



JPL



Interferometry Science Center

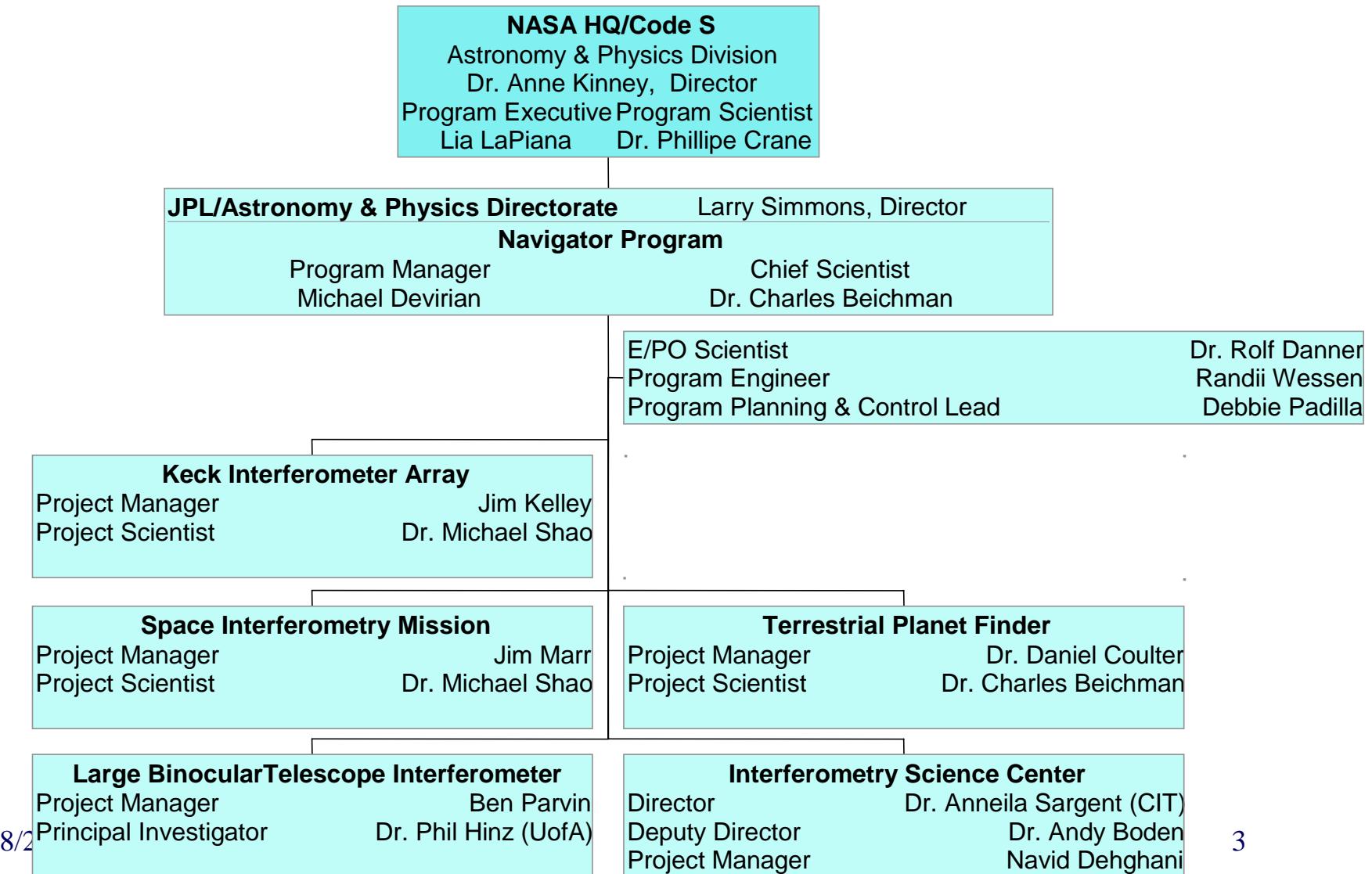
R. Akeson and A. Boden

Outline

- Role of ISC
- Overview of non-project specific tools
 - getCal planning tool
 - External calibration tools
- Update on tool distribution
- Areas for collaboration



