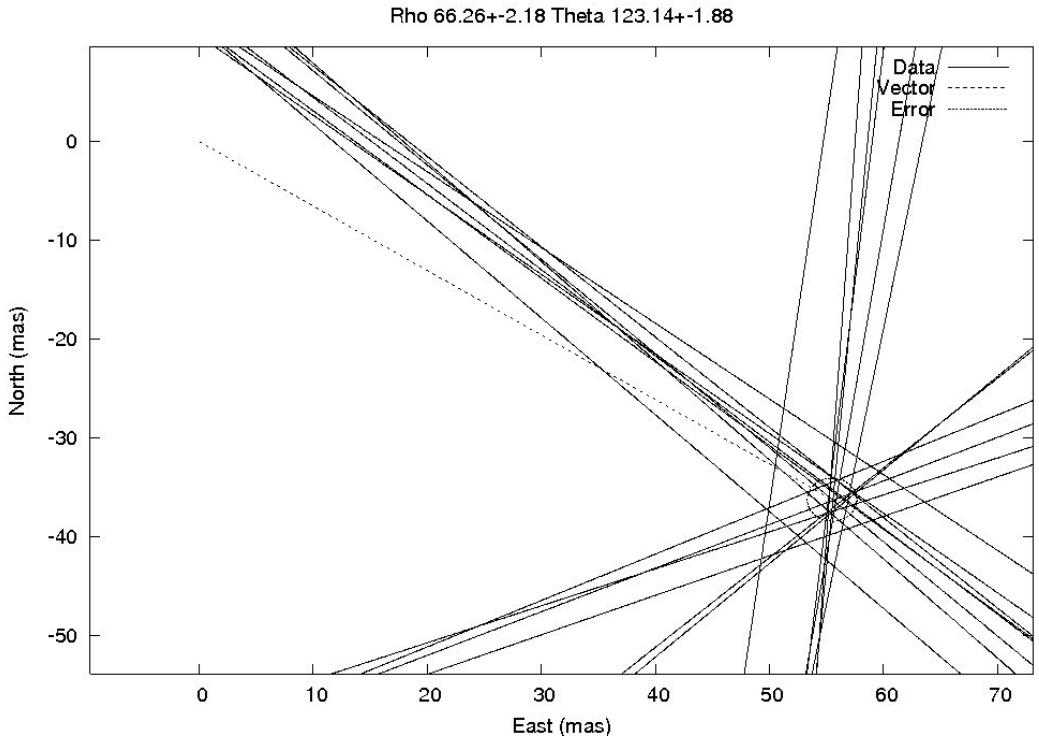
Binary Star Orbits with the CHARA Array

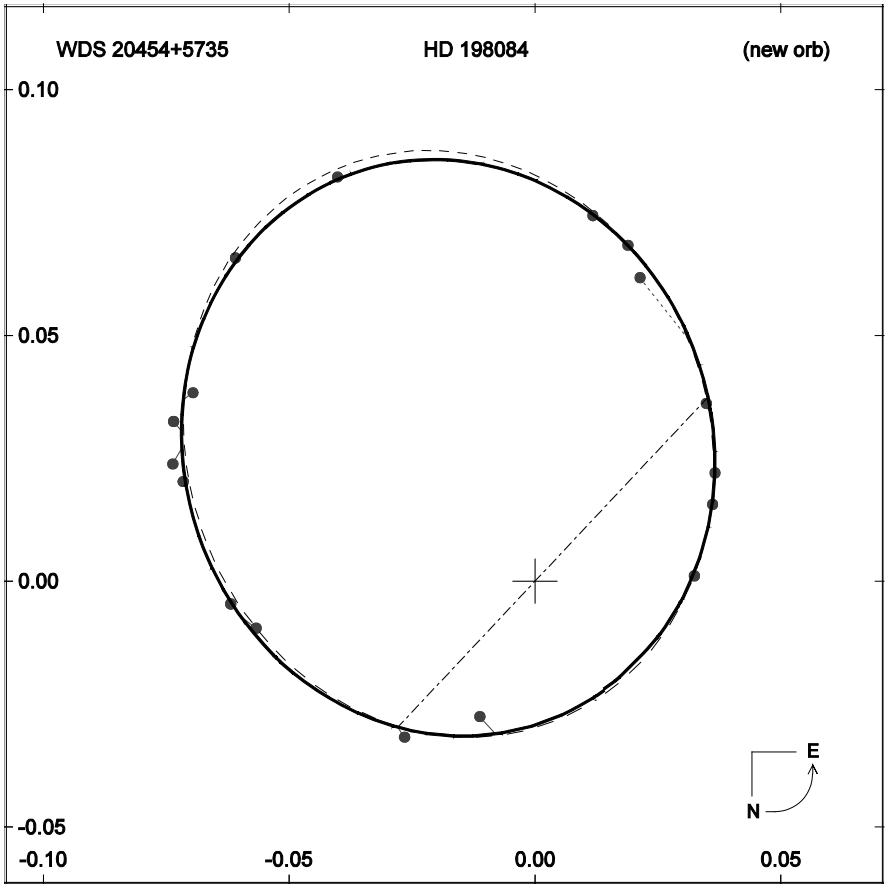


Christopher Farrington

March 1, 2011

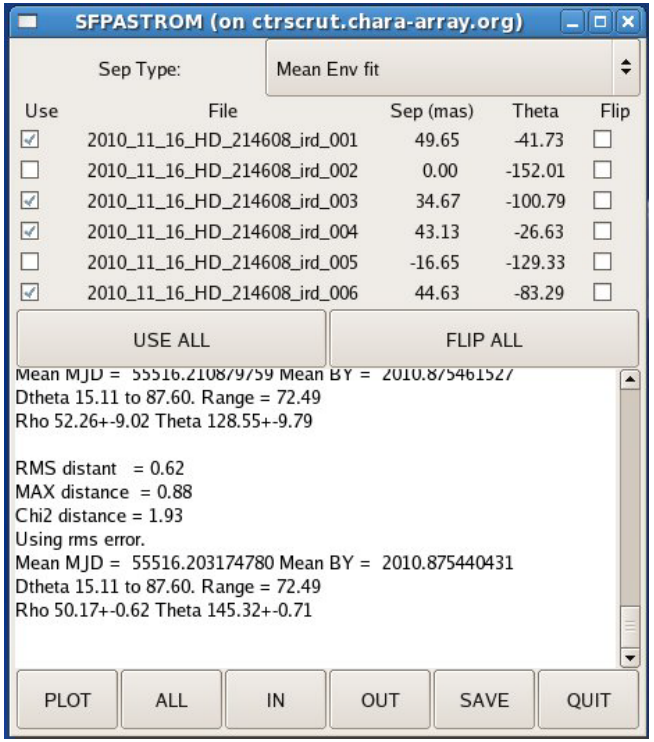
Separated Fringe Packets with CHARA

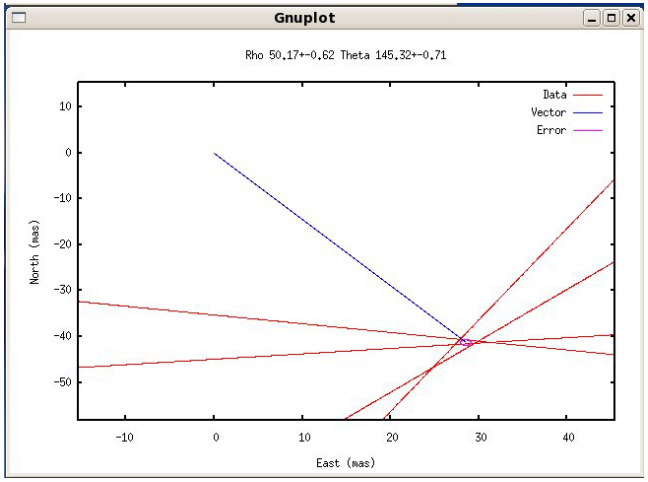
- Switching from Classic to CLIMB
  - From about 4 targets per hour per baseline
  - To 4 targets on all 3 baselines per hour
- Data from the past year shows that we need at least 6 measurements per night, separated by at least an hour
