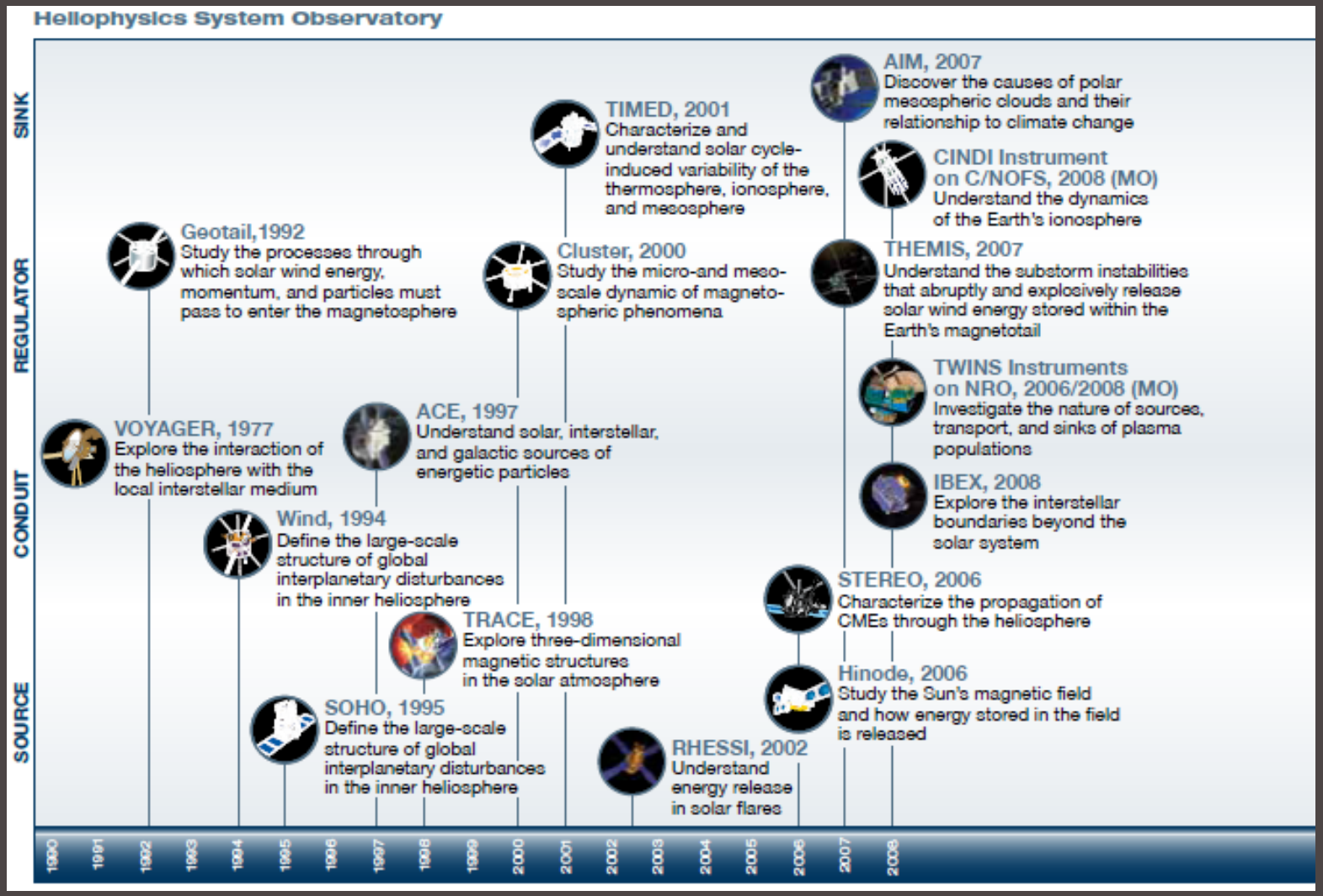
Data Access and Analysis Tools



This Talk

So we have all these awesome spacecrafts, but how can we parse it in a meaningful way?

Give some centralized locations for Heliospheric and Solar Data

Talk about the king of Solar data analysis:

SolarSoft (SSW)

Direct from the Mission Team

OPERATING	IN DEVELOPMENT	UNDER STUDY
ACE	IRIS	Solar Orbiter
AIM	MMS	Solar Probe
CINDI	RBSP	
Cluster		
Geotail	**PAST**	
Hinode (Solar-B)	Equator-S	
IBEX	FAST	
RHESSI	IMAGE	
SDO	IMP-8	
SOHO	Polar	
STEREO	Pioneer 10/11	
THEMIS	SAMPEX	
TIMED	SPARTAN-201	
TRACE	SNOE	
TWINS	ST5	
Voyager	Ulysses	
Wind	Yohkoh	

Virtual Observatories

- But what if you want more context?
- Virtual Observatories / Data centers!