Navigator Program Organization



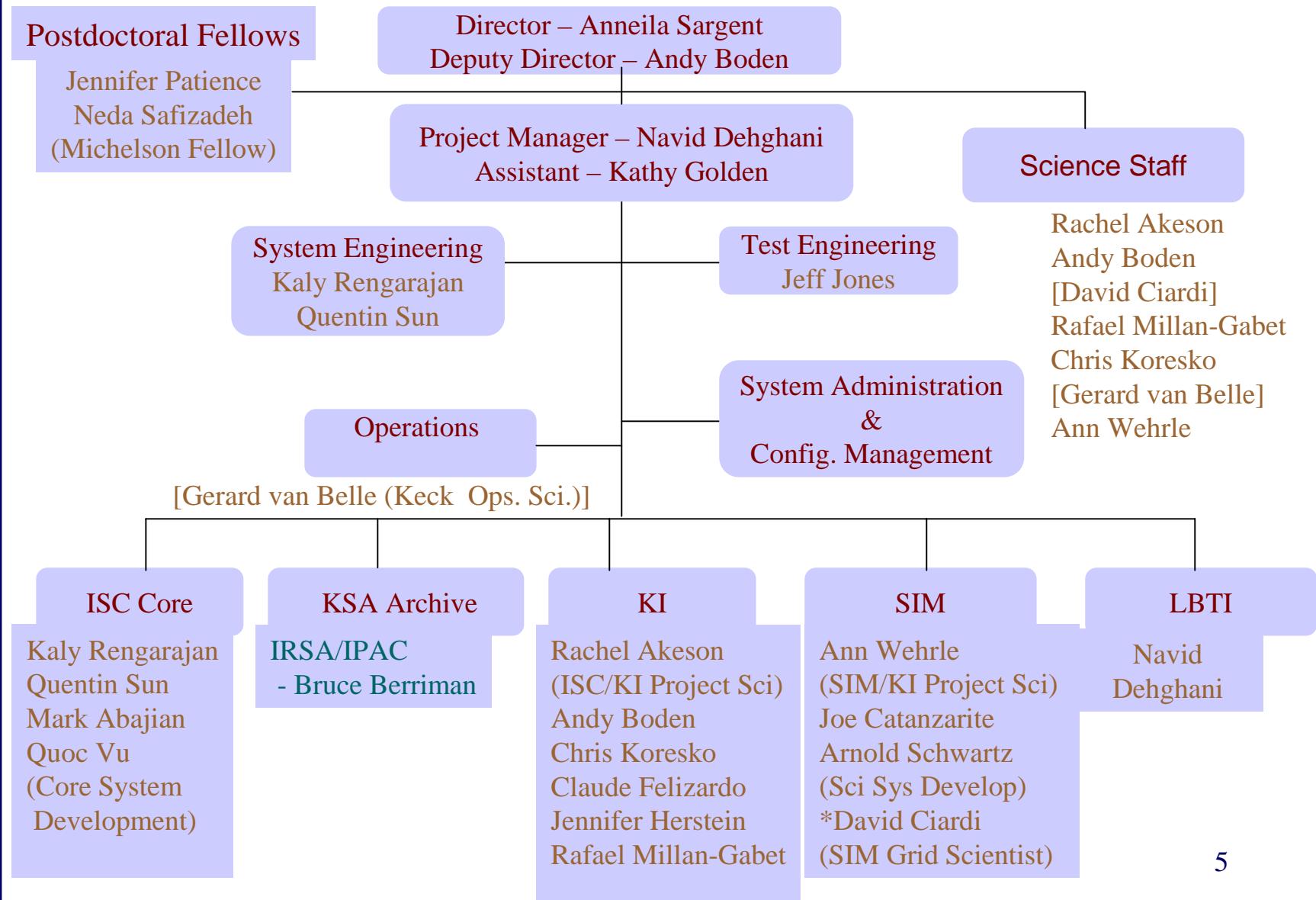


ISC Mission

ISC is a service organization created to facilitate the timely and successful accomplishment of the science objectives of NASA *Origins* program interferometers. Goals include:

- assist the scientific community in deriving meaningful scientific results using observations from these missions and facilities.
 - cultivate a broad user community and increase the awareness of scientific opportunities provided by the missions.
 - archive mission observations for continuing scientific use
-
- Currently supported projects are KI, SIM, LBTI (NASA time), TPF

ISC Staff



ISC V² End-User Tools

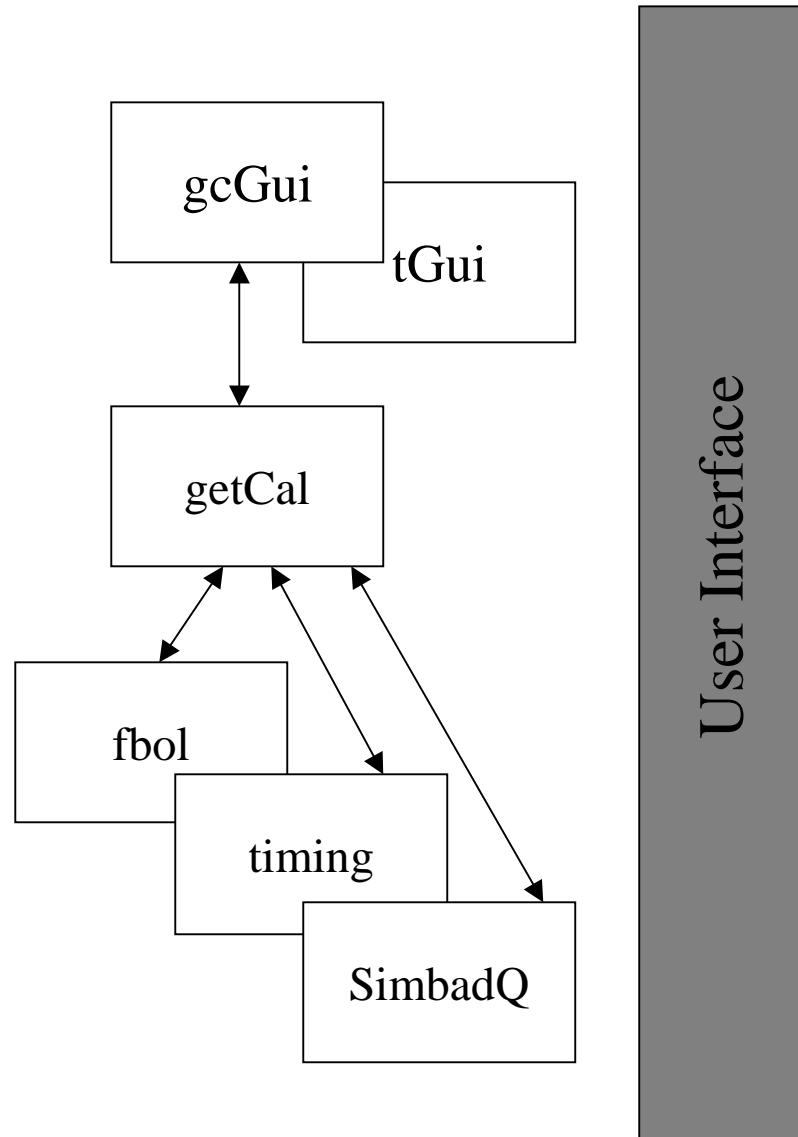
- Observation Planning: getCal
- L-2 (External) Data Calibration: wbCalib & nbCalib

