



# Time Domain Astronomy Focus Session

Enrique Solano  
Spanish Virtual Observatory  
Centro de Astrobiología (INTA-CSIC)



# The Focus Session

Wednesday May 15 2013

9	09:00–09:10	gHS	Focus session on time domain astronomy - Introduction	Enrique Solano (Session Chair)
	09:10–09:30	gHS	CoRoT, Kepler time series	Jonas Debosscher
	09:30–09:50	gHS	Designs and Requirements for Time Domain Data in LSST	Mario Juric (LSST)
	09:50–10:10	gHS	ASKAP/VAST	Paul Hancock
	10:10–10:30	gHS	LOFAR Transients and MeerKAT "ThunderKAT" transients	John Swinbank
<b>10:30–11:00 Break</b>				
10	11:00–12:30	gHS	Focus session on time domain astronomy - Panel Discussion	Mark Allen (Moderator)
			Panel:	
				Severin Gaudet (TCG)
				Enrique Solano
				Matthew Graham (TD IG, CRTS)
				Pat Dowler (DAL WG)
	Jesus Salgado (DM WG)			

# IVOA Standing Committee on Science Priorities

## Current Projects

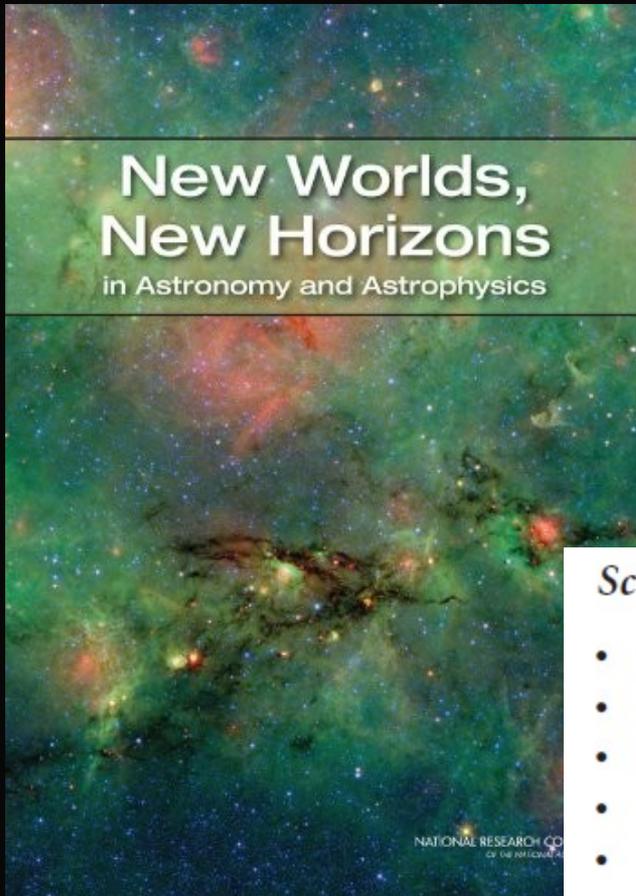
Project	Status	
Time Series	Collecting use cases, preparing <a href="#">focus sessions</a> for May 2013 interop	<a href="#">Use Case development page</a>
Mult-dimensional Data	Collecting use cases, preparing focus sessions for May 2013 interop	<a href="#">Use Case development page</a>

VOEvent WG → TimeDomain IG

IVOA Committee on Science Priorities. The primary objective of the CSP “is to identify research needs of the worldwide astronomy community than can benefit from VO related tools and services, and to take action within the context of the IVOA to assist in placing such tools and services into the research community.”

# Time Series are important

- ✓ Time domain science encompasses every area of astronomy, from Solar System to cosmology.



## *Science frontier discovery areas:*

- *Identification and characterization of nearby habitable exoplanets,*
- *Gravitational wave astronomy,*
- *Time-domain astronomy,*
- *Astrometry,<sup>2</sup> and*
- *The epoch of reionization.*

