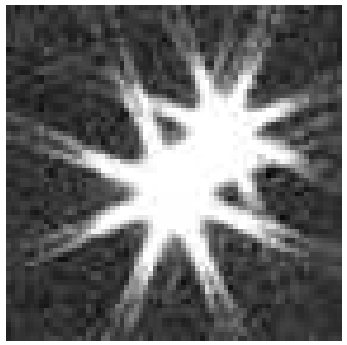
Separated Fringe Packet Analysis

Probes Unexplored Regimes for Stellar Companions



CHARA Collaboration Meeting

March 13, 2007

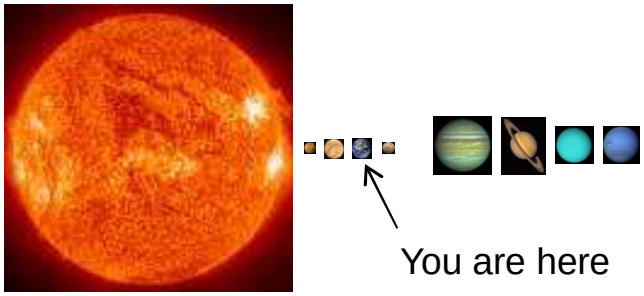
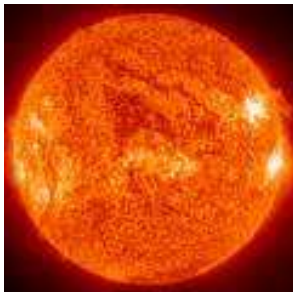
Deepak Raghavan

Graduate Student, GSU

The Motivation: Understanding Stellar Families

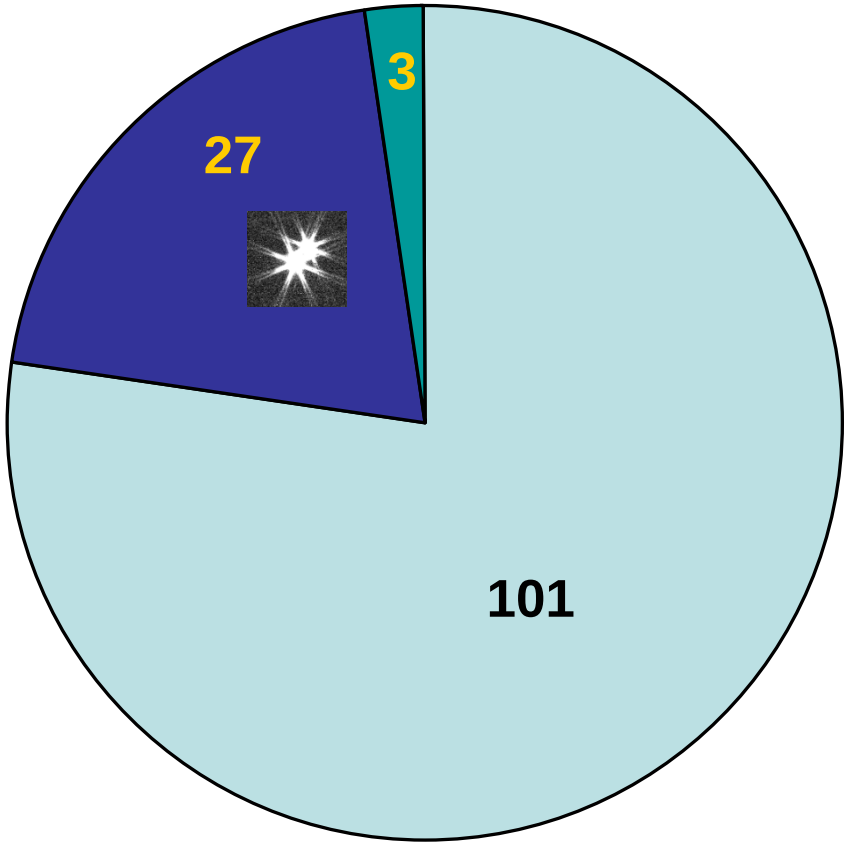
Do Sun-like stars have…

C o m p a n i o n s ?

