



# Binary Star SFP Update

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CHARA Year 8 Science Meeting

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# Overview

- Observing of SFPs
- Orbits
- Massive Binaries
- VEGA Subgiants and Omega Andromeda





# 2011 Observing

- Time assigned:
  - 6 full nights, 7 ½ nights
- Data actually taken:
  - 4 full nights, 3 ½ nights
- SFP targets with multiple triangles
- SFP Data files taken:
  - 152 files on 15 targets
- Massive Binary files:
  - 20 Brackets on 3 targets



# SFP Targets

System	Files	Days	System	Files	Days
1976	3	1	101606	3	1
5408	12	2	138629	9	1
8799	27	4	178475	3	1
16234	5	1	178911	24	5
16811	3	1	181655	26	5
65339	4	1	193322	12	3
71705	6	1	209790	9	2
98353	6	1			

## Massive Binaries

System	Brackets	Days
MWC 314	7	2
15558	6	2
199579	7	2



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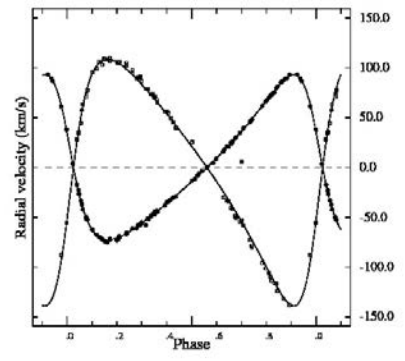
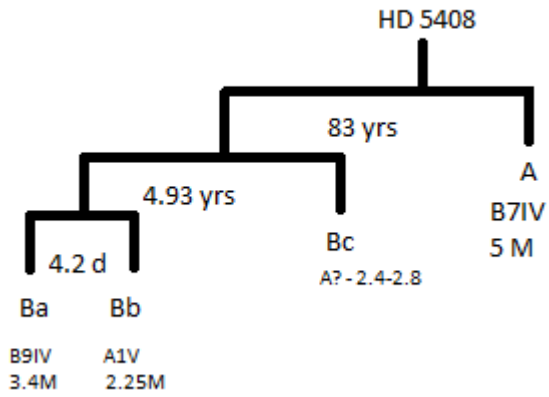
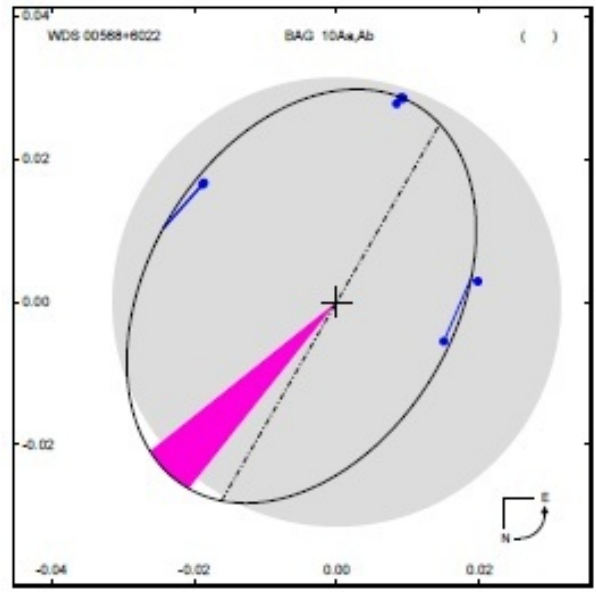
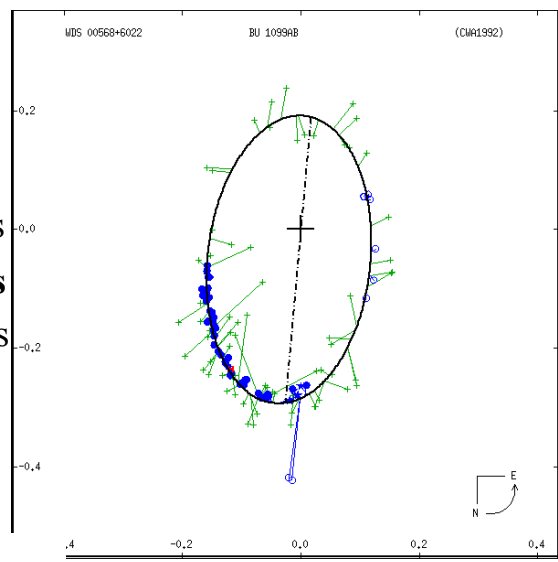


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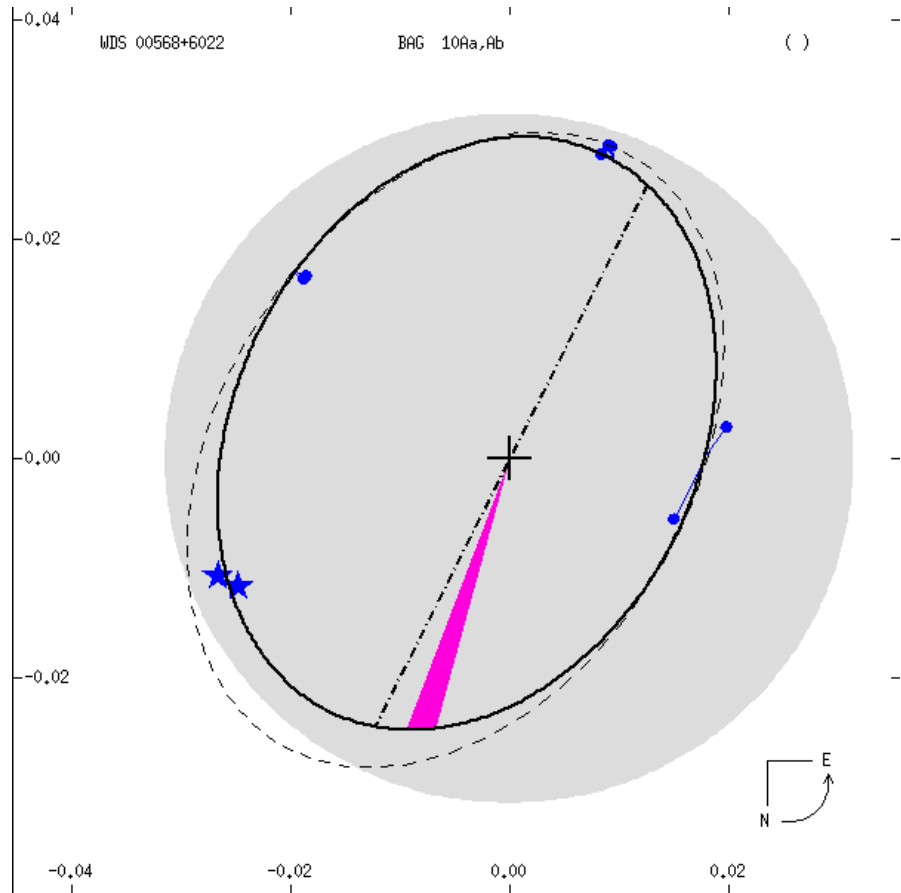
# SFP Orbits

- HD 5408
  - Quadruple system
  - A-Babc = 83 yrs – 250 mas
  - **Bab-Bc = 4.9 yrs – 30 mas**
  - Ba-Bb = 4.2 days – 0.6 mas



