CHARA 96 = HD 193322

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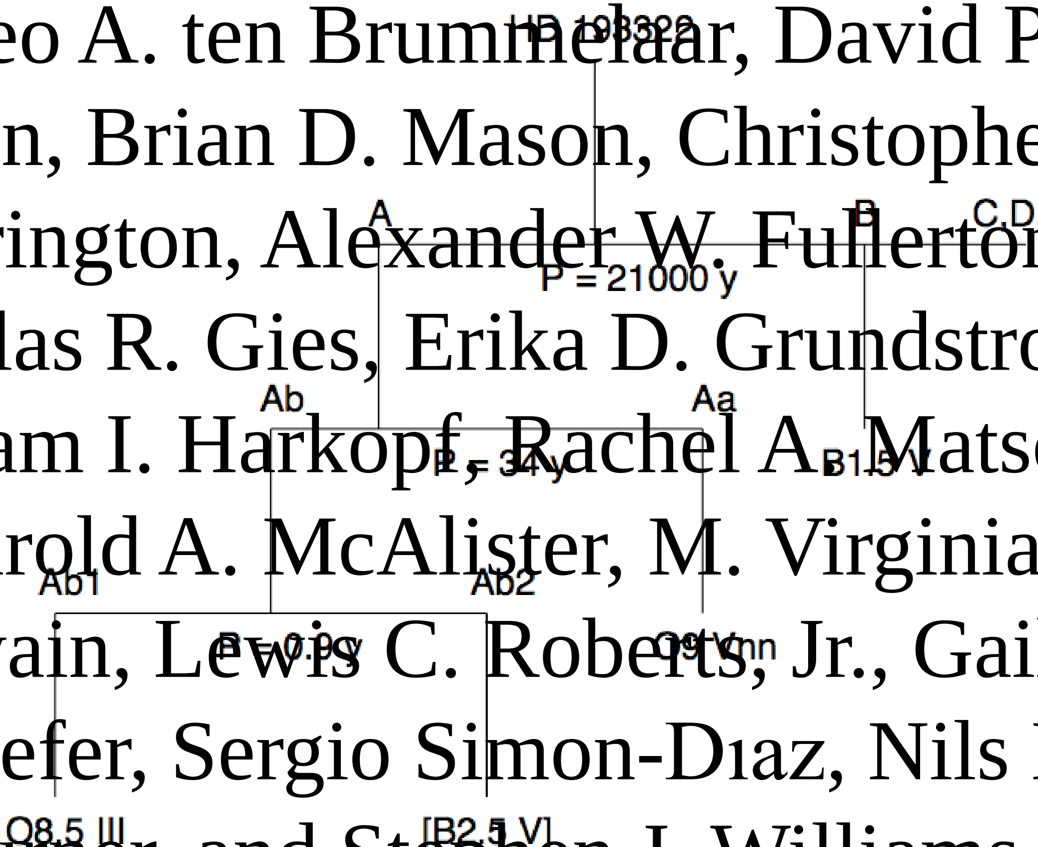
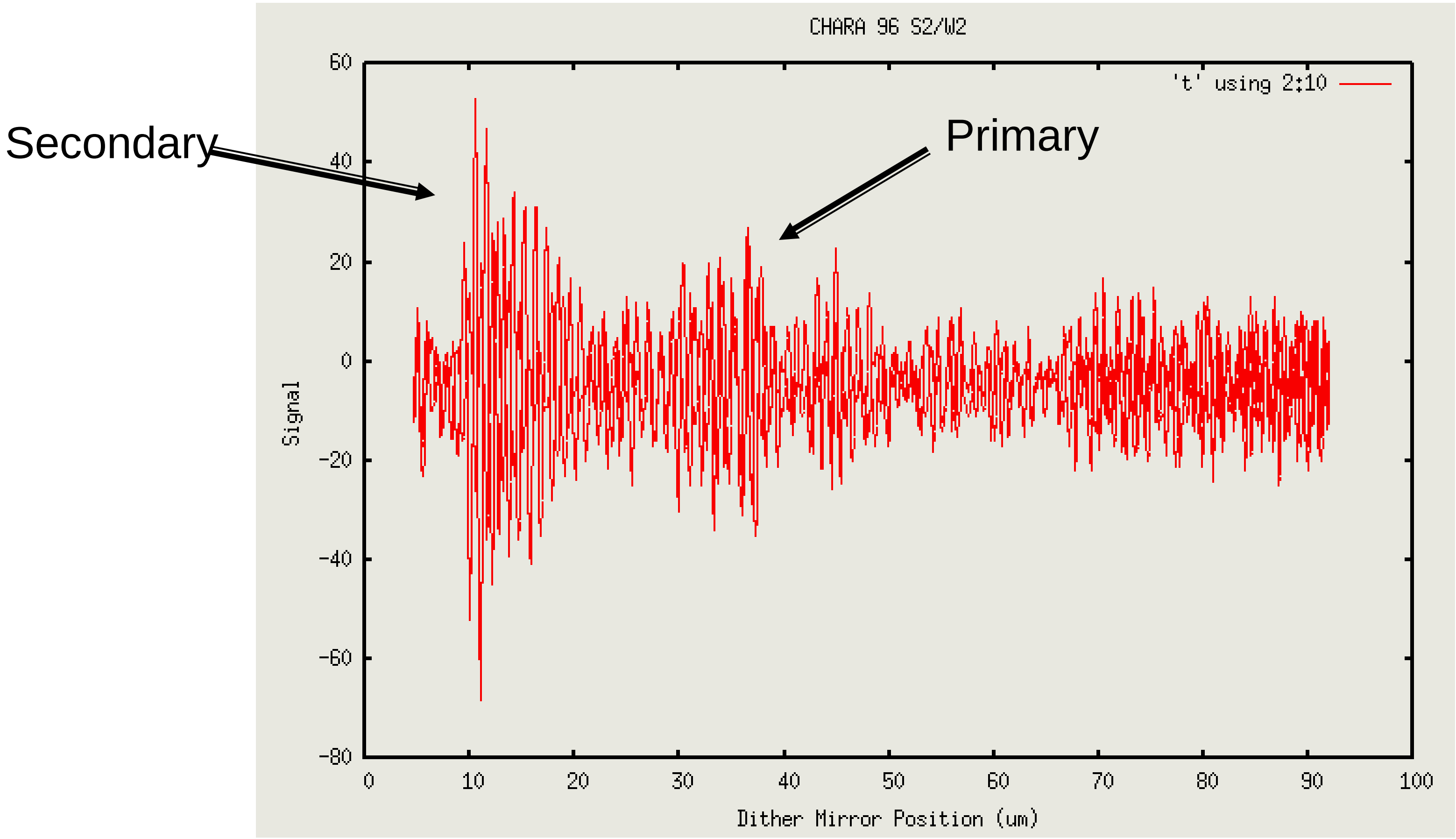


