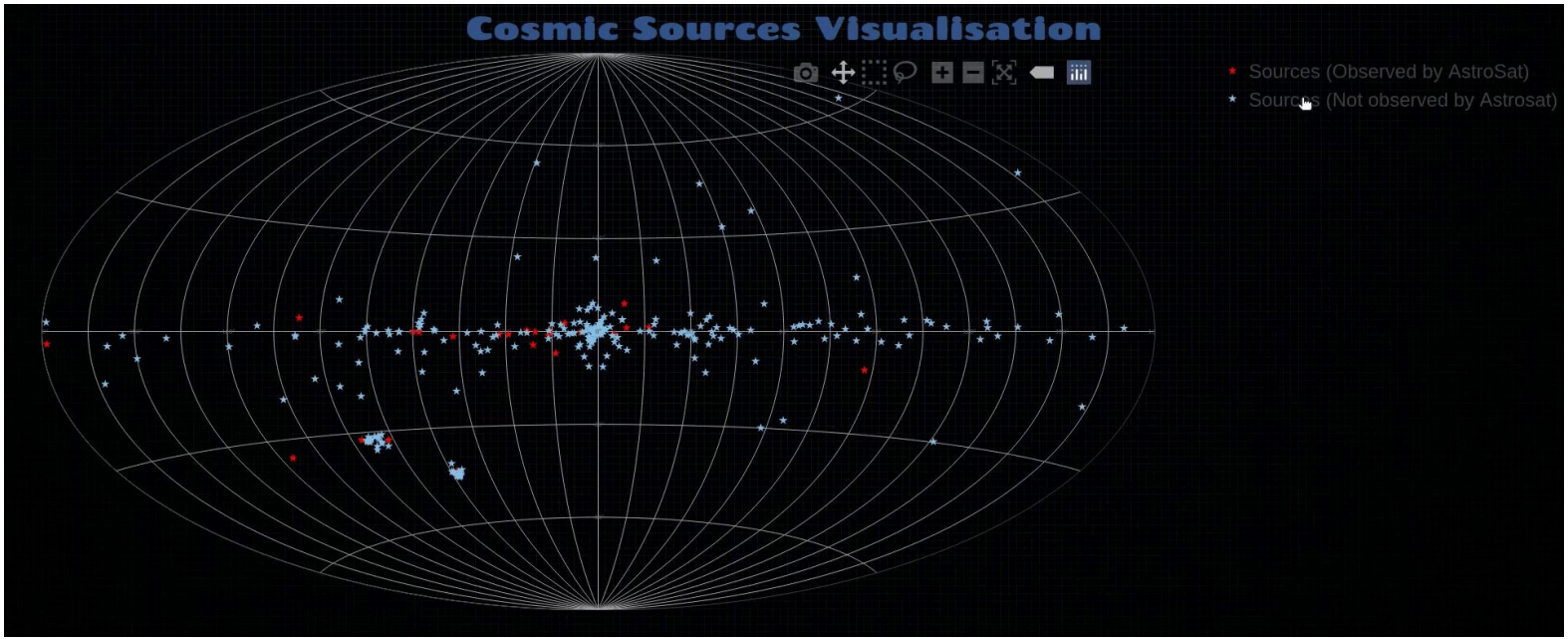


Zoom



View Selective Region

Features



Isolate sources observed by Astrosat

Stand Alone Application

- Command line application for Windows, Linux and MacOS
- Executable divided into two
  - **Data2json.exe (for data analysis and conversion to json)**
    - Created using python library ***pyinstaller*** (convert python scripts to .exe)
  - **Server-win.exe (to run node application.)**
    - ***Node pkg*** (command line interface to package node.js application to executables).
- NSIS (Nullsoft Scriptable Install System) used to archive two exe into one.
- Requirements
  - Any latest version of browser (Desktop view recommended).

Features

- Smooth visualisation of an online plot
- Download dataset as JSON / PDF / CSV
- Hover to view minimal details like Name, Galactic Longitude, Galactic Latitude
- Click to view and download additional information retrieved from dataset
- Download plot as PNG
- NodeJS offers fast, scalable deployment

Code Compatibility and Extensibility

- Backend, python code.
- Different coordinate systems.
- In case of other catalogue, we just need to run python code.

