Implementing TimeSeries in SPLAT

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SPLAT-VO and Time Series

- Why ?
- What
- Implementation experience
- To Do
- Future plans

SPLAT-VO and Time Series

Why implement Time Series in SPLAT-VO?

- SPLAT-VO is a graphical tool for analysing astronomical spectra, supports SSAP and ObsCore
- Can also be used for displaying time series (light curves), which have a similar data structure as spectra
- also a good test for time series standard proposals
- Implementations started by Petr Skodas group (David Andresic, Jiri Nadvornik)

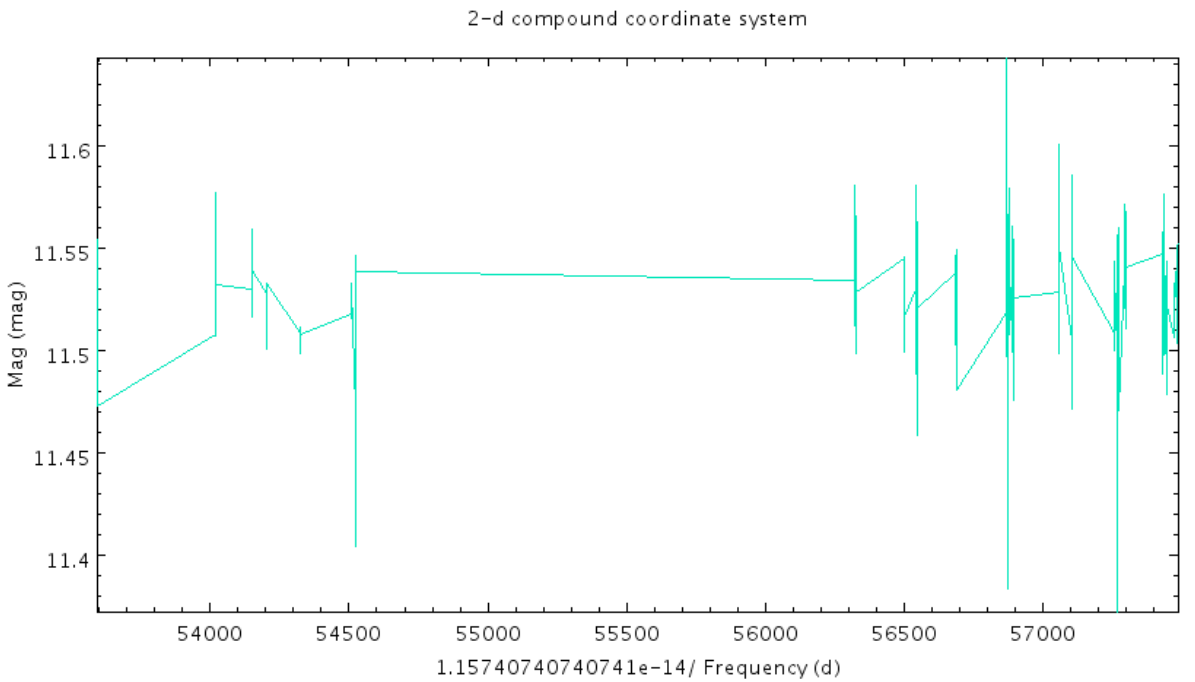
SPLAT-VO and Time Series

What to implement

- Plotting / visualisation
- Discovery (give me VO services providing timeseries)
- Querying service for timeseries (with certain parameters)
- Interpreting the data: Finding out if a dataset (filesystem, SSAP, ObsCore, SAMP) contains time series data
- Time Coordinates handling
- Time series data analysis (to do)