- Separated Fringe Packet Observations with the CHARA Array. I. Methods and New Orbits for χ Draconis, HD 184467, and HD 198084:
  - The Astronomical Journal, Volume 139, Issue 6, pp. 2308-2318 (2010).



SFPASTROM

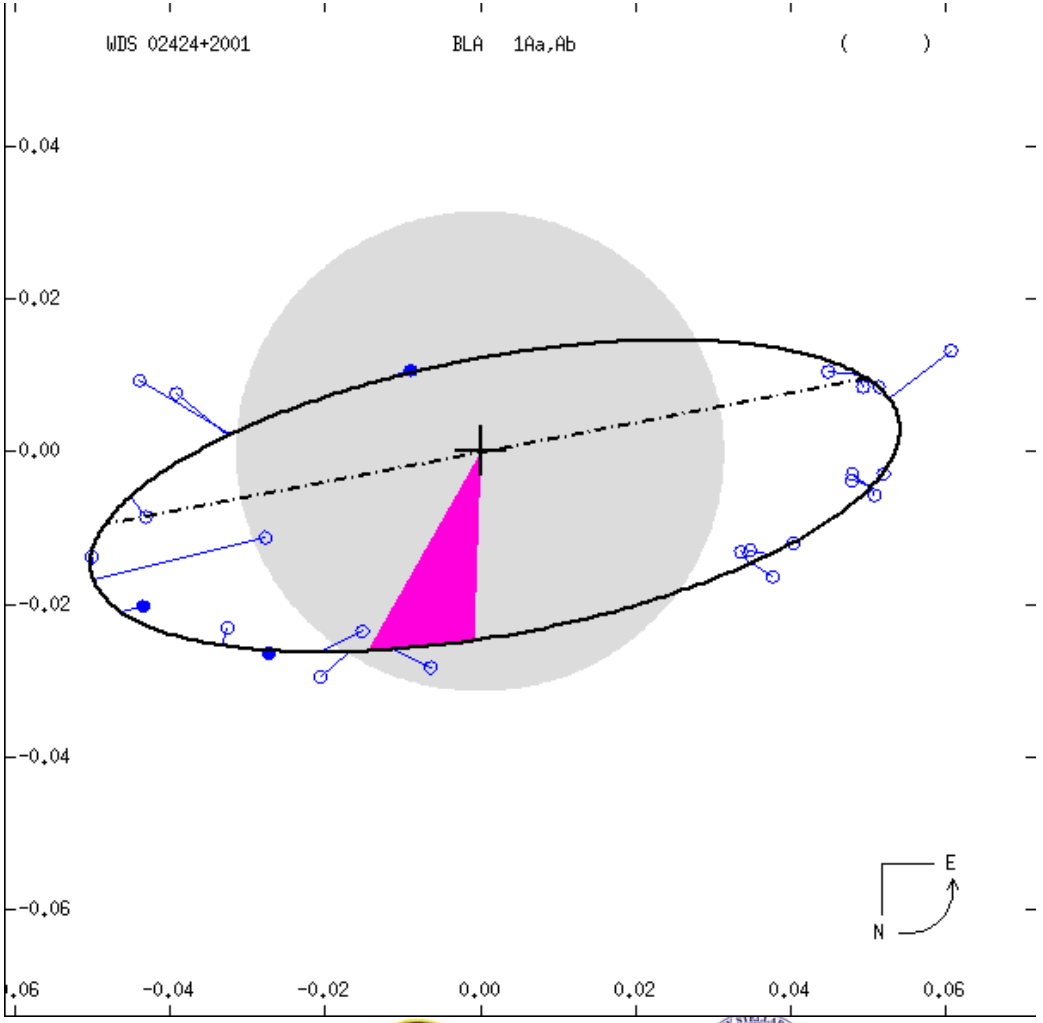
- New addition to our arsenal of tools for measuring SFP data.
- Developed by Theo and modified over the last year.
- Shortens reduction time, easier to manipulate, and provides high quality errors for multiple fitting types.