Do they have… C h i l d r e n ?	No	Yes
Yes		
No		

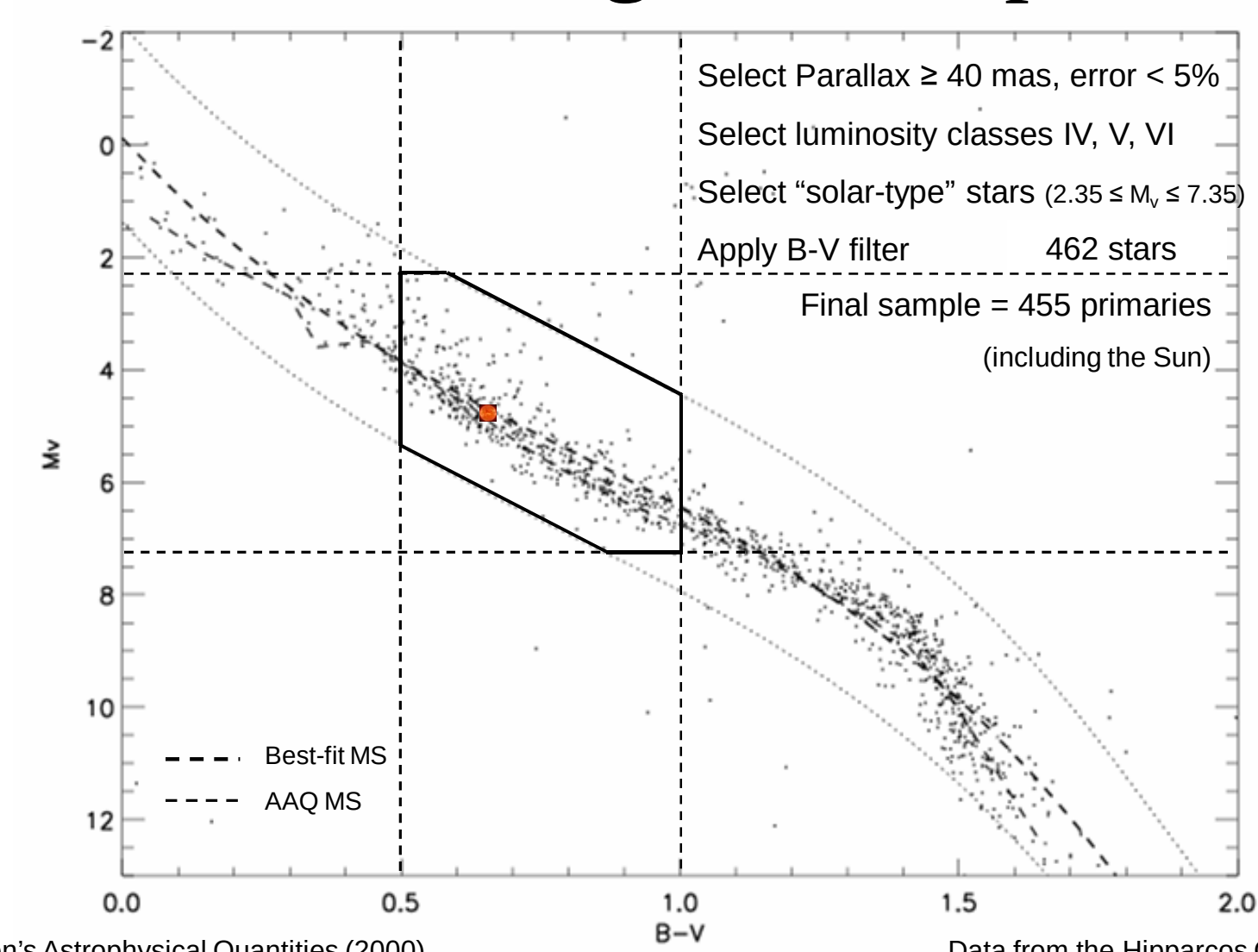
Two Suns in the Sky

Almost ¼ of the planetary systems reside in multiple star environments



Source: Raghavan et al. (2006)