Key Features of getCal

- getCal is a PTI-Heritage Experiment/Observation Planning Tool That:
 - Resolves astronomical designations into standardized catalog entries and astrometry (via Simbad)
 - Identifies potential visibility calibration sources according to various observational and/or astrophysical criteria
 - Retrieves broad-band photometry from archival (Simbad, Catalog of Infrared Observations) sources and models spectral energy distribution (SED) with effective temperature/bolometric flux/angular diameter parameters
 - Computes observing accessibility and geometry according to various constraints
 - Includes various GUIs that facilitate access to components

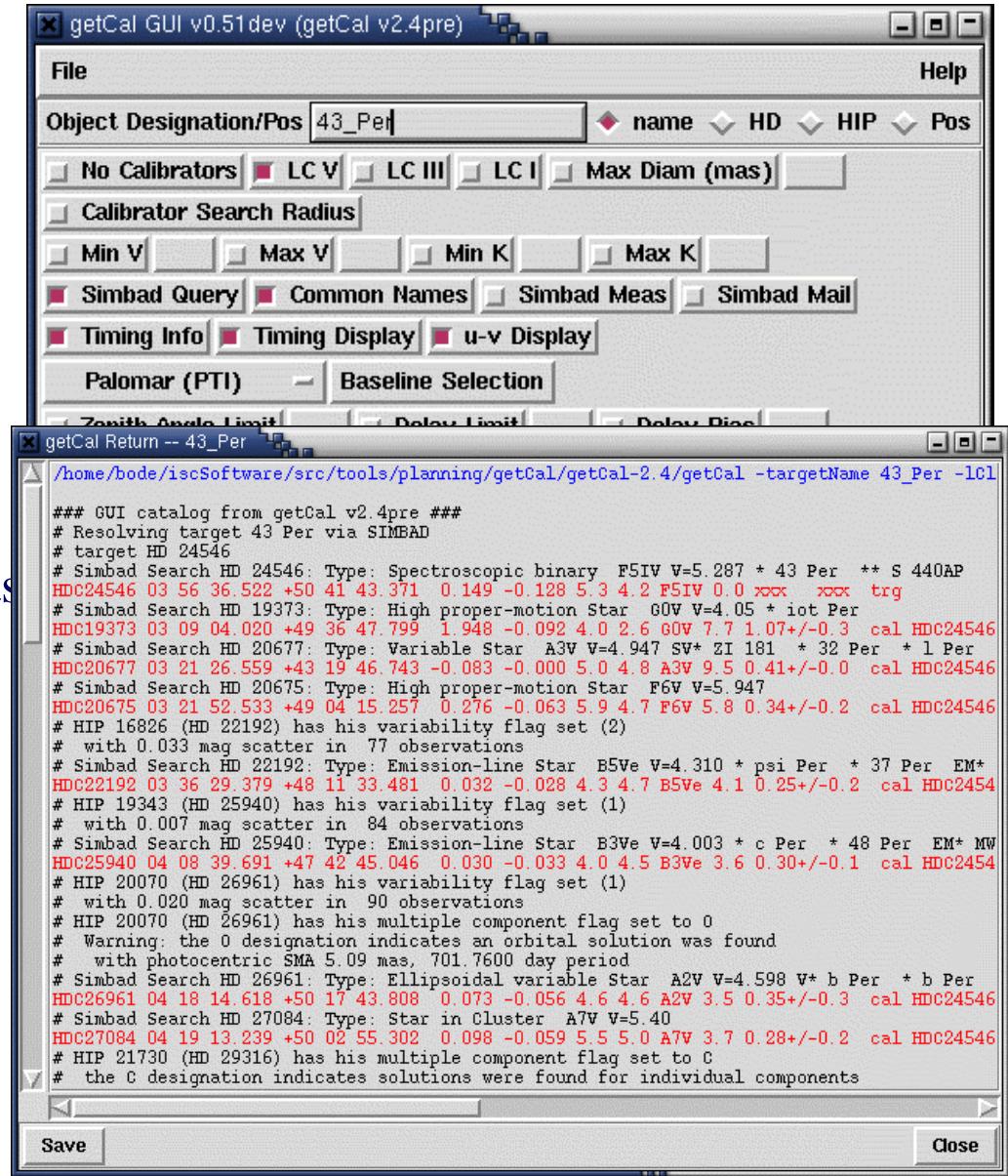
getCal Design Overview

- getCal is designed as multi-layer toolset
 - GUI level – GUIs that interface with command-line tools the facilitate interface or present results (e.g. gcGui, tGui)
 - Wrapper level – top-level scripts that provide consolidated functionality with command-line interface (e.g. getCal, gcList)
 - Component level – individual components that implement individual functions (e.g. Hipparcos catalog “cone search”, Simbad name resolution & information retrieval, accessibility calculations)
- Script (perl) implementation to enhance portability