# SFP Orbits p2

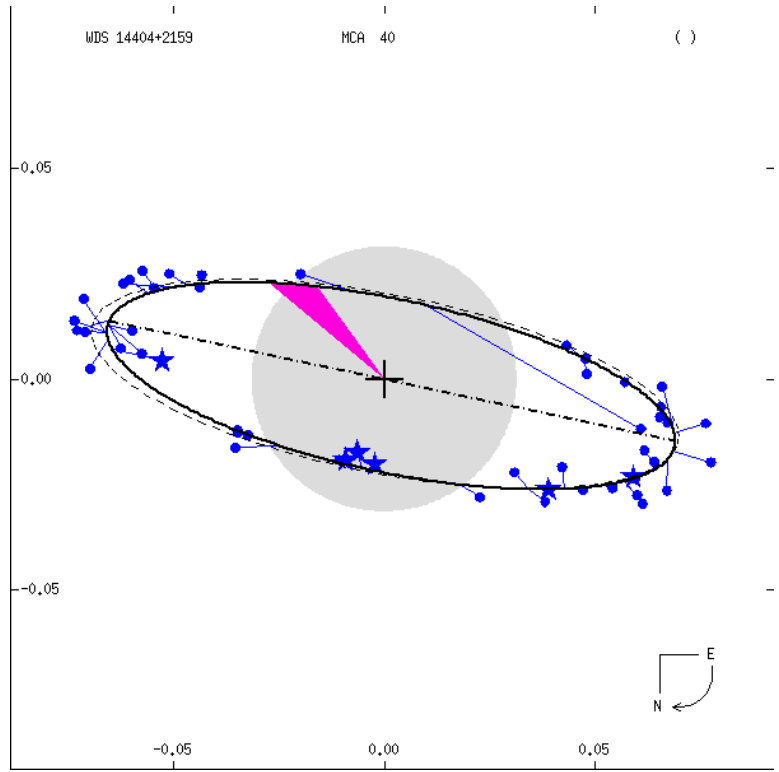
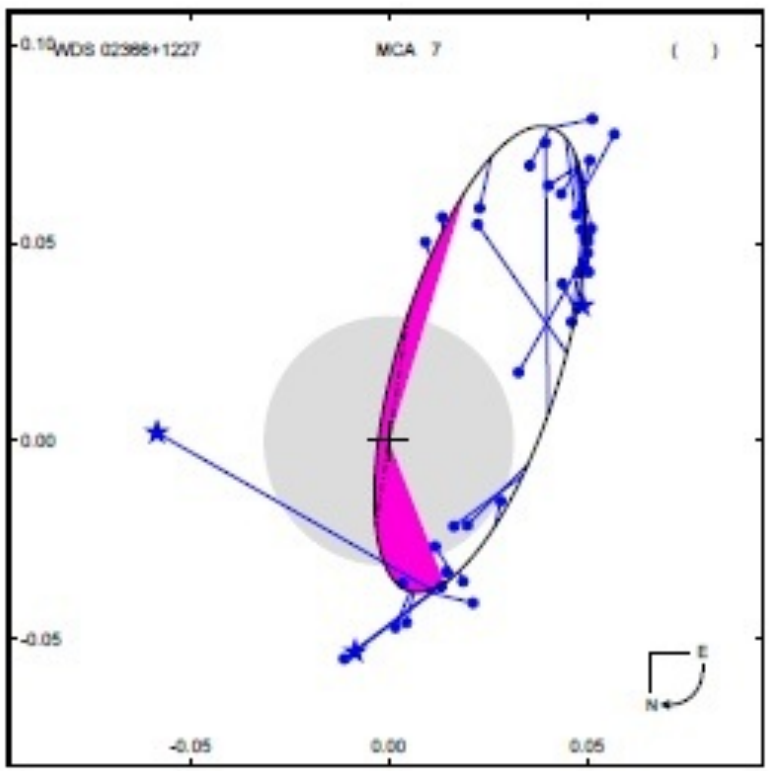
- HD 5408
  - $P = 4.92y$
  - $a = 28.9mas$
  - $i = 42.9 \text{ deg}$  (30 deg error)
  - $T_0 = 2003.5$
  - $e = 0.211$
- More observations in 2012!





# SFP Orbits p3

- HD 16234 and 129132



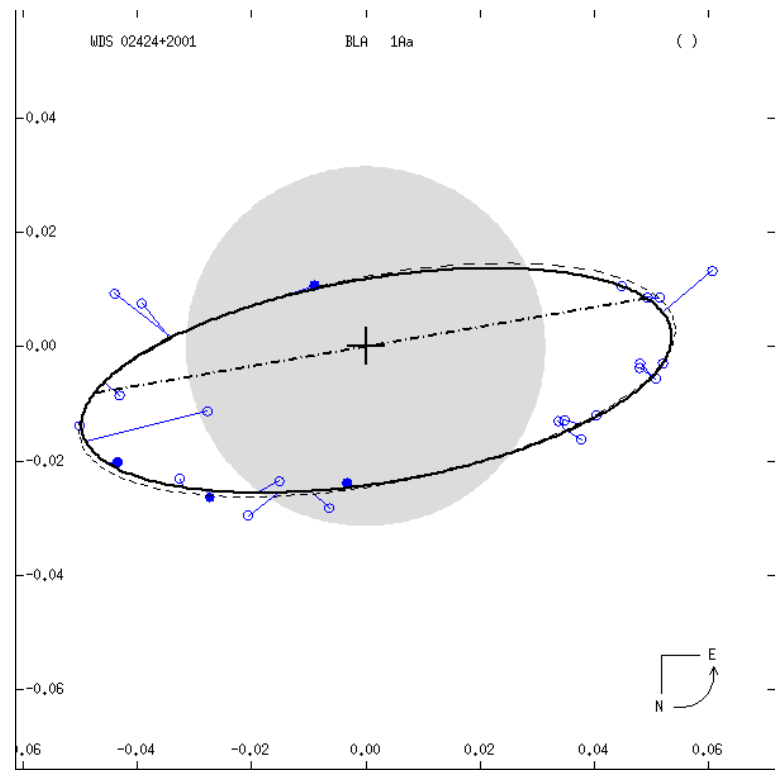
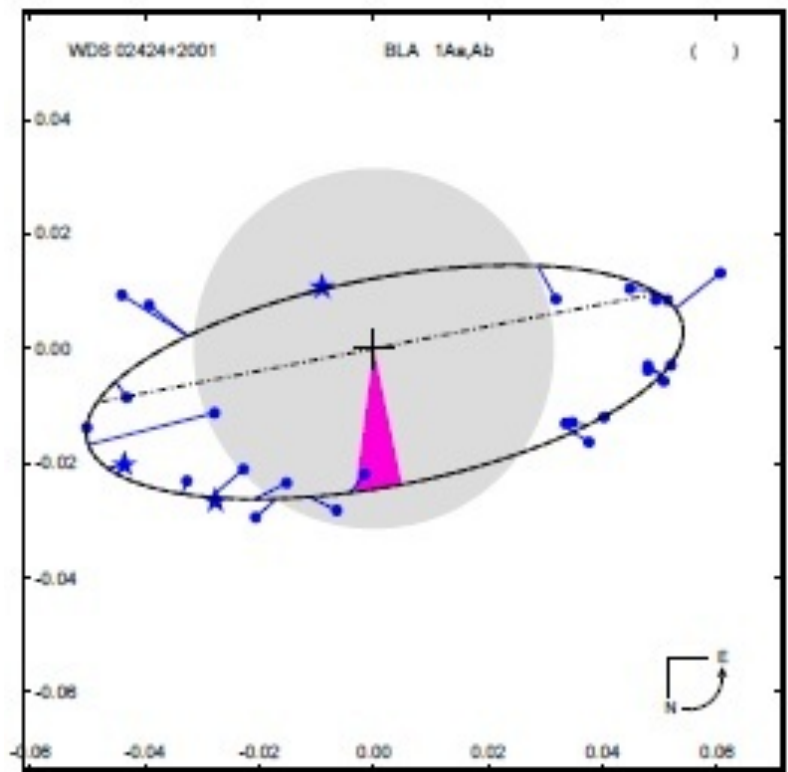
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# SFP Orbits p4

- HD 16811

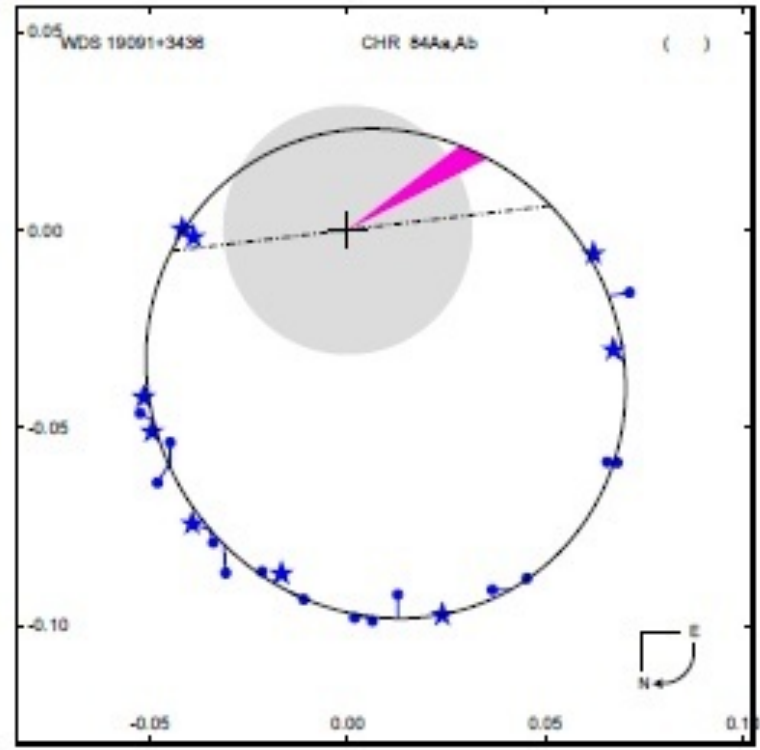
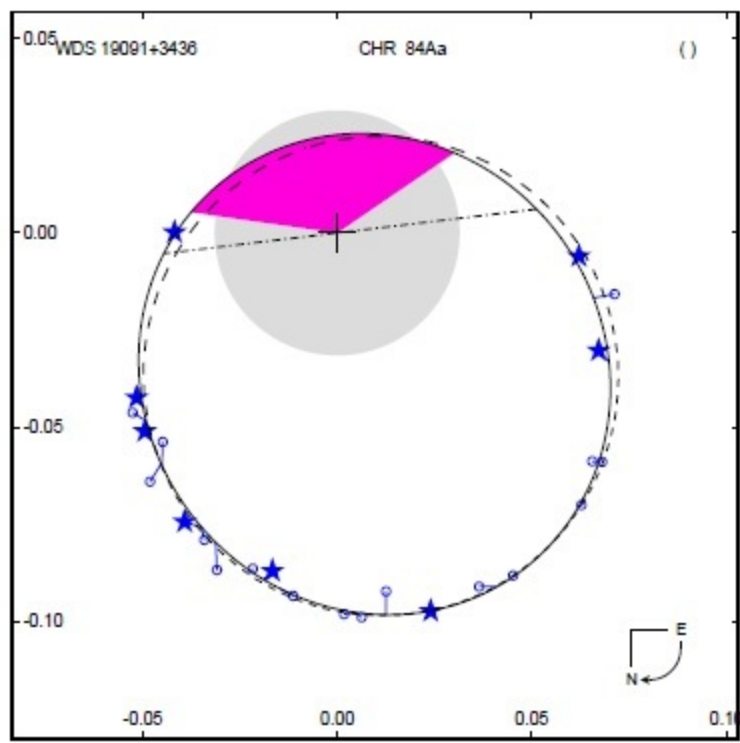