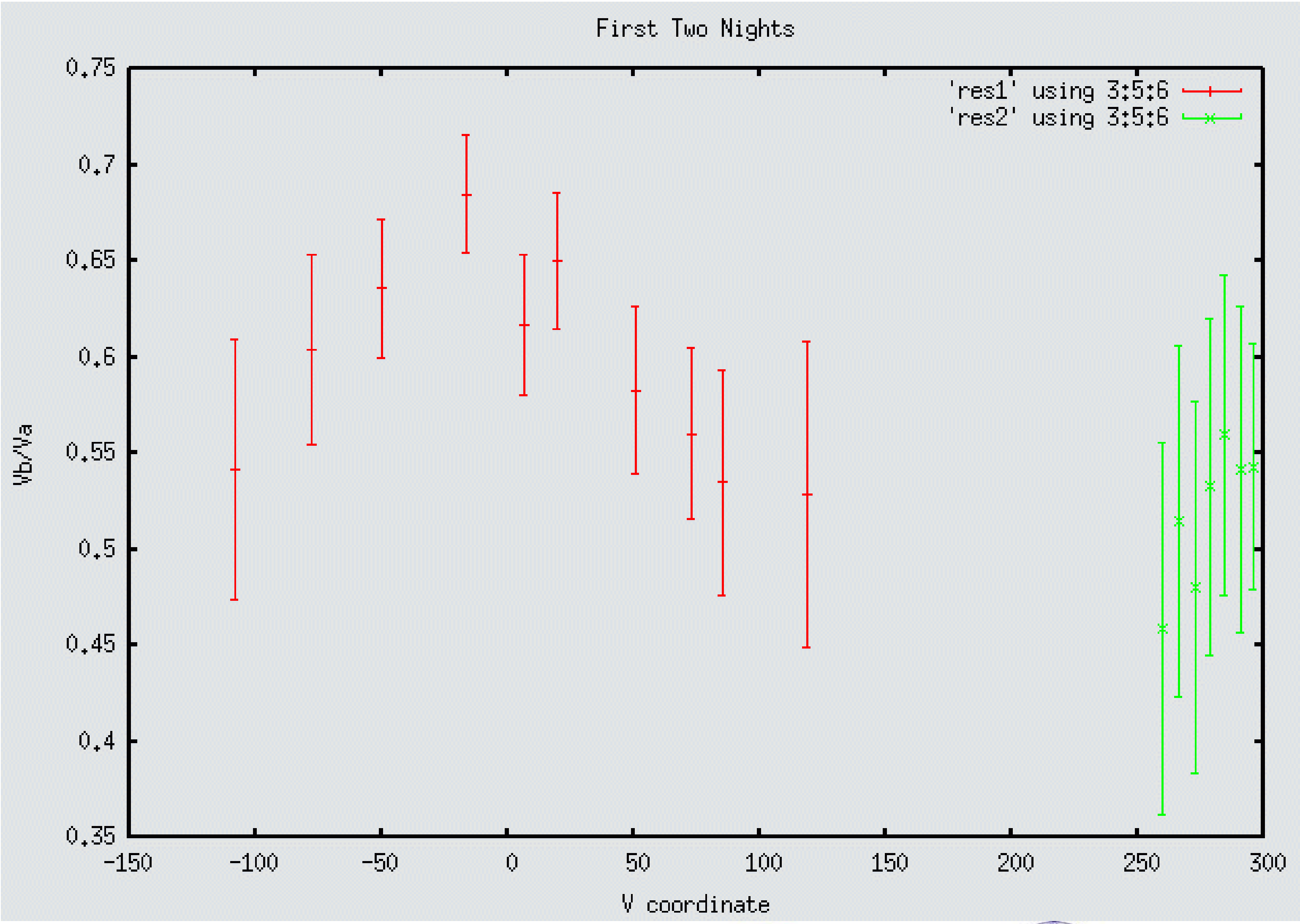
New data on an old object…

- First seen as a multiple system by McAlister in 1987.
- Spectroscopic observations and radial velocities on the narrow lined component Ab1 around the close companion Ab2 (P=312 d).
- Spectroscopic observations and radial velocities of the inner pair Ab1-Ab2 around companion Aa (P=34 y).
- Separated Fringe Packet observations of Aa-Ab.
- Visibility amplitude measurements of Ab1-Ab2.