Illustrative Use Cases (1)

- Identify Candidate Calibrators for Given Source
 - Geometric search
 - Magnitude constraints
 - Astrophysical constraints (e.g. luminosity class, apparent diameter)
 - Multiplicity vetting

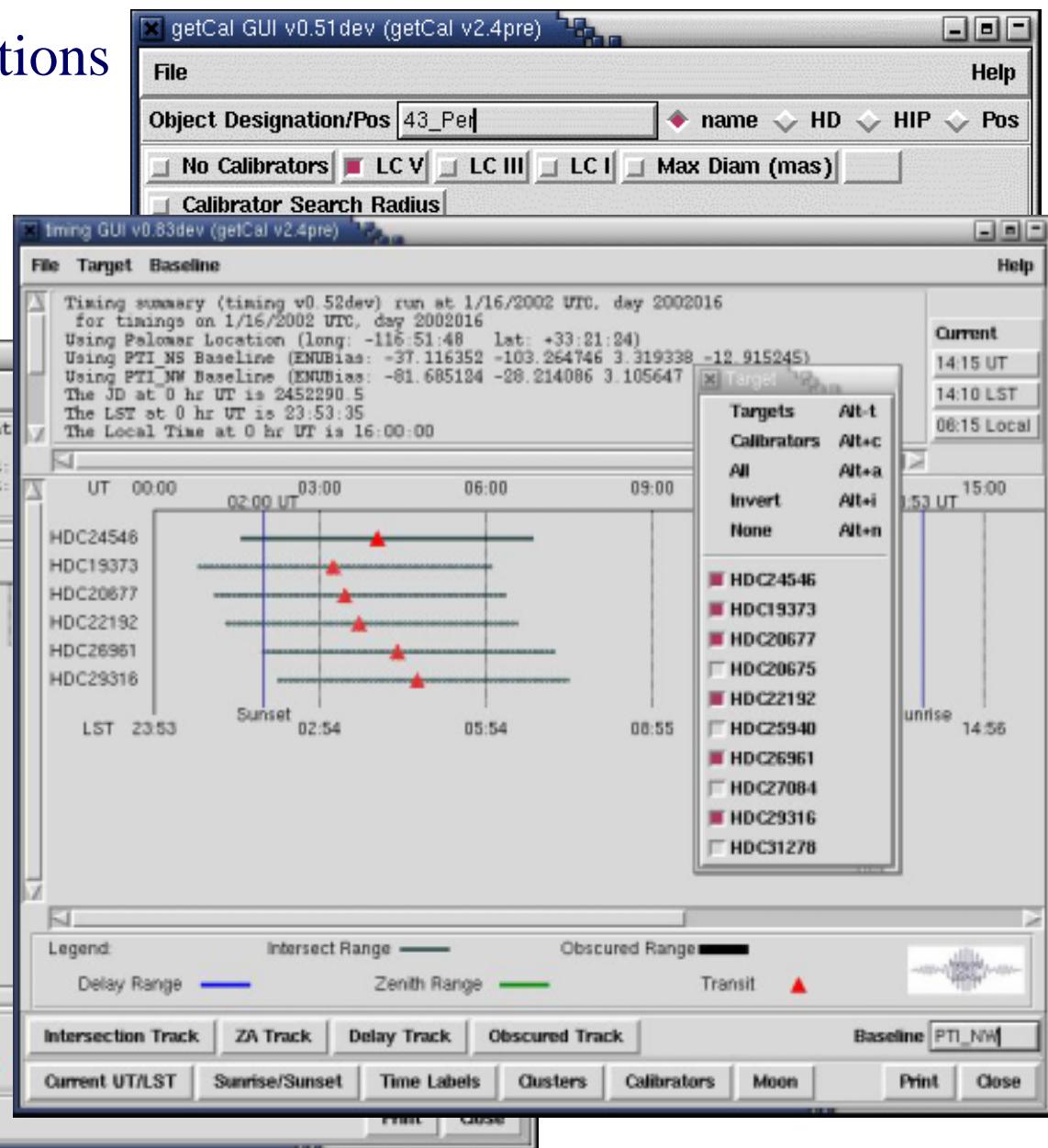
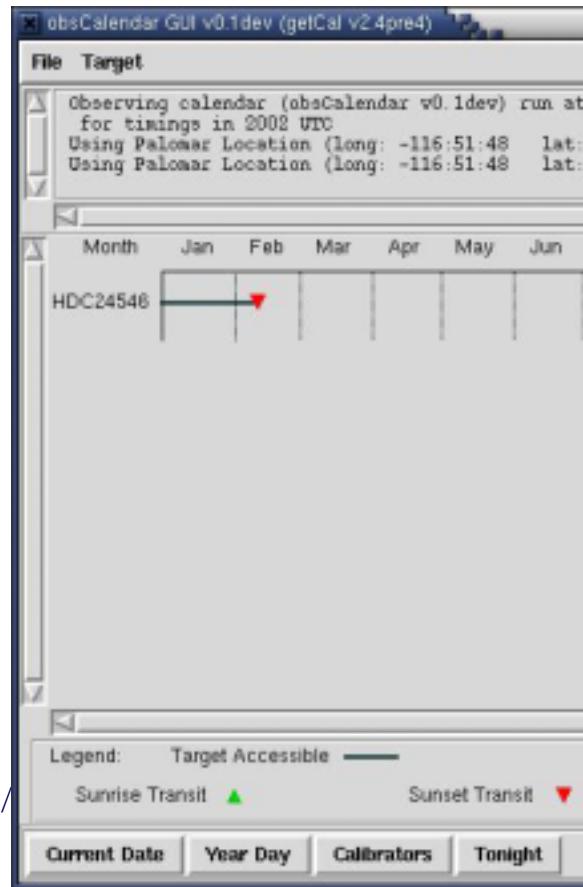