# SFP Orbits p5

- HD 178911



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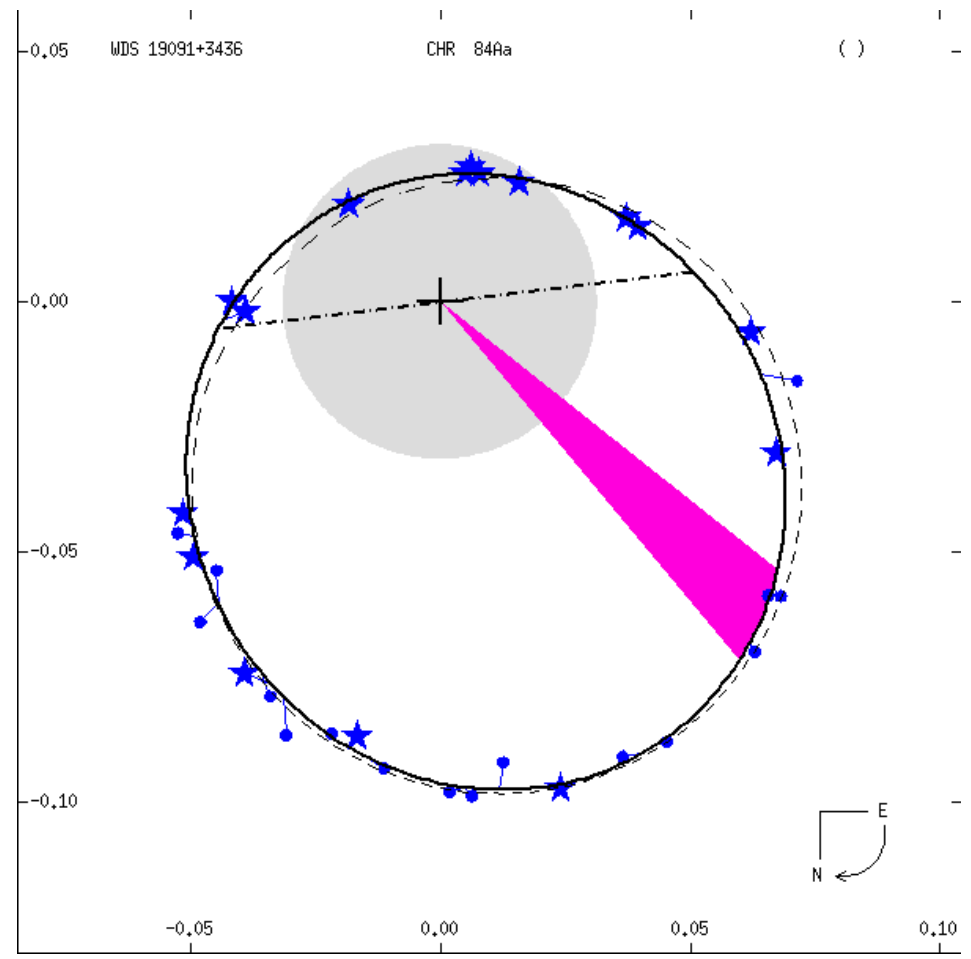


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# SFP Orbits p6

- HD 178911
  - $P = 3.5508y \pm 0.010$
  - $a = 75mas \pm 2.0$
  - $i = 146.8 \pm 1.1$
  - $\Omega = 96.8 \pm 1.5$
  - $T_0 = 1997.3446 \pm 0.0036$
  - $e = 0.597 \pm 0.004$
  - $\omega = 263.75 \pm 0.88$



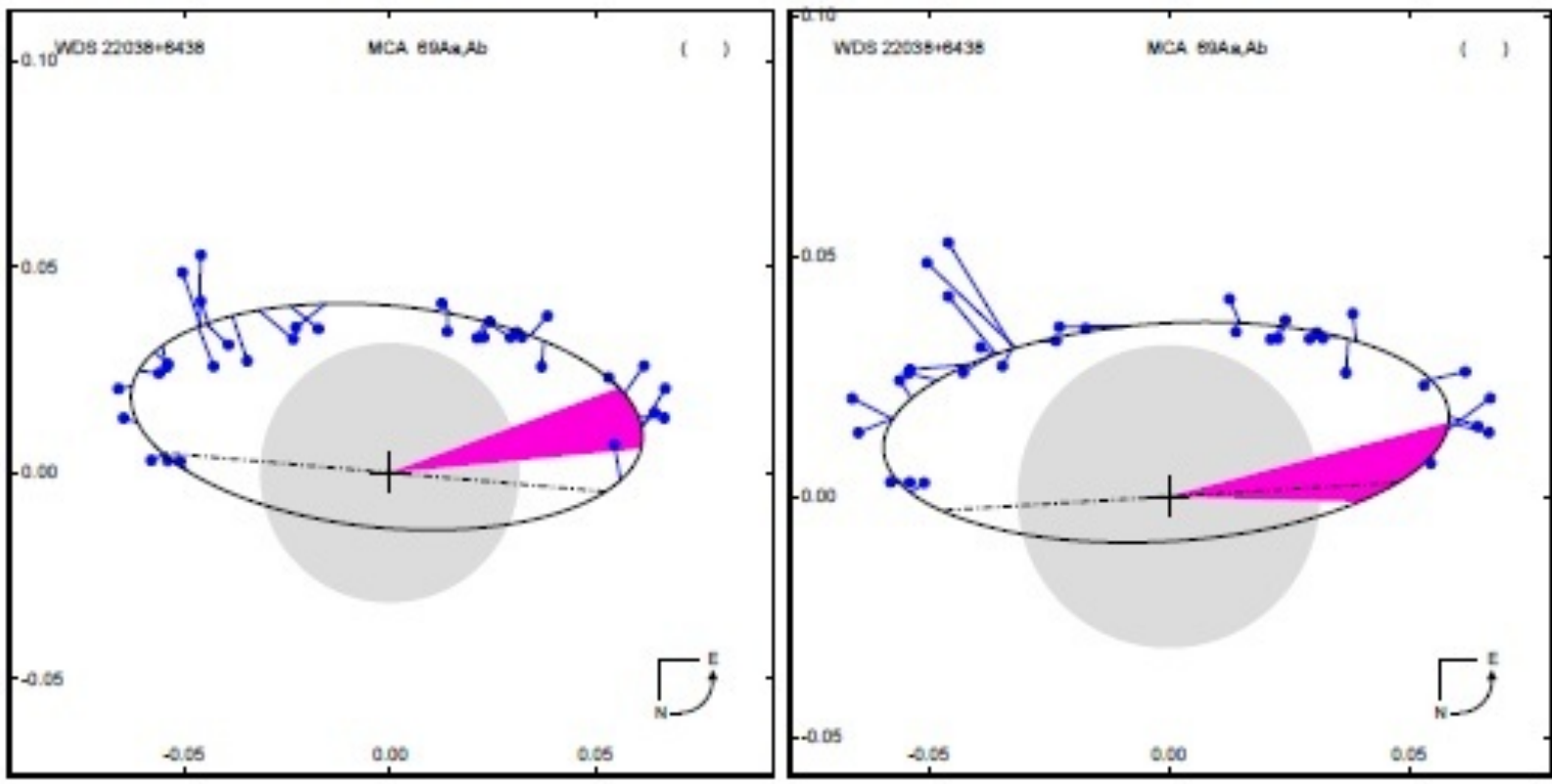
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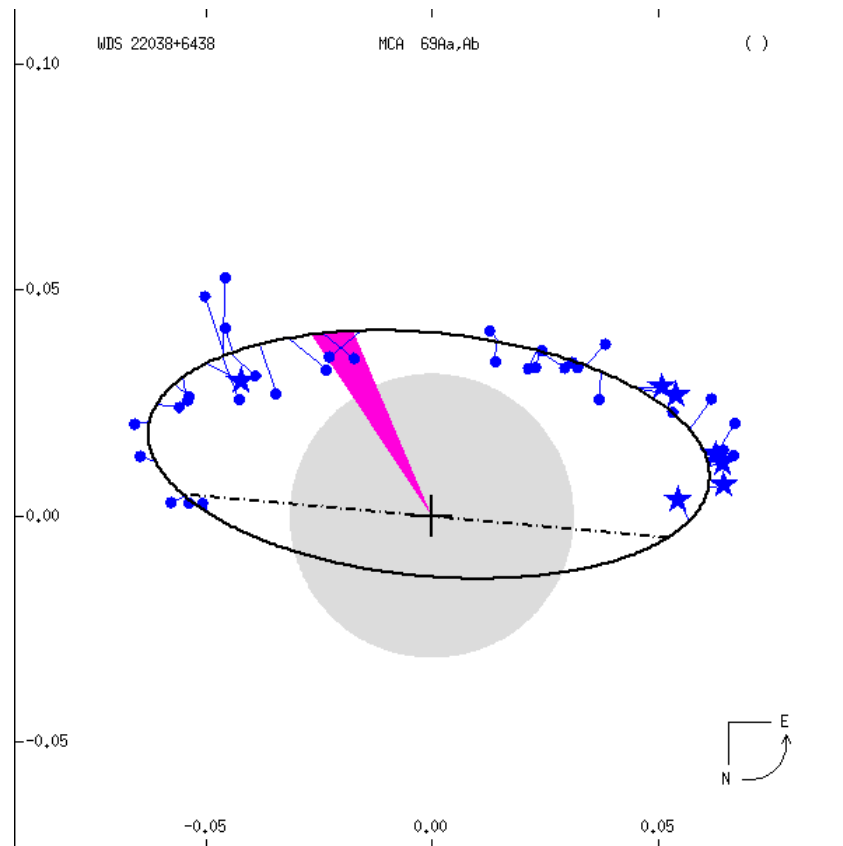
# SFP Orbits p7

