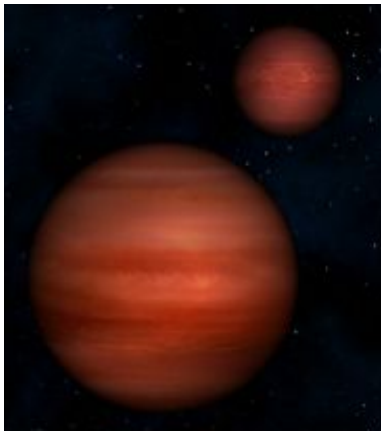


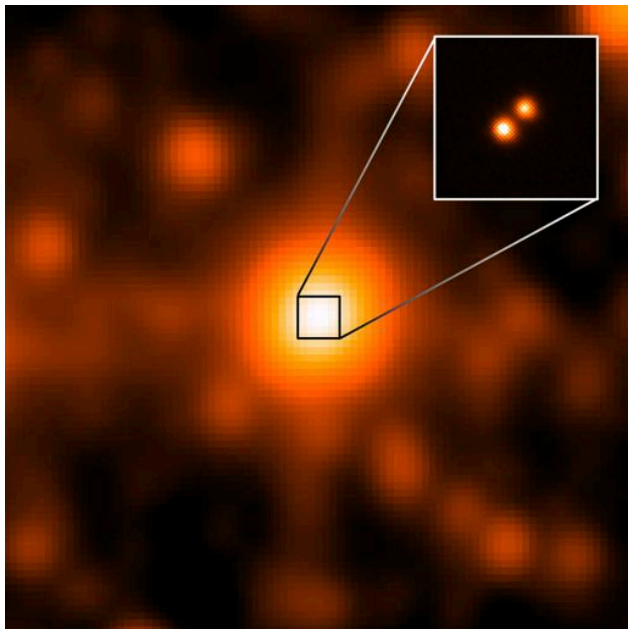
Credit: Janella Williams/Penn State

Latest news on Luhman-16AB

Henri Boffin

D. Pourbaix, K. Mužic, V. D. Ivanov,
R. Kurtev, Y. Beletsky, A. Mehner, J. P. Berger,
J. H. Girard, and D. Mawet

Luhman-16 AB



WISE + GMOS observations
by K. Luhman

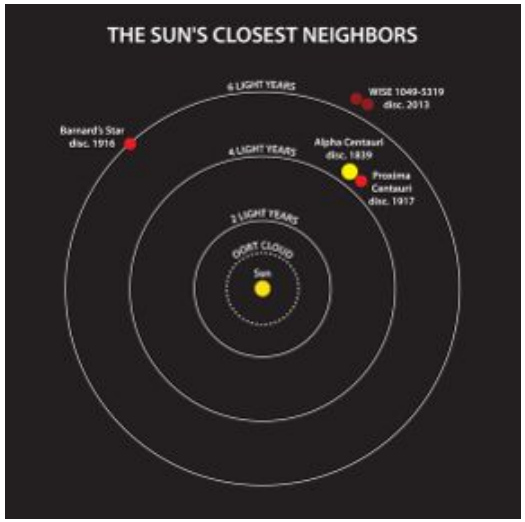
"It was a lot of detective work"

Luhman 2013

Looking for high proper motion in WISE images
→ WISE J104915.57– 531906.1 (Luhman, 2013)

Proper motion: 3”/yr
Two BDs (L8 + …) with 1.5” separation

d = 2 ± 0.15 pc 3rd closest system to Sun !



Credit: Janella Williams/Penn State

A very red object

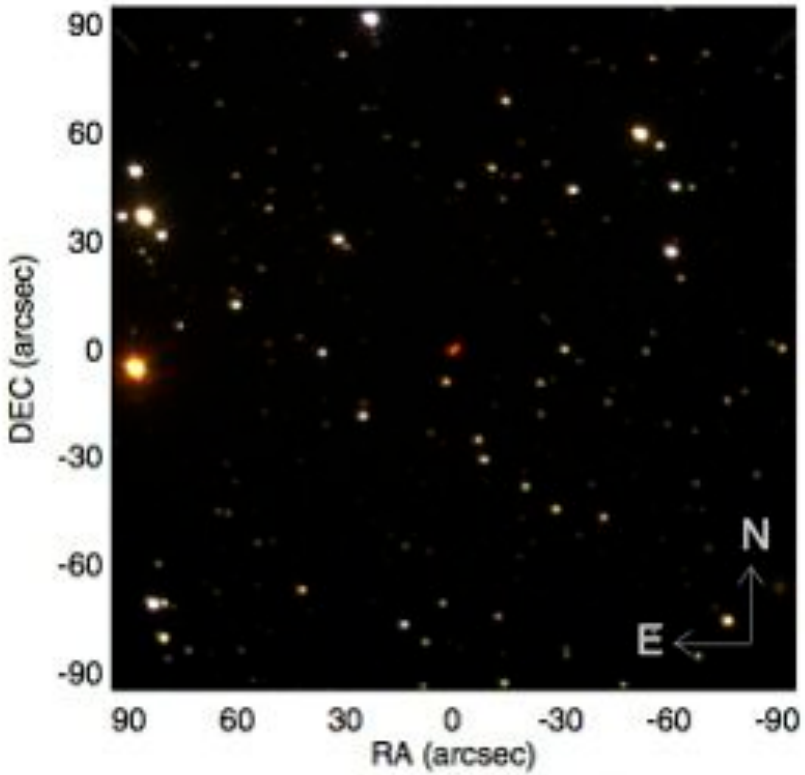


Figure 1. Three-color optical image of the W10−53 field highlighting the extremely red color of the binary. Three 90 s exposures taken with the RSS at SALT at R.A. = $10^h49^m15\overset{s}{.}57$, decl. = $-53°19'06\overset{''}{.}1$ were combined: red, green, and blue correspond to 100–200 Å wide filters centered at 8175, 7260, and 5060 Å, respectively.

Filters	Luh 16A	Luh 16B	Errors
V	23.25	24.07	0.10
R	18.85	19.45	0.08
I	15.29	15.57	0.06
z	13.83	13.76	0.02

Boffin+ ‘14

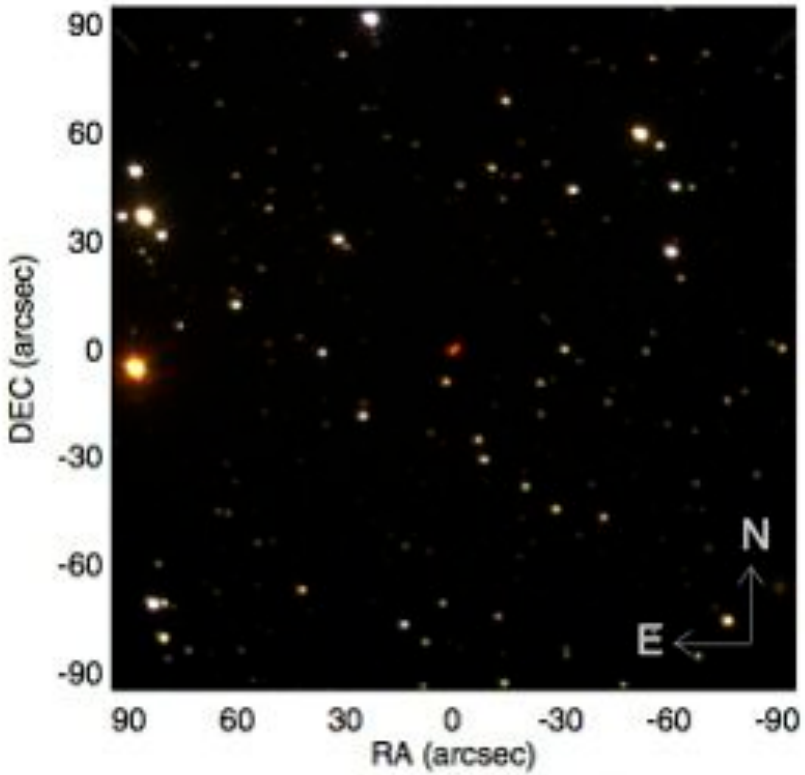
Table 1
IRSF Photometry for W10−53 from 2013 March 16

Band	Component A[a]	Component B[a]	Combined[a]
J	11.511 ± 0.028	11.233 ± 0.028	10.611 ± 0.028
H	10.396 ± 0.026	10.369 ± 0.028	9.634 ± 0.026
K_S	9.559 ± 0.029	9.767 ± 0.029	8.901 ± 0.029

Note. [a] Uncertainties represent the formal Poisson errors.

