



The CoRoT archive. Implementation of the Time Series DM.

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22/03/2017

Time Series at SVO



- SVO was the first time series provider in the VO.
- Two services registered as SSAP:
 - CoRoT and OMC

Time Series at SVO

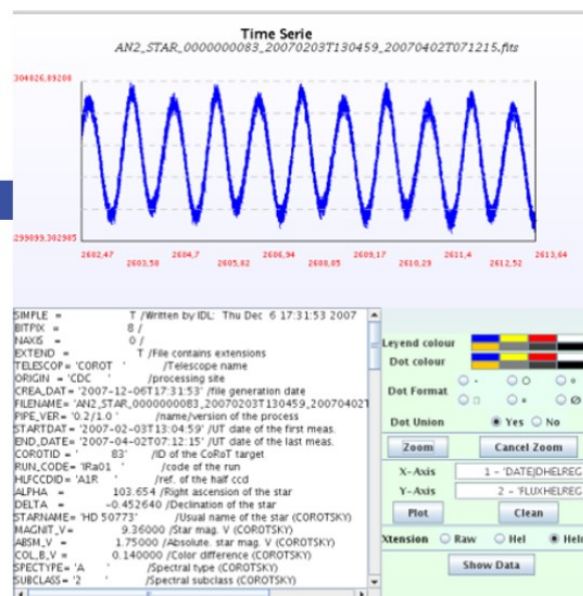


THE COROT PUBLIC ARCHIVE AT LAEFF

This data server provides access to the COROT Archive at LAEFF.

Resources

- ▶ Archive search and data retrieval
- ▶ News
- ▶ System Overview
- ▶ Help Desk
- ▶ Usage Statistics (private)
- ▶ Outreach/Divulgación
 - ▶ Transiting Exoplanets/ Planetas extrasolares detectados utilizando el método de tránsitos.



The COROT Public Archive has been developed in the framework of the Spanish Virtual Observatory project (AYA 2008-02156). The system is maintained by the Data Archive Unit of the CAB (CSIC -INTA).

If you use COROT data in your research, please include the following acknowledgement in any resulting publications: **"Based on data from the COROT Archive at LAEFF"**.

- Available at: <http://sdc.cab.inta-csic.es/corotfa/> since February 2009.
- More than 150.000 light curves.

Time Series at SVO

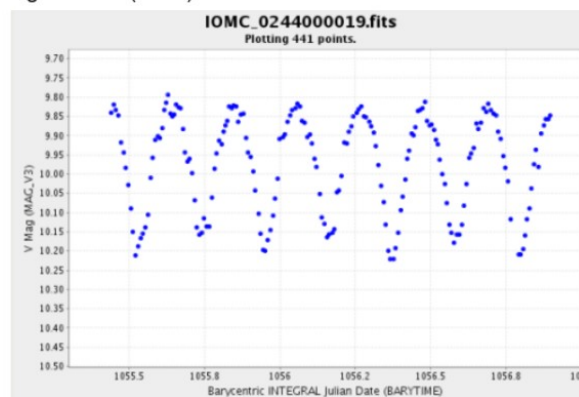


The OMC Archive

This data server provides access to the INTEGRAL Optical Monitoring Camera (OMC) Archive.

Resources

- Archive search and data retrieval
- News
- System Overview
- Help Desk
- Project Documentation
- Change your password



The system is developed and maintained by [LAEFF](#), based on data pre-processed by [ISDC](#). LAEFF is part of the Space Science Division of [INTA](#).

If you use OMC data in your research, please include the following acknowledgement in any resulting publications:

"Based on data from the OMC Archive at LAEFF, pre-processed by ISDC".

- **OMC:** Available at <http://sdc.cab.inta-csic.es/omc/> since 2003.
- More than 86.000 light curves with more than 50 photometric points.