Documentation

We have made our documentation in markdown format.

- Program specific
  - Libraries used, documentation already available.
  - For our code, we have documented as well.

- User specific
  - Web application
  - Standalone

Documentation in Markdown

Web Application

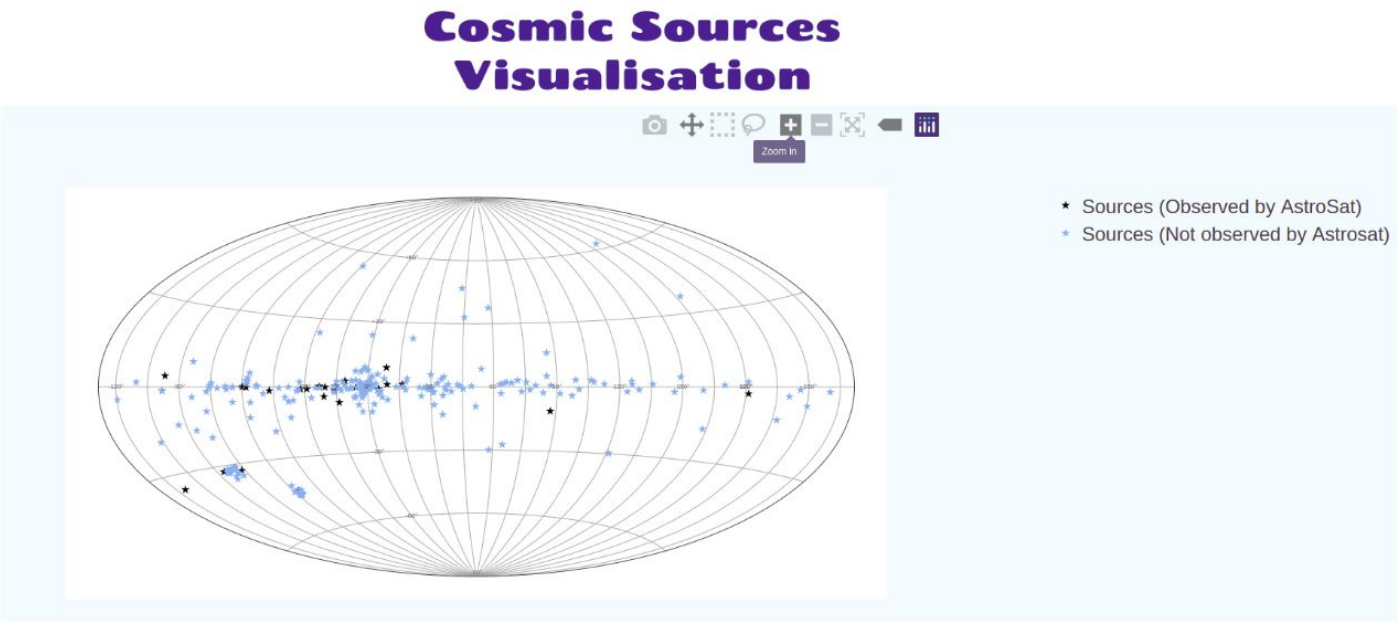
To run the web application you can

- directly launch the executable given.
- use `npm` to run the web application locally (Please check the readme file to install the necessary dependencies).

When you run the web app, you can access it at `https://127.0.0.1:8080`.

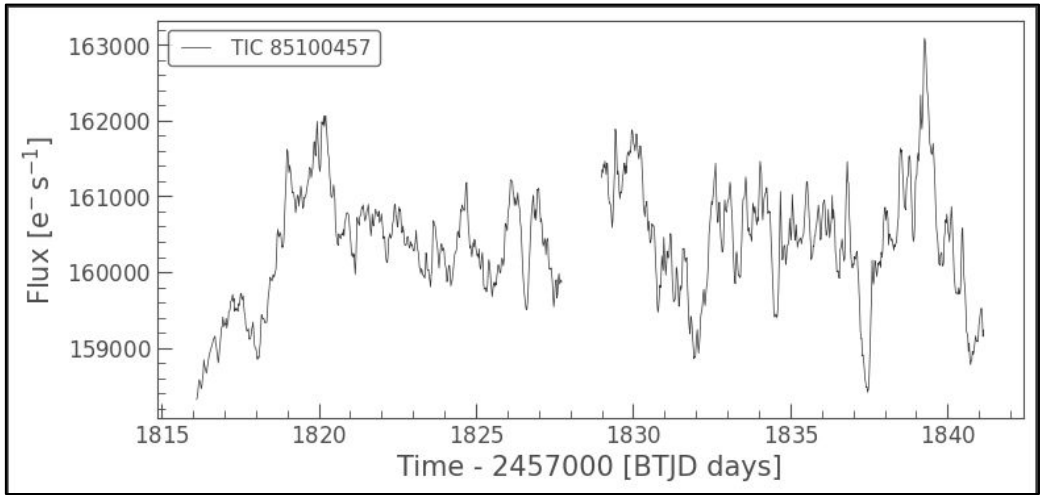
The web app consists a plot of aitoff projection of the sky map. We used the galatic coordinates to plot all the sources.