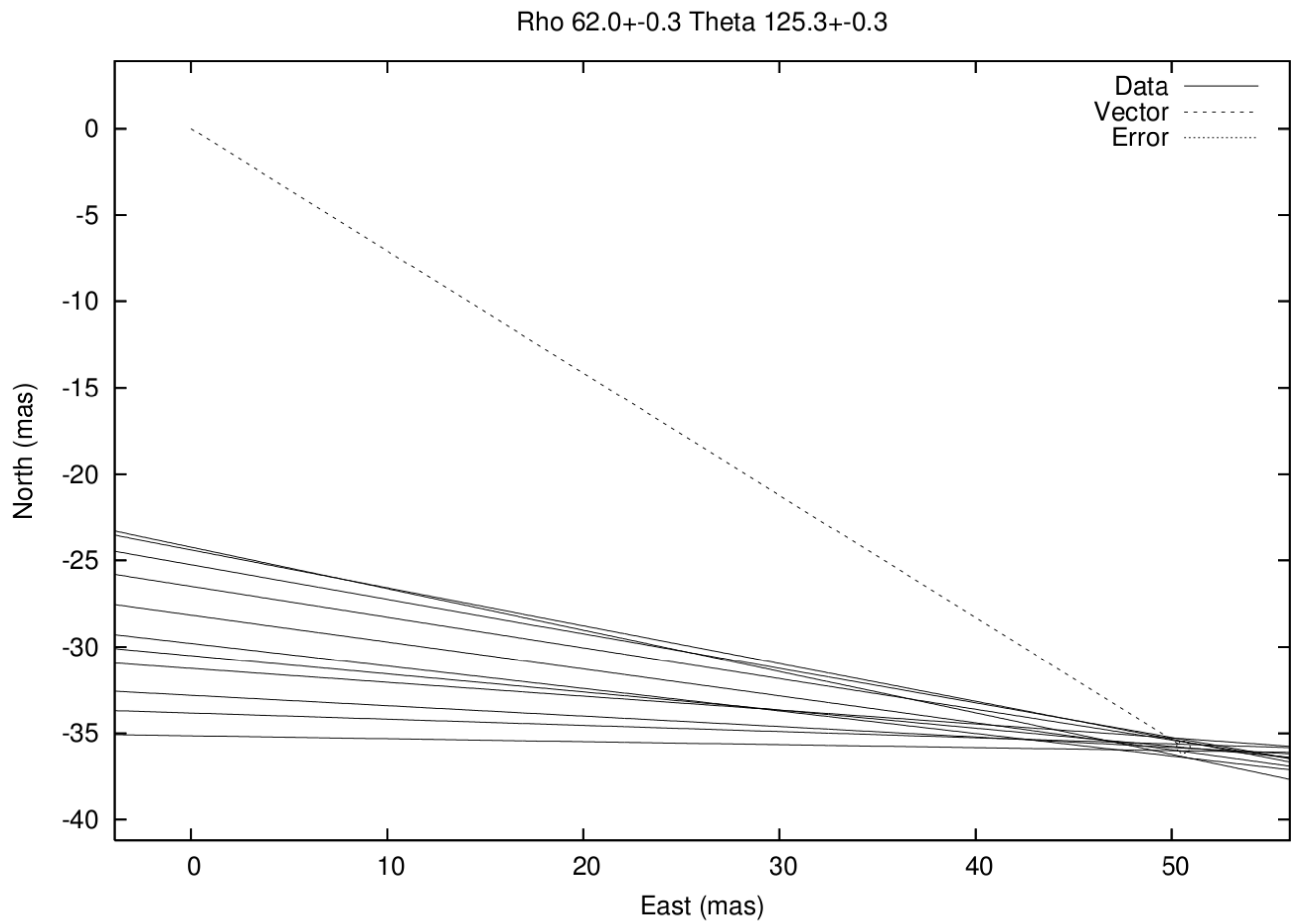
Example Interferometry Data



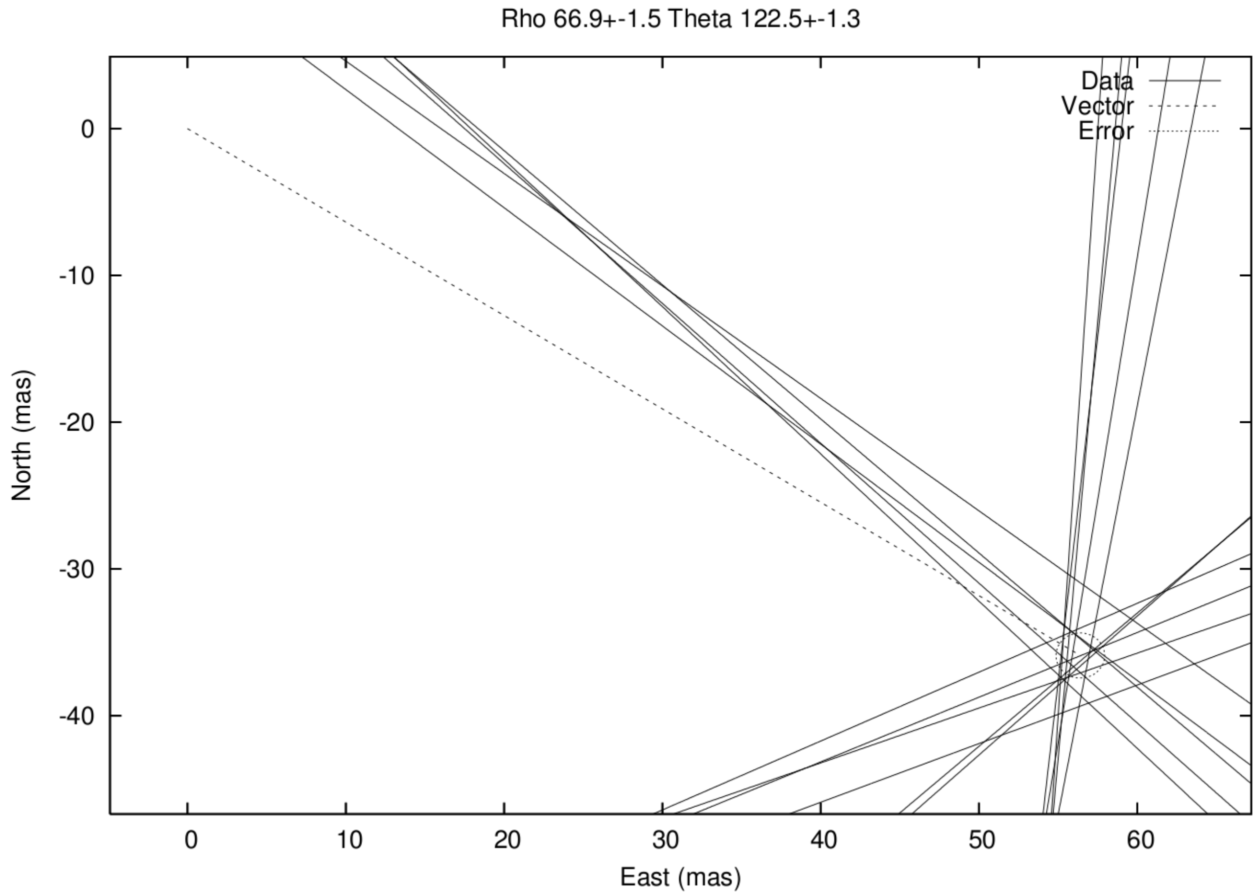
We've been at this for a while….



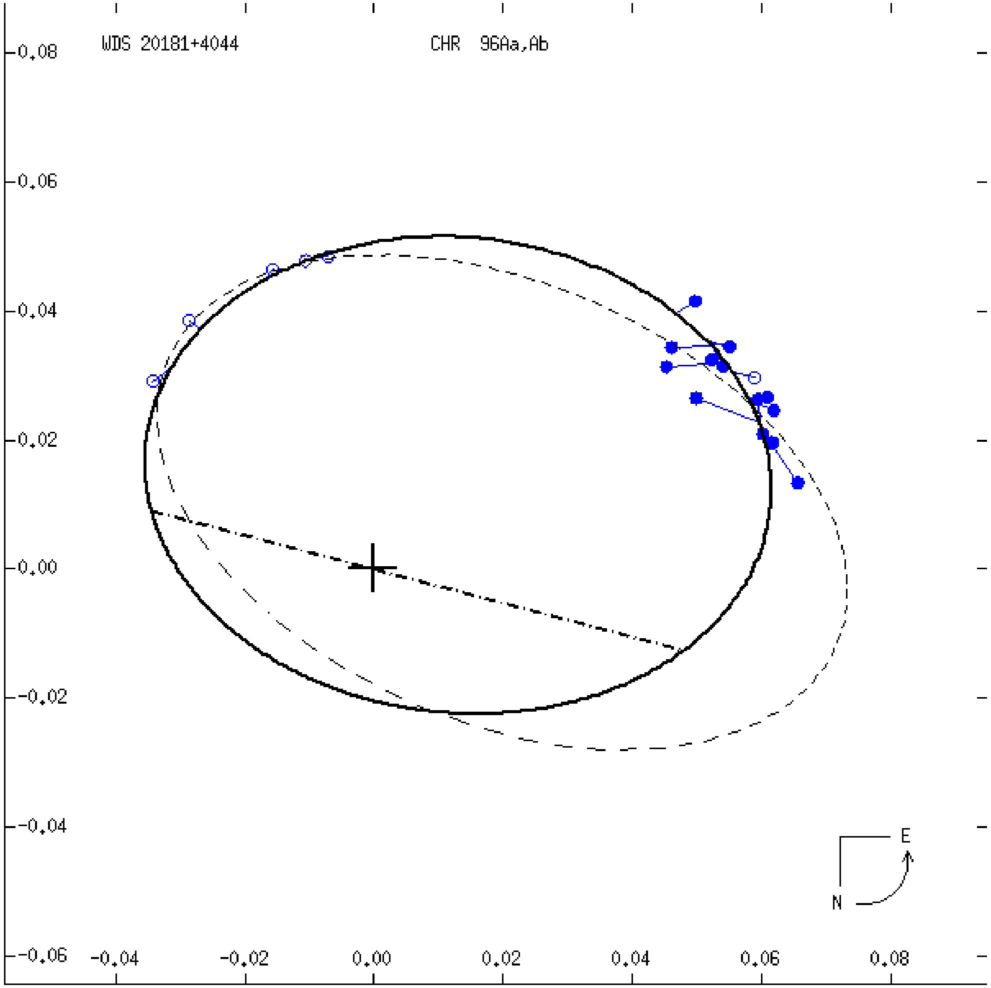
Much of the data contains only one baseline