- NASA language:
  - "Information from a single spacecraft vantage point is being replaced by multispacecraft distributed observatory methods"
  - "The VO program is designed to develop an integrated approach to scientific research and analysis"
  - i.e. Data Assimilation

Heliophysics Virtual Observatories currently supported:

Virtual Cosmic Ray Observatory (ViCRO)

Virtual Heliospheric Observatory (VHO)

Virtual Ionosphere, Thermosphere, Mesosphere Observatory (VITMO)

Virtual Magnetospheric Observatory (VMO)

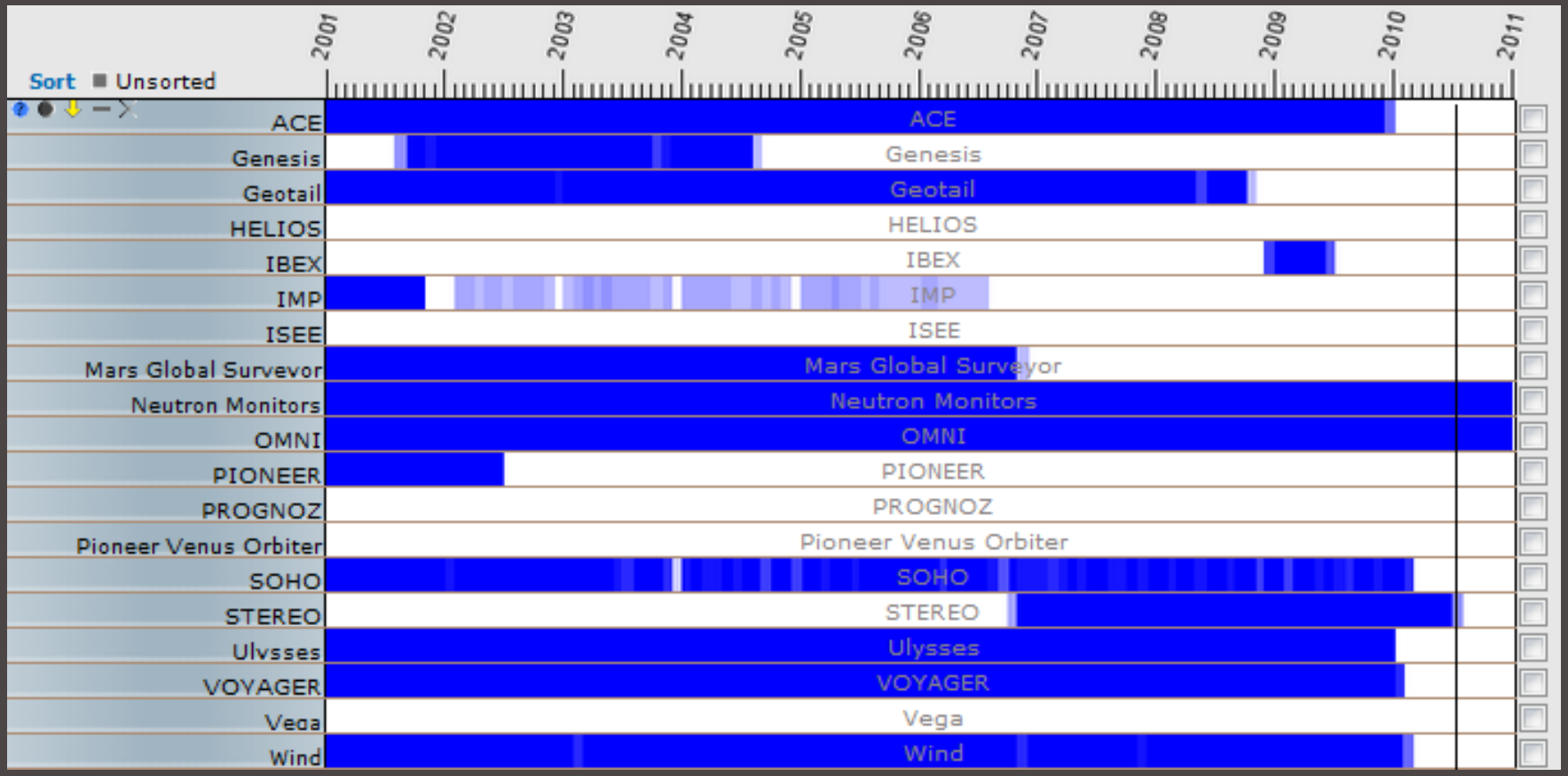
Virtual Radiation Belt Observatory (ViRBO)

Virtual Solar Observatory (VSO)