Kniazev+ ‘13

A very red object



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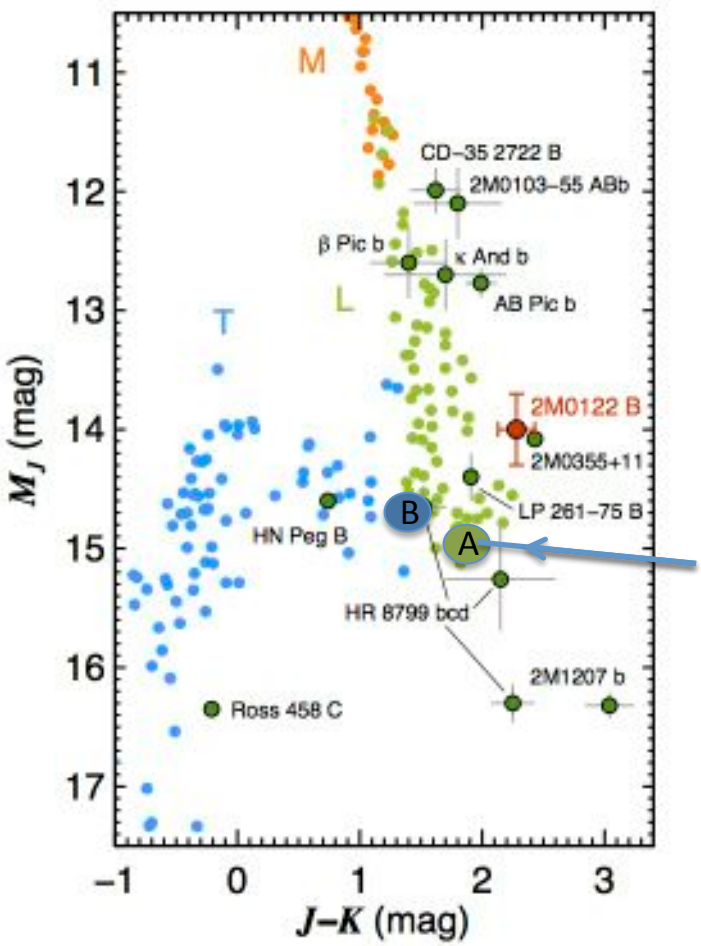
Kniazev+ ‘13

FLUX REVERSAL!

See also Burgasser+ ‘13

A very red object



Luhman-16

Diagram from Bowler+ ‘13

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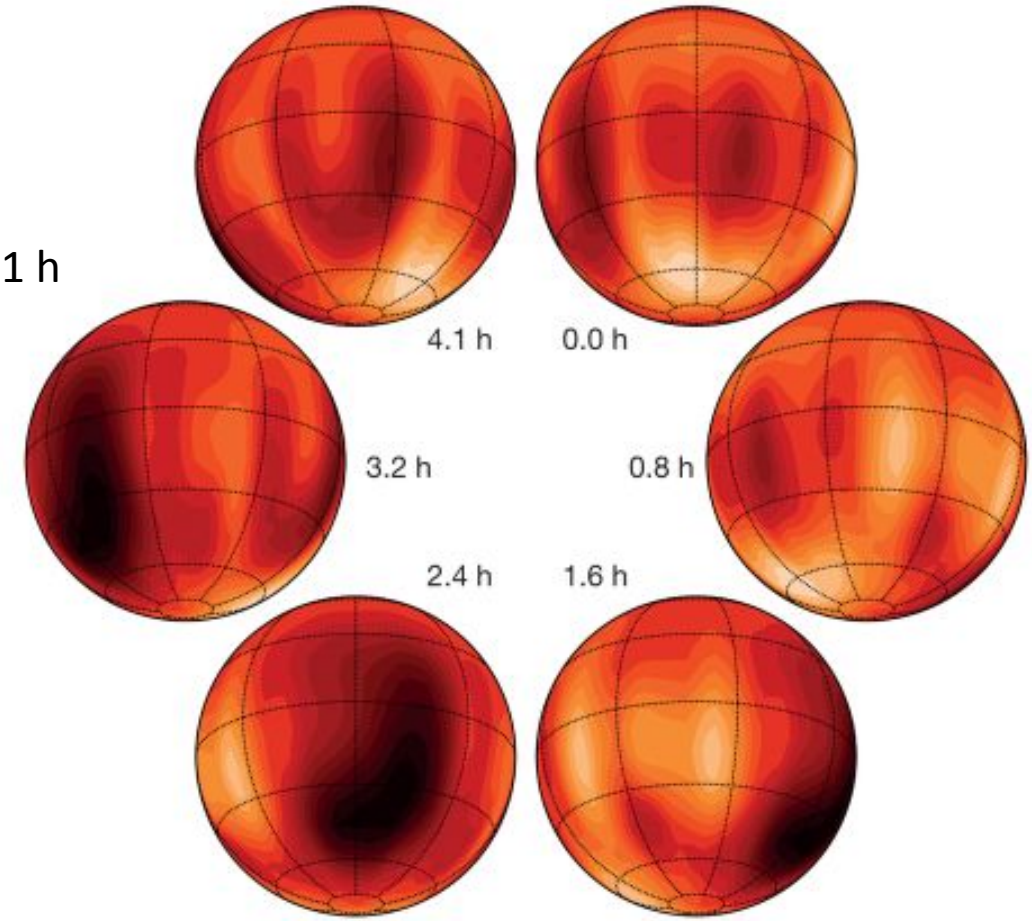
Kniazev+ ‘13

Flux reversal is thought to arise when going from fully cloudy L dwarfs to relatively clear T dwarfs.
(Burgasser+ ‘13, Faherty+ ’14)

Mapping the clouds

Luhman-16B
Clouds!