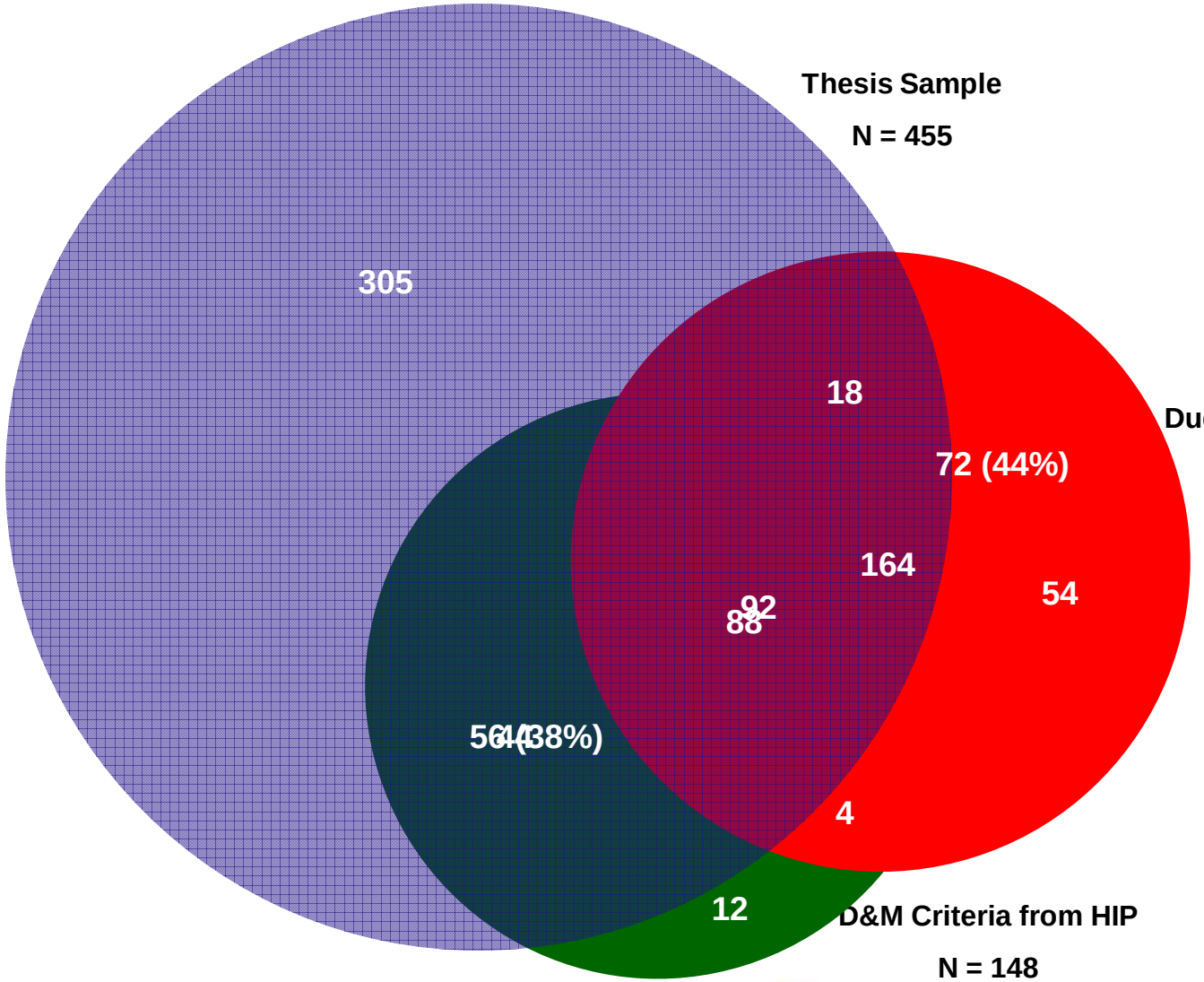
Defining the Sample



AAQ: Allen's Astrophysical Quantities (2000)