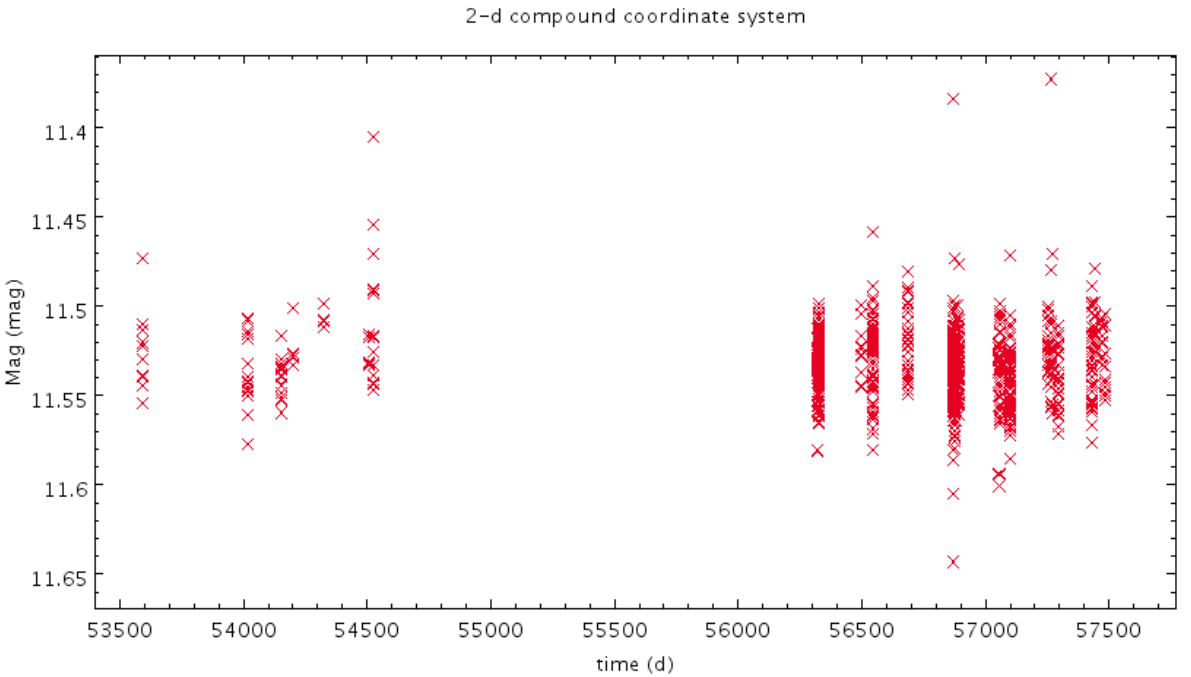
SPLAT-VO and Time Series: Plotting

- SPLAT-VO uses the Starlink AST Library
- In old versions, SPLAT-VO treated all data as spectra (using AST SpectralFrame)



SPLAT-VO and Time Series: Plotting

- Now: using AST TimeFrame
- Crosses instead of lines (configurable)
- if Y-Axis is Magnitude, invert it.