The screenshot shows two windows related to the getCal software. The top window is titled "getCal GUI v0.51dev (getCal v2.4pre)" and contains a search interface for an object designation ("43_Per") and various search parameters like "Calibrator Search Radius", "Min V", "Max V", etc. The bottom window is titled "getCal Return -- 43_Per" and displays a list of astronomical objects found for the target star 43 Persei. The list includes various identifiers (HD, Simbad, HIP), types (Spectroscopic binary, High proper-motion Star, Variable Star, Emission-line Star), and their properties (V-band magnitude, color indices, periods). Some entries are marked as "cal" (calibrators).

```
### GUI catalog from getCal v2.4pre ###
# Resolving target 43 Per via SIMBAD
# target HD 24546
# Simbad Search HD 24546: Type: Spectroscopic binary F5IV V=5.287 * 43 Per ** S 440AP
HDC24546 03 56 36.522 +50 41 43.371 0.149 -0.128 5.3 4.2 F5IV 0.0 xxx xxx trg
# Simbad Search HD 19373: Type: High proper-motion Star G0V V=4.05 * iot Per
HDC19373 03 09 04.020 +49 36 47.799 1.948 -0.092 4.0 2.6 G0V 7.7 1.07+/-0.3 cal HDC24546
# Simbad Search HD 20677: Type: Variable Star A3V V=4.947 SV+ ZI 181 * 32 Per * 1 Per
HDC20677 03 21 26.559 +43 19 46.743 -0.083 -0.000 5.0 4.8 A3V 9.5 0.41+/-0.0 cal HDC24546
# Simbad Search HD 20675: Type: High proper-motion Star F6V V=5.947
HDC20675 03 21 52.533 +49 04 15.257 0.276 -0.063 5.9 4.7 F6V 5.8 0.34+/-0.2 cal HDC24546
# HIP 16826 (HD 22192) has his variability flag set (2)
# with 0.033 mag scatter in 77 observations
# Simbad Search HD 22192: Type: Emission-line Star B5Ve V=4.310 * psi Per * 37 Per EM+
HDC22192 03 36 29.379 +48 11 33.481 0.032 -0.028 4.3 4.7 B5Ve 4.1 0.25+/-0.2 cal HDC24546
# HIP 19343 (HD 25940) has his variability flag set (1)
# with 0.007 mag scatter in 84 observations
# Simbad Search HD 25940: Type: Emission-line Star B3Ve V=4.003 * c Per * 48 Per EM+ MW
HDC25940 04 08 39.691 +47 42 45.046 0.030 -0.033 4.0 4.5 B3Ve 3.6 0.30+/-0.1 cal HDC24546
# HIP 20070 (HD 26961) has his variability flag set (1)
# with 0.020 mag scatter in 90 observations
# HIP 20070 (HD 26961) has his multiple component flag set to 0
# Warning: the O designation indicates an orbital solution was found
# with photocentric SMA 5.09 mas, 701.7600 day period
# Simbad Search HD 26961: Type: Ellipsoidal variable Star A2V V=4.598 V* b Per * b Per
HDC26961 04 18 14.618 +50 17 43.808 0.073 -0.056 4.6 4.6 A2V 3.5 0.35+/-0.3 cal HDC24546
# Simbad Search HD 27084: Type: Star in Cluster A7V V=5.40
HDC27084 04 19 13.239 +50 02 55.302 0.098 -0.059 5.5 5.0 A7V 3.7 0.28+/-0.2 cal HDC24546
# HIP 21730 (HD 29316) has his multiple component flag set to 0
# the C designation indicates solutions were found for individual components
```