Prot = 4.87 ± 0.01 h



CRIRES@VLT

Crossfield+ 14

Luhman-16 AB

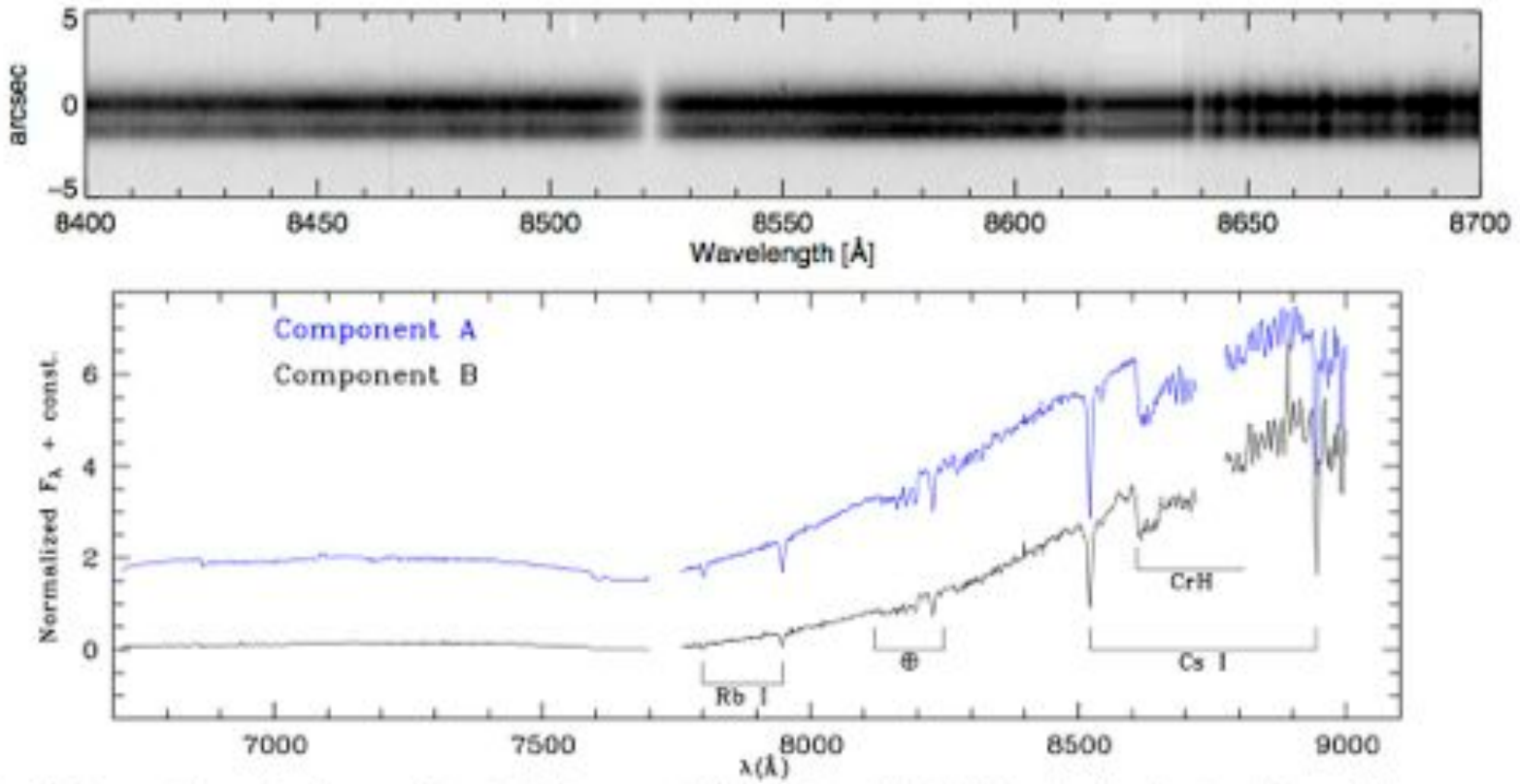
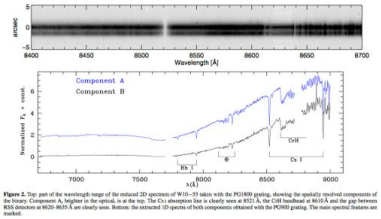


Figure 2. Top: part of the wavelength range of the reduced 2D spectrum of W10−53 taken with the PG1800 grating, showing the spatially resolved components of the binary. Component A, brighter in the optical, is at the top. The Cs I absorption line is clearly seen at 8521 Å, the CrH bandhead at 8610 Å and the gap between RSS detectors at 8620–8635 Å are clearly seen. Bottom: the extracted 1D spectra of both components obtained with the PG900 grating. The main spectral features are marked.

Kniazev+ ‘13

Luhman-16 AB



SALT spectra

L8 ± 1 **T1.5 ± 2**

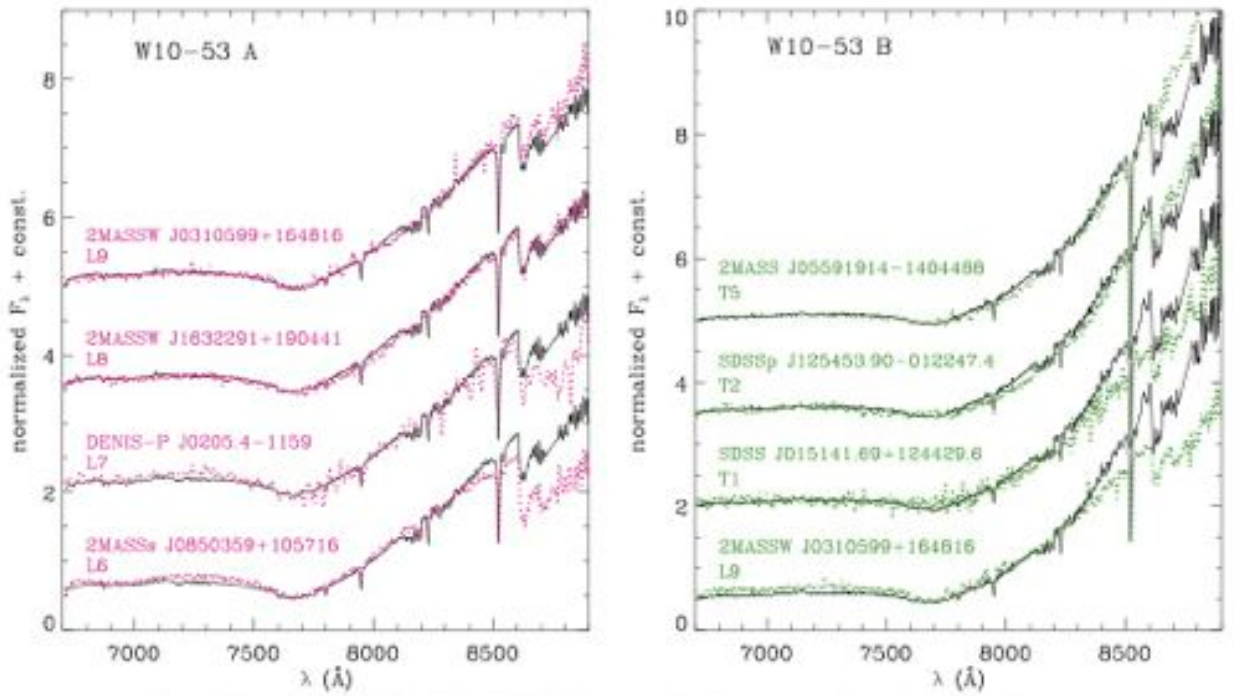
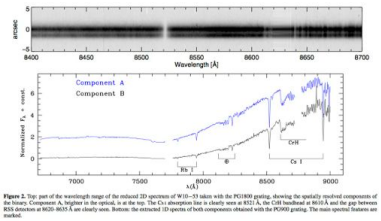


Figure 3. Comparison of the W10−53 A and B PG900 spectra (black) with various spectral templates (green and purple).