- HD 209790



# SFP Orbits p8

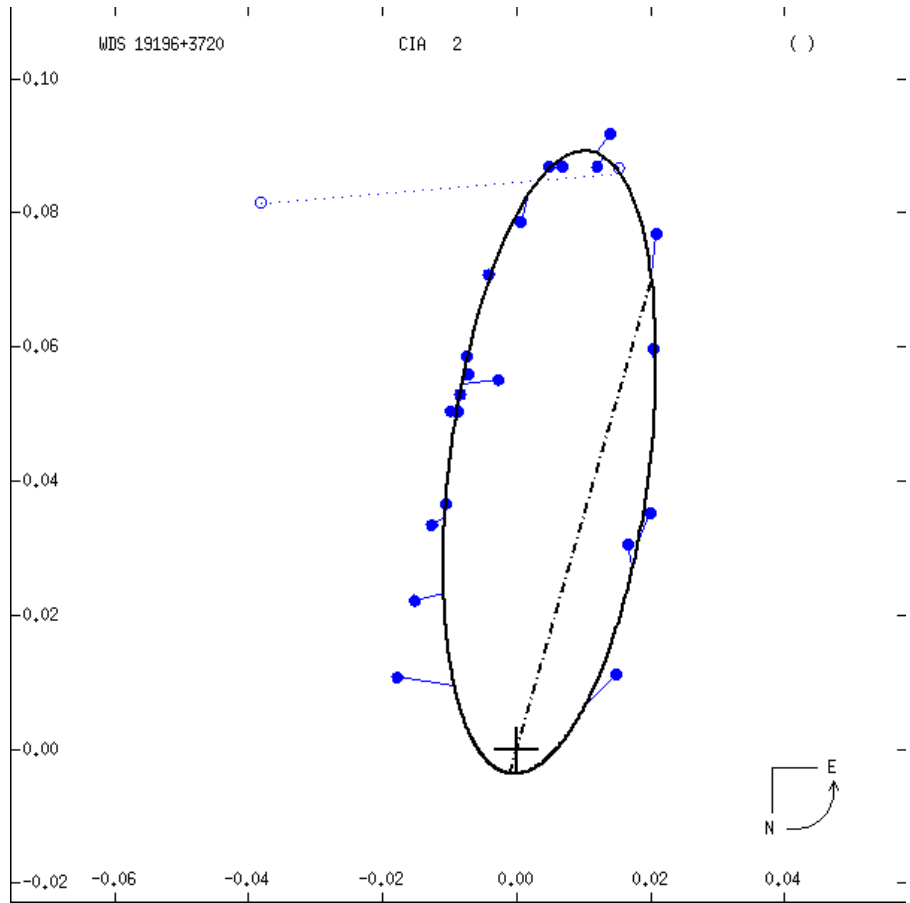
- HD 209790
  - $P = 2.241\text{y} \pm 0.0027$
  - $a = 72\text{mas} \pm 2.7$
  - $i = 68 \pm 1.4$
  - $\Omega = 85 \pm 1.9$
  - $T_0 = 1970.992 \pm 0.0092$
  - $e = 0.500 \pm 0.021$
  - $\omega = 273 \pm 1.1$
- 2003-2005 :
  - 178 data points taken with Classic in old data format.



# SFP Orbits p9

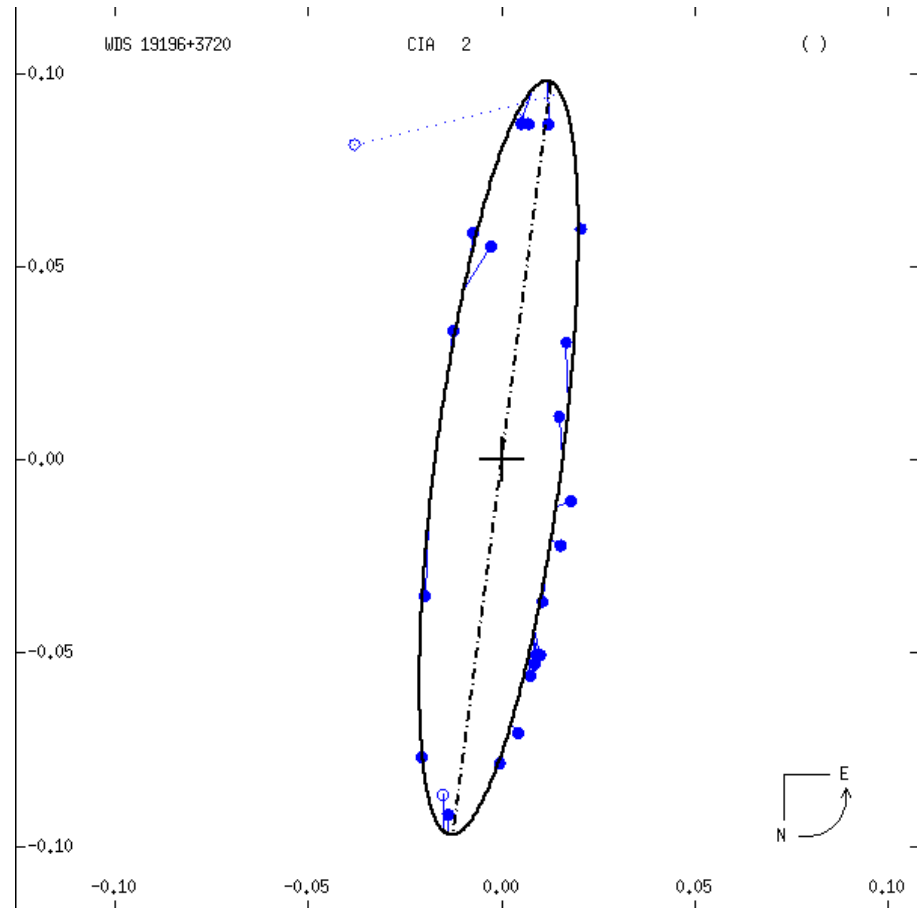
- HD 181655
  - $P = 0.90408\text{y} \pm 0.004$
  - $a = 47.1\text{mas} \pm 2.4$
  - $i = 37.0 \pm 11.4$
  - $\Omega = 344 \pm 25$
  - $T_0 = 2023.47082 \pm 0.051$
  - $e = 0.92 \pm 0.017$
  - $\omega = 11.76 \pm 32$
  - Mass sum  $\approx 2.1 \pm 0.6$

• OR?