Time Series at IVOA



- Time Series identified by IVOA as a *Science Priority*.
- SVO, in its double role of data provider and IVOA member, made in 2012 an assessment on the existing limitations to discover, access and describe time series in the VO:

Committee on Science Priorities

3 groups of scientific use cases identified by IVOA:

- **Group A:** Combine phot. and LCs in the same band.
 - Cases: #1,#2,#3,#4
- **Group B:** Combine phot. and LCs in different bands.
 - Cases: #5
- **Group C:** Time series other than light curves.
 - Cases: #6,#7,#8

Wiki > IVOA Web > IVOA Science Priorities > CSPTTimeSeries (2012-09-20, Main/Item)

Science use Cases for Time Series

Group A:

- Common requirement: Combine photometry and light curves of a given objectlist of objects in the same photometric band
- Use Case #1: Supernova classification using the light curve
 - Description: The visual light curves of the different supernova types vary in shape and amplitude, based on the underlying mechanisms of the explosion, the way that visible radiation is produced, and the transparency of the ejected material.

— Type Ia — Type Ib — Type Ic — Type IIb — Type IIc — Type IIL — Type IIP — Type IIs

Requirements

- Combine photometry and light curves of a given object in the same photometric band
- Show me a list of data that satisfies
 - Targets: SN 2011LFE
 - Catalogue: Photometry or TimeSeriesLightcurves
- Axes include time
- Axes include brightness
- Information on photometric band (zero point, transmission curve of the filter)

Time Series at IVOA



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TimeSeries in VO

Use Case Assessment

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IVOA Interoperability Meeting.
São Paulo, 21-26 October 2012



Raúl Gutiérrez-Sánchez

Time Series in VO. 1

Time Series at IVOA



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Data discovery	•Registry
Data access	•SSAP •IVOA note on 'Time Series Data' (Dec 2010) •ConeSearch •TAP
Data model	•SDM 1.1 •SDM 2.0 •IVOA note on 'Time Series Data' (Dec 2010) •DotAstro SimpleTimeseries

Time Series in CoRoT

Current Time Series model based on **SSAP** for CoRoT:

```
-<GROUP ID="Char.SpatialAxis" name="Char.SpatialAxis" utype="ssa:Char.SpatialAxis">
  <DESCRIPTION>Spatial Axis Characterization</DESCRIPTION>
  <FIELDref ref="Location"/>
  <FIELDref ref="Coverage.Bounds.Extent" utype="ssa:Char.SpatialAxis.Coverage.Bounds.Extent" ucd="instr.fov" datatype="double">
    <DESCRIPTION>Aperture angular size.</DESCRIPTION>
  </FIELDref>
</GROUP>
- <GROUP ID="Char.TimeAxis" name="Char.TimeAxis" utype="ssa:Char.TimeAxis">
  <DESCRIPTION>Time Axis Characterization</DESCRIPTION>
  <FIELDref ref="Coverage.Location.Value" name="Coverage.Location.Value" utype="ssa:Char.TimeAxis" ucd="time.epoch" datatype="double">
    <DESCRIPTION>Midpoint of exposure on MJD scale.</DESCRIPTION>
  </FIELDref>
  <FIELDref ref="StartDate"/>
  <FIELDref ref="EndDate"/>
  <PARAM ID="Calibration" name="Calibration" utype="ssa:Char.TimeAxis.Calibration" value="CALIBRATED" datatype="char" arraysize="*">
    <DESCRIPTION>Type of coord calibration.</DESCRIPTION>
  </PARAM>
</GROUP>
- <GROUP ID="Char.SpectralAxis" name="Char.SpectralAxis" utype="ssa:Char.SpectralAxis">
  <FIELDref ref="Coverage.Location.Value" name="Coverage.Location.Value" utype="ssa:Char.SpectralAxis.Coverage.Location.Value" ucd="instr.bandpass" datatype="double">
    <DESCRIPTION>Spectral coord value</DESCRIPTION>
  </FIELDref>
  <FIELDref ref="Coverage.Bounds.Extent" name="Coverage.Bounds.Extent" utype="ssa:Char.SpectralAxis.Coverage.Bounds.Extent" ucd="instr.bandwidth" datatype="double">
    <DESCRIPTION>Width of spectrum</DESCRIPTION>
  </FIELDref>
</GROUP>
- <GROUP ID="Char.FluxAxis" name="Char.FluxAxis" utype="ssa:Char.FluxAxis">
  <DESCRIPTION>Flux Axis Characterization</DESCRIPTION>
  <PARAM ID="FluxAxisUnit" name="FluxAxisUnit" utype="ssa:Char.FluxAxis.Unit" value="electrons/s" datatype="char" arraysize="*">
    <DESCRIPTION>Unit for flux</DESCRIPTION>
  </PARAM>
  <PARAM ID="FluxCalibration" name="FluxCalibration" utype="ssa:Char.FluxAxis.Calibration" value="RELATIVE" datatype="char" arraysize="*">
    <DESCRIPTION>Type of flux calibration</DESCRIPTION>
  </PARAM>
</GROUP>
```