Kniazev+ ‘13

Luhman-16 AB



From near-IR spectroscopy, Burgasser+ ‘13 found L7.5 ± 0.9 and T0.5 ± 0.7

L8 ± 1

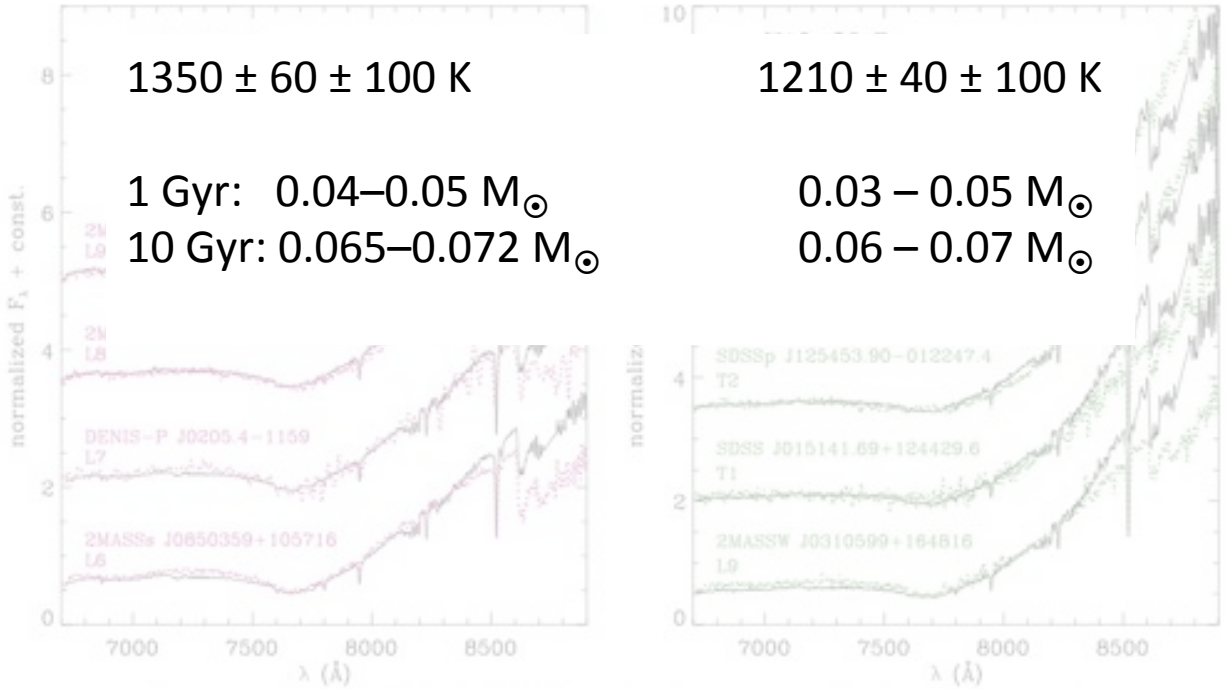
1350 ± 60 ± 100 K

1 Gyr: 0.04–0.05 $M_\odot$
10 Gyr: 0.065–0.072 $M_\odot$

T1.5 ± 2

1210 ± 40 ± 100 K

0.03 – 0.05 $M_\odot$
0.06 – 0.07 $M_\odot$



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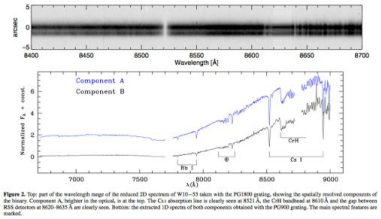

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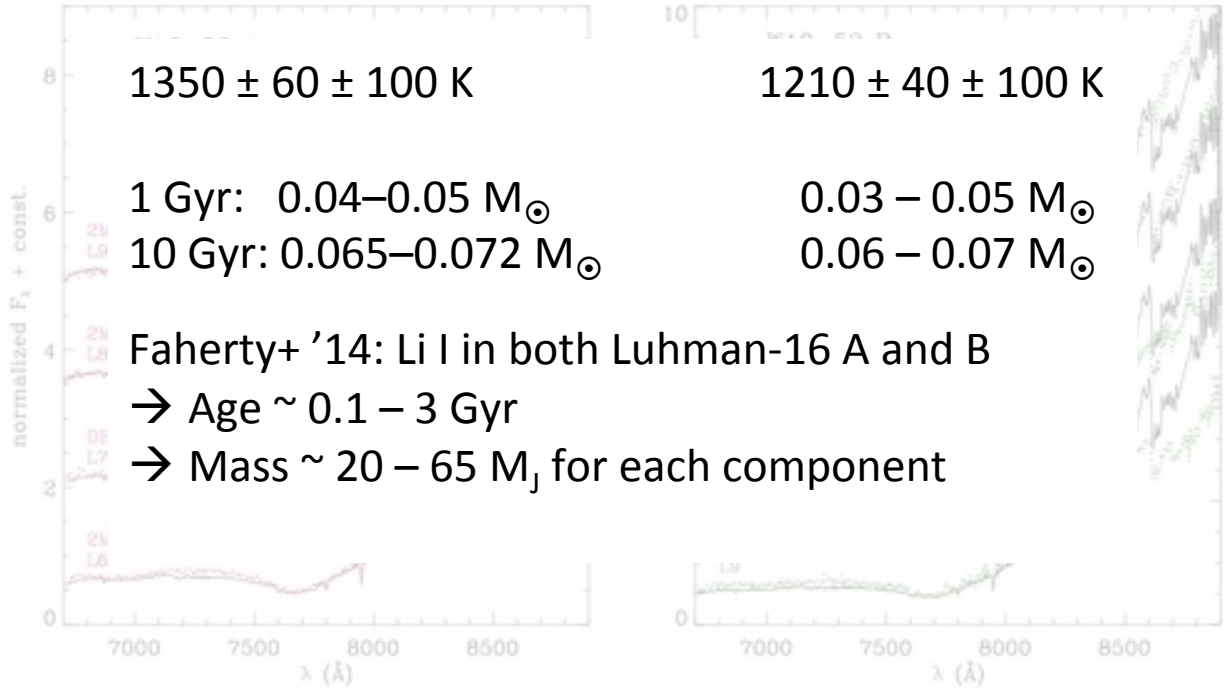
Faherty+ ’14: Li I in both Luhman-16 A and B
→ Age ~ 0.1 – 3 Gyr
→ Mass ~ 20 – 65 M_J for each component



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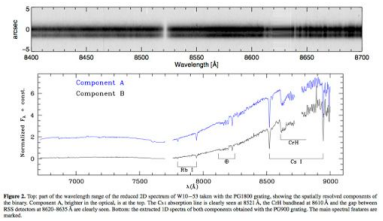
Luhman-16 AB



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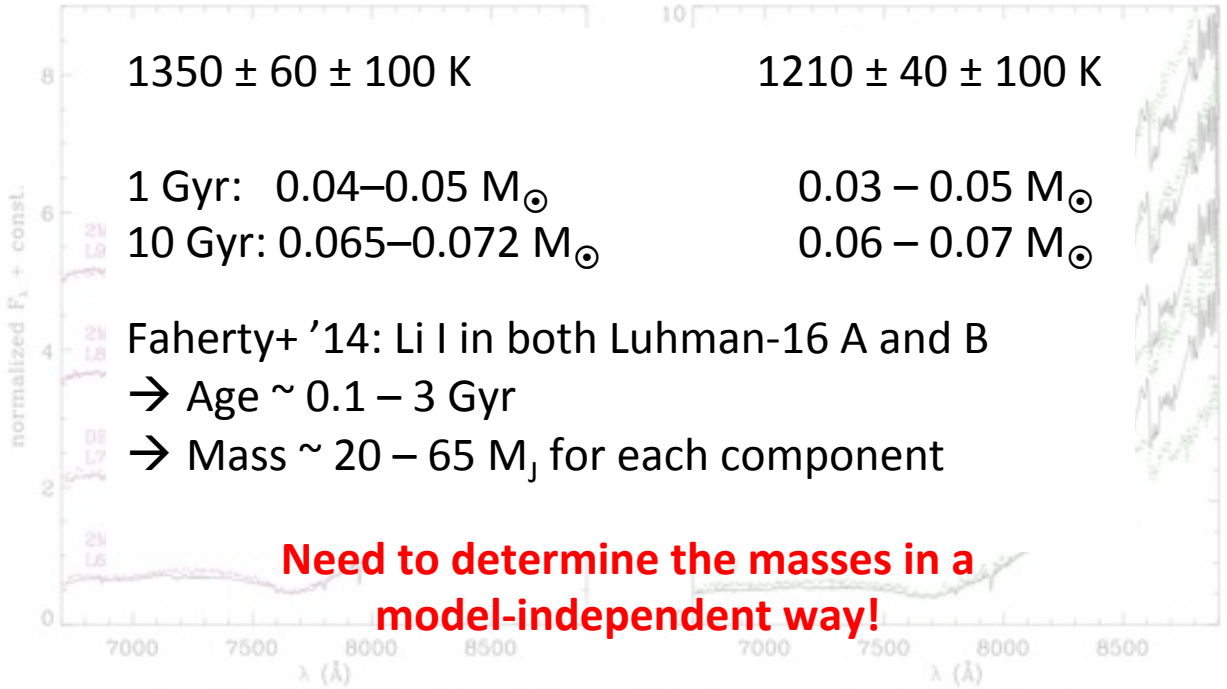
Need to determine the masses in a model-independent way!