Data from the Hipparcos Catalog

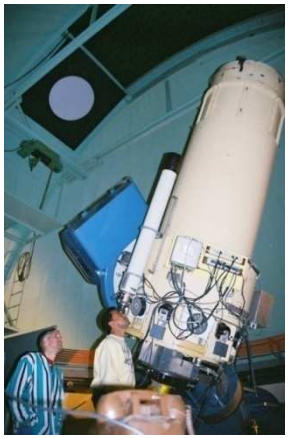
Comparison of Samples



Three Pieces of the Effort…

Synthesize

Observe



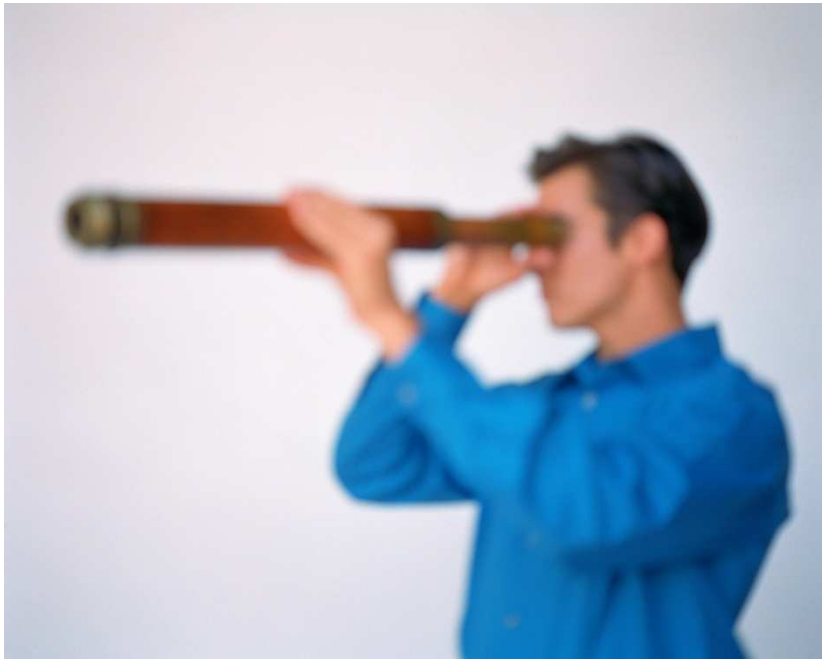
Analyze

Synthesize

- ✓ Archival images: Common Proper Motion
- ✓ The Washington Double Star Catalog
- ✓ Fourth Interferometric Catalog
- ✓ Sixth Visual Orbit Catalog
- ✓ Ninth Spectroscopic Binary Catalog
- ✓ Hipparcos multiple star entries
- ✓ Catalog of Nearby Stars
- ✓ Exoplanet catalogs

Observe

- CHARA
- Speckle Interferometry
- Photometry



CHARA Observing

Twin Objectives using the SFP technique:

- Identify new stellar companions
- Fully characterize orbits of known binaries

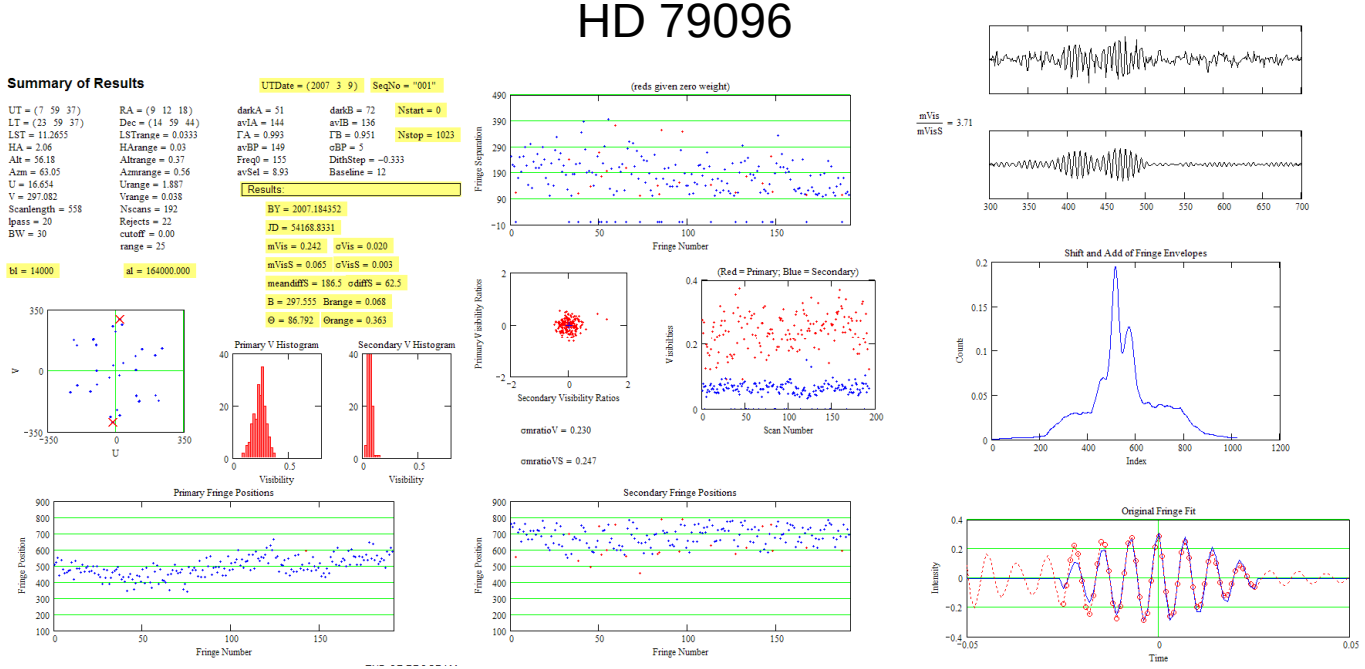
- Targets observable with CHARA = 288 (63%)
  - $V \leq 9$, $K \leq 6$, Dec $\geq$ -10
- Overlap with CF list = 92
- On my observing list = 196