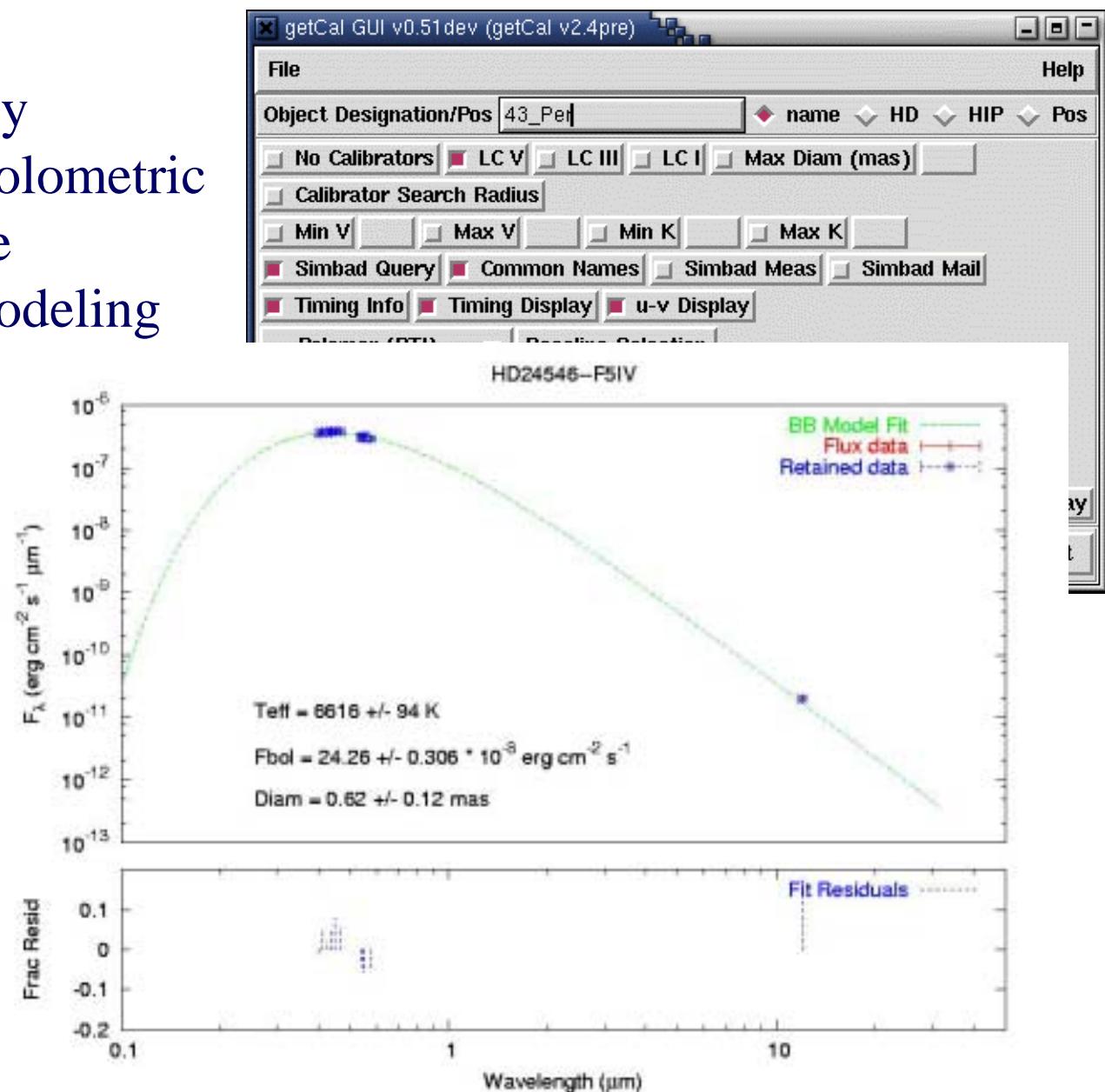
Illustrative Use Cases (2)

- Accessibility calculations
 - Annual accessibility
 - Diurnal accessibility
 - u-v tracks



Illustrative Use Cases (3)

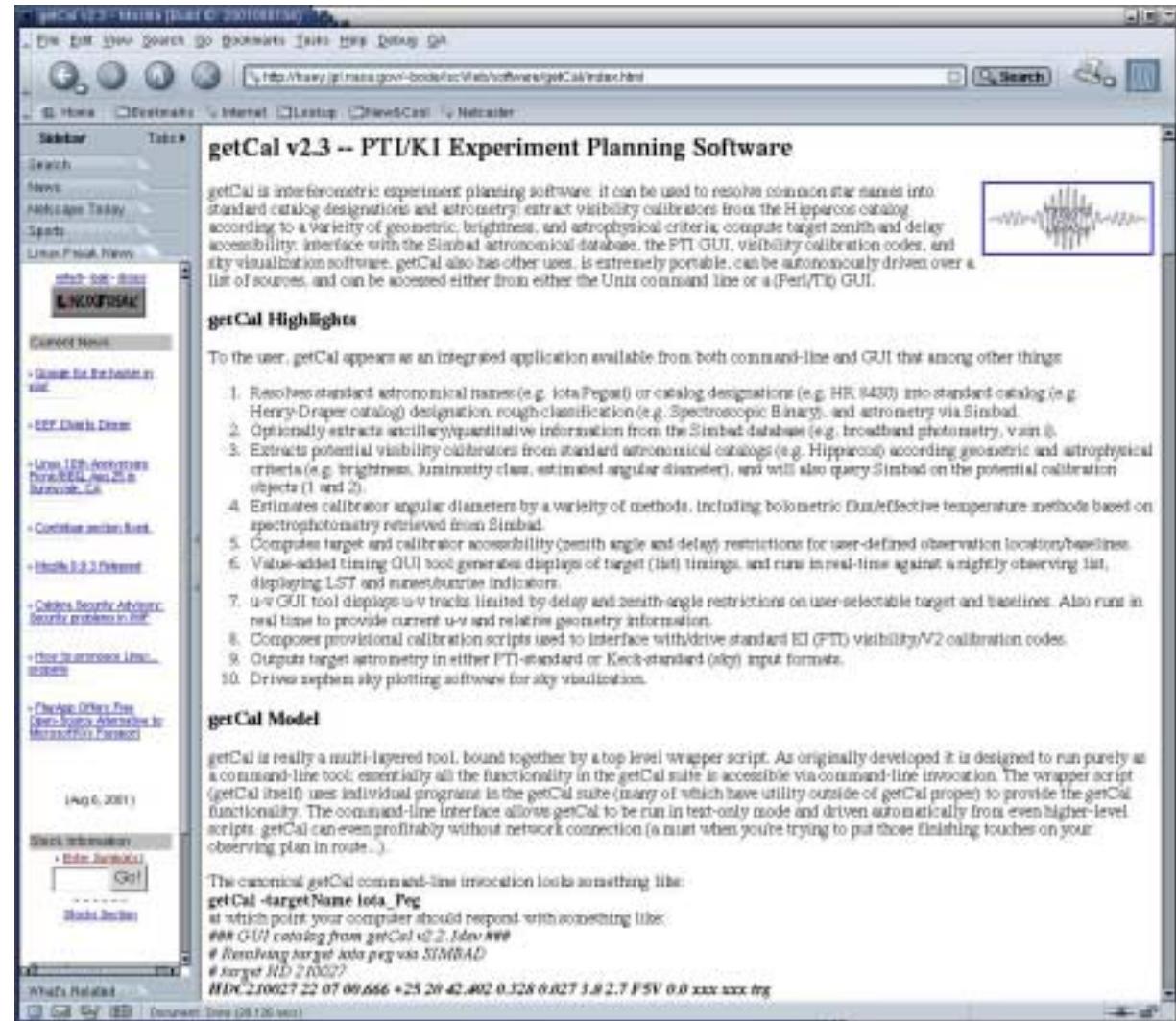
- Spectral Energy Distribution/Bolometric flux – effective temperature modeling