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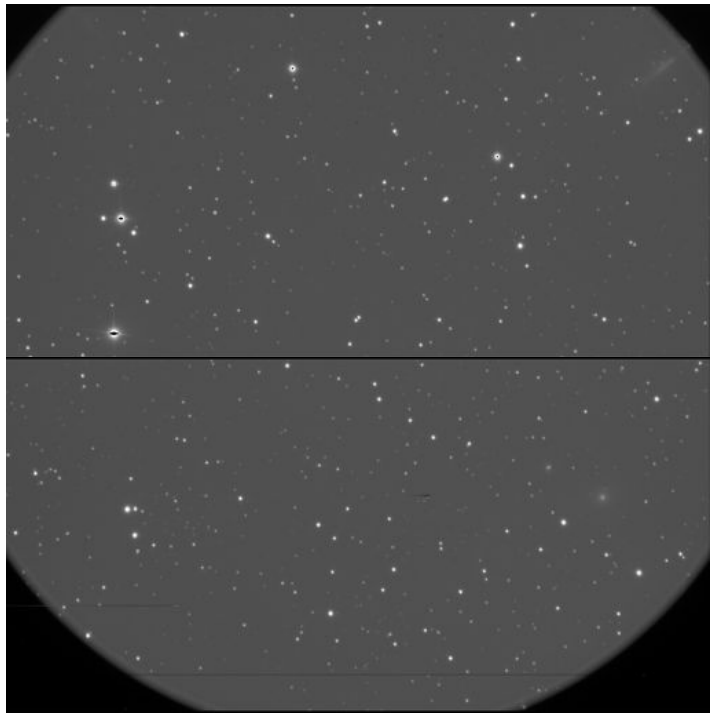
Astrometry with FORS2@VLT

The Swiss knife of Paranal



Luhman 16AB with HR Coll

	SR Coll	HR Coll
FoV:	6.8'x'6.8'	4'x4'
Pixel scale (2x2)	0.25"	0.125"

Astrometry: can reach sub-milli arcsec accuracy

Eps Indi Ba,b

The previous closest binary BD
d=3.622 pc

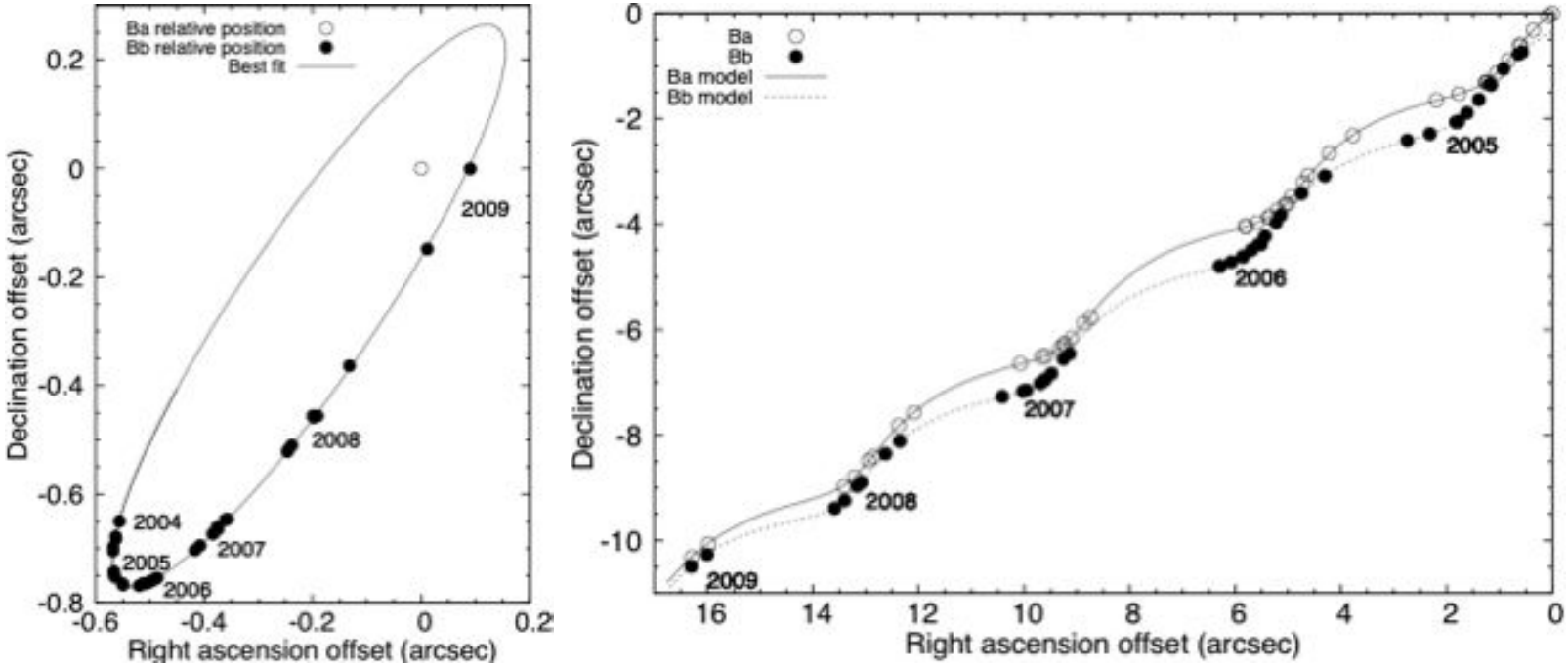
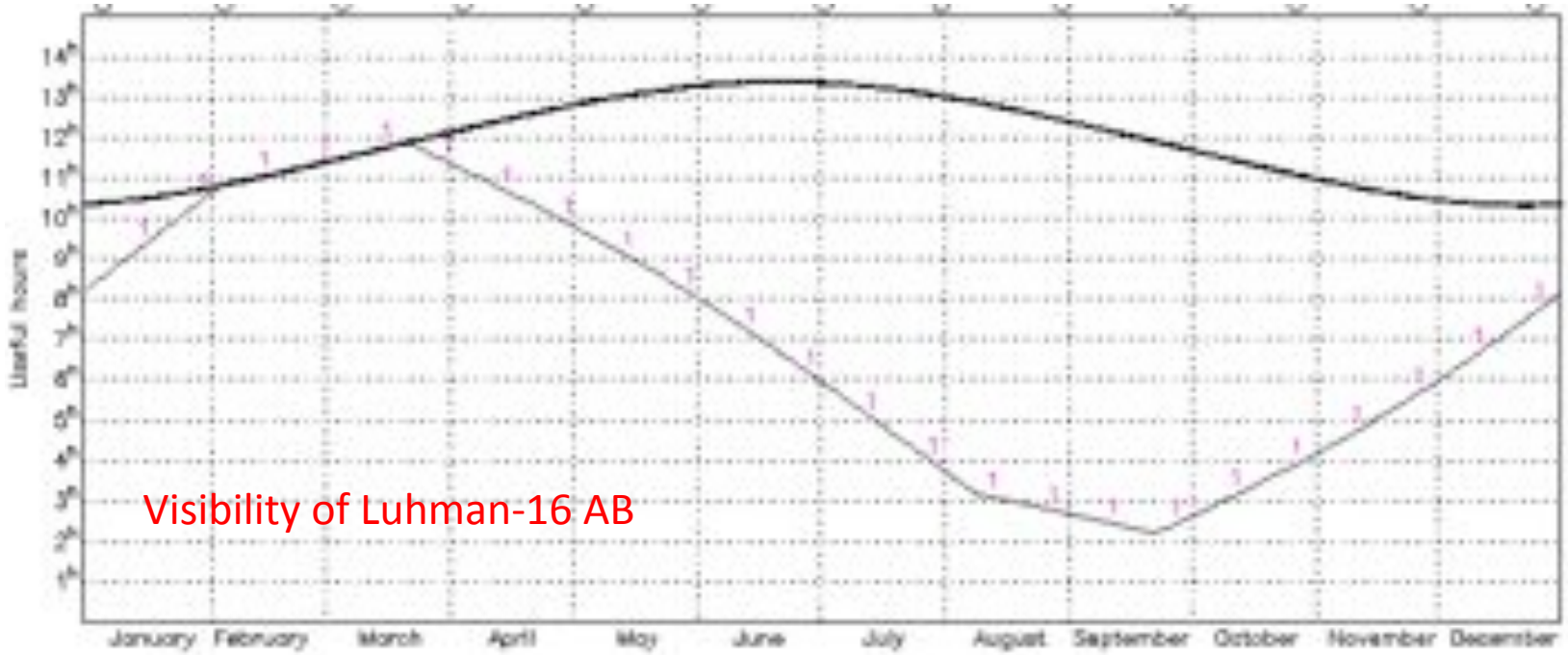