# SFP Orbits p9-2

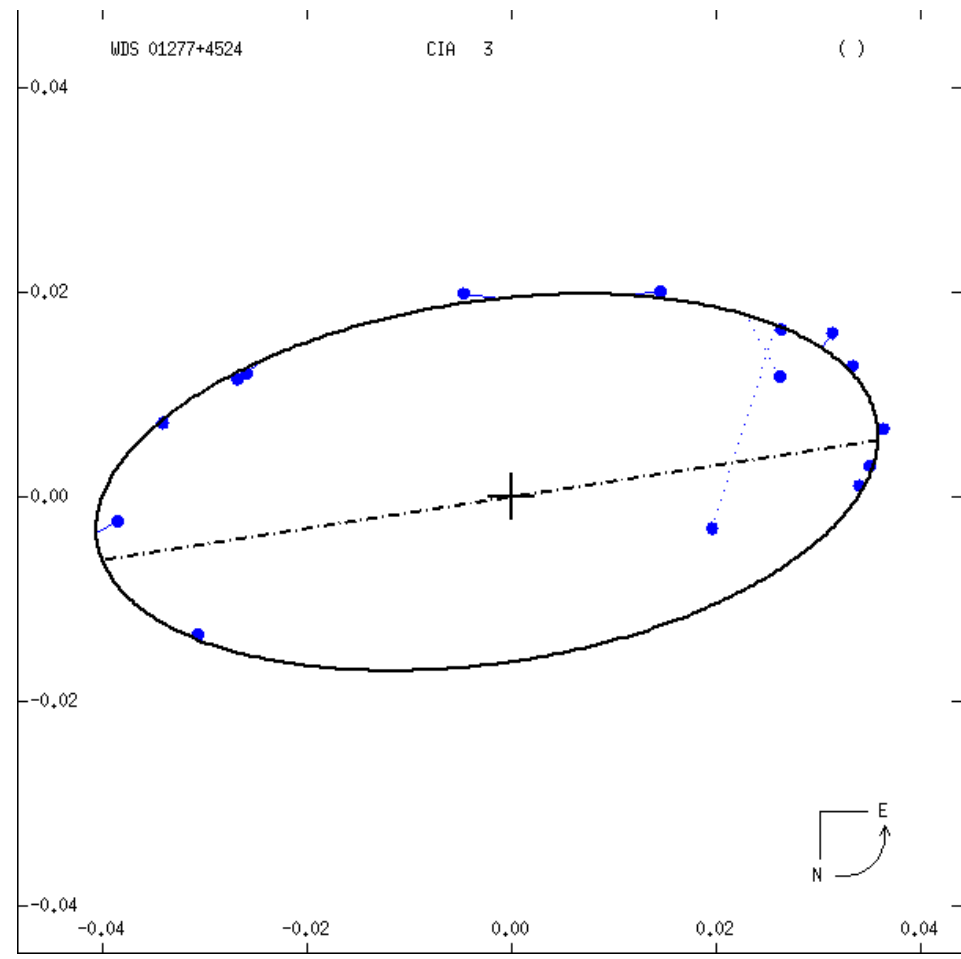
- HD 181655
  - $P = 1.8276\text{y} \pm 0.0071$
  - $a = 98.3\text{mas} \pm 2.6$
  - $i = 80.4 \pm 1.05$
  - $\Omega = 172.6 \pm 1.6$
  - $T_0 = 2011.7081 \pm 0.0556$
  - $e = 0.045 \pm 0.038$
  - $\omega = 265.744 \pm 11.34$
  - Mass sum  $\approx 4.7 \pm 1.2$
- Neither is favorable





# SFP Orbits p10

- HD 8799
  - $P = 0.69514\text{y} \pm 0.0013$
  - $a = 38.76\text{mas} \pm 0.53$
  - $i = 62.80 \pm 1.27$
  - $\Omega = 98.81 \pm 1.27$
  - $T_0 = 2007.3304 \pm 0.016$
  - $e = 0.112 \pm 0.015$
  - $\omega = 299.74 \pm 5.74$
- R. Griffin spectroscopic orbit published early 2012
- More later...



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# SFP Masses

System	$M_p$	$M_s$	$\pi_{HIP}$	$\pi_{ORB}$	Sp. Type
209790	$1.01 \pm 0.148$	$0.365 \pm 0.064$	$33.79 \pm 1.06$	$37.8 \pm 1.56$	A3m?
8799	$0.885 \pm 0.065$	$0.834 \pm 0.061$	$34.94 \pm 0.31$	$41.23 \pm 0.82$	F3V+F5V? F5IVe?
170153	$0.96 \pm 0.03$	$0.75 \pm 0.03$	$124.11 \pm 0.87$	$123.4 \pm 1.9$	F8IV-V + LateG V?
198084	$1.071 \pm 0.037$	$1.047 \pm 0.037$	$36.64 \pm 0.48$	$39.8 \pm 2.04$	F8IV-V + F9IV-V
178911	$0.769 \pm 0.054$	$0.597 \pm 0.052$	$19.11 \pm 2.35$	$28.15 \pm 1.1$	G1V+G5V
184467	$0.82 \pm 0.09$	$0.77 \pm 0.09$	$58.96 \pm 0.65$	$59.2 \pm 2.0$	K2V+K4V



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# Massive Binaries

- Using CLIMB, we had the opportunity to add in some massive spectroscopic binaries from Doug/Tabby in the Fall of 2011.
- Data was taken on the larger triangles (S1/2, E1/2, W1)
- 6-7 brackets for each system on CLIMB
- Data reduced and passed along to Doug for interpretation.

System	Spectral Type
MWC 314	B3Ibe
HD 15558	O5e
HD 199579	O6V((f))



# VEGA Sub-giants

Object	Calibrator	Dates	Baseline	Number of Obs
89449	92825	5/8/2010e1e2		1
89449	92825	5/9/2010e1e2		1
150680	153808	5/8/2010e1e2		1
150680	153808	5/9/2010e1e2		1
175225	178207	6/21/2010w1w2		2
175225	178207	7/30/2010w1w2		1
175225	178207	7/31/2010s1s2		1
175225	178207	8/1/2010s1s2		1
196524	196180	8/1/2010s1s2		1
196524	196180	8/27/2010w1w2		1
196524	196180	9/14/2010e1e2		2
196524	196180	9/15/2010e1e2		2
196524	196180	9/16/2010s1s2		1
198084		10/16/2011s1s2		2
202444	204414	7/25/2009s1s2		1
202444	204414	7/26/2009w1w2		2
202444	204414	7/27/2009w1w2		3
211336	204770	11/5/2009w1w2		1
211336	204770	11/20/2009w1w2		3
216385	216735	7/29/2009w1w2		1
216385	216735	7/30/2009w2s2		1
216385	216735	7/30/2009w1w2		1
216385	216735	7/31/2009w1w2		1
216385	216735	7/31/2009w2s2		1
220657	220061-C2	7/27/2009s1s2		1

Object	Calibrator	Dates	Baseline	Number of Obs
220657	220599-C1	7/27/2009w1w2		1
11443	7964	7/29/2010w1w2		2
11443	7964	7/30/2010w1w2		2
11443	7964	8/1/2010s1s2		1
11443	7964	9/14/2010e1e2		1
11443	7964	9/15/2010e1e2		1
11443	7964	9/18/2010s1s2		1
8799	10205	11/23/2008s1s2		1
8799	10205	11/24/2008s1s2		3
8799	10205	10/1/2009s1s2		1
8799	10205	10/24/2009s1s2		3
8799	10205	10/26/2009s1s2		2
8799	10205	11/17/2009s1s2		2
8799	10205	11/18/2009s1s2		3
8799	10205	9/14/2010e1e2		2
8799	10205	9/15/2010e1e2		3
8799	10205	9/16/2010s1s2		1
8799	10205	9/18/2010s1s2		1
8799	10205	8/24/2011e1e2		2
8799	10205	8/25/2011e1e2		1
8799	10205	8/27/2011e1e2		1
8799	10205	8/30/2011w1w2e2		1
8799	10205	9/1/2011e1e2w2		1
8799	10205	8/30/2011w1w2e2		1
8799	10205	9/1/2011e1e2w2		1