Virtual Heliospheric Observatory

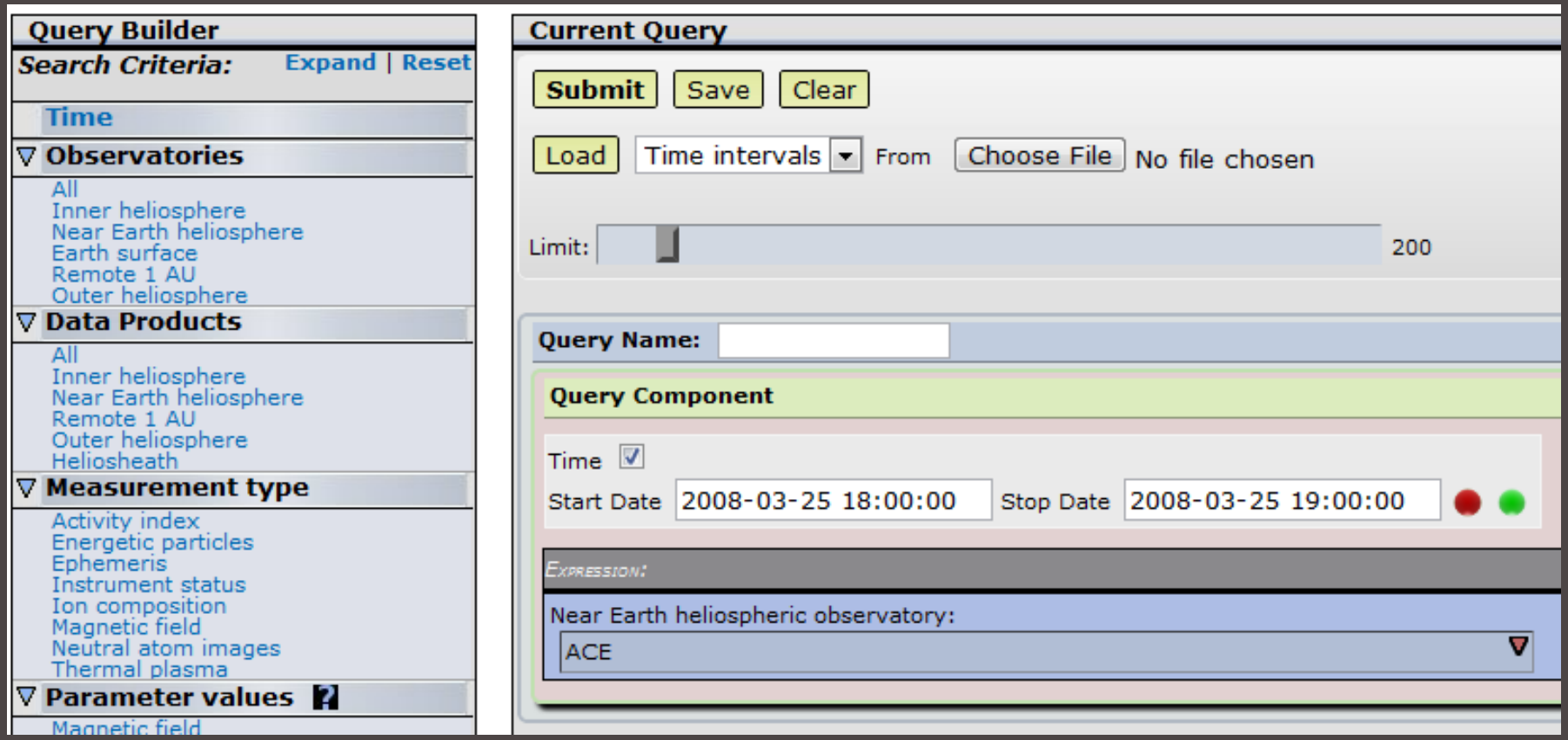
- Centralized data distribution center for in-situ data