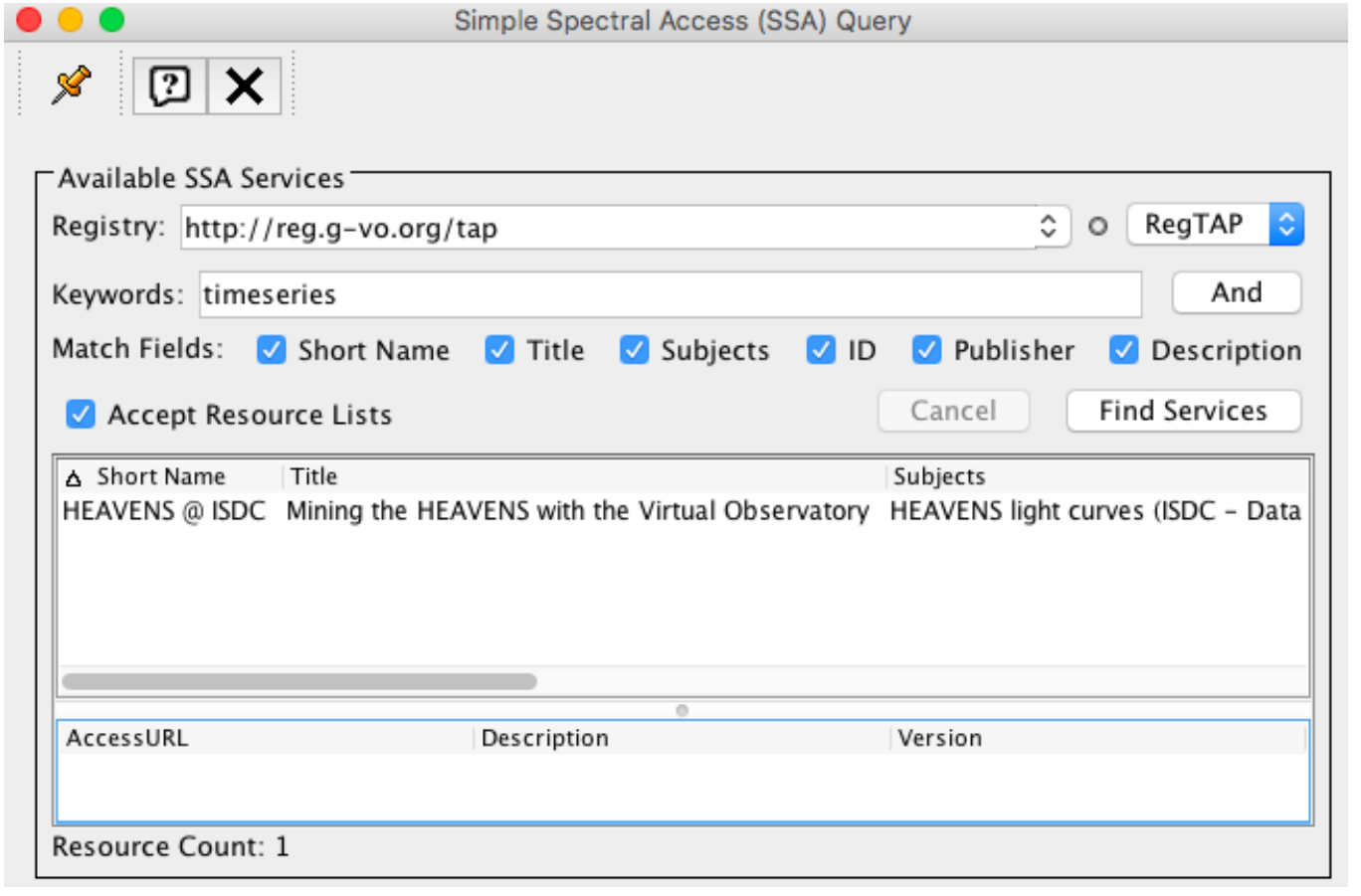
SPLAT-VO and Time Series: Registry query

Example in SSAP (not much different in ObsCore)

- There are several SSAP services containing time series. And getting more.
- Registry record does not always contain information on the content, mostly as *description* or *subjects*
- Some services contain spectra and timeseries and...