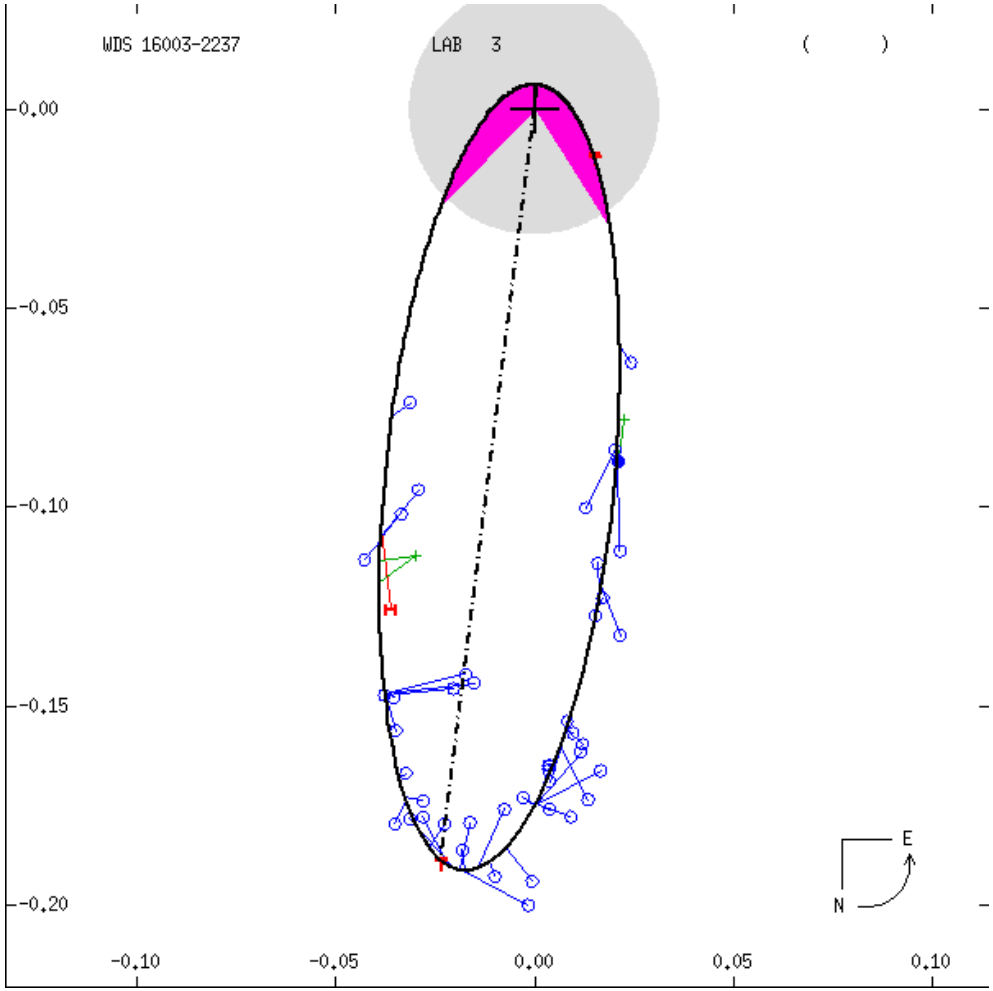
HD 16811 (BLA 01)

- Period (years) = 8.83940±0.03592
- Semi-major Axis = 0.05666±0.00099
- Inclination = 71.49674 ± 1.90203
- Longitude Node = 100.74799±1.27393
- T0 = 1981.0909424 ± 0.0661059
- Eccentricity = 0.3452832 ± 0.0306141
- Longitude per = 92.9575500 ± 1.9964956