# Time Series: they are everywhere



**SuperWASP**

> 10 million objects

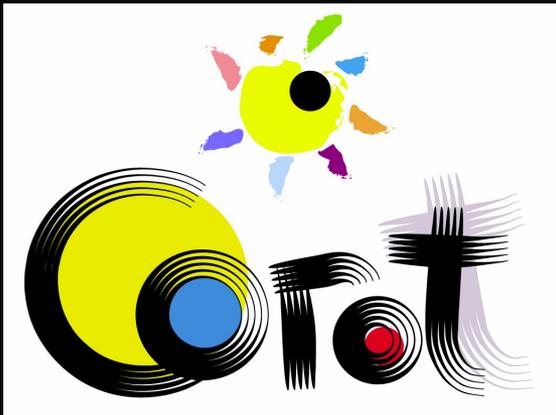
>17 million light curves



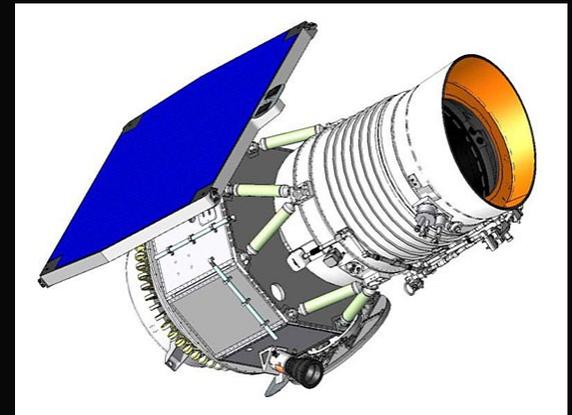
**The All Sky  
Automated  
Survey**

**OGLE**

> 40 million objects



**Kepler**



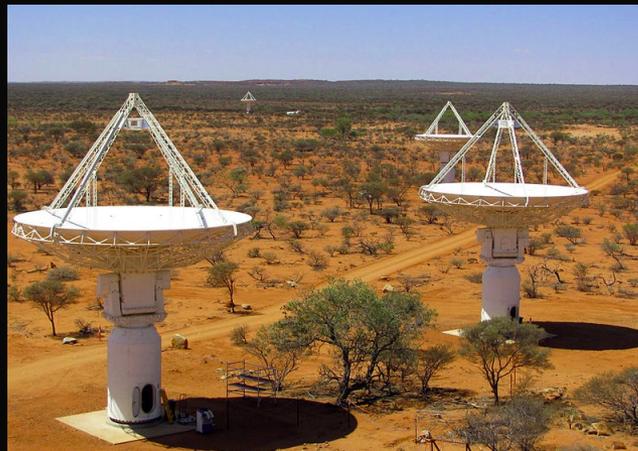
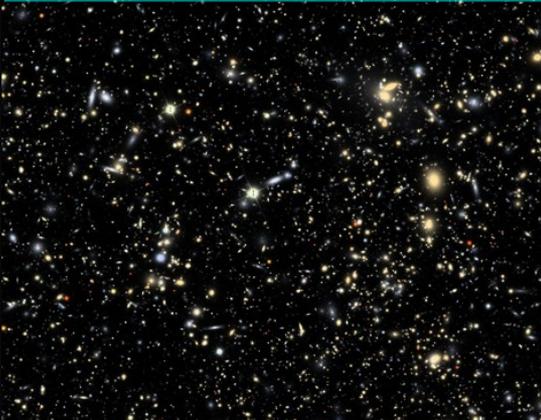
# Time Series everywhere

- **The future:** From pictures to movies



- A 3.2 gigapixel, 15-second exposure image every 20s.

Observing the sky with sub-mJ sensitivity at a 5s cadence.