Estimate 28 full nights for the survey + 12 nights for follow-up observations of binaries

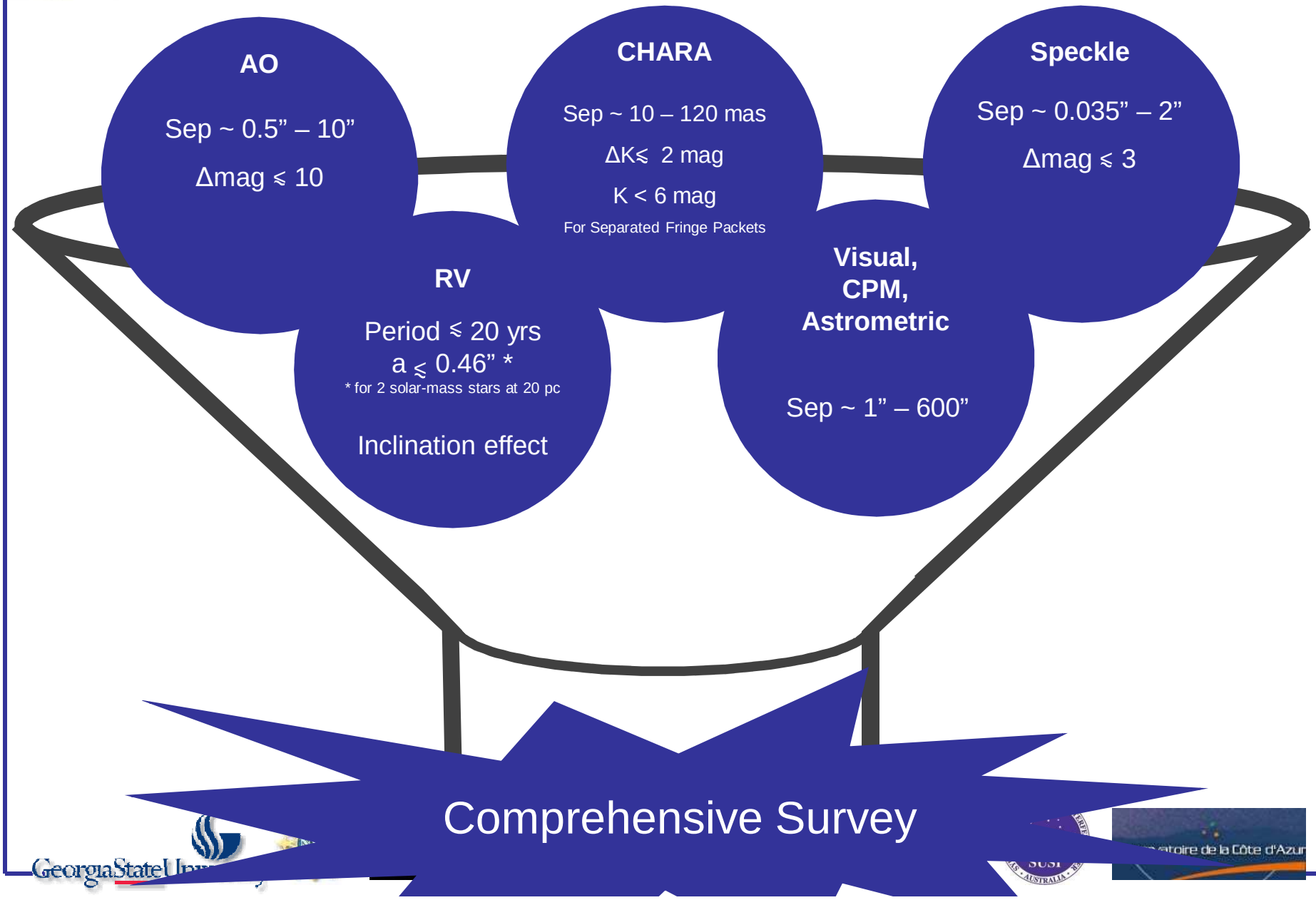
CHARA Observation Status

- 30 targets observed to-date
- Only 1 separated fringe envelope found so far

HD 79096

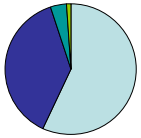
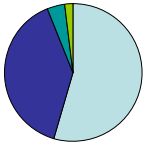
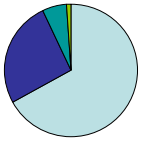


Maximizing the Search Space

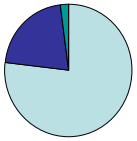
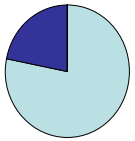


Progress Report

Volume Limited Samples

		Percentages			
		★	★★	★★★	★★★★
D&M 1991 (N = 164)		57	38	4	1
D&M criteria subset (N = 92)		55	39	4	2
This Work (in progress, N = 455)		67	26	6	1

Planetary Systems

Raghavan et al. 2006 (N = 131)		77	21	2	0
Planet-hosts within 25 pc (N=32)		78	22	0	0

Peripheral Work

- Chara_Plan_B
  - Batch version of Chara_Plan
  - Useful for observation planning for surveys
- Online Observing Log
  - Accessed via CHARA password protected site
- Minor enhancements to
  - Chara_Plan
  - VisUVCalc: MathCAD reduction program

Chara_Plan_B

```
;IMPORTANT: DO NOT MODIFY THE FORMATTING OF THIS FILE.
;           ENTER YOUR DATA IN RELEVANT PLACES, BUT LEAVE HEADER LINES
;           AND POSITIONING OF THE DATA ELEMENTS UNCHANGED!
;#########################################################################