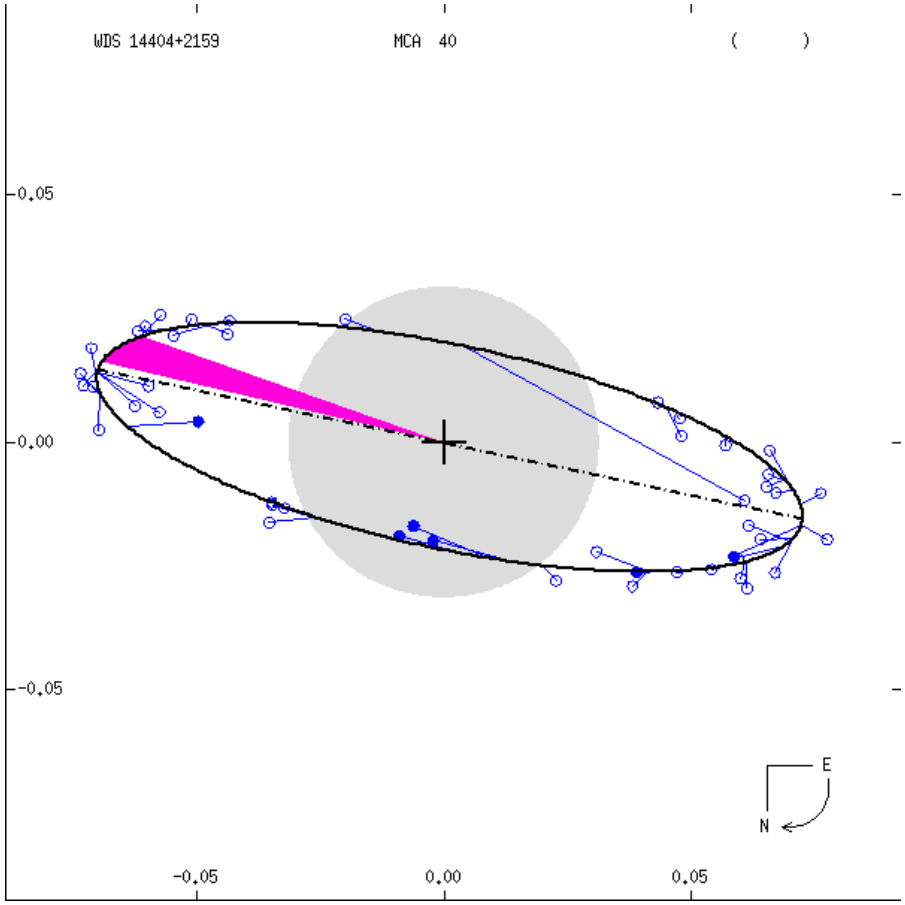


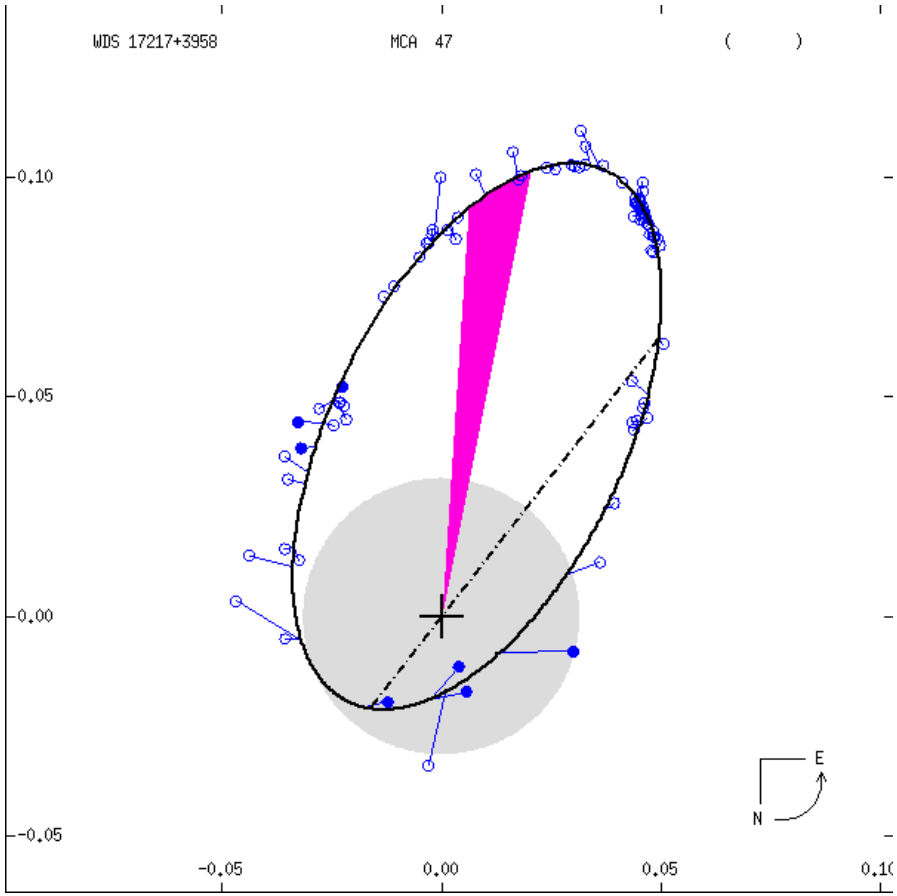
HD 143275 (δSco)

- From Tycner et al. 2011
  - Period (years) = 10.817± 0.005
  - Semi-major Axis (mas) = 99.1 ± 0.1
  - Inclination = 32.9 ± 0.2
  - Longitude Node = 172.8 ± 0.9
  - T0 = 2000.6927 ± 0.0014
  - Eccentricity = 0.9380 ± 0.0007
  - Longitude per = 2.1 ± 1.1
- High priority target in 2011 observing season as it travels through periastron
- Masses from Tycner et al. are better than those from Tango et al.
  - Has fixed mass for secondary based on radius and B-V.



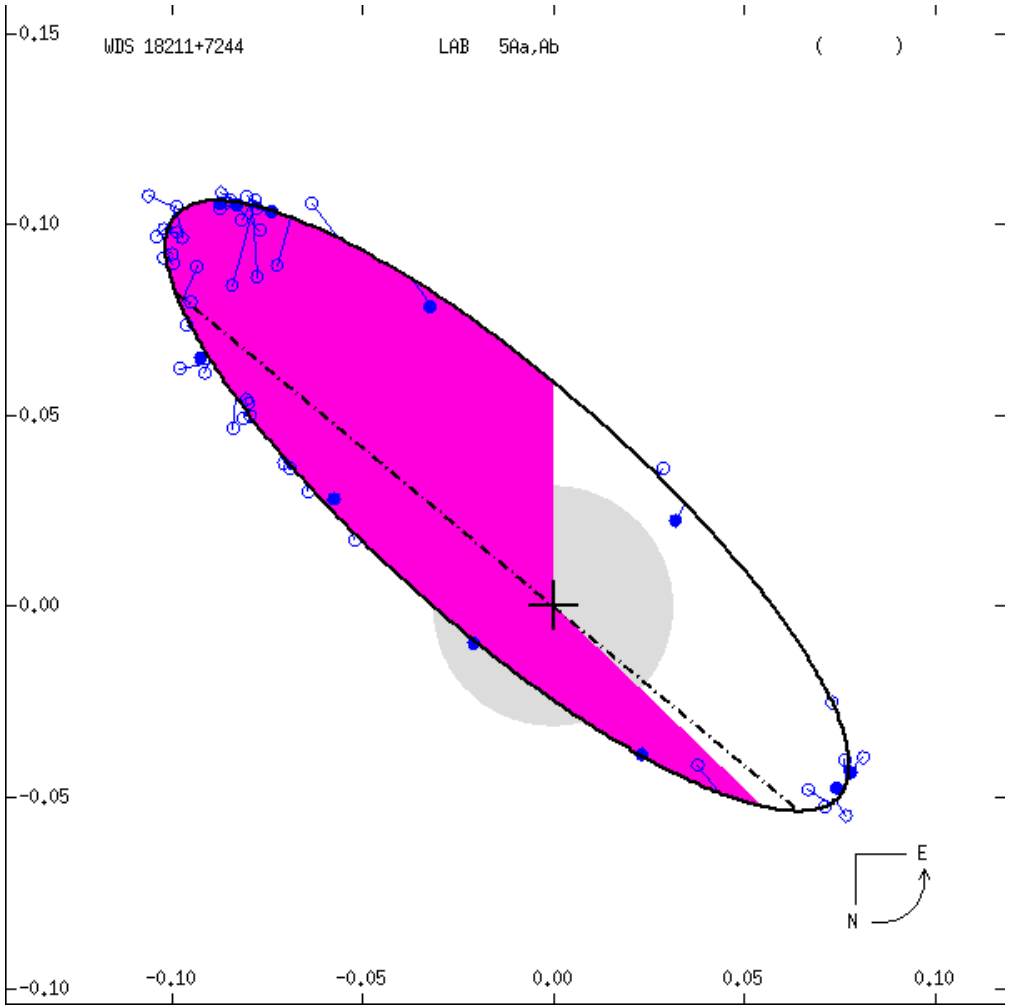
HD 129132 (MCA40) & HD 157482 (MCA 47)