vho.nasa.gov



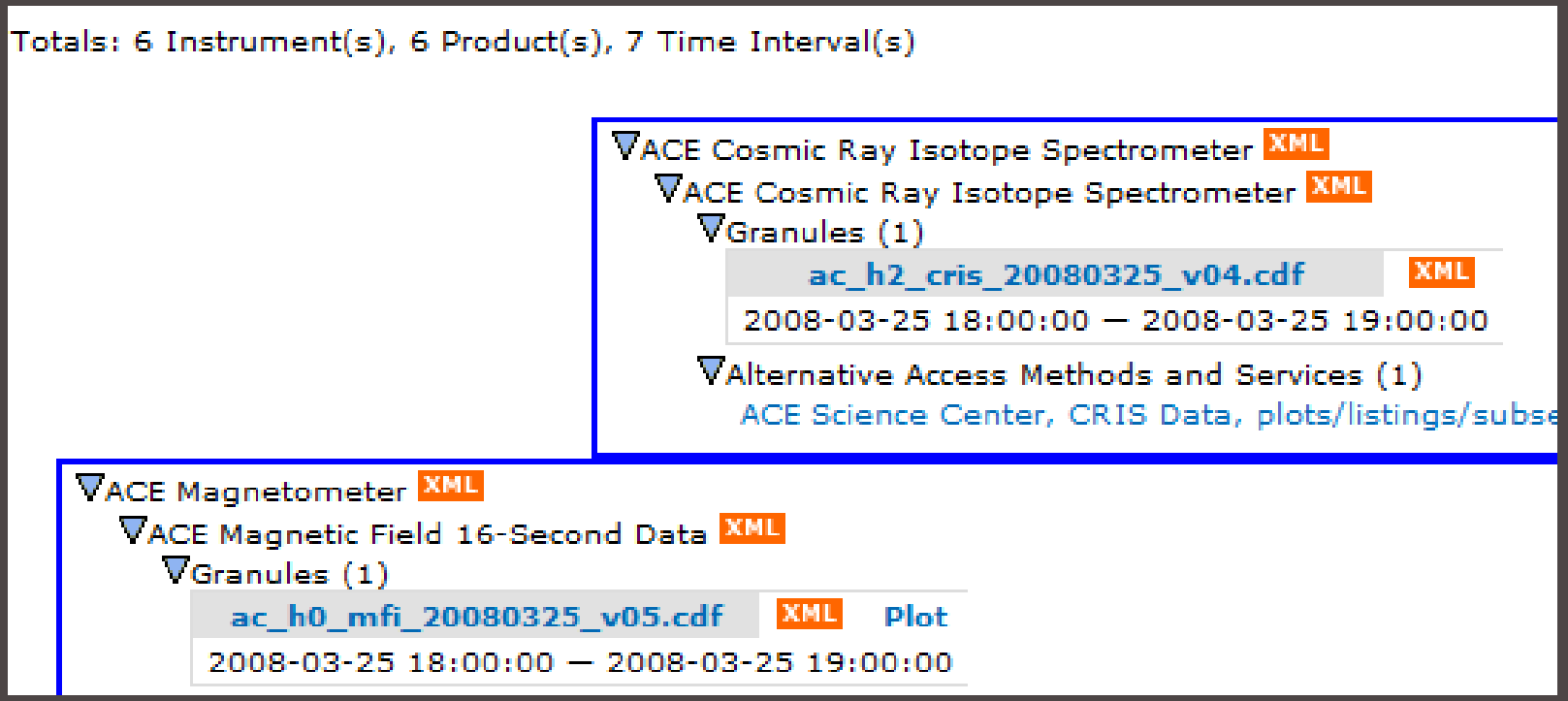
Virtual Heliospheric Observatory

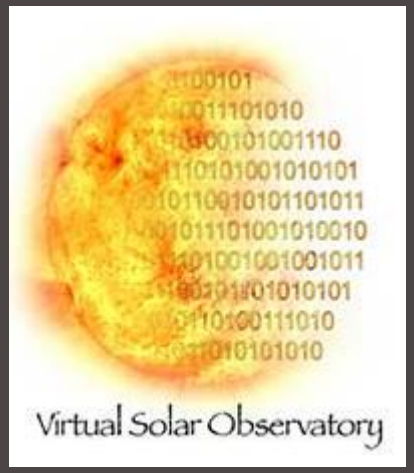
- Many diff types of queries, can span many instruments



Virtual Heliospheric Observatory

- Can download data or even plot directly





Virtual Solar Observatory

- Centralized data distribution center Solar data

sdac.virtualsolar.org

- ☑ **Time**
  Search by time interval.
  Derive time intervals from event catalogs
- ☐ **Observable**
  Search based on physical observables
- ☐ **Instrument / Source / Provider**
  Search based on instruments or data archives
  - ☑ Compact listing
  - ☐ Instrument / Source (not provider dependent)
  - ☐ Instrument Only (not source or provider dependent)
- ☐ **Spectral Range**
  Search based on a spectral range
- ☐ **Nicknames**
  Search based on common terms used to describe data products

Virtual Solar Observatory

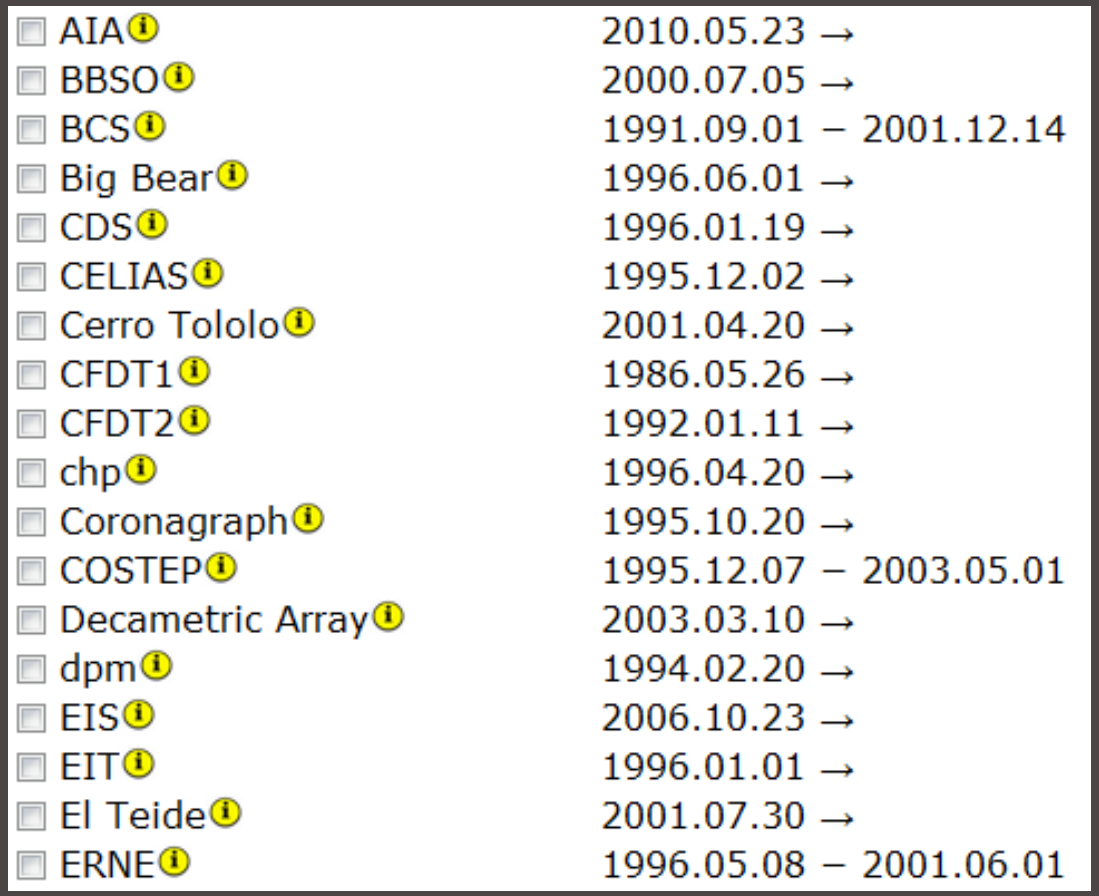
- Centralized data distribution center Solar data