;#  INPUT FILE FOR CHARA PLAN (BATCH VERSION)                            #
;#  See comments in IDL program chara_planB.pro for a better             #
;#  description of the program.                                          #
;#  Questions? Contact: Deepak Raghavan (raghavan@chara.gsu.edu)         #
;#########################################################################
;
Observing Date (YYYY/MM/DD): 2007/02/15
Wave Band (K, H): K
Minimum observing time required per target (hours): 1.5

START BASELINE/POP LIST
+--------------+----------------+----------------+
| Baseline     |  POPs Tel 1    |  POPs Tel 2    |
| (e.g. S1-E1) |  (e.g. 1,2,3)  |  (e.g. 1,2,3)  |
| Enter your data below, as many lines as needed |
|              |                |                |
| S1-E1        |  1,2,3,4       |  1,2           |
| S1-W1        |  1             |  1             |
| W1-W2        |  1,2           |  1,2,4         |
|              |                |                |
|              |                |                |
+---END-BP-----+----------------+----------------+

START TARGET LIST (HD number or coordinates & epoch)
Enter HD numbers or coordinates & epoch below, one entry per row:
HD number format: nnnnnn; Coordinate/epoch format: hh:mm:ss.ss +dd:mm:ss.s eeee.ee
224930
00:06:36.78 +29:01:17.4 2000.00
000166
039587
07:29:01.
--:--  chara_p
Beginning
```