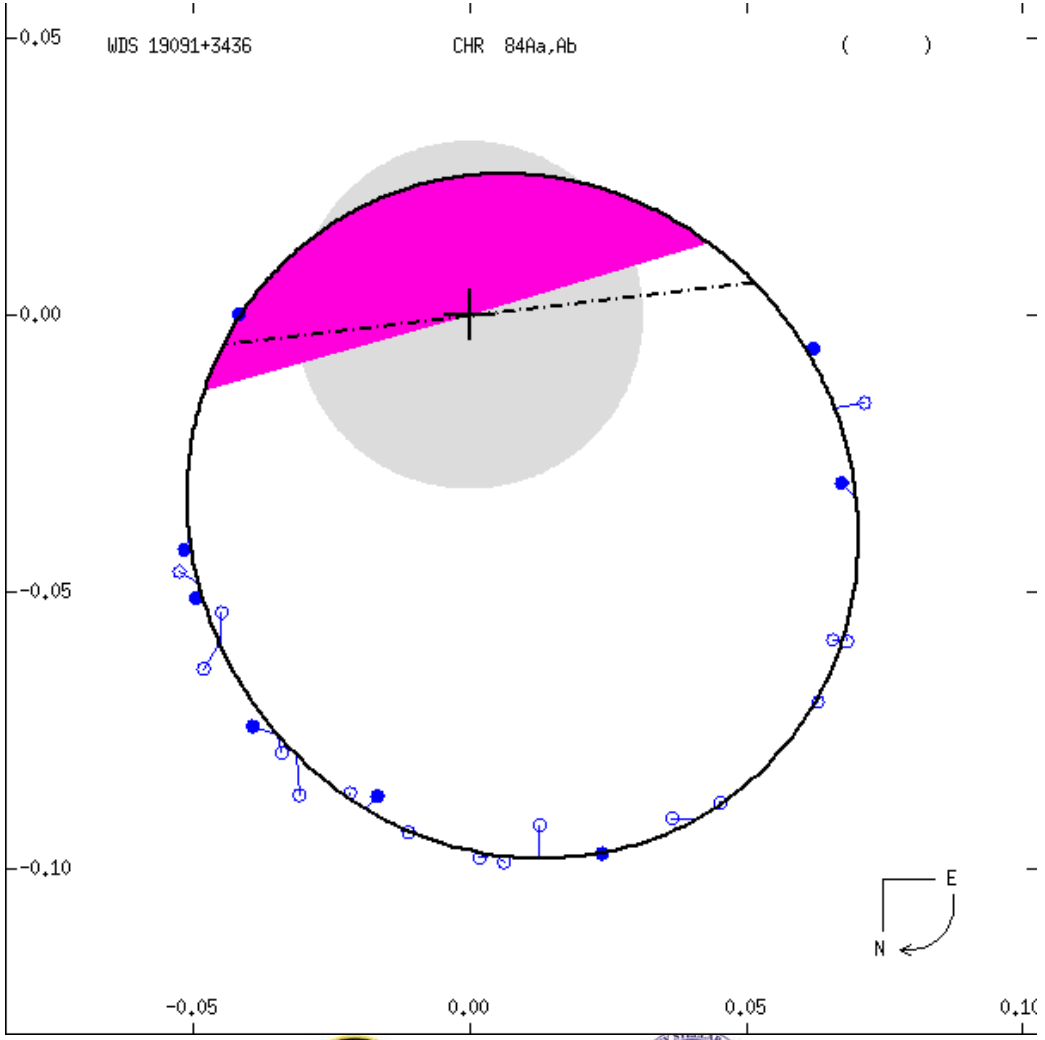
HD 170153 (χDra)

- Orbit from SFP1 paper:
  - Period (years) = 0.7680599 ± 0.000061
  - Semi-major Axis (mas) = 124.4 ± 1.1
  - Inclination = 74.42 ± 0.58
  - Longitude Node = 230.30 ± 0.51
  - T0 = 1984.83239 ± 0.00259
  - Eccentricity = 0.428 ± 0.012
  - Longitude per = 119.3 ± 1.1
  - Mass (Primary) = 0.96 ± 0.03 MΘ
  - Mass (Secondary) = 0.75 ± 0.03 MΘ
  - Orbital Parallax (mas) = 123.4 ± 1.9