Figure 1. Left: Relative motion (NACO). Right: Absolute motion (FORS2).

T1 + T6; Total mass = 121 M_J
A ~ 2 AU; P~ 15 yr

Cardoso+ 10

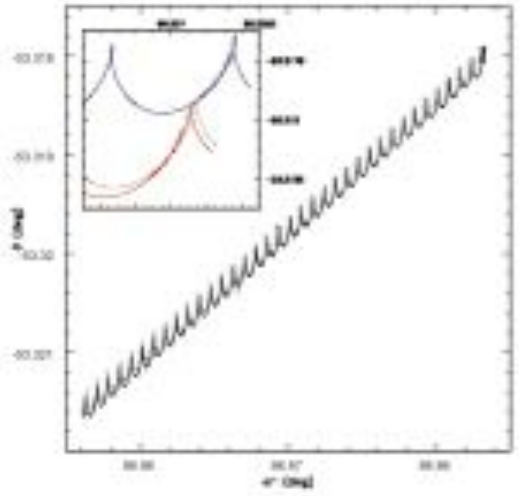
Campaign

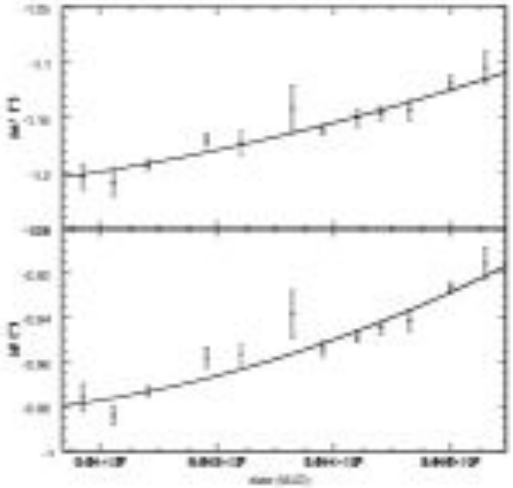


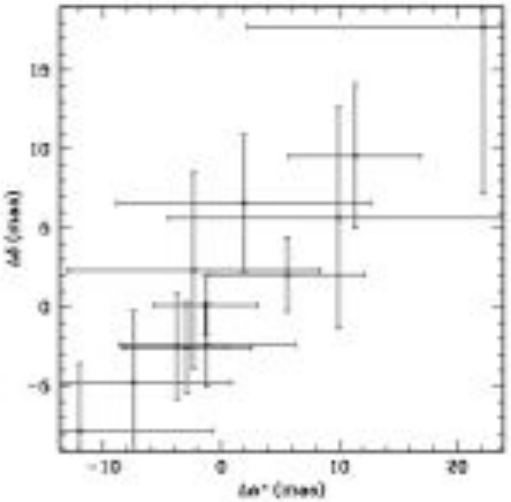
From Paranal, it is visible from end November till beginning of June at low airmass

First study: DDT – Observations from April till June 2013
Monitoring: Since February 2014 – 4 semesters