Here is a look of web application

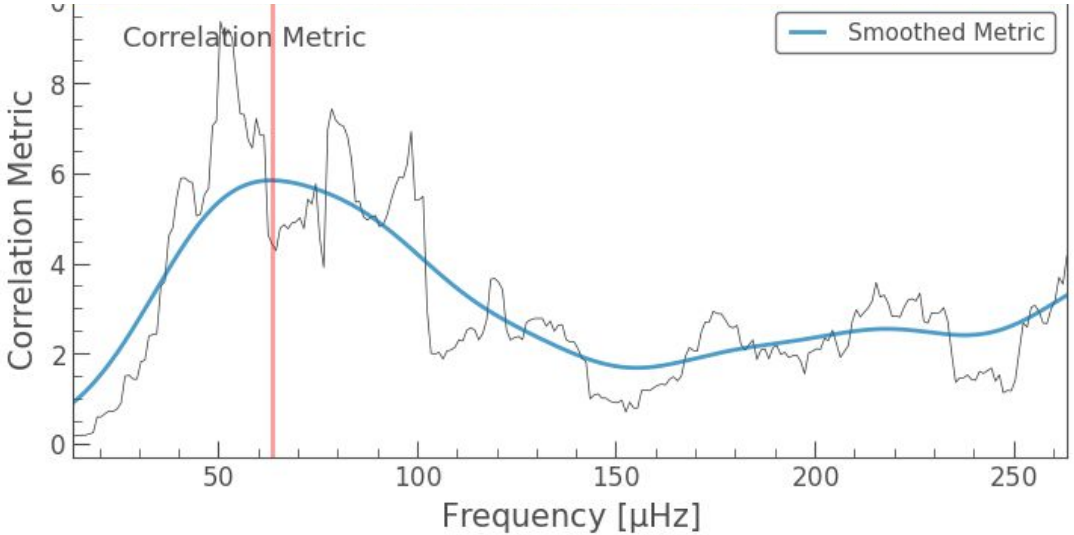


Astrophysical Analysis

Estimating the mass and radius of HD31648 using asteroseismology



Analysis Followed



$$\frac{M}{M_\odot} \simeq \left(\frac{\nu_{\max}}{\nu_{\max,\odot}}\right)^{3} \left(\frac{\Delta\nu}{\Delta\nu_\odot}\right)^{-4} \left(\frac{T_{\rm eff}}{T_{\rm eff,\odot}}\right)^{3/2},$$

$$\frac{R}{R_\odot} \simeq \left(\frac{\nu_{\max}}{\nu_{\max,\odot}}\right) \left(\frac{\Delta\nu}{\Delta\nu_\odot}\right)^{-2} \left(\frac{T_{\rm eff}}{T_{\rm eff,\odot}}\right)^{1/2} \text{and}$$

$$\frac{g}{g_\odot} \simeq \left(\frac{\nu_{\max}}{\nu_{\max,\odot}}\right) \left(\frac{T_{\rm eff}}{T_{\rm eff,\odot}}\right)^{1/2}$$

Results and Accuracy

We estimated stellar mass and radius using Uncorrected Scaling Relations as:

Mass = 1.91 $M_{\odot}$

Radius = 2.89 $R_{\odot}$

An accurate estimate of the surface temperature (through spectral analysis) would lead to more accurate mass radius estimates

Thank You