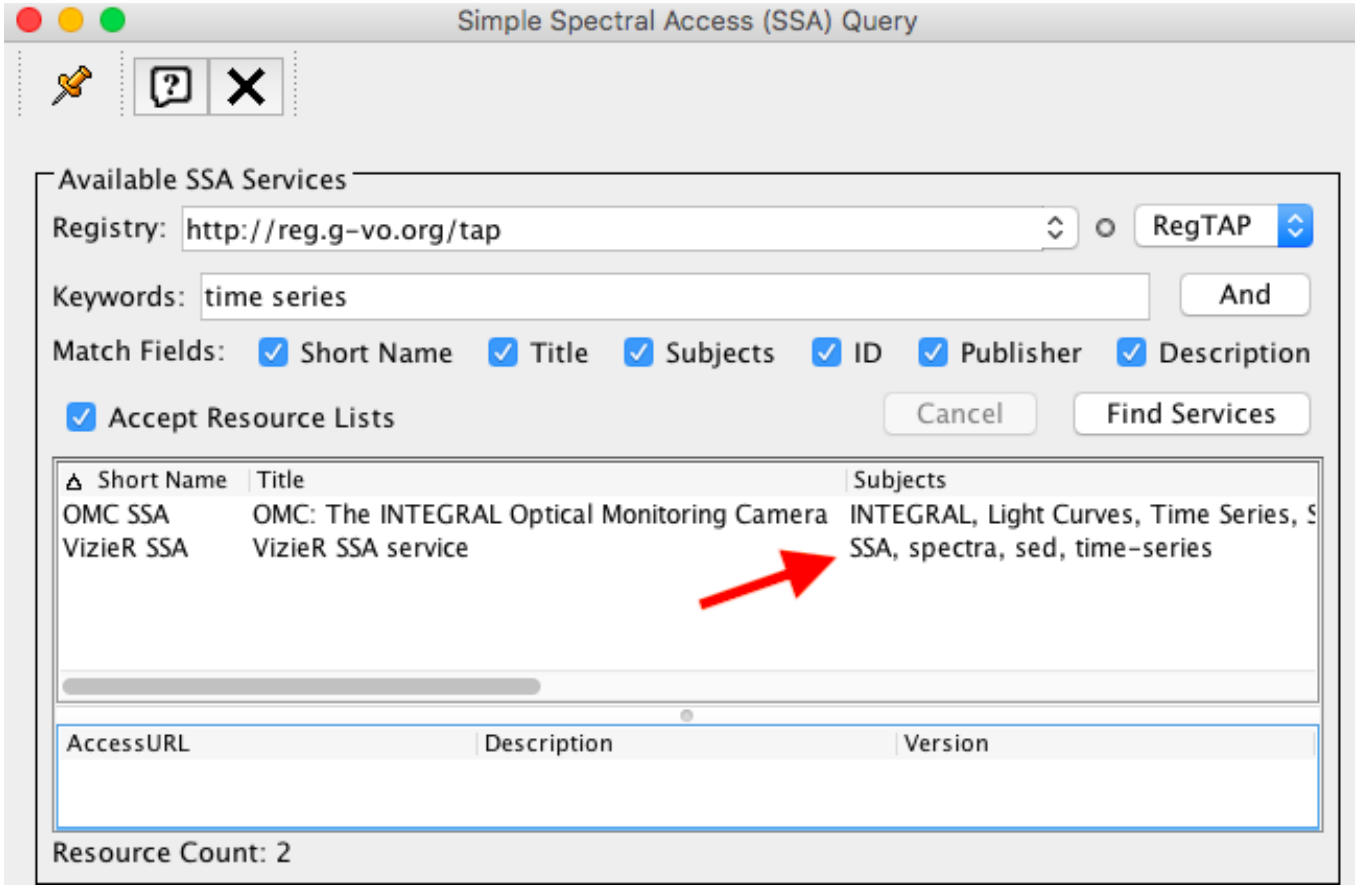
SPLAT-VO and Time Series: Registry query

from TOPCAT:



SPLAT-VO and Time Series: Registry query

from TOPCAT:



SPLAT-VO and Time Series: Registry query

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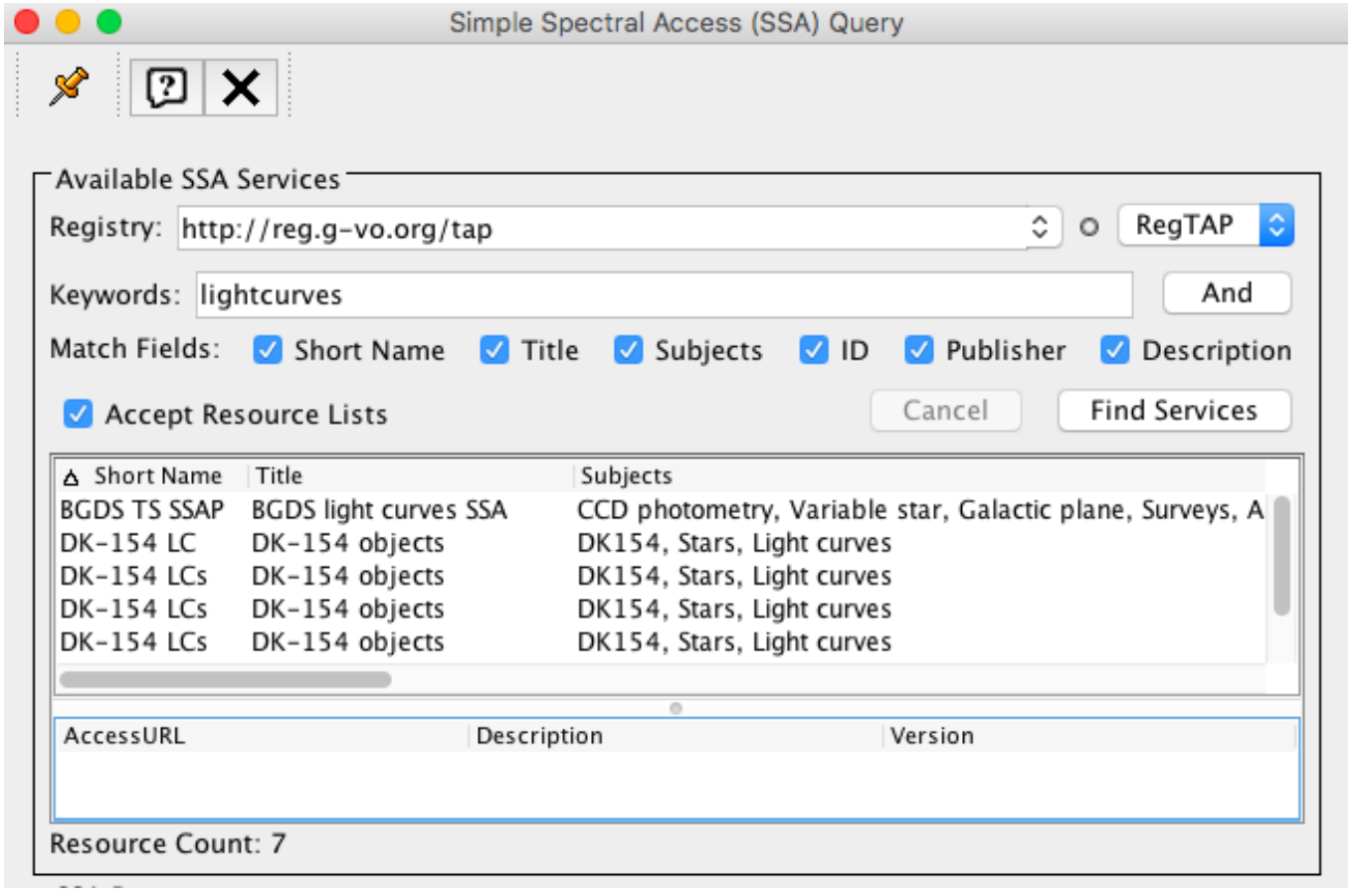


SPLAT-VO and Time Series: Registry query

Needed: machine readable information about the content

- add new capability element to the VOResource extension for SSA services for example "abscissaType", that can be wavelength, time, energy...
- Will VODataServices solve the problem?

SPLAT-VO and Time Series: Service query

Assuming we found a timeseries service:

- ideal: to make a query like "get timeseries with parameters..."
- Some SSAP (and ObsCore) contain different types of objects.
- in Obscore, it's easy:

```
select * from ivoa.obscore
      where dataproduct_type='timeseries' and ...
```

- what to do to ask SSAP only for timeseries?
  - change SSAP Standard? too much to change!
  - service providers use `dataproduct_type` as SSAP optional metadata

Interpreting the data

Finding out if a dataset (from filesystem, SSAP, ObsCore, SAMP) contains time data
Should this information be inside (data model) or outside (user input, query results, mime type) ?
SPLAT-VO tries to recognise automatically the content using several approaches:

- VODML - IVOA Dataset Metadata Model - dataProductType
- mime type
- table column description, utype, ucd, unit
- ObsCore: according to query made (`dataproduct_type`)
- reading from file: user can set the type manually

datasets coming from SAMP - Would be useful to have a new SAMP MType timeseries.load.ssa-generic equivalent to spectrum.load.ssa-generic

Time Coordinates handling

<TIMESYS> and AST

- SPLAT-VO reads <TIMESYS> information
- using it in AST not straightforward
- AST TimeFrame class does not support reference position, it's implied by the time scale:
  - geocenter for TCG,
  - barycenter for TDB, TCB
  - topocenter for all others

Can we live with that? Alternatively hope for AST improvements or implement it in some other way

TO DO

What can be done to improve the use of Time Series?