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# VEGA Sub-giants

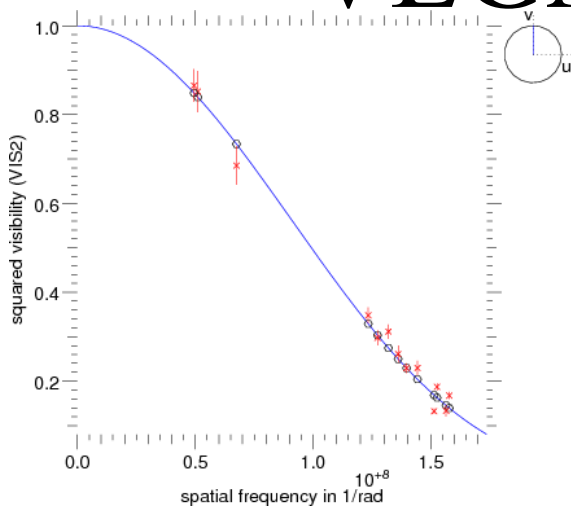
System	Sp Type	Diameter(")	Parallax(mas)	R (R <sub>sun</sub> )
11443	<b>F5III</b>	SB	51.5	
89449	<b>F6IV</b>	Bad Data	46.80	
150680	<b>G0IV</b>	Cal SB	93.32	
175225	<b>G9IVa</b>	Binary	38.96	
196524	<b>F5IV</b>	Binary	32.33	
202444	<b>F0IV</b>	*0.001069	49.16	2.338
211336	<b>F0IV</b>	0.000694	38.17	1.955
216385	<b>F7IV</b>	0.000617	36.66	1.810
220657	<b>F8IV</b>	0.001007	19.14	5.658



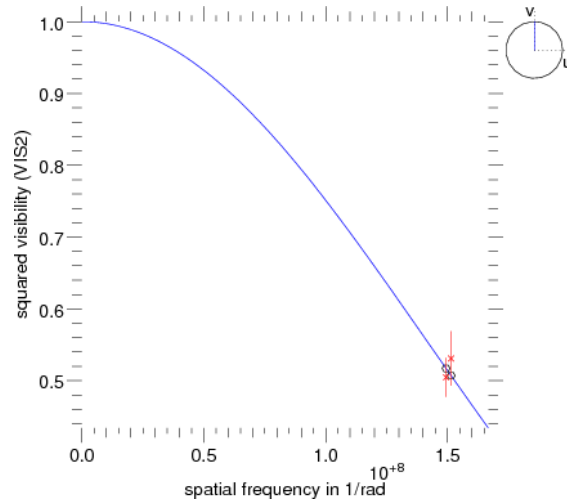


# VEGA Sub-giants

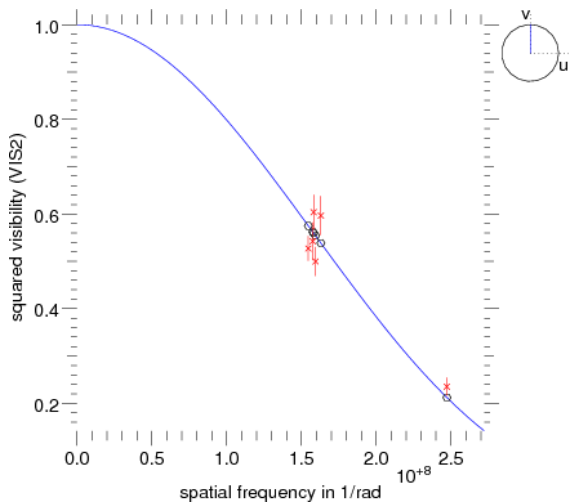
202444



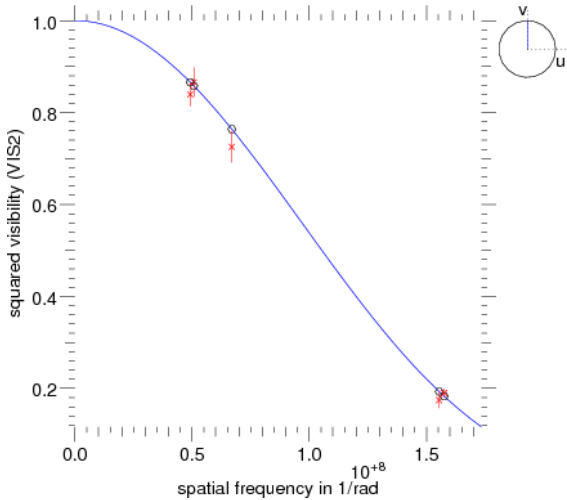
211336



216385



220657



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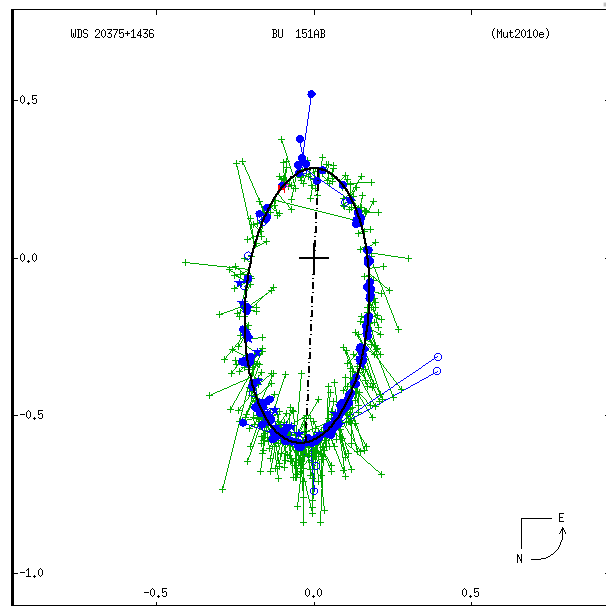
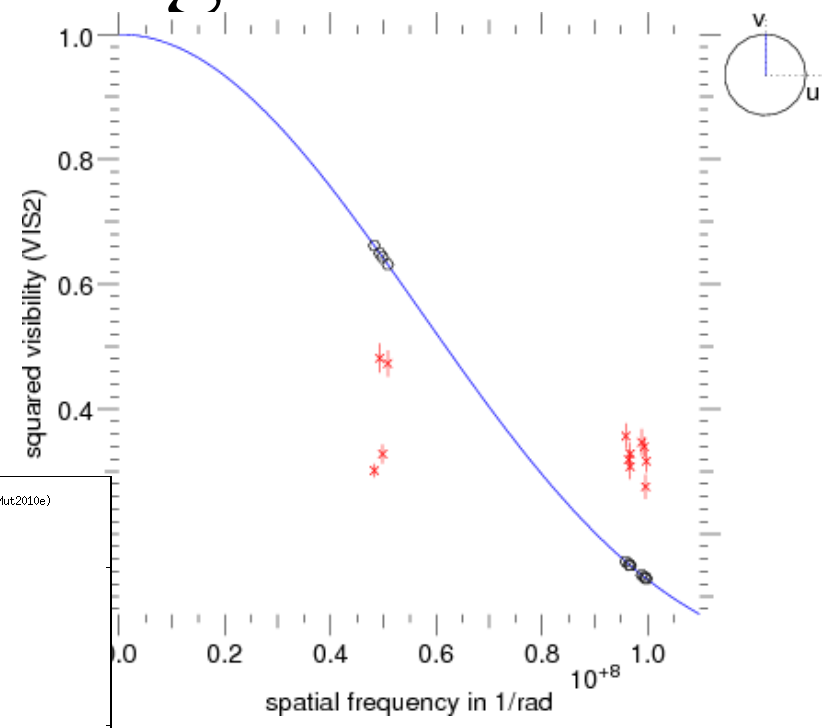


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# VEGA Sub-giants

- Other Systems
  - 196524
  
- Binary:
  - 9745 days
  - $a=437\text{mas}$
  - 34 deg
  - 293 mas in 2011





# VEGA Sub-giants

Selection des fichiers 17/09/2010 (on vegadrs)

Load ds,fits files  
 Current directory : V22GE2E1.2010.09.14.04.05  
 list of fits files :  
 V22GE2E1\_028.algolr.ds.fits  
 V22GE2E1\_029.algolr.ds.fits  
 V22GE2E1\_030.algolr.ds.fits  
 Reject file  
 Save selection

plot cumul  
 y axis : Y1 : Plot raw V2

plot OPD plot SNR  
 SNR limite select bad file  
 pos. min : pos. max : select bad file  
 files selected :  
 plot selected pic reset all

Infos : Visualisation du cumul ;/data/divers/farrington/196524/redred/2010.09.14/V22GE2E1.2010.09.14.04.05/V22GE2E1.cumul.algolr.ds.fits Quit