  sdac.virtualsolar.org

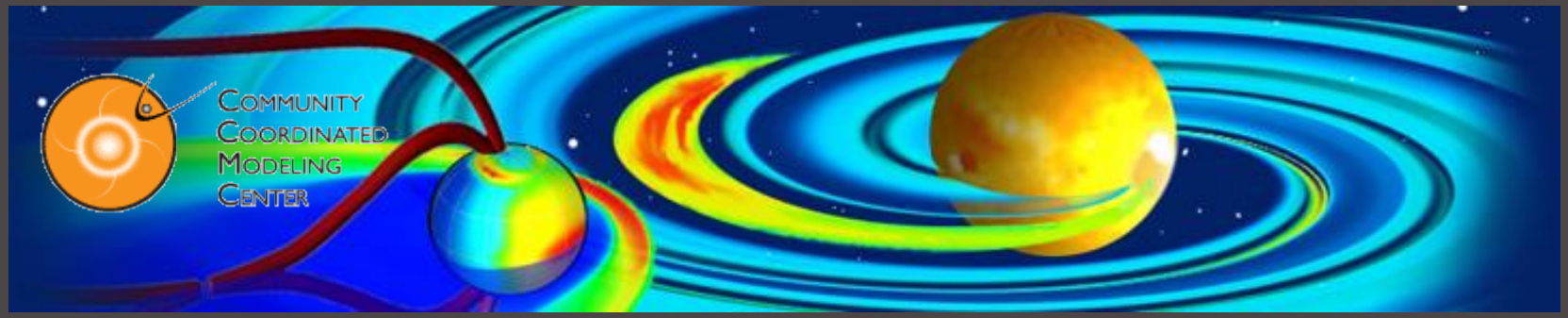
- Huge number of instruments (too many to list)

- Includes ground based obs as well

- Interface is a bit clunky, but can help finding multiple datasets

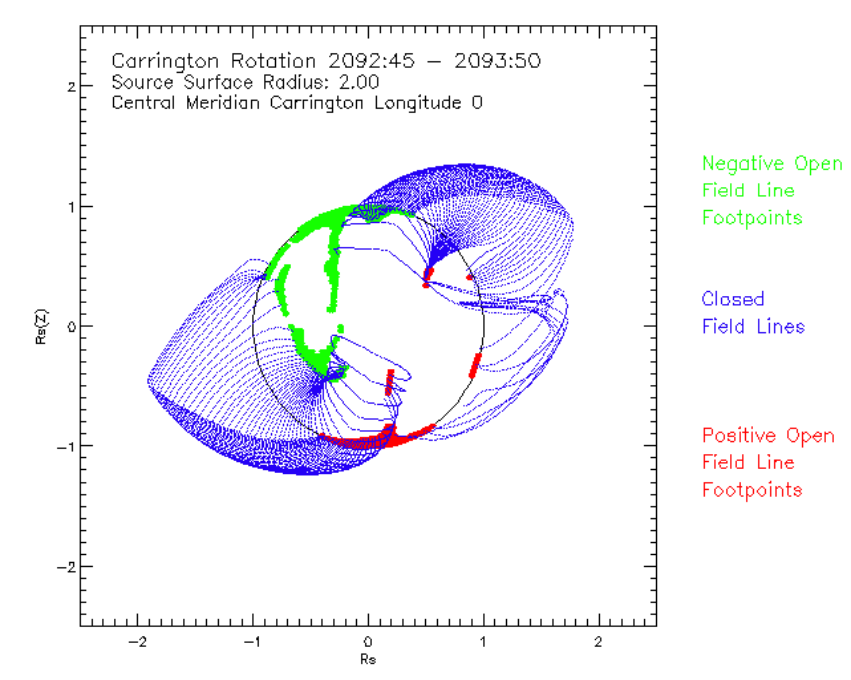


More Context: Models at the CCMC



http://ccmc.gsfc.nasa.gov/

- Community repository for validated heliospheric models
- MHD models, B extrapolations
- Runs on Request
- Lets you ask what 3D magnetic, velocity, thermodynamic structures might look like for any time in the past 2 decades