# Time Series and the VO: present

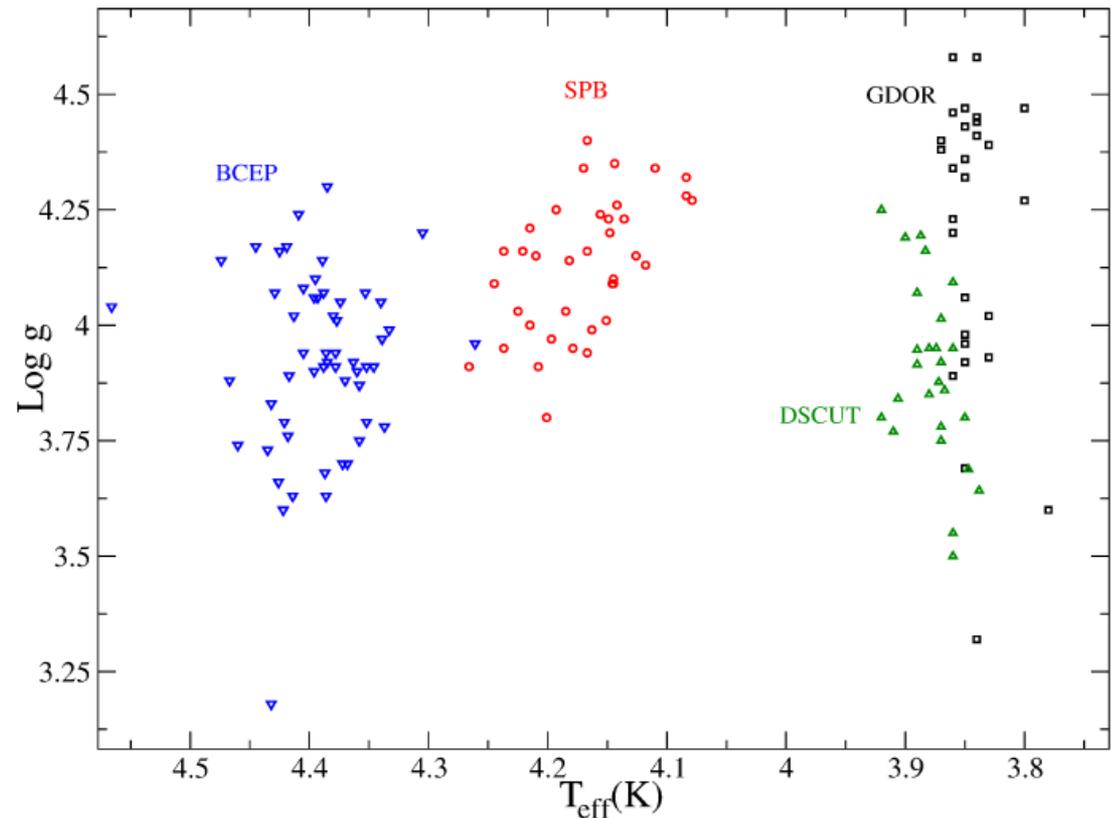
✓ Access to spectroscopic data

A&A 550, A120 (2013)  
DOI: 10.1051/0004-6361/201220184  
© ESO 2013

Astronomy  
&  
Astrophysics

## Improved variability classification of CoRoT targets with Giraffe spectra<sup>\*,\*\*</sup>

L. M. Sarro<sup>1</sup>, J. Debosscher<sup>2</sup>, C. Neiner<sup>3</sup>, A. Bello-García<sup>4</sup>, A. González<sup>5</sup>,  
G. León<sup>1</sup>, C. Aerts<sup>2,7</sup>, and B. de Rudder<sup>1</sup>



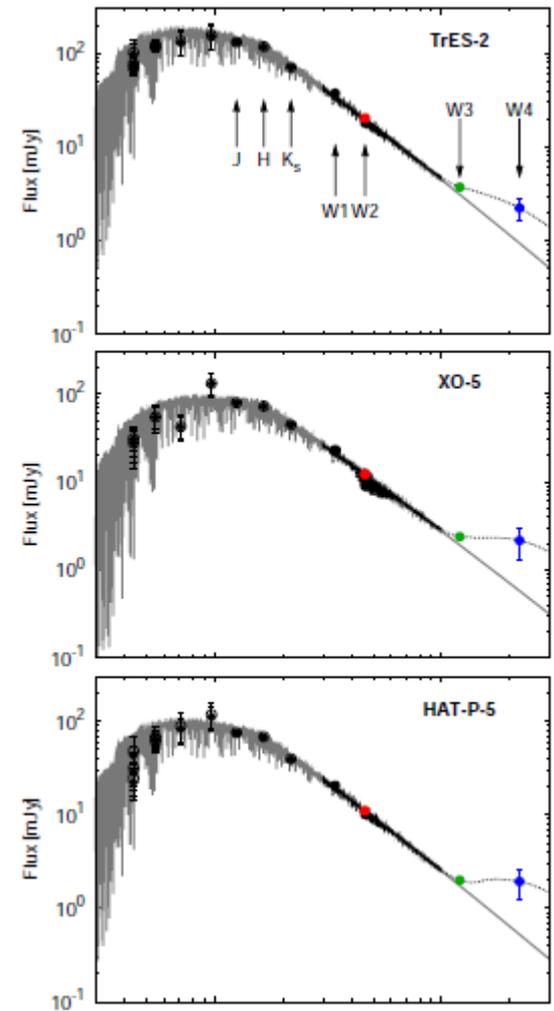
# Time Series and the VO: present (II)