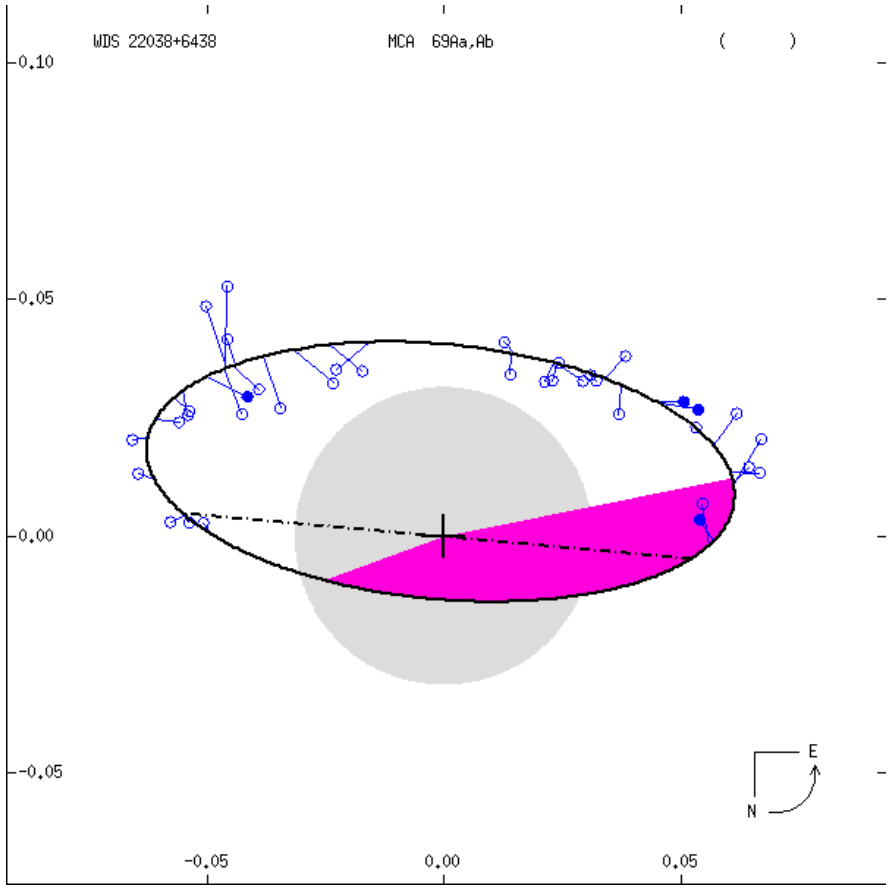


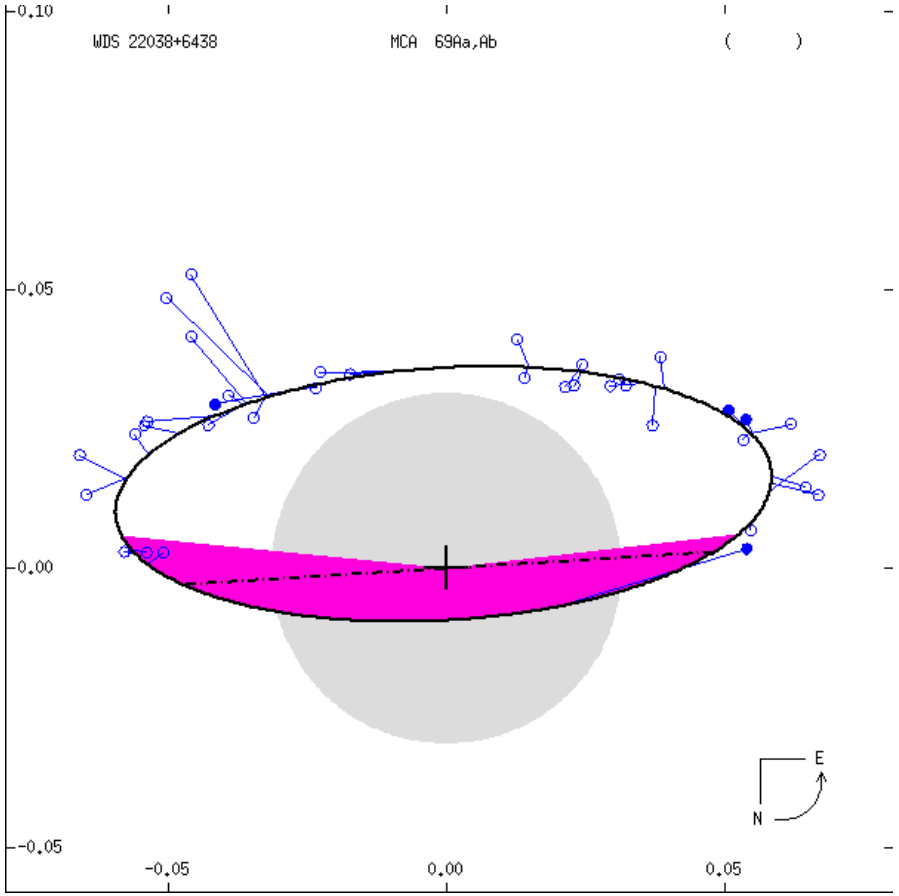
HD 178911 (CHR 84)

- CHARA Orbit including speckle
  - Period (years) = 3.54631 ± 0.00153
  - Semi-major Axis (mas) = 75 ± 2
  - Inclination = 146.31 ± 1.04
  - Longitude Node = 96.80 ± 1.35
  - T0 = 1997.33891 ± 0.00359
  - Eccentricity = 0.600 ± 0.004
  - Longitude per = 263.32 ± 0.81
  - Mass (Primary) = 0.736 ± 0.049 MΘ
  - Mass (Secondary) = 0.572 ± 0.047 MΘ
  - Orbital Parallax (mas) = 29.49 ± 1.72
- As it passes through periastron this year, another high priority target
- Masses are small for G1V+G5V components. Periastron measurements should help



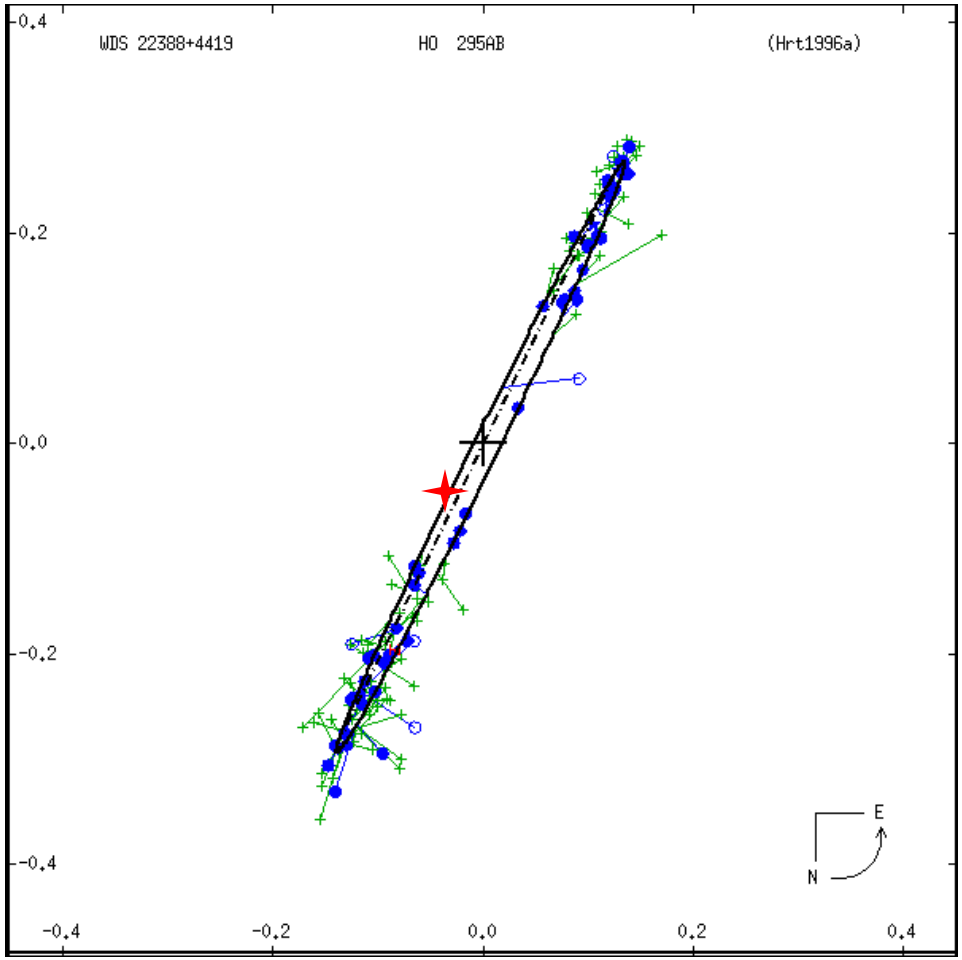
HD 209790 (17 Cep)