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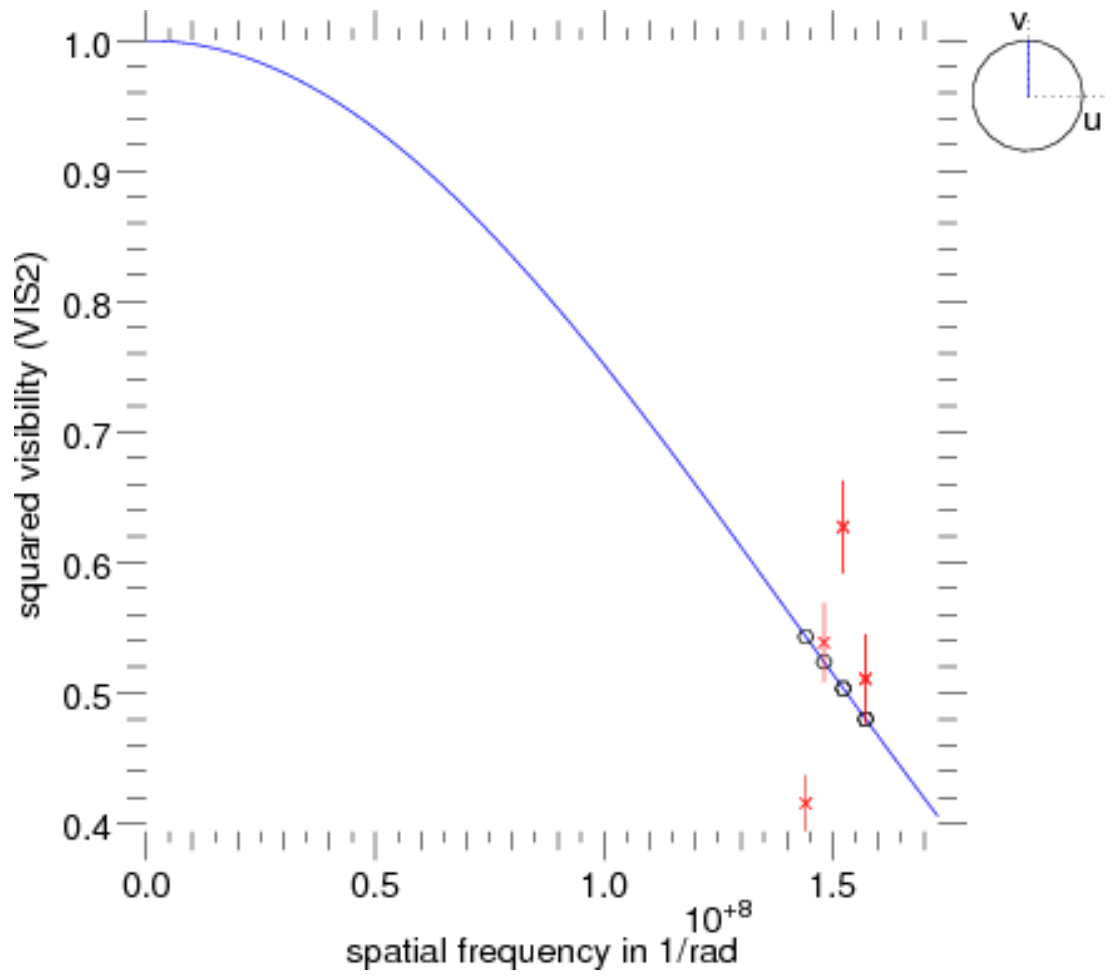


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# VEGA Sub-giants

- Other Systems – 175225
- Definitely a binary
- Last seen in 1999
  - 101 degrees
  - 1.07 arcsec!
  - Magnitude difference of 0.2-0.5?







# Omega And (HD 8799)

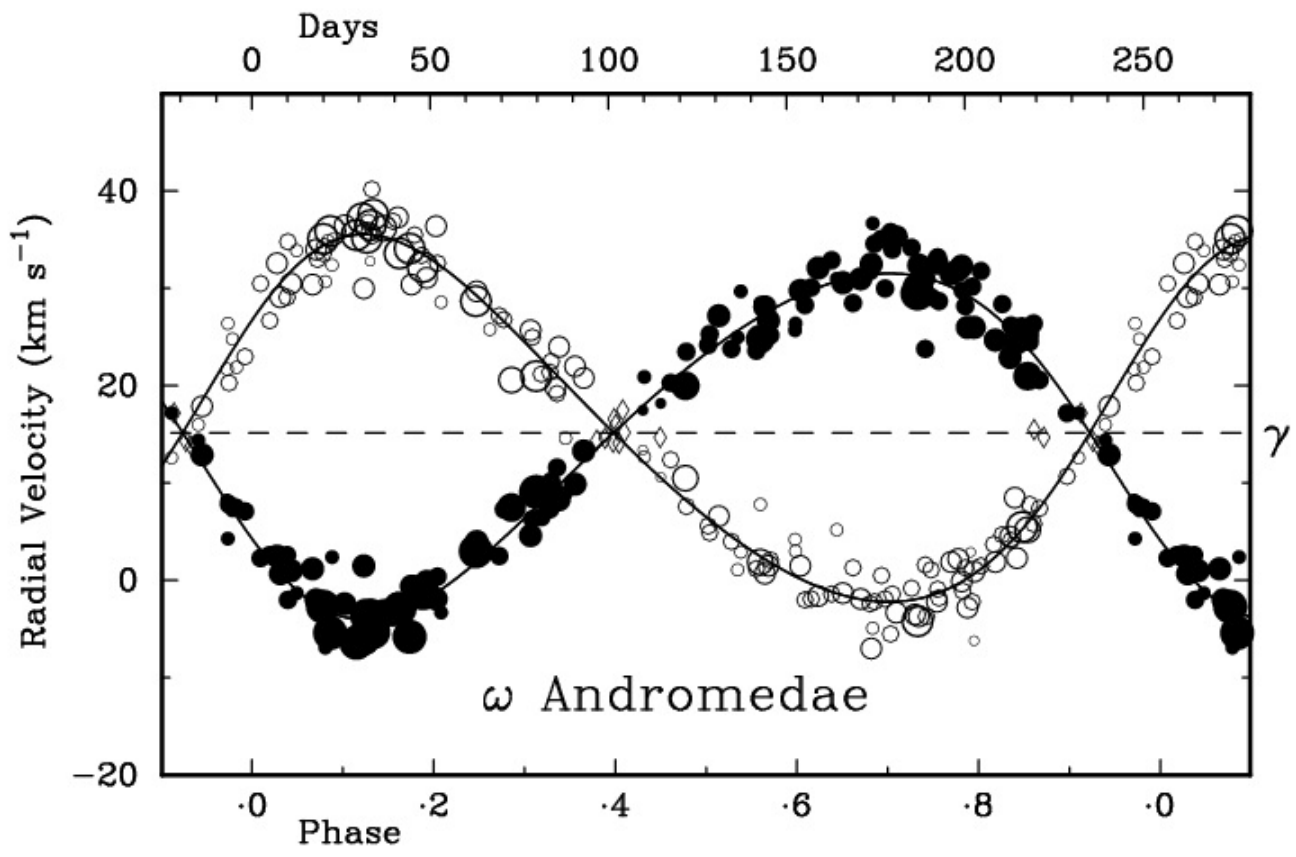
- Sub-giant, but testing to see if VEGA could do what we had difficulty with on CLIMB.
  - Individual component radii
  - Flux Ratios
- Probably not the best system to start with:
  - Magnitude difference
    - R. Griffin = 0.1 mag
    - VEGA solution = 1.7 vs 1.2 flux weights
  - Mass difference
    - R. Griffin mass ratio = 4-8% difference
    - CLIMB orbit = 5% difference

Component	$\theta''$ mas	$R_{\odot}$
$M_p$	0.7433	1.939
$M_s$	0.3767	0.983





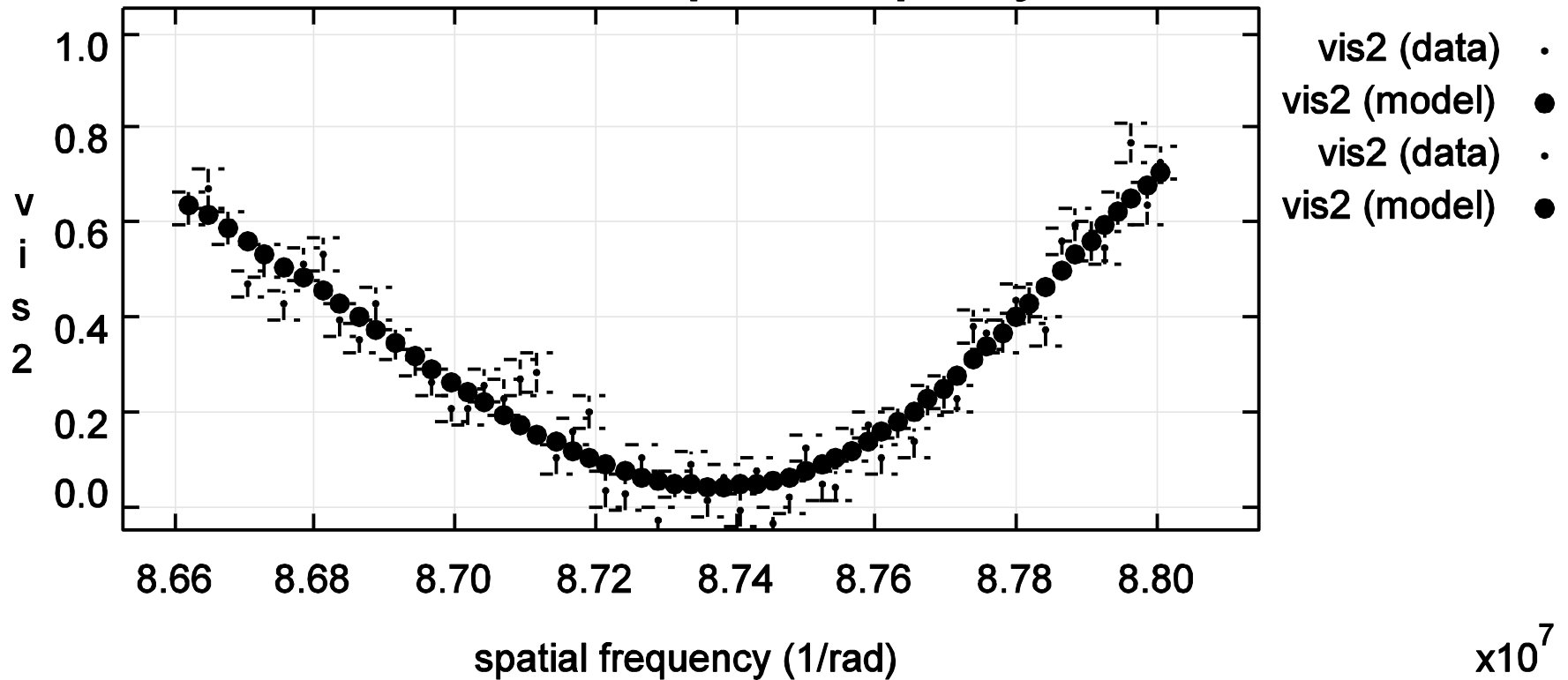
# Omega And (HD 8799)