First 2-month campaign





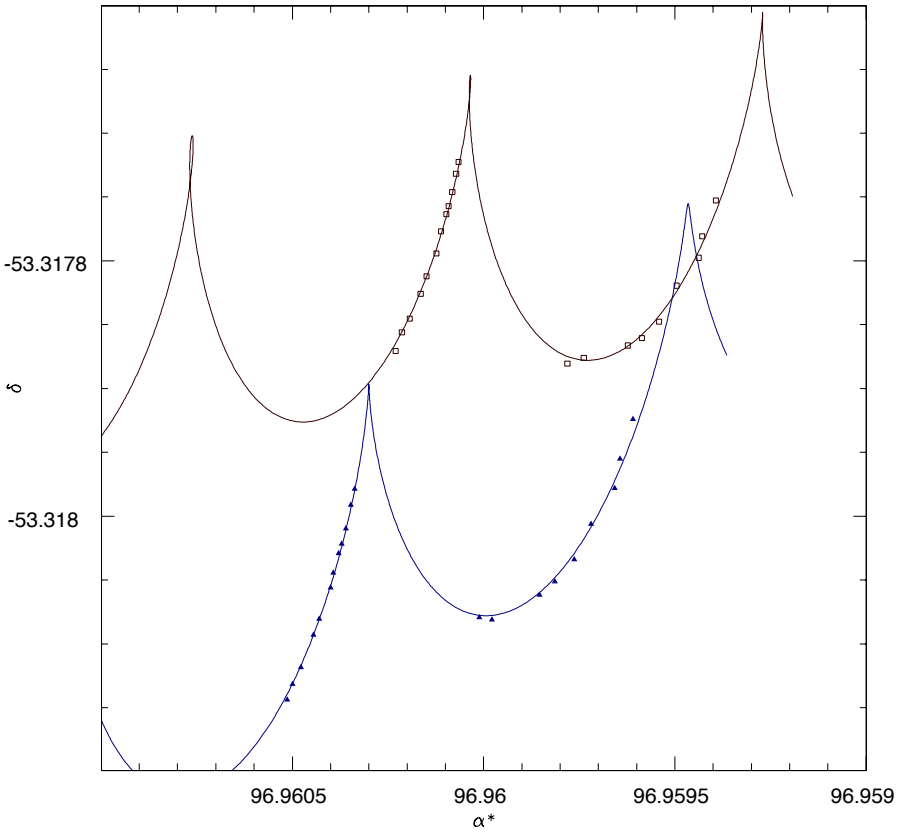


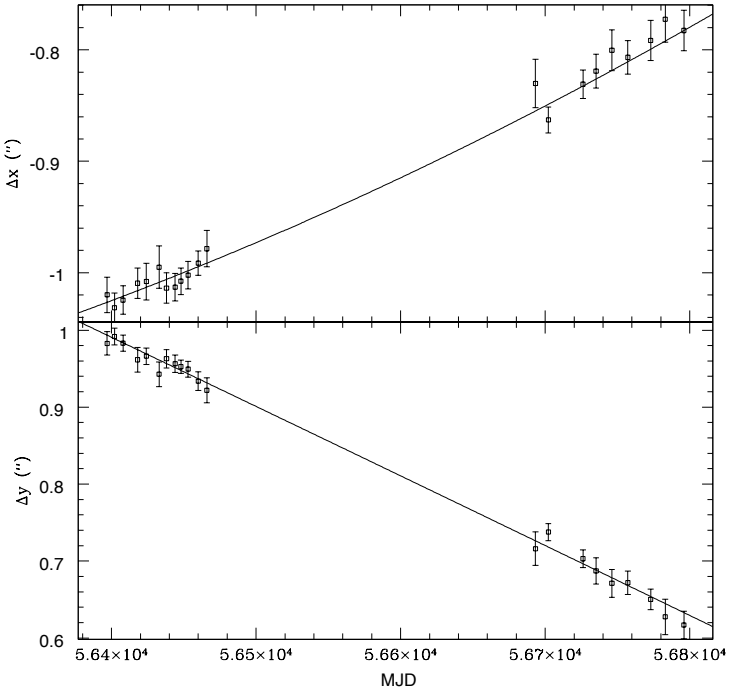
Parameter	This work	Luhman (2013)
ϖ (mas)	495 ± 4.6	496 ± 37
$\mu_{\alpha*}$ (mas yr^{-1})	−2 763 ± 2.7	−2759 ± 6
μ_{δ} (mas yr^{-1})	363 ± 4.1	354 ± 6

a companion *might* be present around the primary
M ~ a few M_J
P < 100 d (i.e. A < 0.2 AU!)