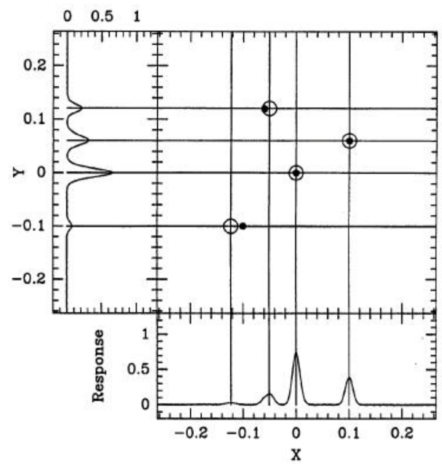


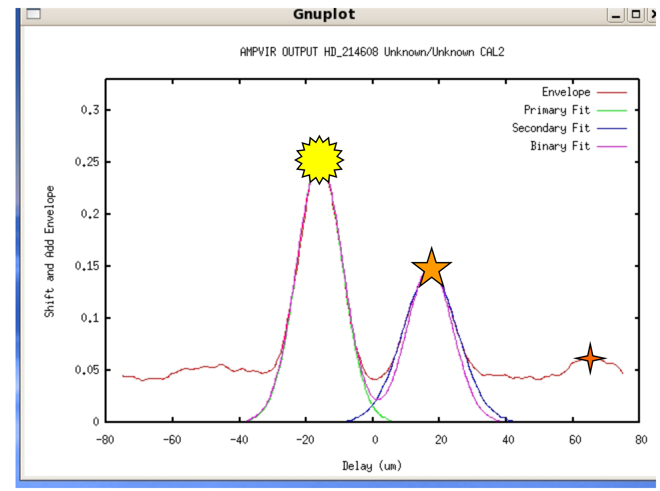
HD 214608 (BAG 15)

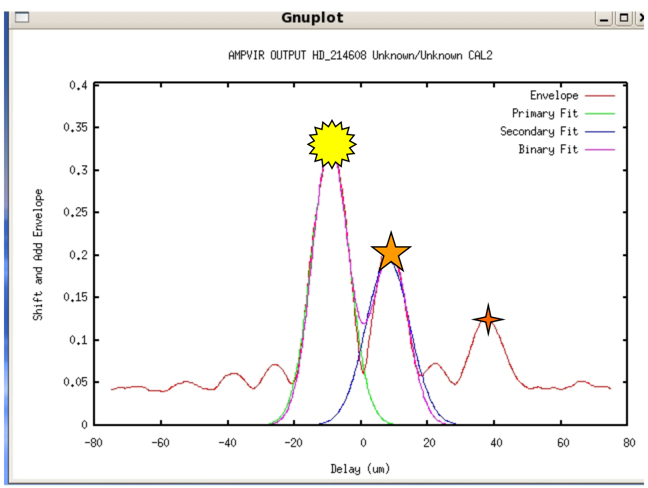
- Triple system
  - Outer orbit: 29.889 y
  - Observed 09/01/2010
    - Predicted position on outer orbit 61.69 mas at 326 degrees
    - Second observation 11/16/2010
      - 81 mas 328 degrees
  - Inner orbit: 551.6 days
    - Resolved with speckle 6 times
    - No visual orbit

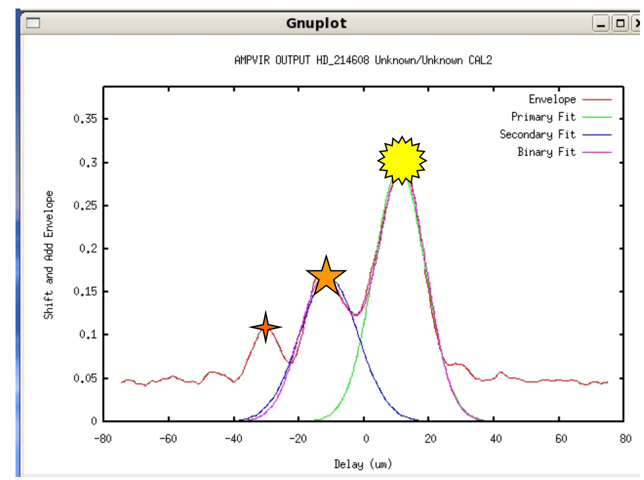


HD 214608 (BAG 15)