## ✓ Access to photometric data

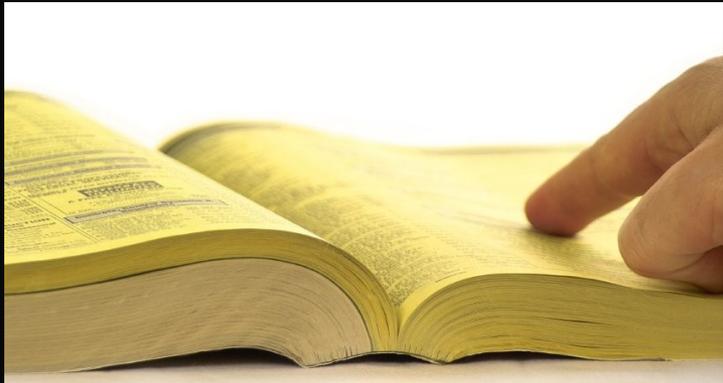
Mon. Not. R. Astron. Soc. 000, 111–115 (2011) Printed 19 July 2012 (MN  $\LaTeX$  style file v2.2)

## Debris disc candidates in systems with transiting planets

A. V. Krivov\*, M. Reidemeister, S. Fiedler, T. Löhne, and R. Neuhäuser  
*Astrophysikalisches Institut, Friedrich-Schiller-Universität Jena, Schillergäßchen 2–3, 07745 Jena, Germany*



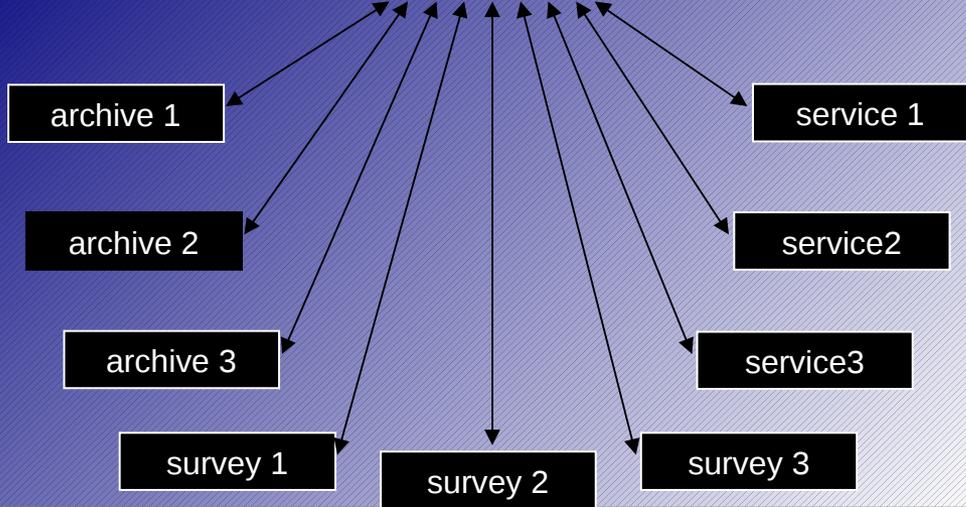
# What can't VO do for Time Series? Discovery



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 TESS (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-S	?
5)	<input checked="" type="checkbox"/> cutout server of HEROS archive of Ondrejov observati...	?
6)	<input checked="" type="checkbox"/> SSA Service for Synthetic 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	?

And light curves?