Data Analysis

SolarSoft (SSW)

- Huge Repository of general IDL tools and mission specific data analysis routines and calibration files.

- Primary Goal: "**Provide a large reuse software library**"

  → save everyone time and effort!

- Website: http://www.lmsal.com/solarsoft

- (or just google 'solarsoft lmsal')

SolarSoft (SSW)

- Time series analysis, time conversions
- Spectral fitting
- Image and Image cube (movies) display, wavelets
- IDL data manipulation (structure, string, array, math)
- File I/O
- Solar utilities: limb fitting, grid overlay, coordinate transformations…
- Provide access to supporting ancillary data bases
- Provide integrated access to other IDL packages

SolarSoft (SSW)

- Caveat, SSW website / main documentation is pretty ‘dated’

- But SSW is constantly being contributed to/updated
  - Individual package documentation (+file headers) is usually good
- Once you manage to install it, very easy to keep up to date
- If it is at all relevant to what you do, It is well worth the initial effort!

SSW: Packages

- Software suites for a number of observatories (SDO, SOHO, HINODE, STEREO, GOES, YOHKOH, TRACE, + other optical and radio observatories

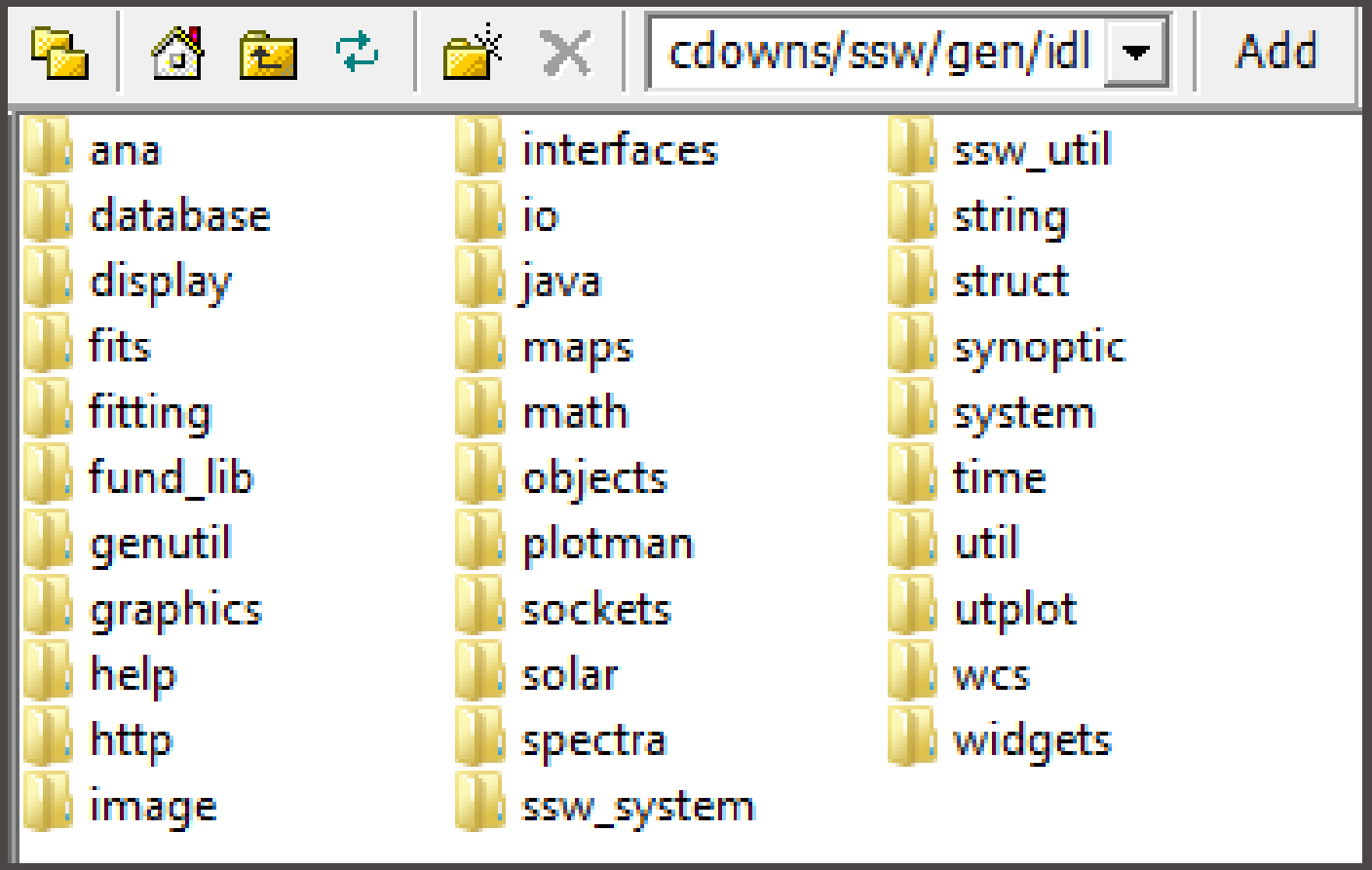
- Also has virtual observatory packages
  - This includes a VSO interface → can script data acquisition in IDL!