getCal Documentation

- getCal documentation is on-line at isc.caltech.edu



<http://isc.caltech.edu/software/getCal>

External Calibration Applications

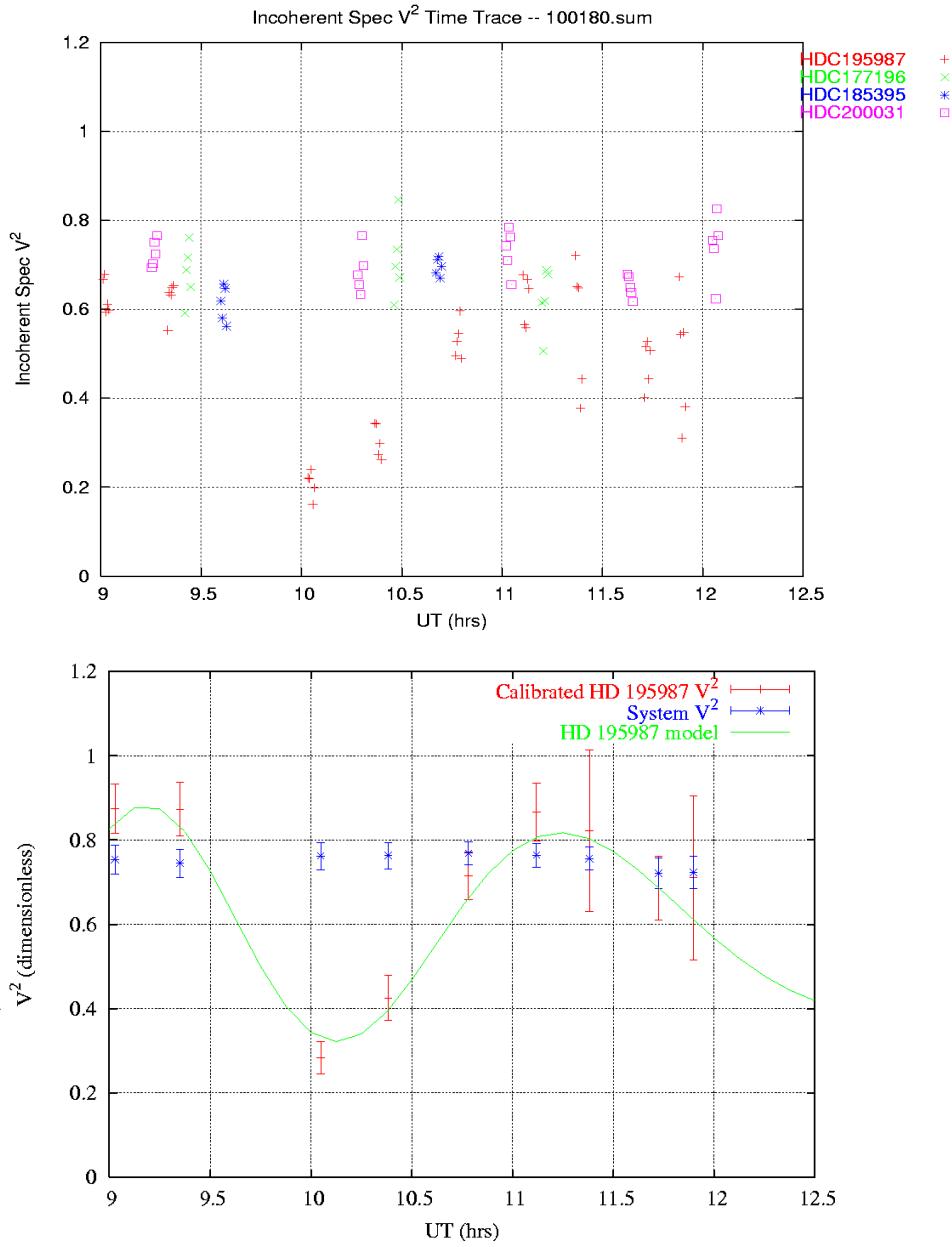
- PTI-Heritage wbCalib & nbCalib are *external* visibility amplitude (V^2) calibration applications
- wbCalib & nbCalib produce “externally calibrated” visibility data products – estimates of visibility measured by ideal interferometer
 - u-v points for calibrated visibilities
- wbCalib & nbCalib are the entry point to astrophysical modeling of visibilities
- Testing criteria based on external comparisons with other astronomical results (e.g. binaries, stellar diameters)