Time Series in CoRoT

Current Time Series model based on **SSAP** for CoRoT:

```

- <FIELD ID="AcRef" name="AcRef" utype="ssa:Access.Reference" ucd="meta.ref.url" data
  <DESCRIPTION> URL used to access dataset. </DESCRIPTION>
</FIELD>
- <FIELD ID="Format" name="Format" utype="ssa:Access.Format" datatype="char" arrays
  <DESCRIPTION> Content or MIME type of dataset. </DESCRIPTION>
</FIELD>
- <FIELD ID="Title" name="Title" utype="ssa:DataID.Title" ucd="meta.title;meta.dataset"
  <DESCRIPTION> Dataset Title. </DESCRIPTION>
</FIELD>
- <FIELD ID="TimeAxis" name="TimeAxis" utype="ssa:Dataset.TimeAxis" datatype="char"
  <DESCRIPTION> Table column containing time values </DESCRIPTION>
</FIELD>
- <FIELD ID="FluxAxis" name="FluxAxis" utype="ssa:Dataset.FluxAxis" datatype="char" ar
  <DESCRIPTION> Table column containing flux values </DESCRIPTION>
</FIELD>

```

```

- <DATA>
- <TABLEDATA>
- <TR>
- <TD>
  http://sdc.cab.inta-csic.es:80/corotfa/gateway?type=SSAP&runcode=LRa01&corotid=20
</TD>
<TD>timeseries/fits</TD>
<TD>CoRoT light curve, COROT_ID: 20</TD>
<TD>DATEJDHELREG</TD>
<TD>FLUXHELREG</TD>
<TD>LRa01</TD>