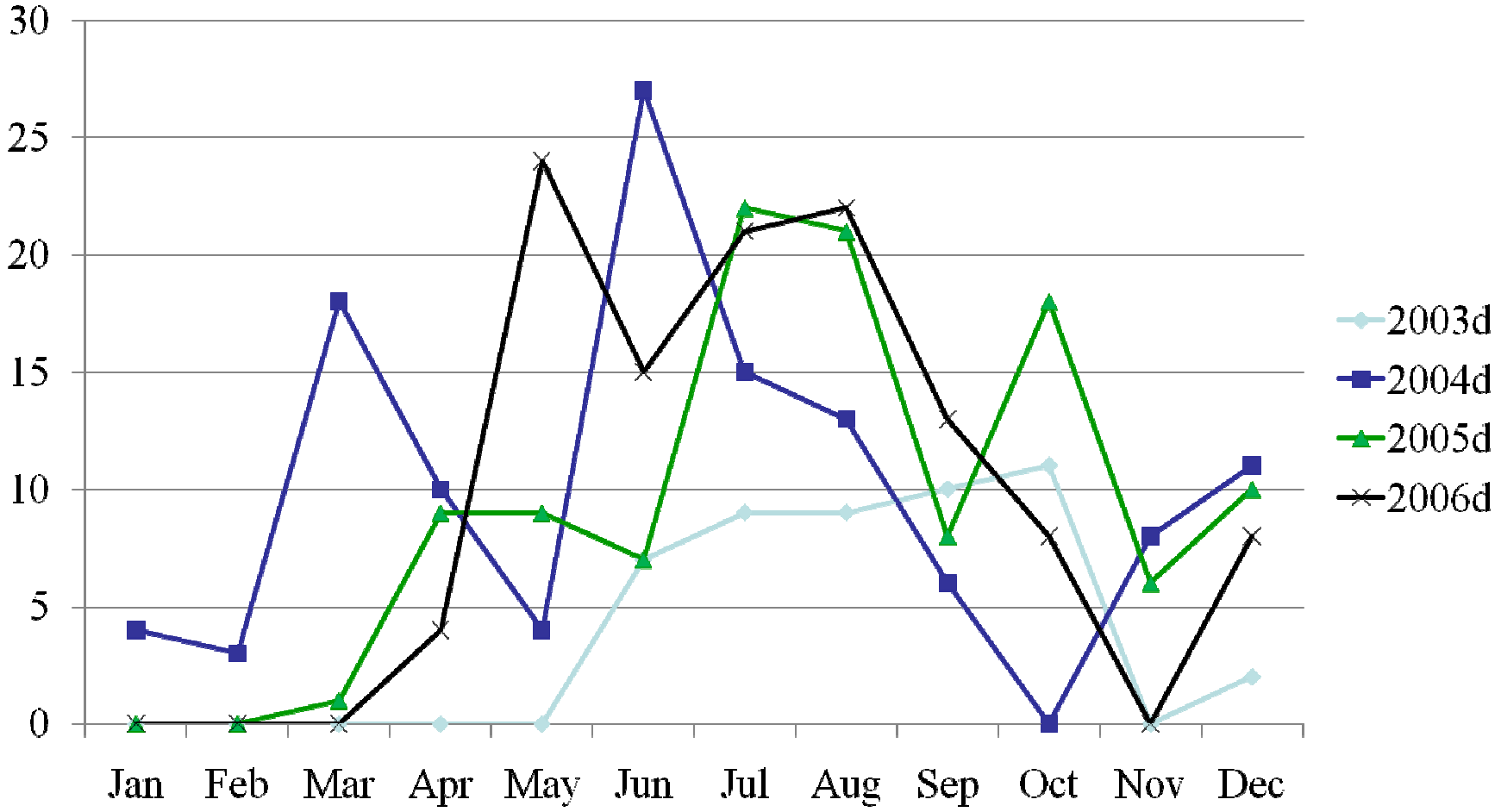
Input file

Output file

```
CHARA observing report created by CHARA_PLANB on Mon Jan 29 16:13:49 2007

Observing Date: 2007/01/21
Wave Band: K
Minimum observing time required per target:  1.50 hours
Total number of valid targets:  138

                                                  Obs      Obs Window Opens      Obs Window Closes     Min  at     Max  at
 HD ID  <=== Coordinates ===>  Epoch              Dur      HA     UT    Alt      HA     UT    Alt       Base UT     Base UT
                                                  (h)      (h)  (hh:mm) (deg)    (h)  (hh:mm) (deg)     (m)        (m)

Baseline/POP: S1(1)-E1(1)

 10086  01:39:35.8 +45:52:42.0 1991.25  4.00     1.25  02:47  71.5     5.25  06:46  31.1     323 06:46  329 03:47
 12051  01:59:06.5 +33:12:37.9 1991.25  3.75     1.00  02:51  77.5     4.75  06:36  32.1     327 04:06  330 06:36
 19373  03:09:02.9 +49:36:48.6 1991.25  5.50    -0.25  02:47  74.3     5.25  08:16  32.2     318 08:16  326 05:16
 20675  03:21:52.4 +49:04:15.8 1991.25  5.75    -0.50  02:44  74.1     5.25  08:28  32.1     319 08:28  327 05:29
 19373  03:09:02.9 +49:36:48.6 1991.25  5.50    -0.25  02:47  74.3     5.25  08:16  32.2     318 08:16  326 05:16
--:--  chara_planB.out      (Fundamental)--L18--C0--Top----------------------------------------------------------------
Beginning of buffer
```