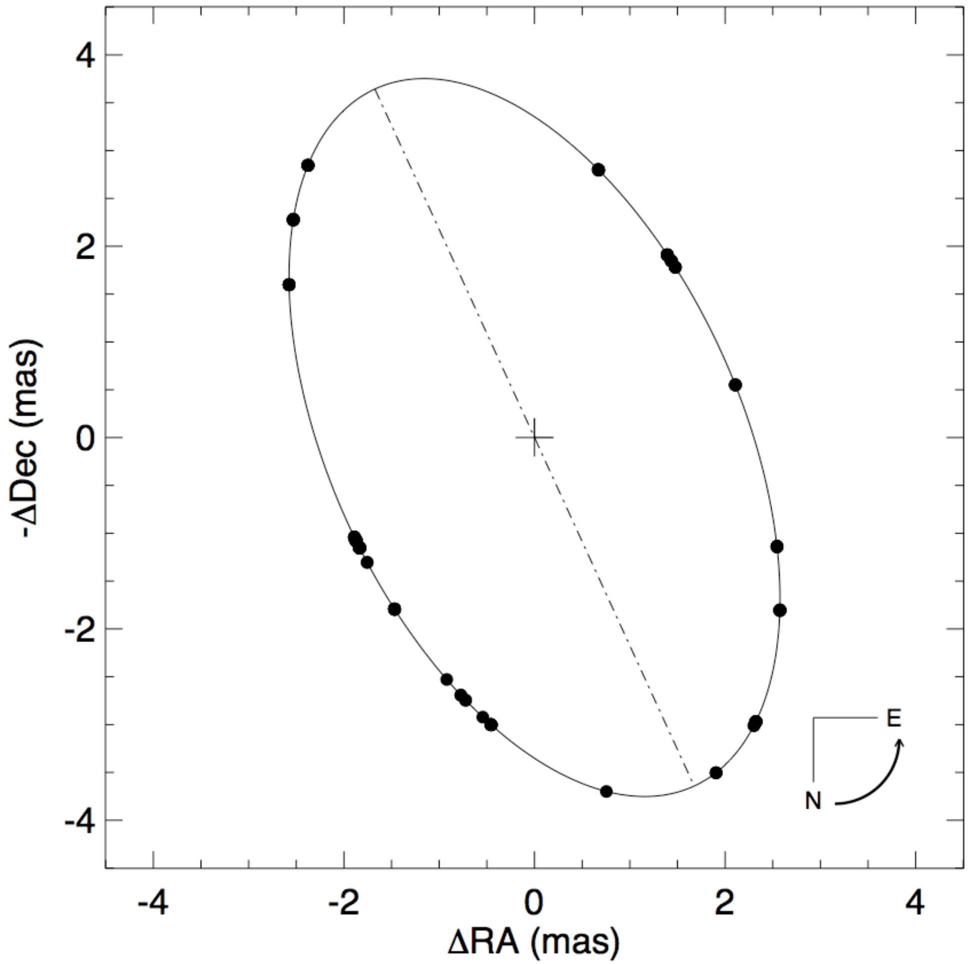
Even multiple baseline data is noisy.