Boffin+ ‘14

After 1 year of FORS2 data…





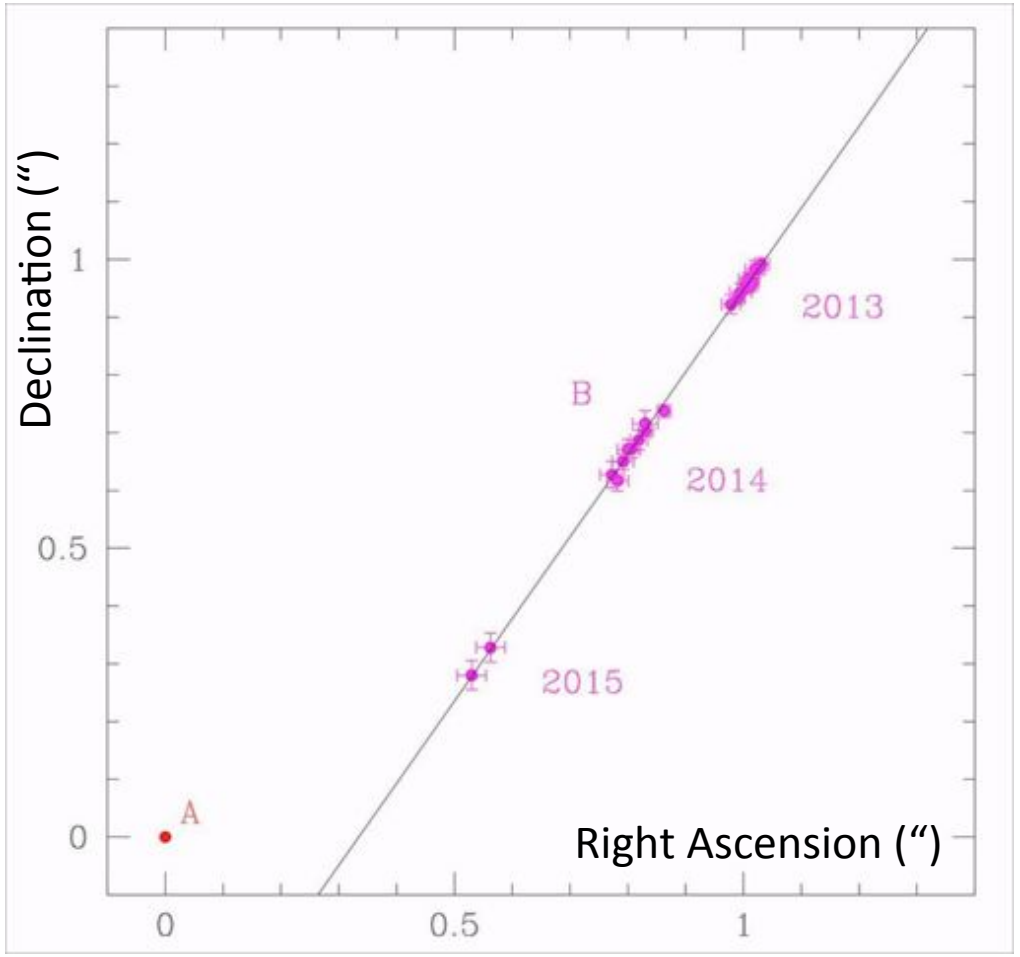
$\varpi = 498 \pm 2$ mas

Pourbaix+ ‘15

Moving closer…

FORS2
Observations
Pourbaix+ ‘15

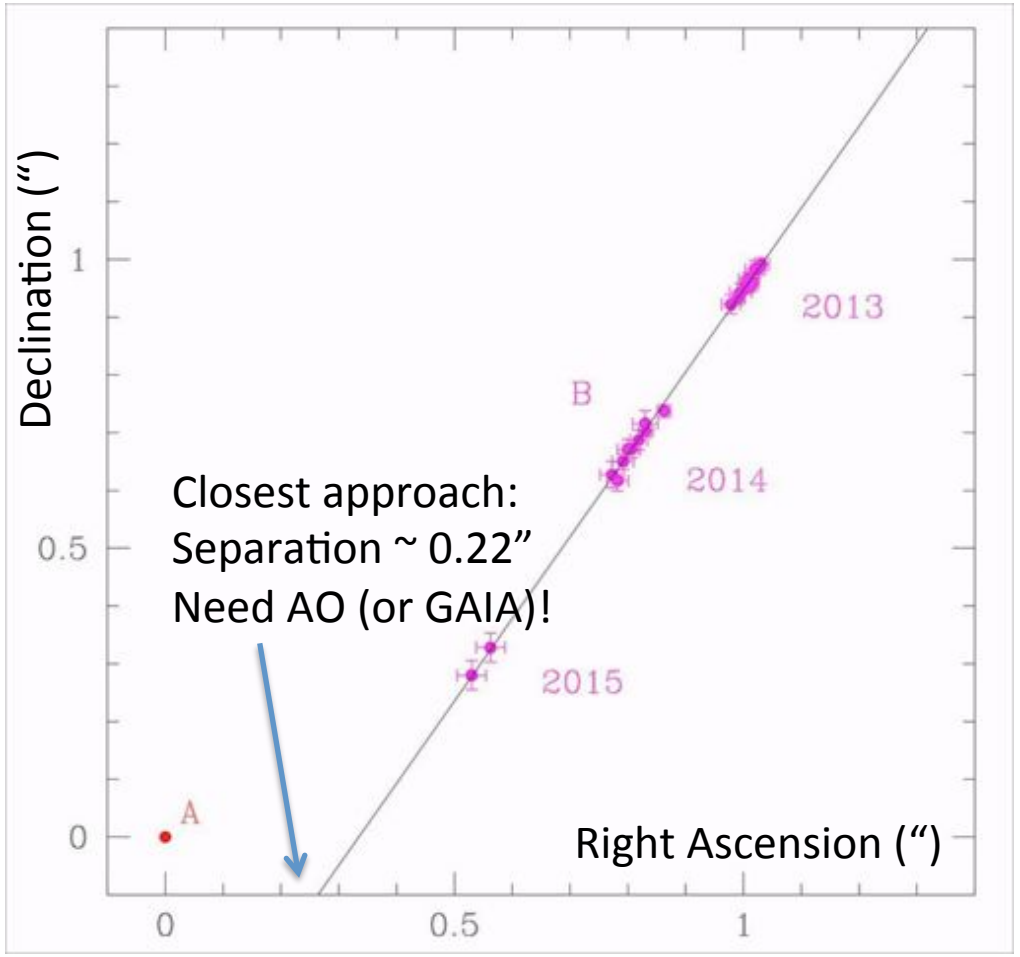
Relative positions of 2 BDs



Still in linear part…

Pourbaix+ ‘15

Relative positions of 2 BDs



Still in linear part…

Pourbaix+ '15

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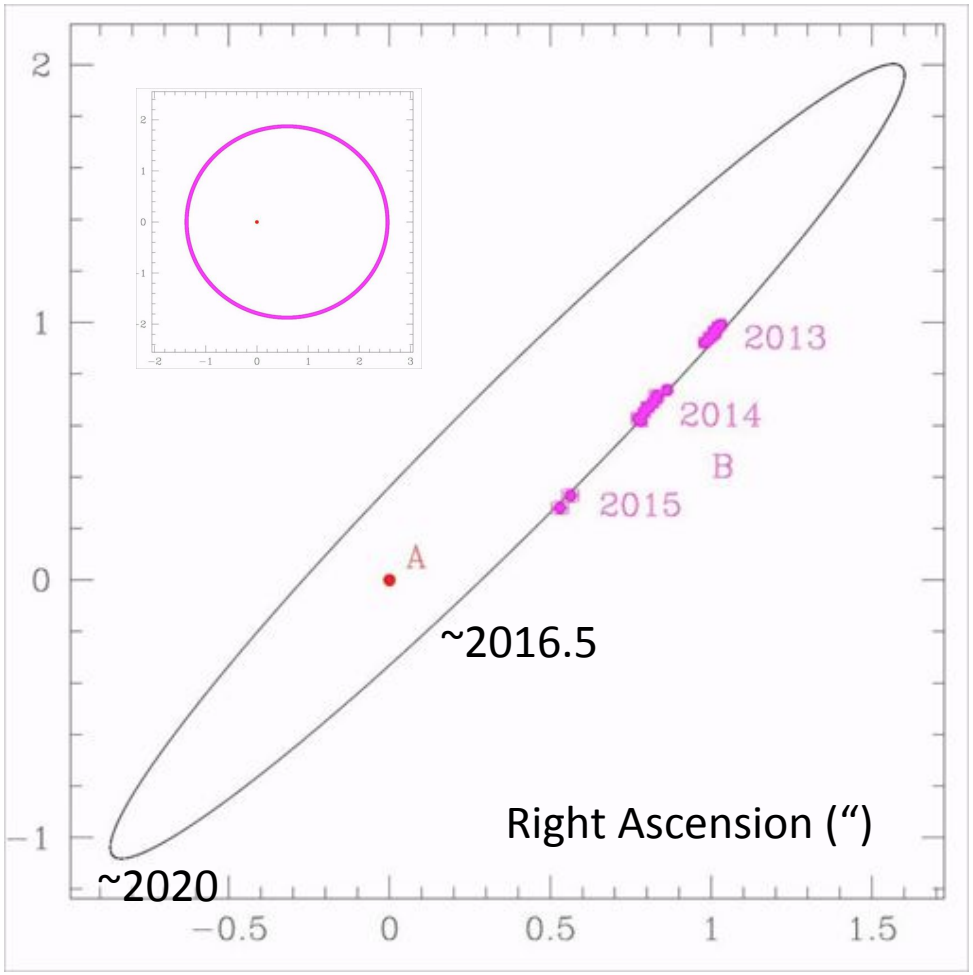


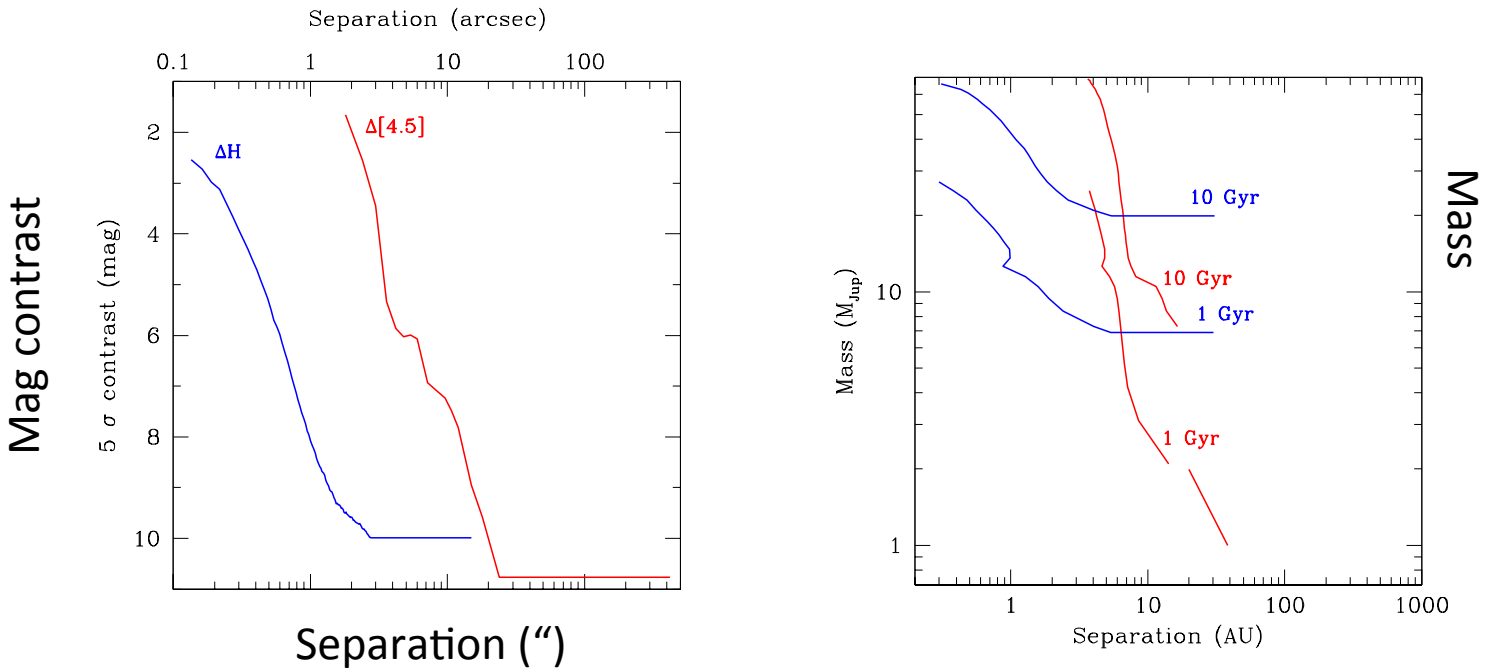
Pourbaix+ '15

A possible orbit:
P = 27 yr
i = 83 deg
e = 0.3
$M_1 = 0.06\ M_\odot$
$M_2 = 0.05\ M_\odot$

Relative velocity:
0.5 km/s!

Looking for a companion

NACO H-band
Spitzer



No companion found!
M > 7 M_J at 3 AU

Melso+ ‘15

Summary

- Luhman-16AB is the 3rd closest system to Sun and is composed of L/T binary BD
- It could be a real Rosetta stone for the field
- An astrometric programme was started on FORS2
- Separation will go down to 0.2” → need for AO
- There is no detected companion to the 2 BDs
- It should be possible to derive the masses of the two objects… by the time I retire!


Thank You!
Pourbaix+ ‘15

But… remember