```

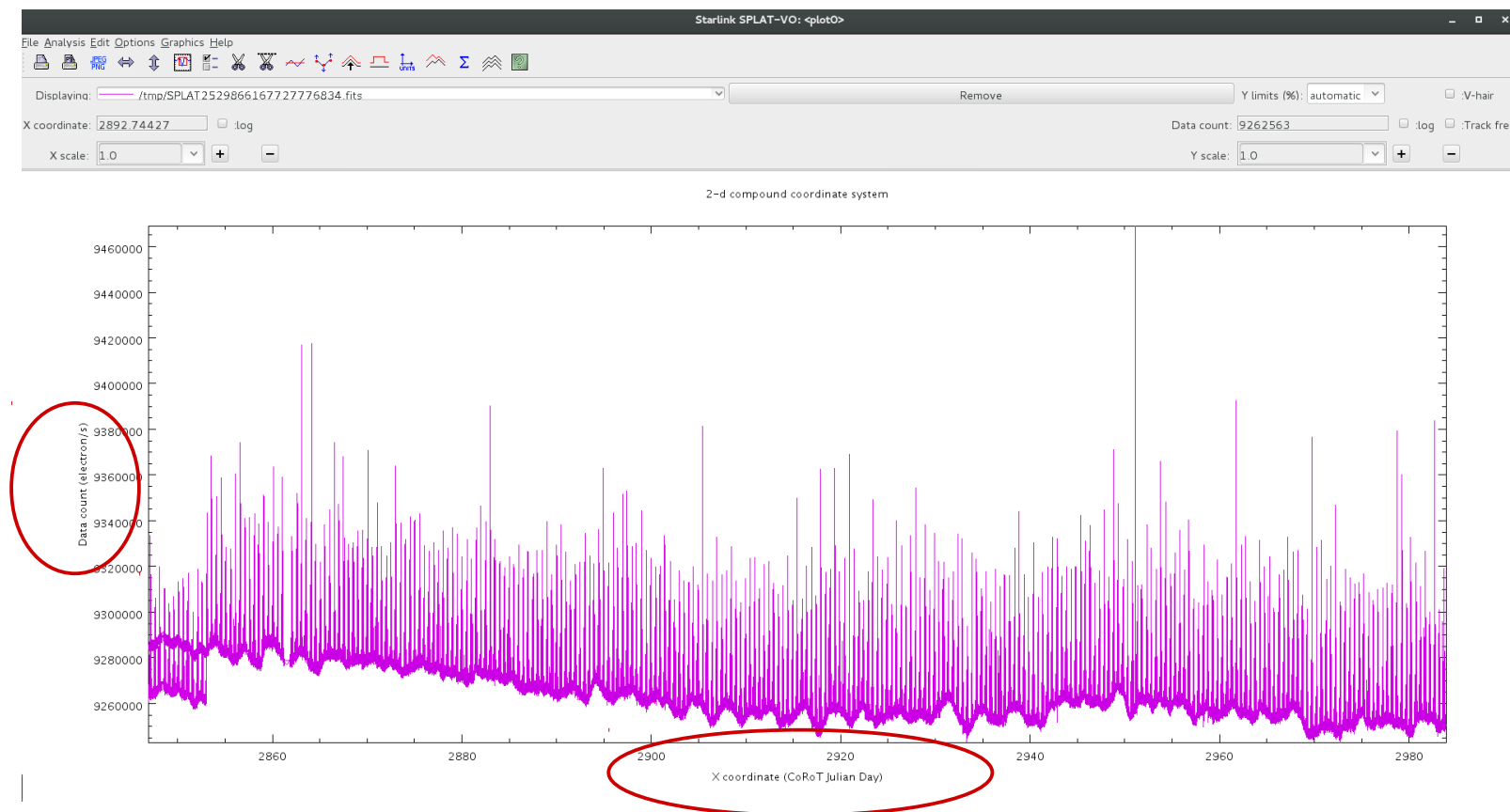


Data in FITS format

Analysis of VO-CoRoT light curves



CoRoT light curves described with the Spectral Data Model can be managed with VO tools like SPLAT.