Key Features of Calibration Applications

- Common Command-Line Interface
 - I/O
 - Option flags
- Input:
 - Calibration script defining calibration targets and reference objects (ASCII)
 - L-1 data format (PTI & KI -- ASCII)
- Output:
 - ASCII output format (stdout)
 - FITS output format (through separate filter)
- Processing:
 - Identification of “pertinent” calibration observations
 - Modeling of scalar “system visibility” (on baseline basis)
 - Application to target scans
 - Delay value checking and computation of u-v geometry

Illustrative Use Case

- Standard invocation
wbCalib cs.hd195987 100180.sum
- Identification of Calibration Sources
- Consolidation of Data Points into “Scans”
- Modeling and Application of System Visibility



wbCalib & nbCalib Documentation



8/2

<http://isc.caltech.edu/software/wbCalib>

<http://isc.caltech.edu/software/nbCalib>

Node:Top, Next:Description, Up:(dir)

wbCalib - Wide-band Optical Interferometric Visibility Amplitude Calibration

wbCalib - Wide-band Interferometric Visibility Calibration A.B. 7/97 - 4/01

- [wbCalib General Description](#)
- [Inputs and Outputs](#)
- [wbCalib Additional Features](#)
- [wbCalib Algorithm, Internals, and Dependencies](#)
- [Algorithm Details](#)
- [Data Management](#)
- [System Visibility Estimation](#)
- [Error Estimatology](#)
- [Astrometric Processing](#)
- [Dependencies](#)
- [wbCalib Command-line Arguments](#)
- [Build/install Instructions](#)
- [Test Cases](#)
- [Auxiliary Components](#)
- [bad3cane](#)

Node:Description, Next:Inputs_and_Outputs, Previous:Top, Up:Top

General Description and Features

wbCalib is a wide-band interferometric (squared) visibility amplitude (modulus) calibration application: it correlates observations on one or more science targets with observations on one or more calibration sources, estimates a model of the system visibility (see [Algorithm](#) below) at the times of the target scan, applies this system visibility estimate to estimate the calibrated target visibility amplitude at time, and optionally computes ancillary geometric information (i.e. u-v coordinates, delays, hour angles). wbCalib was developed in the context of PTI, where it reads the interferometric data from one or more vis-output sum files (L-1 data). All wbCalib input comes in two (or more) input ASCII files; all data output is ASCII and goes to stdout (with error messages to stderr).

The canonical use case for wbCalib is:

```
wbCalib [options] xxx.calScript xxx.sum [yyy.sum...] [> xxx.calData]
```

where xxx.calScript is a script file that contains object designation and astrometry information in a standard format, and xxx.sum (and any number of additional input data files yyy.sum) is the standard L-1 V^2 reduced data product file. Options for wbCalib are summarized below in [Arguments](#).

Update on tool availability

- Recent permission from Caltech to distribute getCal and external calibration applications (wbCalib/nbCalib)
 - Plan to extend to all applications
- Packages will be available to ALL interested users via a web download interface
 - Expected availability - November
 - Check web site isc.caltech.edu for updates

Areas for collaboration

- getCal extensions
- Data fitting/modeling routines for externally calibrated (Level 2) data
- FITS format for data exchange
- Calibration sources

getCal extensions

- The standard getCal distribution contains the location and baseline information for PTI, KI, NPOI, CHARA and VLTI
 - A mechanism could be added for including user specified locations and baseline
- Currently calibrator searches are done using the Hipparcos catalog
 - Working on including access to the Tycho2 and 2MASS point source catalog
 - Defined interface for including other catalogs

Graphical interfaces to tools

- The tools presented here are command line based and modular
 - GUI tools are a separate layer – could have multiple GUI tools if desired
 - Example: calGui is a prototype GUI for plotting data and running wbCalib
 - ❖ Other users might want different functionality in a GUI or a different look (we use mostly perlTk) to match other tools

Data modeling and fitting tools

- After data have been externally calibrated, often the next step is producing fits or models
 - Uniform brightness disk, Gaussian, binary etc.
- As instrument specifics have been removed, these tools could work on data from many instruments
- ISC plans to develop fitting tools with same design philosophy
 - Modular routines with separate calculation and graphics components
- If a flexible set of underlying routines were developed, they could be used by many groups
 - Question: Are there already packages in use that the OIR interferometry community should consider using? (aips++, IRAF, ??)

FITS data exchange

- Per community agreement, FITS is a good mechanism for exchange of externally calibrated data
- ISC has prototype routines to write both calibrated and uncalibrated data to FITS files
 - Includes keywords from draft standard

Calibrators

- ISC has started to accumulate a list of calibrator sources used at PTI and KI
 - Will be available on web page