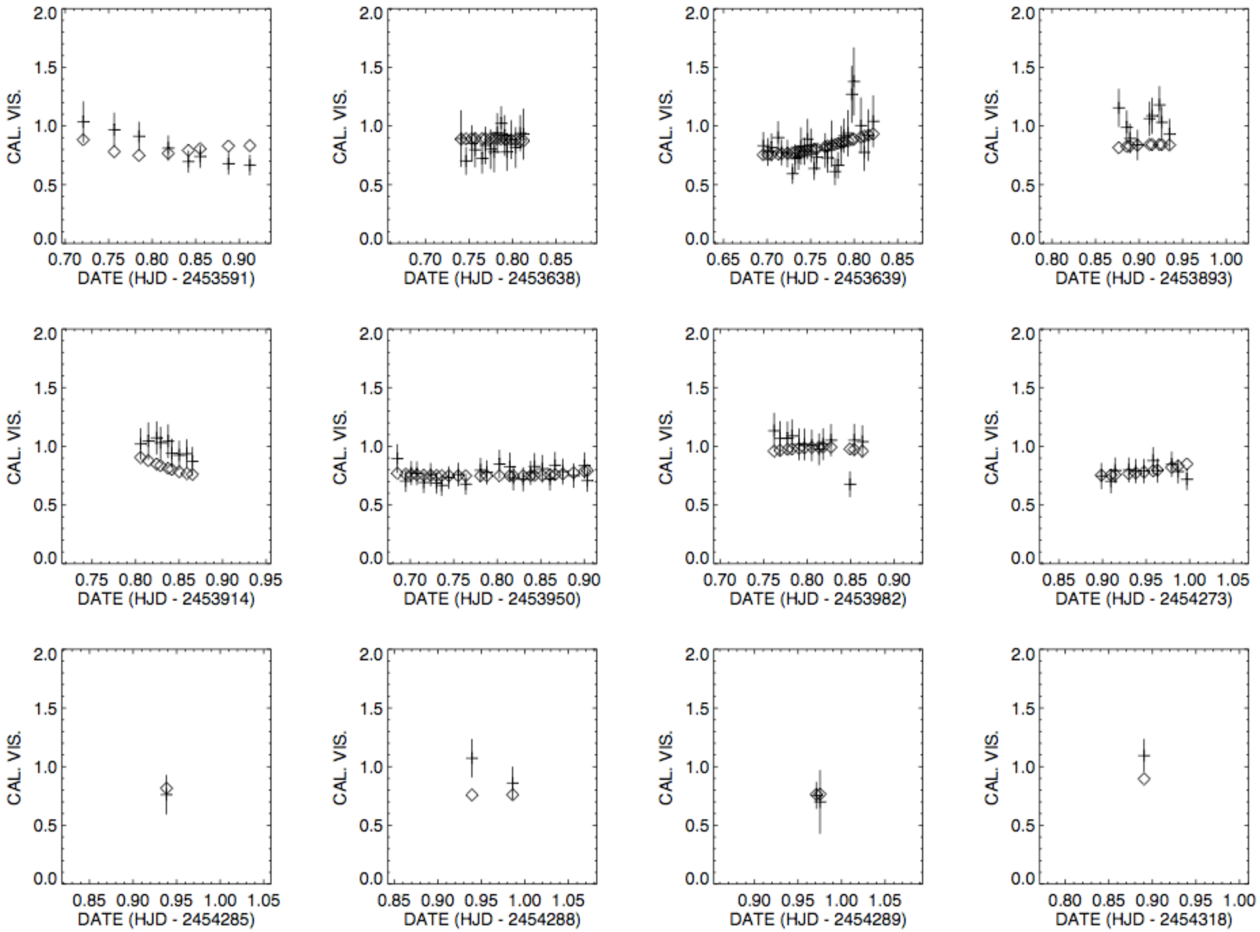
Final Orbit Aa-Ab



Orbital Coverage Ab1-Ab2



First 12 nights of data Ab1-Ab2.



One data set – Two Orbits

Table 2. Visual Orbital Elements

Element	Wide Orbit	Close Orbit
P (y)	34.39 ± 1.01	0.85547[a]
P (d)	12561 ± 369	312.45[a]
T (BY)	1996.27 ± 1.49	1996.103[a]
T (HJD–2,400,000)	50182 ± 544	50121.2[a]
a (mas)	55.41 ± 2.97	$4.0^{+0.6}_{-0.7}$
i (deg)	44.41 ± 7.43	58^{+8}_{-20}
Ω (deg)	273.03 ± 7.42	25^{+3}_{-37} [b]
e	0.3974 ± 0.0412	0[a]
ω (deg)	59.86 ± 7.25	180[c]

[a]Fixed with values from the radial velocity orbit (Table 6).

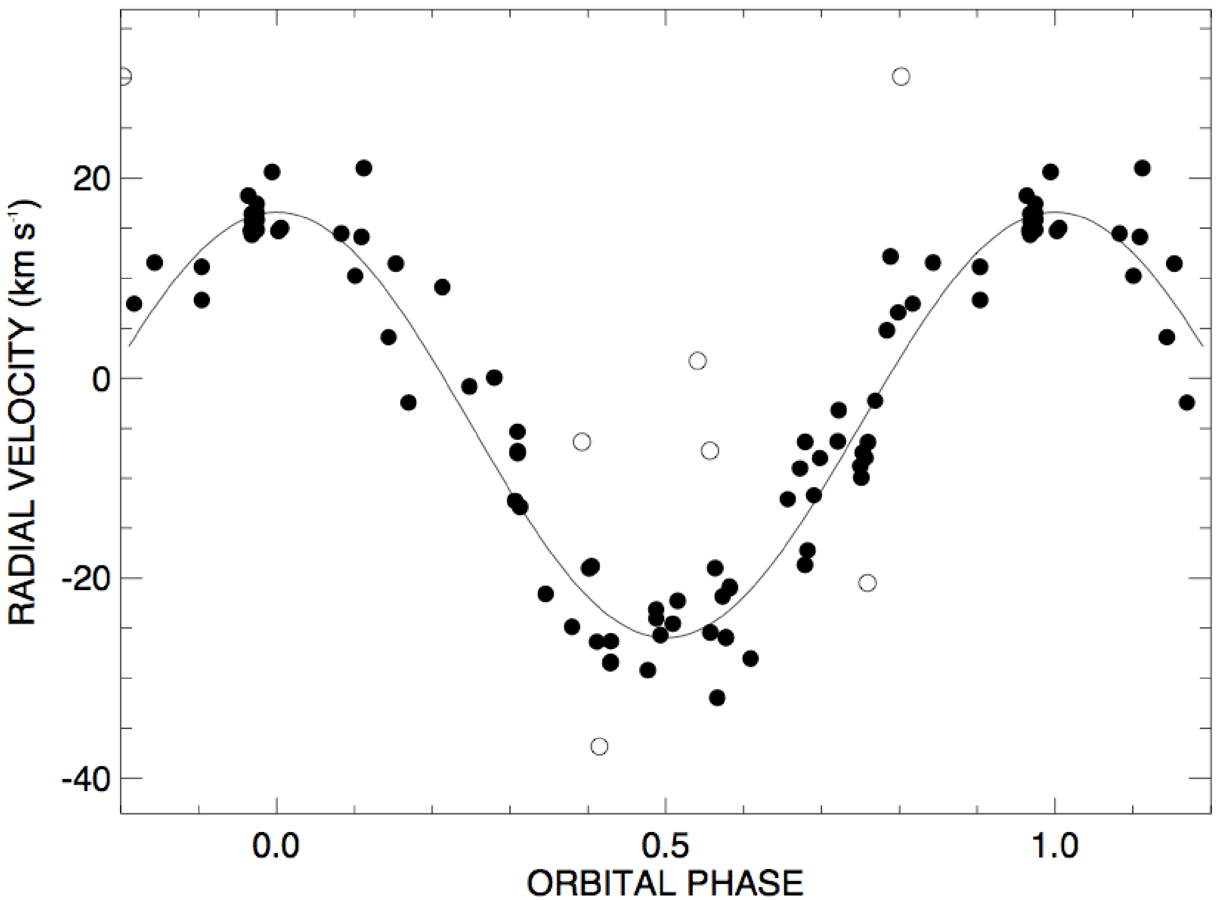
[b]Or 205^{+3}_{-37} deg.

[c]Fixed for the relative orbit of Ab2 with respect to Ab1.