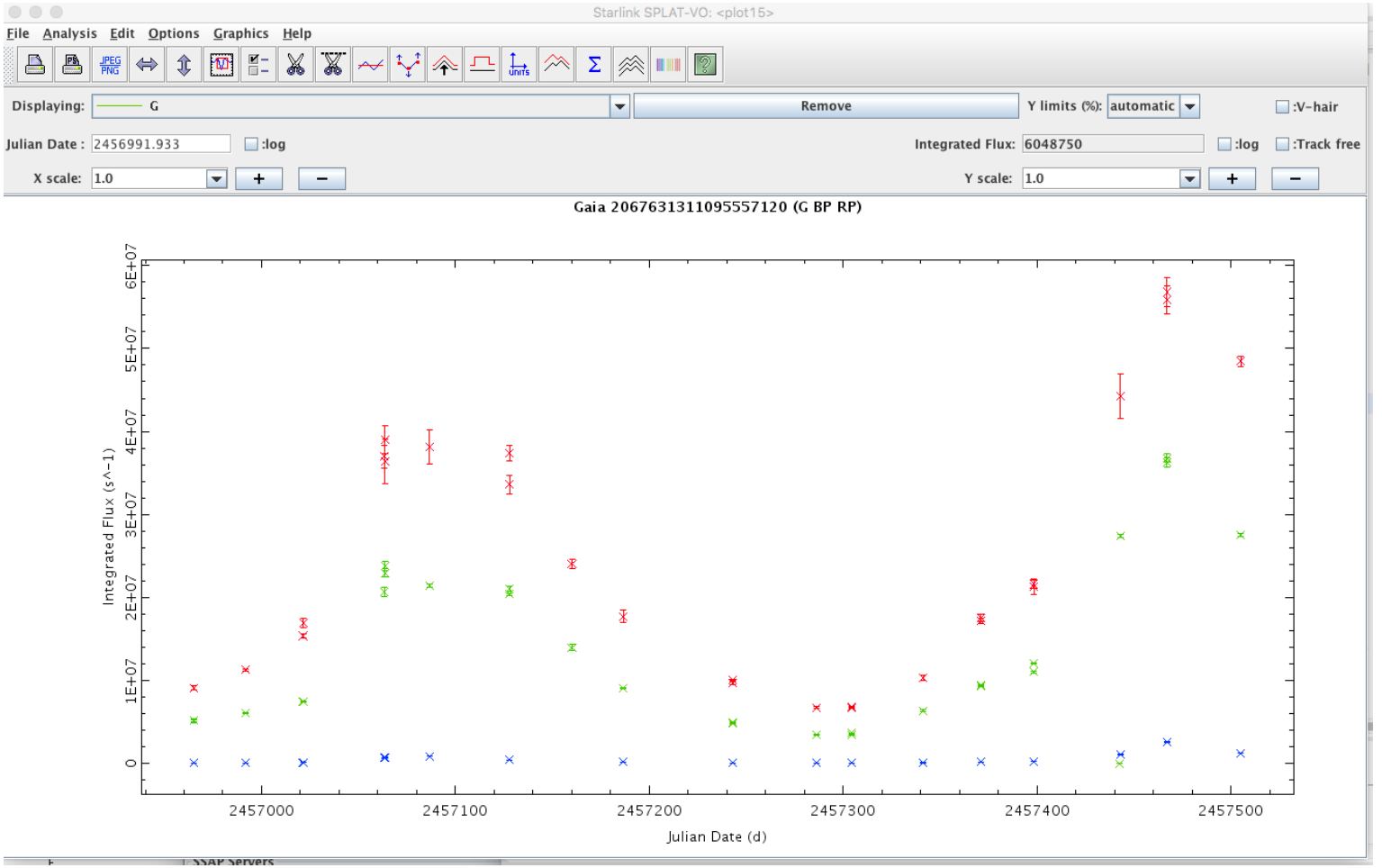
- Registry: add new element to SSA resource extension, VODataService solution
- SSAP: use `dataproduct_type` as optional SSAP metadata
- define mime types for timeseries and use them
- Data Model: annotation about data content (spectrum, time series , image, ...)
- SAMP MType indicating that the data is a time series
- AST TimeFrame improvement

Future improvements for TimeSeries in SPLAT

What to do next (not necessarily VO related)

- SPLAT-VO can read (most) time series and plot them
- time units conversion (AST)
- data analysis, in SPLAT or interface to other programs/libraries
- need use cases!

Thank you for your attention!



time series from Gaia DR2, in BandPass G (green), BP(blue), RP(red)