Time Series Data Model in CoRoT



Data Model



Time Series Cube Data Model Version 1.1

IVOA Note 2017-02-05

Working group

Time domain interest group

This version

<http://www.ivoa.net/documents/cubeDM/20170205>

Latest version

<http://www.ivoa.net/documents/cubeDM>

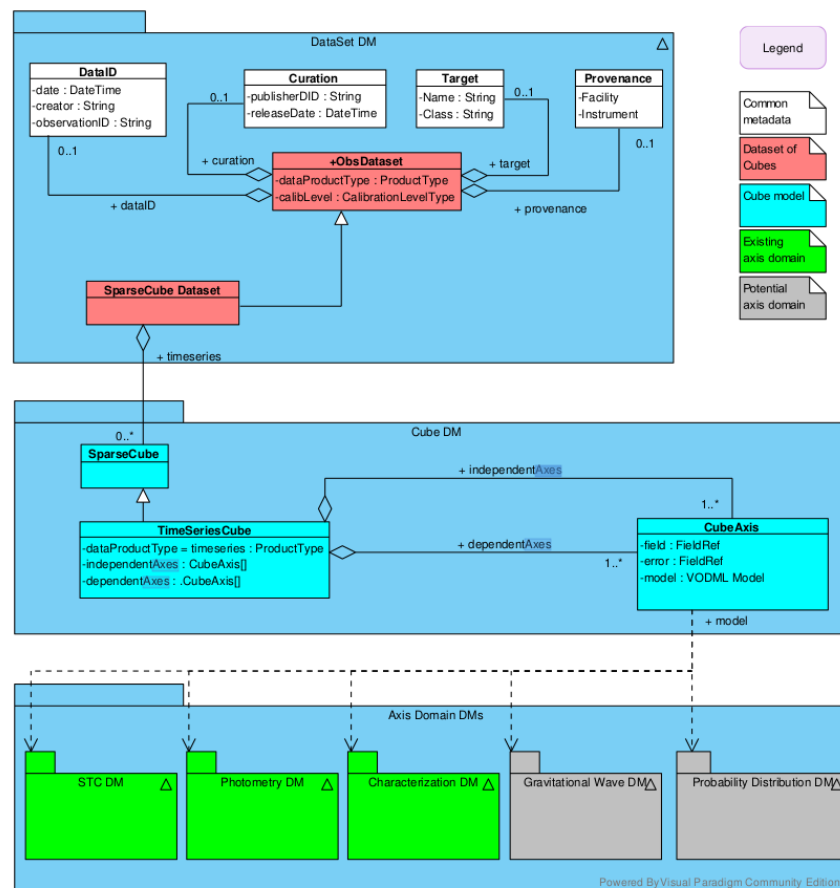
Previous versions

Author(s)

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Editor(s)

Jiří Nádvořník



Time Series Data Model in CoRoT

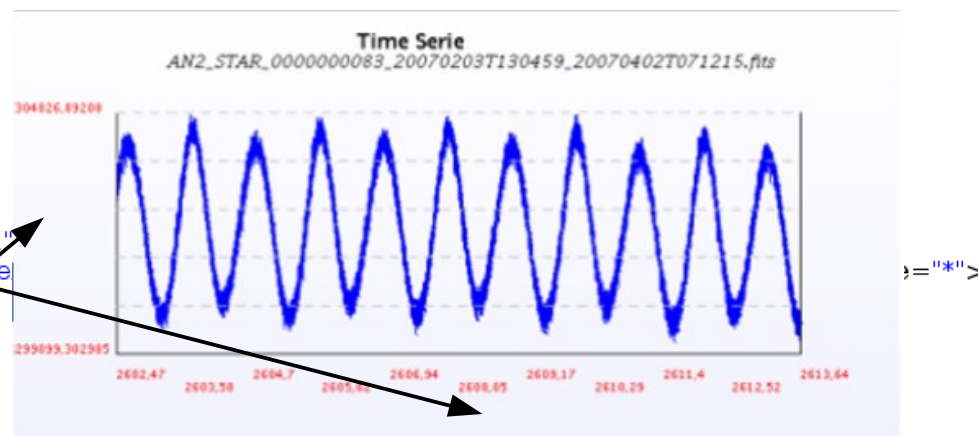


Implementation of **Time Series DM** for CoRoT

```

<!-- Time Series Data Model -->
<GROUP id="timeseries" vodml="ndcube:TimeSeriesCube">
  <GROUP vodml="ndcube:TimeSeriesCube">
    <PARAMref vodml="ProductType" value="TimeSeries"/>
    <!-- Independent Axes -->
    <GROUP id="independent_axes" vodml="ndcube:CubeAxis">
      <!-- Date/Time Axis -->
      <GROUP name="dateTimeAxis" vodml="ndcube:CubeAxis">
        <FIELDref ref="TimeAxis" id="field"/>
        <GROUPref ref="Char.TimeAxis" id="model" vodml="VODML Model"/>
        <PARAM ID="Calibration" name="Calibration" utype="ssa:Char.TimeAxis"/>
        <DESCRIPTION>Type of coord calibration.</DESCRIPTION>
      </PARAM>
      </GROUP>
      <!-- Spatial Axis -->
      <GROUP name="spatialAxis" vodml="ndcube:CubeAxis">
        <FIELDref ref="raj2000" id="field"/>
        <GROUPref ref="Char.SpatialAxis" id="model" vodml="VODML Model"/>
      </GROUP>
      <GROUP name="spatialAxis" vodml="ndcube:CubeAxis">
        <FIELDref ref="dej2000" id="field"/>
        <GROUPref ref="Char.SpatialAxis" id="model" vodml="VODML Model"/>
      </GROUP>
    </GROUP>
    <!-- Dependent Axes -->
    <GROUP id="dependent_axes" vodml="ndcube:CubeAxis">
      <GROUP name="fluxAxis" vodml="ndcube:CubeAxis">
        <FIELDref ref="FLUX" id="field"/>
        <FIELDref ref="FLUXERR" id="error"/>
        <GROUPref id="model" vodml="VODML Model"/>
      </GROUP>
    </GROUP>
  </GROUP>
</GROUP>