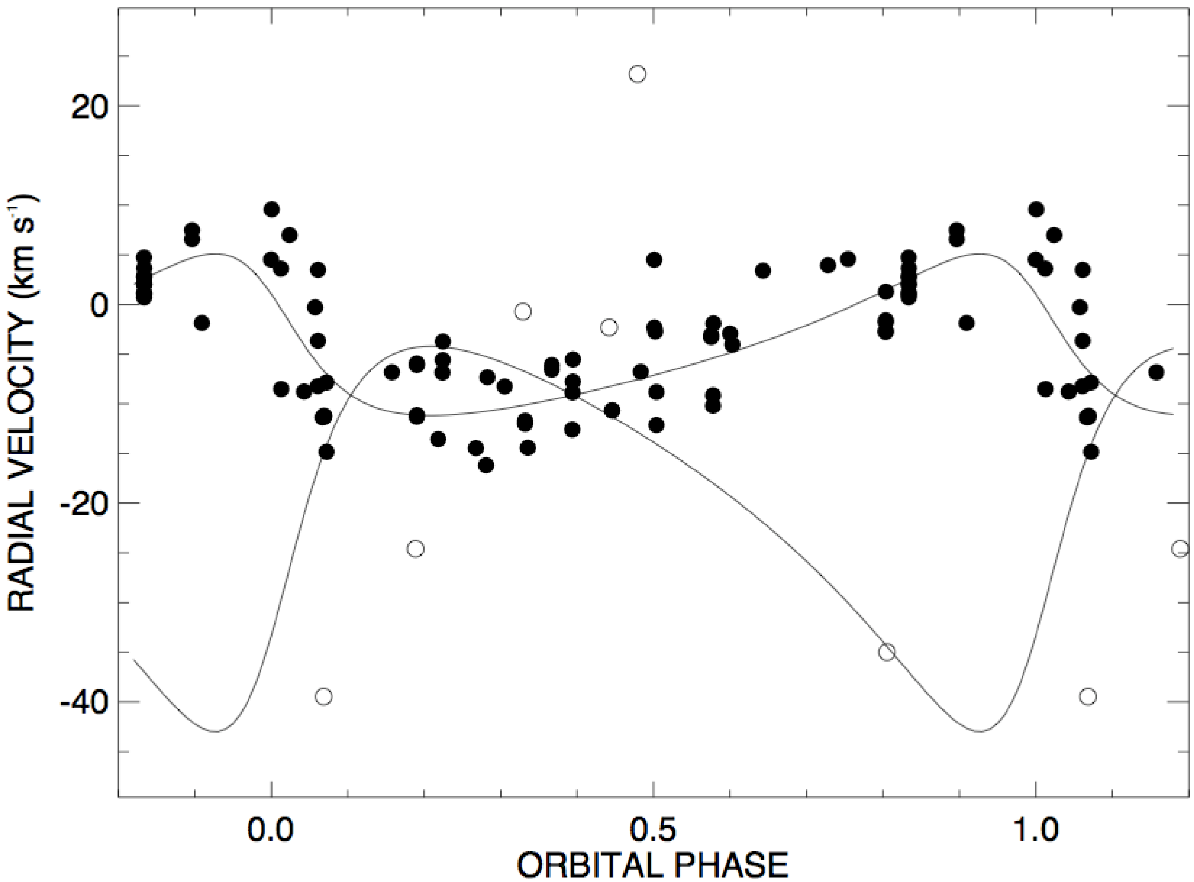
Radial Velocity Measurements

- The flux of all three (Aa, Ab1 and Ab2) appear in the same spectra in ground base measurements.
- Ab2 contributes very little.
- Aa has a broad-lined component.
- Ab1 has a narrow-lined component that dominates and represents the sum of motion in both the narrow Ab1-Ab2 and the wide Aa-Ab pairs – one must solve for both.

The Derived Radial Velocity Curve of Ab1 in the Ab1-Ab2 312 day orbit.



Derived Radial Velocity Curve of Ab1/Ab2 in the Aa-Ab 34 year Orbit.



We want Masses…..

If we assume a distance d from the cluster fitting results of Roberts et al. (2010), then Kepler's Third Law relates the known period P, the total mass, and a by

$$(M(\mathrm{Ab1}) + M(\mathrm{Ab2}))/M_\odot = \frac{(ad)^3}{P^2} = \left(\frac{a}{1.22\ \mathrm{mas}}\right)^3 \left(\frac{d}{741\ \mathrm{pc}}\right)^3. \quad (2)$$

Next, we can use to the spectroscopic semiamplitude K for component Ab1 (§4, Table 6) to derive a relation for the mass of Ab2 as a function of i and a,

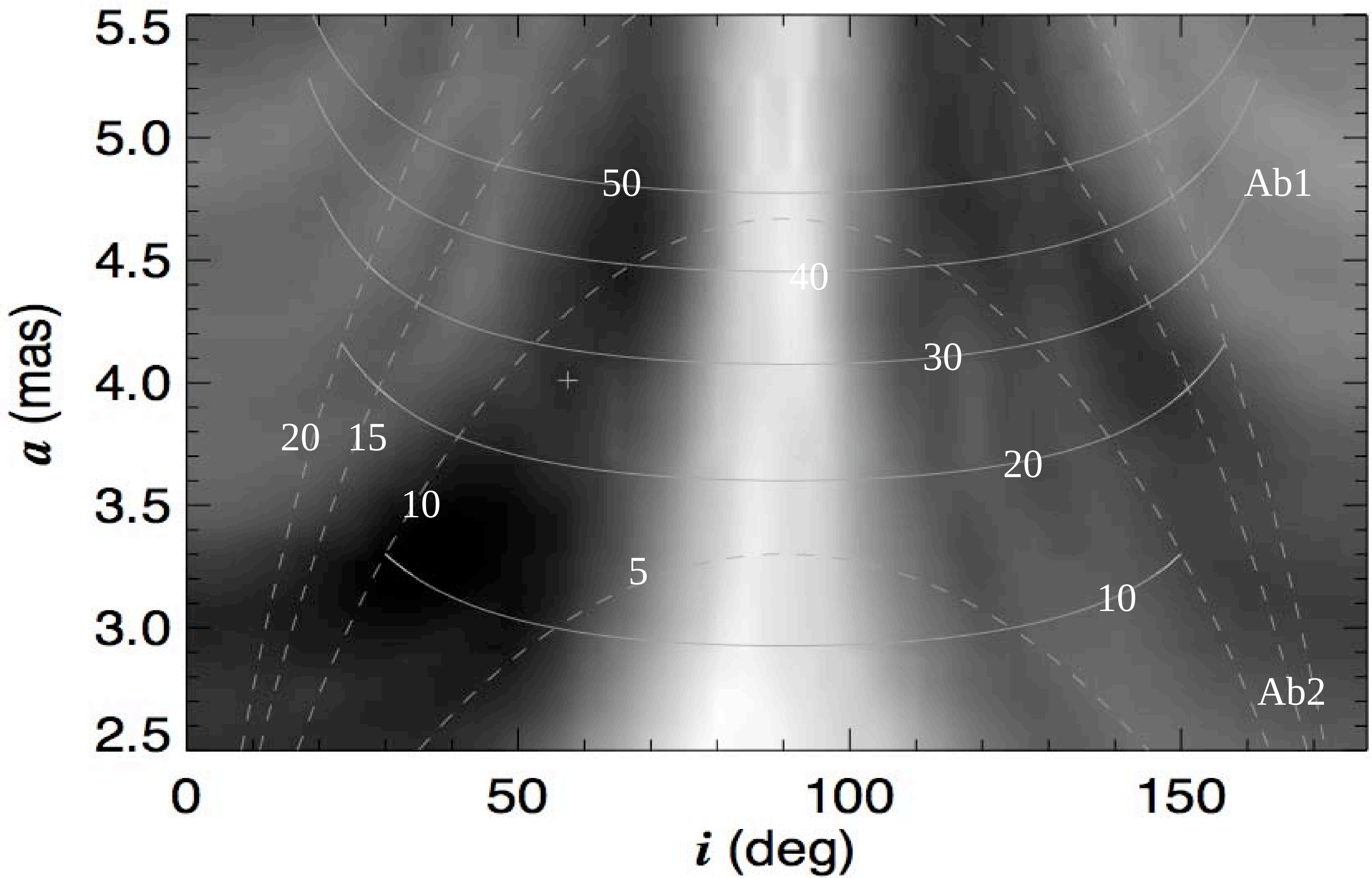
$$M(\mathrm{Ab2}) = \frac{a^2}{P \sin i} \frac{K(1-e^2)^{1/2}}{29.8\ \mathrm{km\ s^{-1}}} = 0.457 M_\odot \frac{a^2}{\sin i} \left(\frac{d}{741\ \mathrm{pc}}\right)^2. \quad (3)$$