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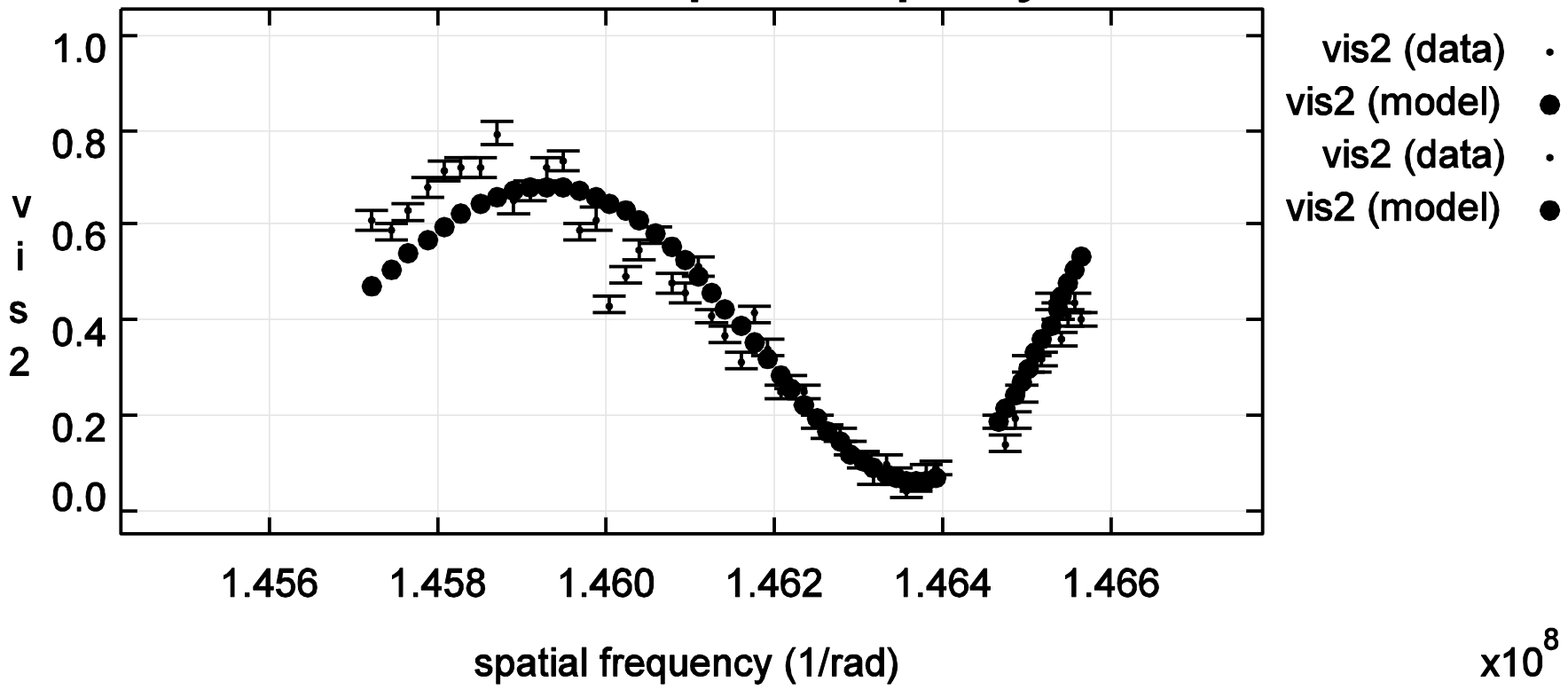
Plot vis2 versus spatial frequency





# Omega And (HD 8799)

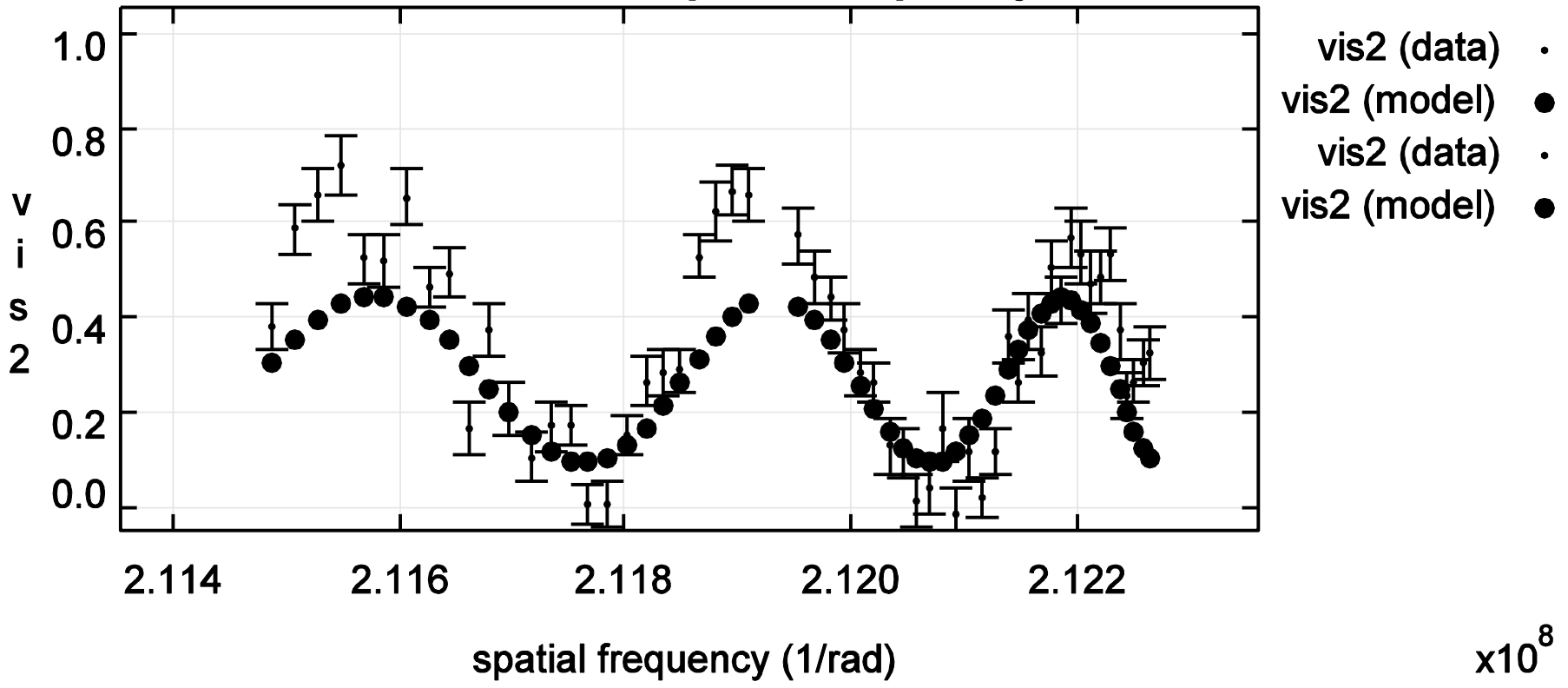
### Plot vis2 versus spatial frequency





# Omega And (HD 8799)

## Plot vis2 versus spatial frequency





# Omega And (HD 8799)

## Plot vis2 versus spatial frequency