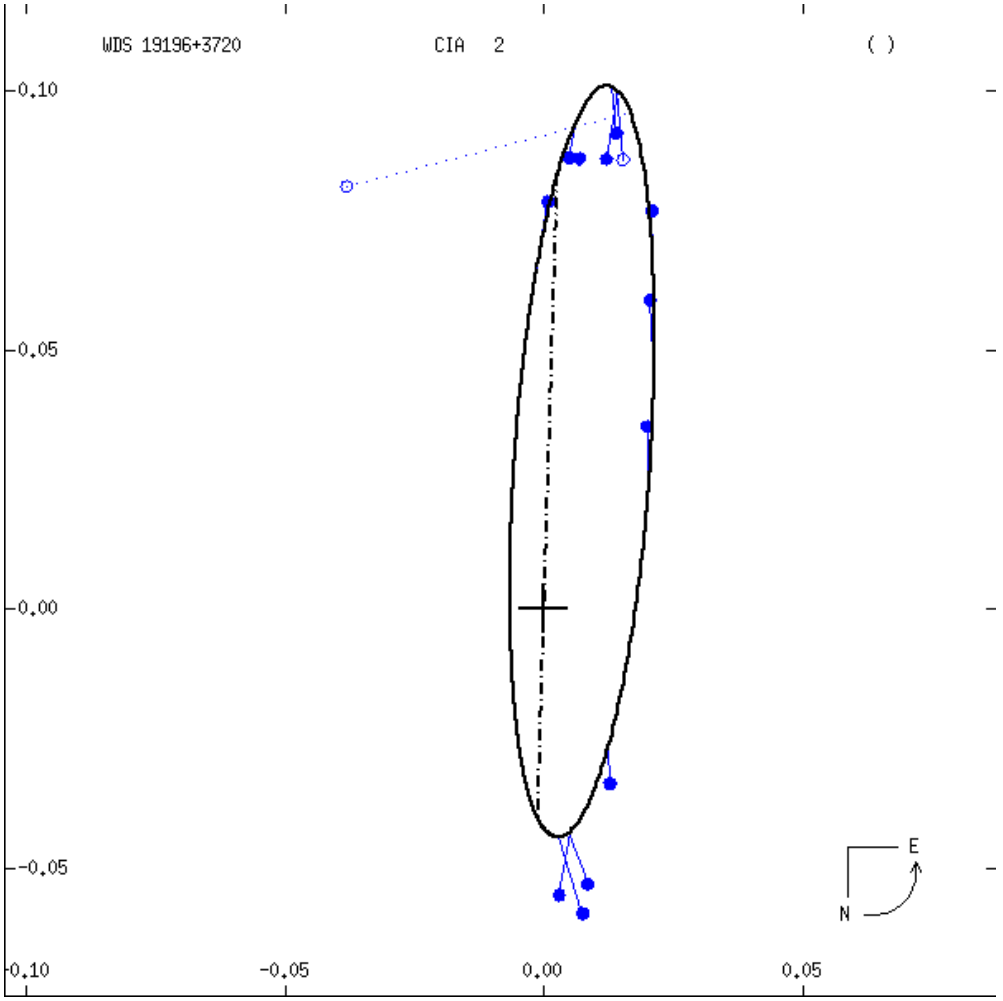






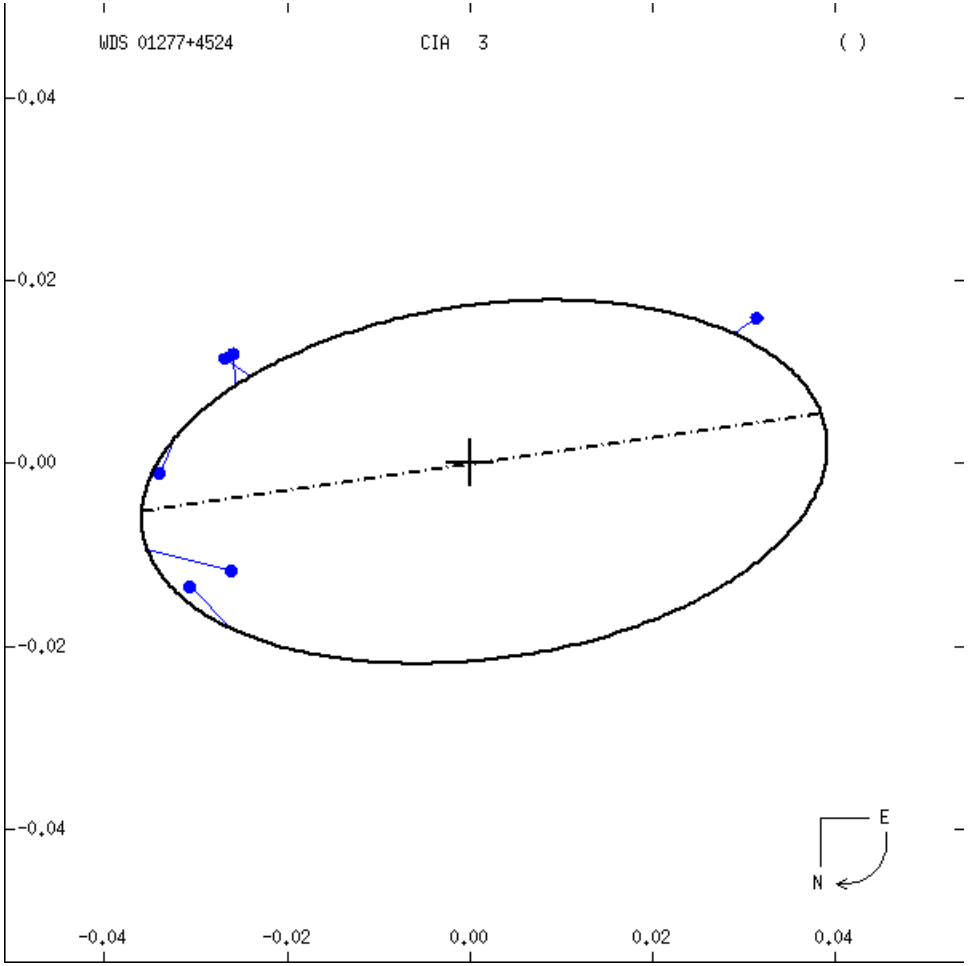
HD 181655

- Preliminary orbit from CHARA 2005-2010
  - Period (years) = 0.9017 ± 0.0052
  - Semi-major Axis (mas) = 81.6 ± 5.2
  - Inclination = 79.93 ± 2.54
  - Longitude Node = 178.25 ± 2.6
  - T0 = 2010.6073 ± 0.0229
  - Eccentricity = 0.577 ±0.070
  - Longitude per = 127.57 ± 4.98
- Difficult system:
  - No radial velocity variations over 0.1 km/s over 15-20 years worth of observations
  - Almost always north/south but always has 2 fringes



HD 8799 (ω And)

- Asked to look into this system by R. Griffin
  - Period (years) = 1.161 ± 0.048
  - Semi-major Axis (mas) = 38.05 ± 8.27
  - Inclination = 120.61 ± 12.06
  - Longitude Node = 278.22 ± 11.95
  - T0 = 2009.84 ± 0.20
  - Eccentricity = 0.120 ± 0.089
  - Longitude per = 73.4 ± 78.9
- Very preliminary, another target for this year.
  - Does not fit spectroscopic orbit as yet. (254 days vs 424 days)
  - Nearly identical components



Scheduling Statistics

2010-1

BC	Proposals	Optimal	Assigned
Classic	14	86	79
FLUOR	3	45	32
MIRC	8	50	45
PAVO	7	42	33
VEGA	13	28	28
CLIMB	3	39	26
Totals	48	290	243
153 Nights		89.5%	58.8%

2010-2

BC	Proposals	Optimal	Assigned
Classic	7	55	35
FLUOR	2	36	20
MIRC	7	54	32
PAVO	6	29	19
VEGA	15	30	25
CLIMB	5	38	23
Totals	42	245	154
108 Nights		126.9%	42.6%

Scheduling Statistics Pt.2

- 2010-1
  - Beams 1-4: 132 nights
  - Beams 5-6: 111 nights
  - Ratio: 1.2 : 1
- 2010-2
  - Beams 1-4: 99 nights
  - Beams 5-6: 55 nights
  - Ratio: 1.8 : 1

- 2011-1 (requested)
  - Beams 1-4: 145
  - Beams 5-6: 68
  - Ratio: 2.1 : 1
  - 153 days available
  - 208 days requested
  - 36% oversubscribed