```



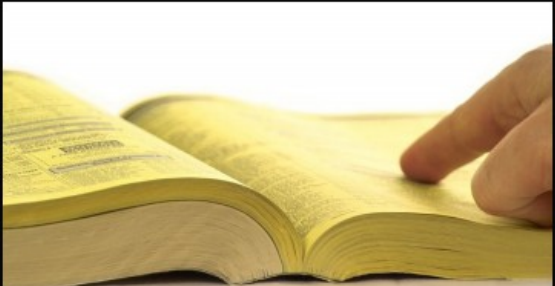
Time Series Data Model in CoRoT

- New DM:
- Simple Light curve (CoRoT) : Not real difference with the new DM.
- Generic Time series / Group of light curves ¿?

Discovering Time Series in VO



- Time Series cannot be discovered at Registry level.



And light curves?

Catalog servers		
1)	<input checked="" type="checkbox"/> CDS VizieR catalog service (>5000 astronomical cat...	?
2)	<input checked="" type="checkbox"/> CDS SIMBAD astronomical database (>3,000,000 obj...	?
3)	<input checked="" type="checkbox"/> NASA/IPAC Extragalactic Database (Caltech/Pasad...	?
4)	<input checked="" type="checkbox"/> SuperCOSMOS catalog server - Edinburgh (UK)	?
5)	<input checked="" type="checkbox"/> LEDA Hypercat (Lyon-Meudon Extragalactic Databa...	?
6)	<input checked="" type="checkbox"/> Generic ConeSearch query	?
7)	<input checked="" type="checkbox"/> Galaxy Evolution Explorer Catalog (STScI)	?
8)	<input checked="" type="checkbox"/> San Pedro Martin Open Cluster Survey	?
9)	<input checked="" type="checkbox"/> Starlight Synthesis parameters	?
Image servers		
1)	<input checked="" type="checkbox"/> The Aladin image server (CDS/Strasbourg)	?
2)	<input checked="" type="checkbox"/> The UKIRT DR7 Infrared Deep Sky Survey	?
3)	<input checked="" type="checkbox"/> SDSS DR7 images	?
4)	<input checked="" type="checkbox"/> Multimission Archive of the T21 (MAST)	?
5)	<input checked="" type="checkbox"/> Hubble Legacy Archive Footprint Data (HLA)	?
6)	<input checked="" type="checkbox"/> Canadian Astronomical Data Center (CADC)	?
7)	<input checked="" type="checkbox"/> Hubble press release images	?
8)	<input checked="" type="checkbox"/> VO-Paris Southern Atlas (VOPSAT)	?
9)	<input checked="" type="checkbox"/> Generic SIA query	?
10)	<input checked="" type="checkbox"/> The XMM-Newton Science Archive InterOperability System	?
11)	<input checked="" type="checkbox"/> The ISO Data Archive InterOperability System	?
12)	<input checked="" type="checkbox"/> The Integral Science Data Archive InterOperability System	?
13)	<input checked="" type="checkbox"/> SkyView Virtual Observatory	?
14)	<input checked="" type="checkbox"/> SuperCOSMOS Sky Surveys SSS SIAP Cutout Service	?
15)	<input checked="" type="checkbox"/> UKIDSS DR1 SIAP Service	?
Spectra servers		
1)	<input checked="" type="checkbox"/> AXIS-XMS Optical Spectra	?
2)	<input checked="" type="checkbox"/> Be Star Spectra SSAP	?
3)	<input checked="" type="checkbox"/> HEROS archive of Ondrejov observations	?
4)	<input checked="" type="checkbox"/> SSA Service for Optical Spectroscopy in the CDF-5	?
5)	<input checked="" type="checkbox"/> cutout server of HEROS archive of Ondrejov observati...	?
6)	<input checked="" type="checkbox"/> SSA Service for Synthetical Spectra (TMAP)	?
7)	<input checked="" type="checkbox"/> Espadons/Narval legacy database (Castor)	?
8)	<input checked="" type="checkbox"/> HiG - Simple Spectral Access to HI (21cm) Spectra of Ga...	?
9)	<input checked="" type="checkbox"/> International Ultraviolet Explorer	?
10)	<input checked="" type="checkbox"/> International Ultraviolet Explorer	?
11)	<input checked="" type="checkbox"/> Wisconsin Halfwave Spectropolarimeter	?
12)	<input checked="" type="checkbox"/> Wisconsin Halfwave Spectropolarimeter	?
13)	<input checked="" type="checkbox"/> HyperLeda FITS Archive Simple Spectrum Data Access(...)	?
14)	<input checked="" type="checkbox"/> ELODIE archive	?