Then we can find the mass of Ab1 from a relation for the mass ratio,

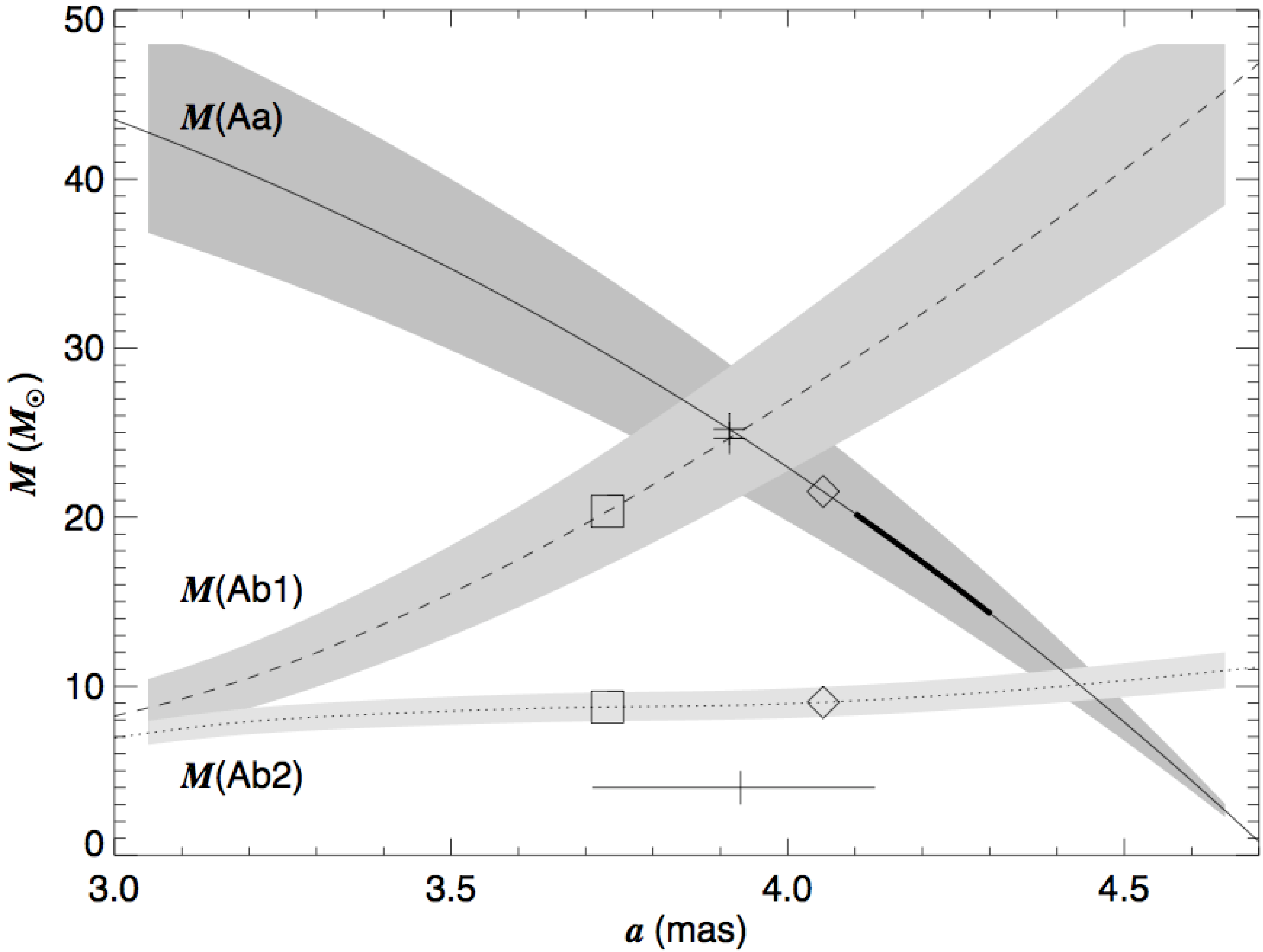
$$\frac{M(\mathrm{Ab1})}{M(\mathrm{Ab2})} = \frac{29.8\ \mathrm{km\ s^{-1}}}{K} \frac{ad \sin i}{P\sqrt{1-e^2}} - 1 = \frac{a \sin i}{0.825\ \mathrm{mas}} \left(\frac{d}{741\ \mathrm{pc}}\right) - 1. \quad (4)$$

Thus, each point in the (i, a) plane is associated with specific masses $M(\mathrm{Ab1})$ and $M(\mathrm{Ab2})$, and we can use the relations above to construct loci of constant primary and secondary mass in Figure 3 (shown by solid and dashed lines, respectively).