- Many other special use packages:

Packages: [BINARIES ☑] [SPEX ☐] [CHIANTI ☐] [PINTofALE ☐] [XRAY ☐] [PFSS ☐] [S3DRS ☐] [FESTIVAL ☐] [CORIMP ☐] [MKIT ☐] [Panorama ☐] [HYDROSTATIC ☐] [FINDSTUFF ☐] [ANDRIL ☐] [LPARL ☐] [VDEM ☐] [ANA ☐] [ZTOOLS ☐] [MJASTEREO ☐] [NGDC ☐] [CMES ☐] [CACTUS ☐] [NLFFF ☐] [PDL ☐] [NRL ☐]

SSW: GEN

- Standard tools with SSW (ssw/gen/idl)
- Great resource for IDL code to use

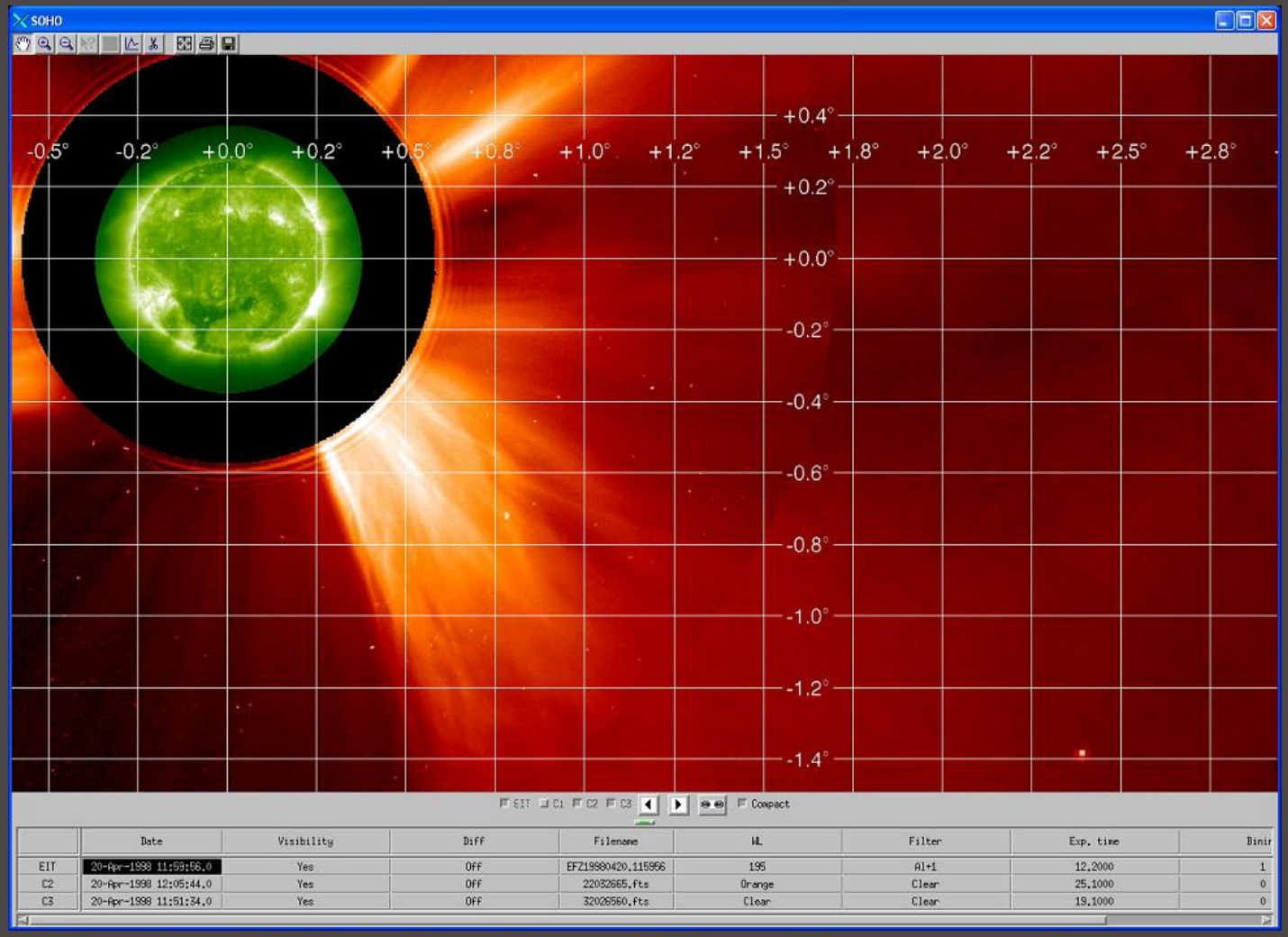


SSW: FESTIVAL

- SSW package for studying multiple imaging datasets in unison with a variety of analysis tools