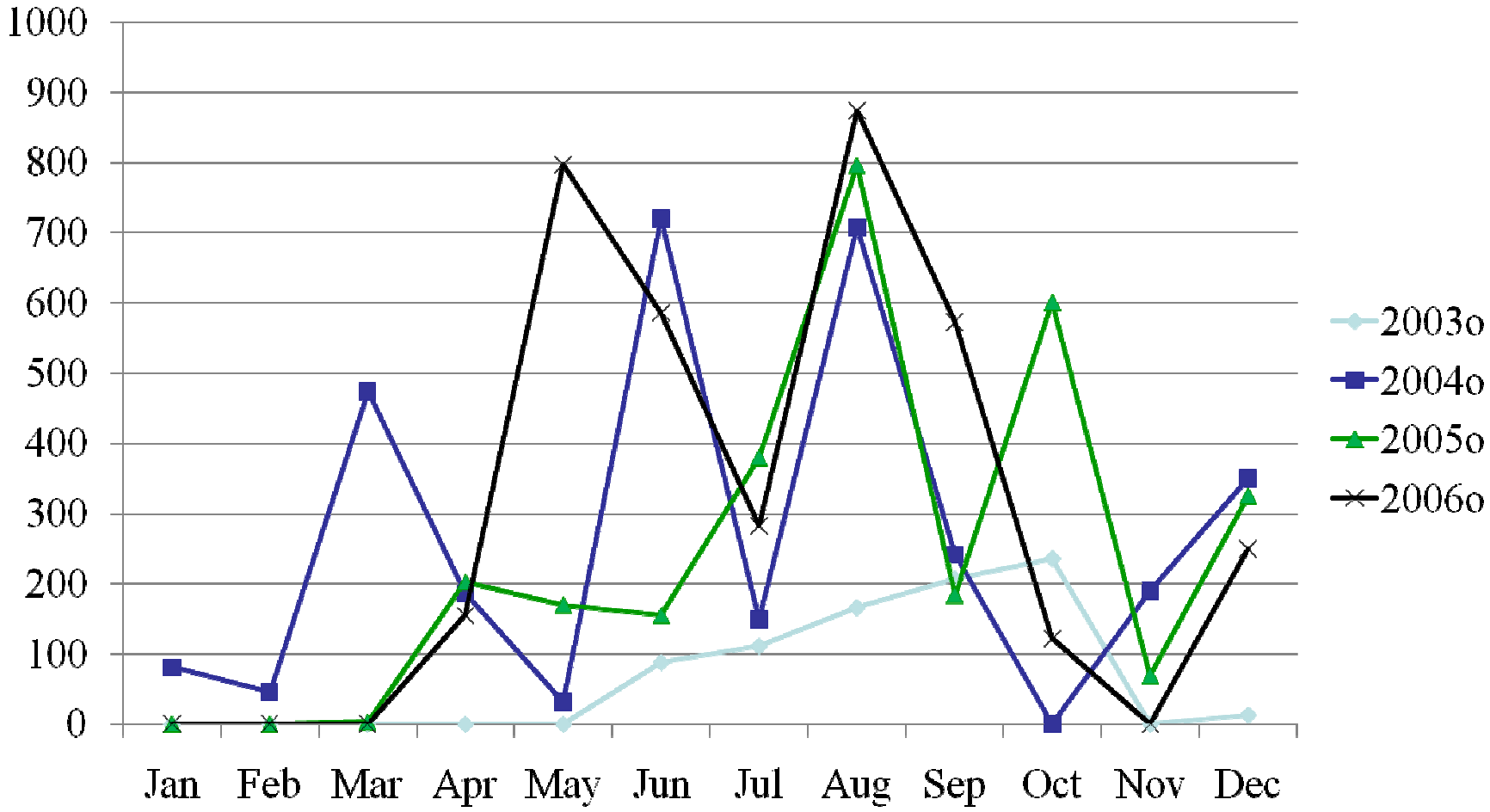
Number of days with observations

Note: CHARA Classic ONLY



Number of Observations

Note: CHARA Classic ONLY



Percent of obs with good seeing (> 6cm)

Note: CHARA Classic ONLY