Discovering Time Series in VO



- Time Series could be discovered using ObsCore / TAP .



*International
Virtual
Observatory
Alliance*

**Observation Data Model Core Components
and its Implementation in the Table Access
Protocol**

A.4. Discovering time series

A.4.1. Use case 4.1

Times series for a sky position, with date, length and exposure constraints

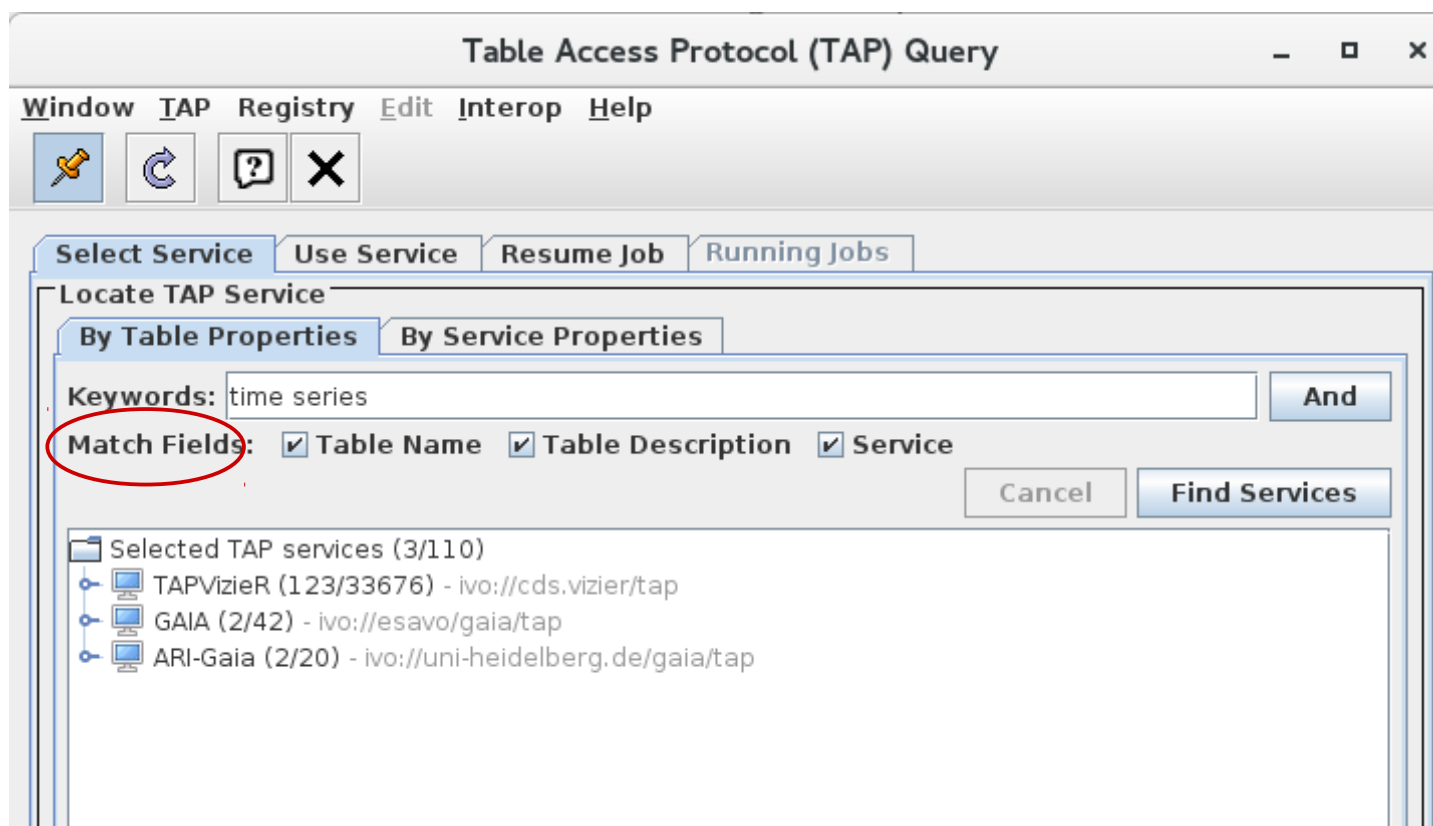
Show me a list of all data which satisfies:

- I. **DataType=TimeSeries**
- II. RA includes 16.00 hours
- III. DEC includes +41.00
- IV. Time resolution better than 1 minute
- V. Time interval (start of series to end of series) > 1 week
- VI. Observation data before June 10, 2008
- VII. Observation data after June 10, 2007

Discovering Time Series in VO



- Time Series could be discovered using ObsCore / TAP **BUT...**
Datatype not included in the Match Fields options of TOPCAT.



Analyzing Time Series in VO



VO Tools: Splat-VO

Include Time Series?

Starlink SPLAT-VO: Query VO for Spectra

File Options | Help | Search parameters: Simple Query

Object: HD49933

Wave Band: Radio

RA: 06:50:49.831 Dec: -00:32:27.18

Radius: 10.0 MAXREC

Band: /

Time: /

Query Format: None

Wavelength calibration: None

Flux calibration: None

Optional Parameters

U	Name	Value	UCD
<input type="checkbox"/>	SPECPR		
<input type="checkbox"/>	SPECRES		
<input type="checkbox"/>	TARGETSPECTYPE		
<input type="checkbox"/>	VERSION	1.02	
<input type="checkbox"/>	teff		phys.temperature.effective
<input type="checkbox"/>	logg	4.4	phys.gravity
<input type="checkbox"/>	feh	0	phys.abund.Fe
<input type="checkbox"/>	OBJECT		
<input type="checkbox"/>	SamplingTime	6.30	

Query: <SERVER>?REQUEST=queryData&POS=102.70762916666666,-0.5408833333333334&SIZE=0.16666666666666666

Query results:

Title	Corot Id	AcRef	Format	TimeAxis	FluxAxis	Run	Location	StartDate	EndDate	SPECTYPE	LUM	VMAG	B-V
1 CoRoT light curve COROT...	20	http://sdc.cab.inta-csic.es/8	timeseries/fits	DATE/JDHELREG	FLUX/HELREG	IRa01	(102.708, -0.54088)	(2846.8733)	(2983.9094)	F	V	5.77	0.39
2 CoRoT light curve COROT...	20	http://sdc.cab.inta-csic.es/8	timeseries/fits	DATE/JDHELREG	FLUX/HELREG	IRa01	(102.708, -0.54088)	(2586.963)	(2647.8003)	F	V	5.77	0.39

Display selected | Display all | Download selected | Download all | Deselect table | Deselect all

Save query results | Restore query results | Close

Time Series at SVO



Thanks!