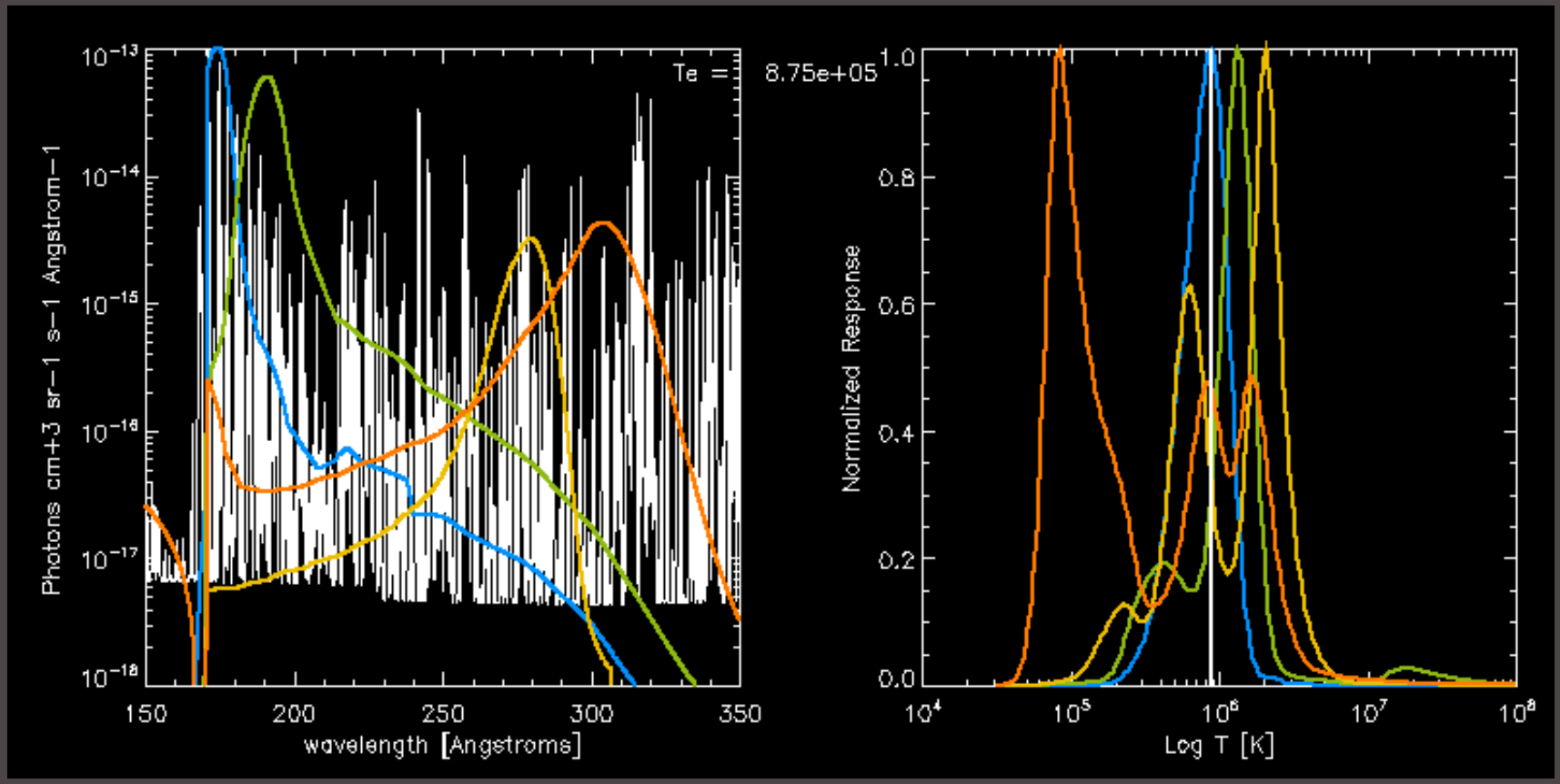
SOHO EIT + LASCO

STEREO EUVI + COR1&2 + HI1&2



SSW: CHIANTI

- Comprehensive spectral analysis suite (next talk)



Other: Helioviewer.org

- NASA/ESA project that uses VSO API and makes nice web and java interface for viewing data.
  - Will load calibrated images in real time!
  - Intended eventually for SDO scale data, so check back!