Visibility Amplitude Orbit Fit for Ab1-Ab2



Mass Solution



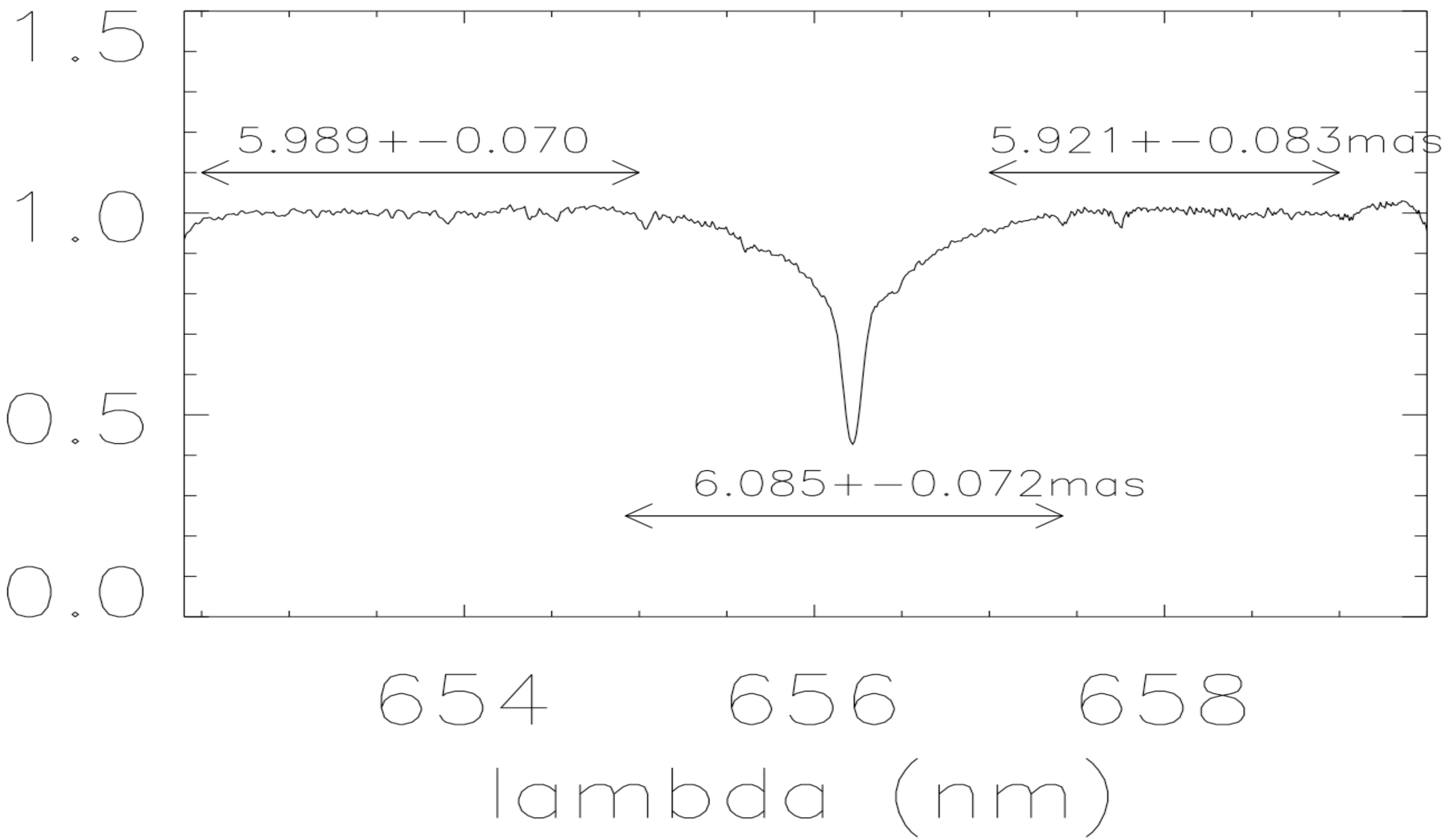
Are you Sirius?
Or
Limb Darkening, Lines and Diameters.

An experiment first
begun by John Davis at
SUSI and now
continued using VEGA
here at CHARA

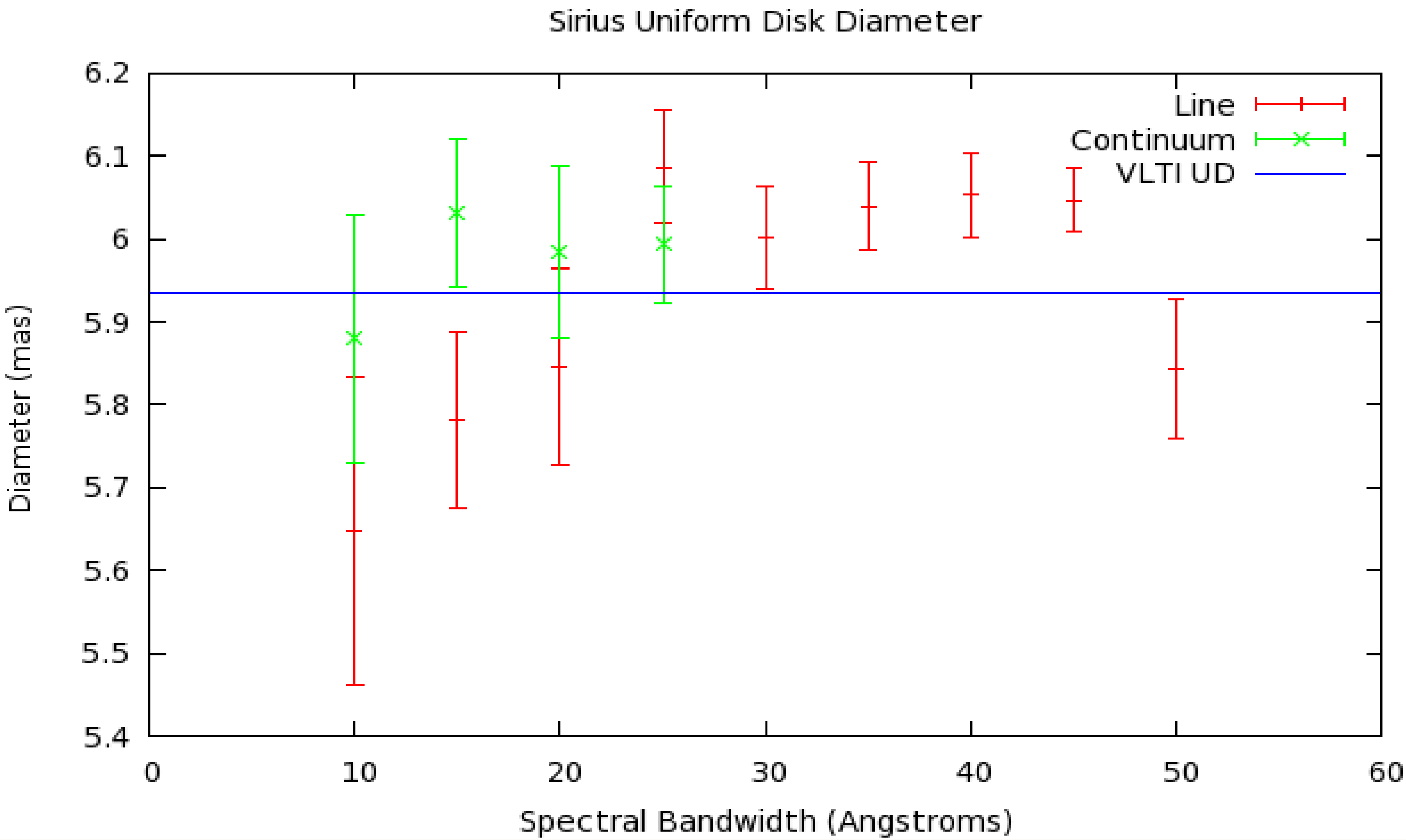
In the center of absorption lines, like Hα and Hβ, one is seeing the cool outer layer of the star.
In the continuum we see the effect of limb darkening.
The UD diameter in the center of the line should therefore be larger than that in the continuum.

An experiment using the old “Blue” beam combiner at SUSI in Hβ showed the UD to be *smaller* in the line center.

VEGA UD Measurement (yes singular)



Same Data – UD centered on Line varying Bandwidth



- The SUSI result was for a very small bandwidth, so we might be confirming their result.
- A second data set would be nice.
- Preliminary differential phase analysis shows no asymmetry. Differential visibility analysis needs more work.
- The center of the line is faint compared to the continuum, so achieving good SNR is hard.
- Using bins of equal total light across the spectrum.
- We plan an observing run later this year to try and obtain very high SNR data.