# What can't VO do for Time Series? Access and description



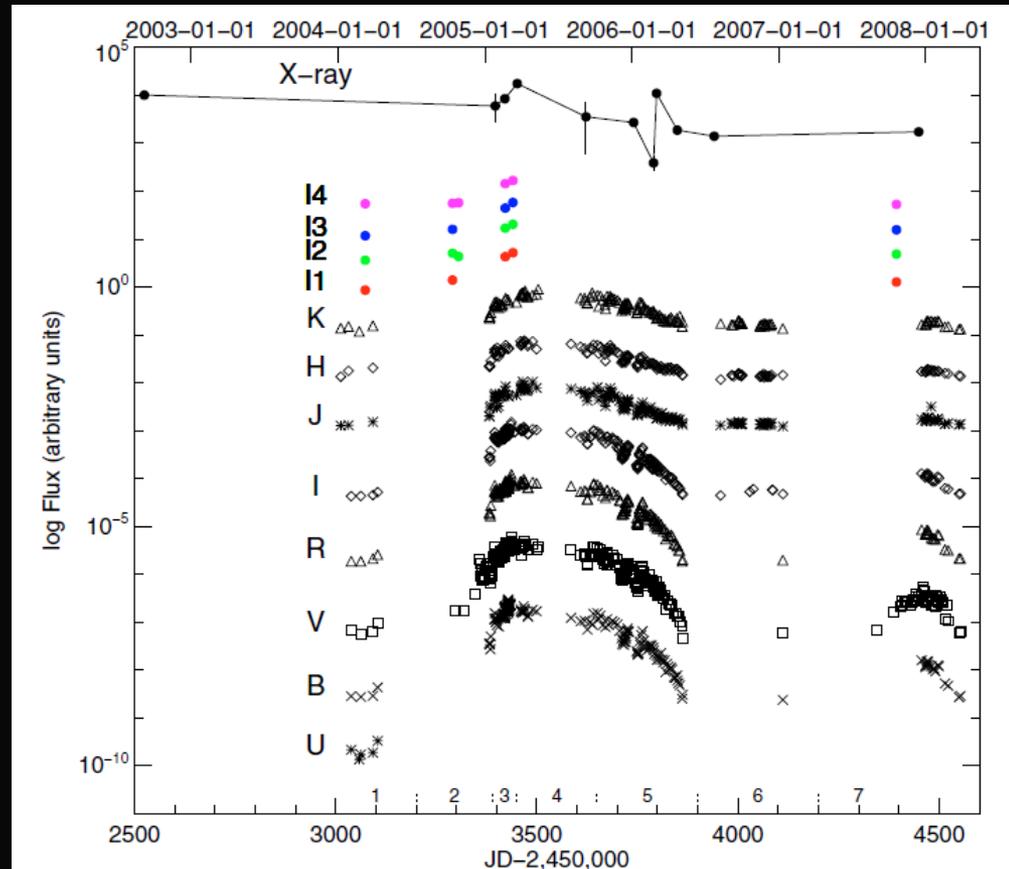
# Data access and data description

A&A 511, A63 (2010)  
DOI: 10.1051/0004-6361/200913037  
© ESO 2010

Astronomy  
&  
Astrophysics

## A multi-wavelength study of the young star V1118 Orionis in outburst<sup>\*,\*\*</sup>

M. Audard<sup>1,2</sup>, G. S. Stringfellow<sup>3</sup>, M. Güdel<sup>4</sup>, S. L. Skinner<sup>3</sup>, F. M. Walter<sup>5</sup>, E. F. Guinan<sup>6,7</sup>,  
K. R. Briggs<sup>4</sup> and C. Baldwin-Saavedra<sup>1,2</sup>





# *TimeSeries in VO*

## *Use Case Assessment*

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*Spanish Virtual Observatory*  
*Centro de Astrobiología (INTA-CSIC)*  
raul@cab.inta-csic.es

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



# VO tools and Time Series



[Home](#) [Science Tools](#) [About the VAO](#) [VAO News](#) [Contact & Connect](#)

## VAO Time Series Tool

### Introduction

Discover time series data sets at the [Harvard Time Series Center \(TSC\)](#), the [NASA Exoplanet Archive](#) at IPAC/Caltech, and the [Catalina Real-Time Transient Survey](#) at CACR/Caltech, and analyze them with the NASA Exoplanet Archive's periodogram application.

This service is to a pathfinder for developing a utility that interconnects repositories of time series data. Please give us your feedback - it is important in driving future VO capabilities.

**This service is recommended for use with the most recent versions of Firefox, Chrome or Safari. Internet Explorer 9, old versions of Firefox (prior to version 8) and Opera are not supported.**

### VAO Time Series Search

Use the fields below to enter a search location and radius.

Location:

Radius:  arcsec

# Homepage of Period04

Period04 is a computer program especially dedicated to the statistical analysis of large astronomical time series containing gaps. The program offers tools to extract the individual frequencies from the multiperiodic content of time series and provides a flexible interface to perform multiple-frequency fits.

## Latest news:

--- **2010-11-24**: Period04 v1.2.0 has been released.

This version provides some **new features**:

- Period04 now supports the **SAMP communication protocol** to provide interoperability with other applications of the [Virtual Observatory](#)

The screenshot displays the Period04 software interface. A context menu is open over a table entry in the 'Table List' pane. The menu options are:

- Register with PLASTIC
- Unregister with PLASTIC
- Start internal PLASTIC Hub
- Start external PLASTIC Hub
- Show Registered Applications
- Broadcast table
- Send table to ... (highlighted)
- Help on interoperability

The 'Send table to ...' option has a sub-menu open with the following option:

- Send to Period04

The 'Table List' pane shows the following table entry:

Table List
1: 2001-01-08.1999-2000.B

The 'Current' pane shows the following file path:

CMi.v.Var-FIT.dat  
strings/datenfiles/2001-01-08.1999-2000.B

At the bottom of the interface, there are two buttons: 'Display table' and 'Display graph'. A footer message reads 'For help press F1'.