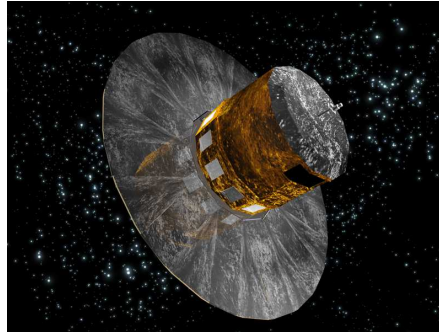




*Accurate stellar masses for SB2
components: Interferometric observations
for Gaia validation*

*J.-L. Halbwachs, H. Boffin, J.-B. Le Bouquin, B. Famaey,
J.-B. Salomon, F. Arenou, D. Pourbaix, F. Anthonioz,
R. Grellman, S. Guieu, P. Guillout, A. Jorissen, F. Kiefer,
Y. Lebreton, T. Mazeh, A. Nebot, H. Sana, L. Tal-Or*

Diapositive 1

oa1

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The “Accurate Mass” programme

Orbital elements of SB2 $\Rightarrow$

- $\mathcal{M}_1 \sin^3 i, \mathcal{M}_2 \sin^3 i,$
- $a_1 \sin i$ (km), $a_2 \sin i$ (km)

GAIA astrometric observations : $+ i, a_0$ (mas), ϖ

SB2 + GAIA $\Rightarrow \mathcal{M}_1, \mathcal{M}_2, \Delta G$ (mag)

Observations of SB with T193/Sophie (OHP) since 2010, in order

- To get accurate SB2 orbits
- To derive accurate masses when the GAIA observations will be available.

Diapositive 2

oa6

observatoire astronomique; 03/06/2013

The OHP sample

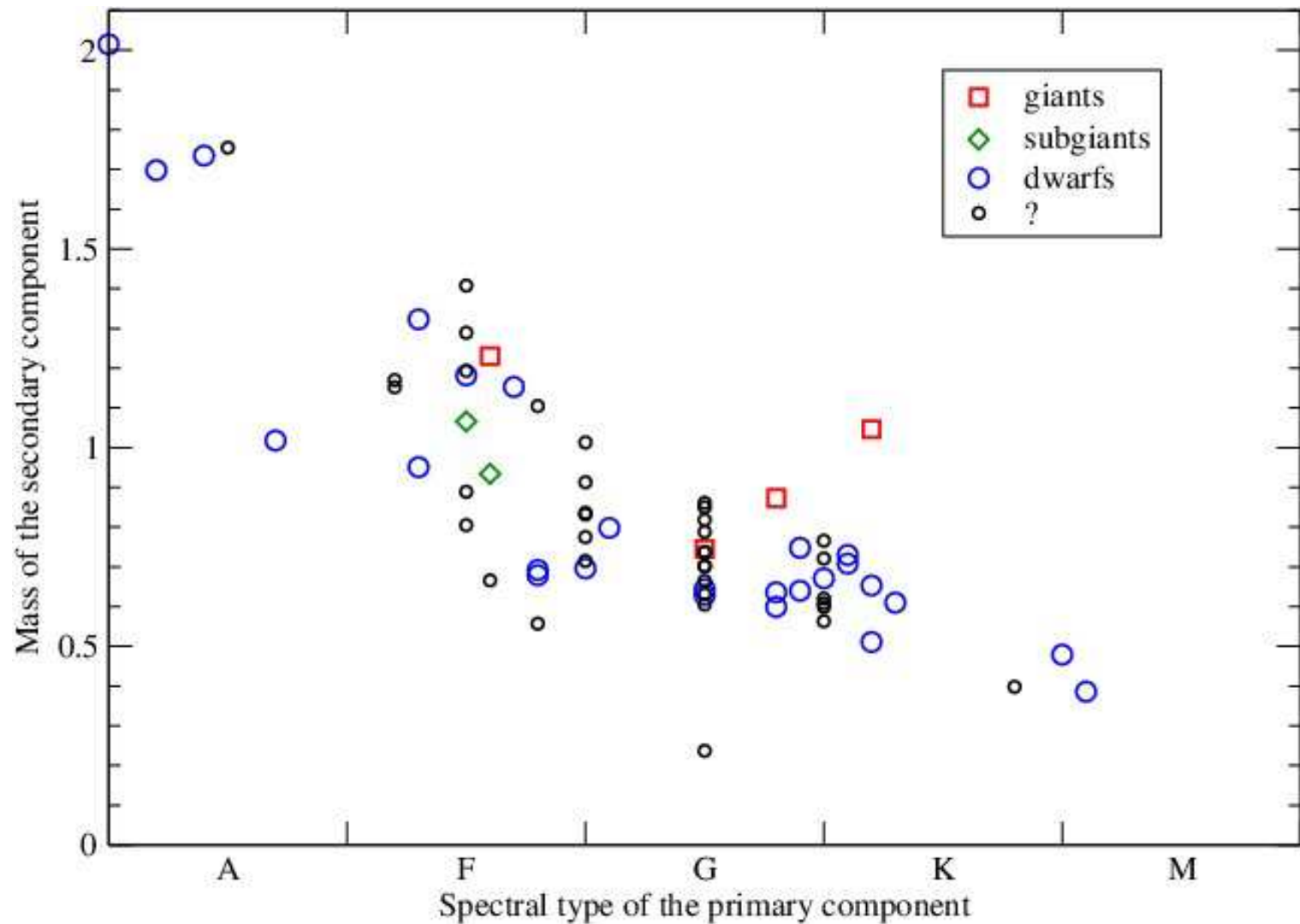
- 68 SB2

Primary components:

- A0 – M1.5
- 3 late-type giant stars

Masses:

$0.3 - 2 \mathcal{M}_{\odot}$



Diapositive 3

oa4

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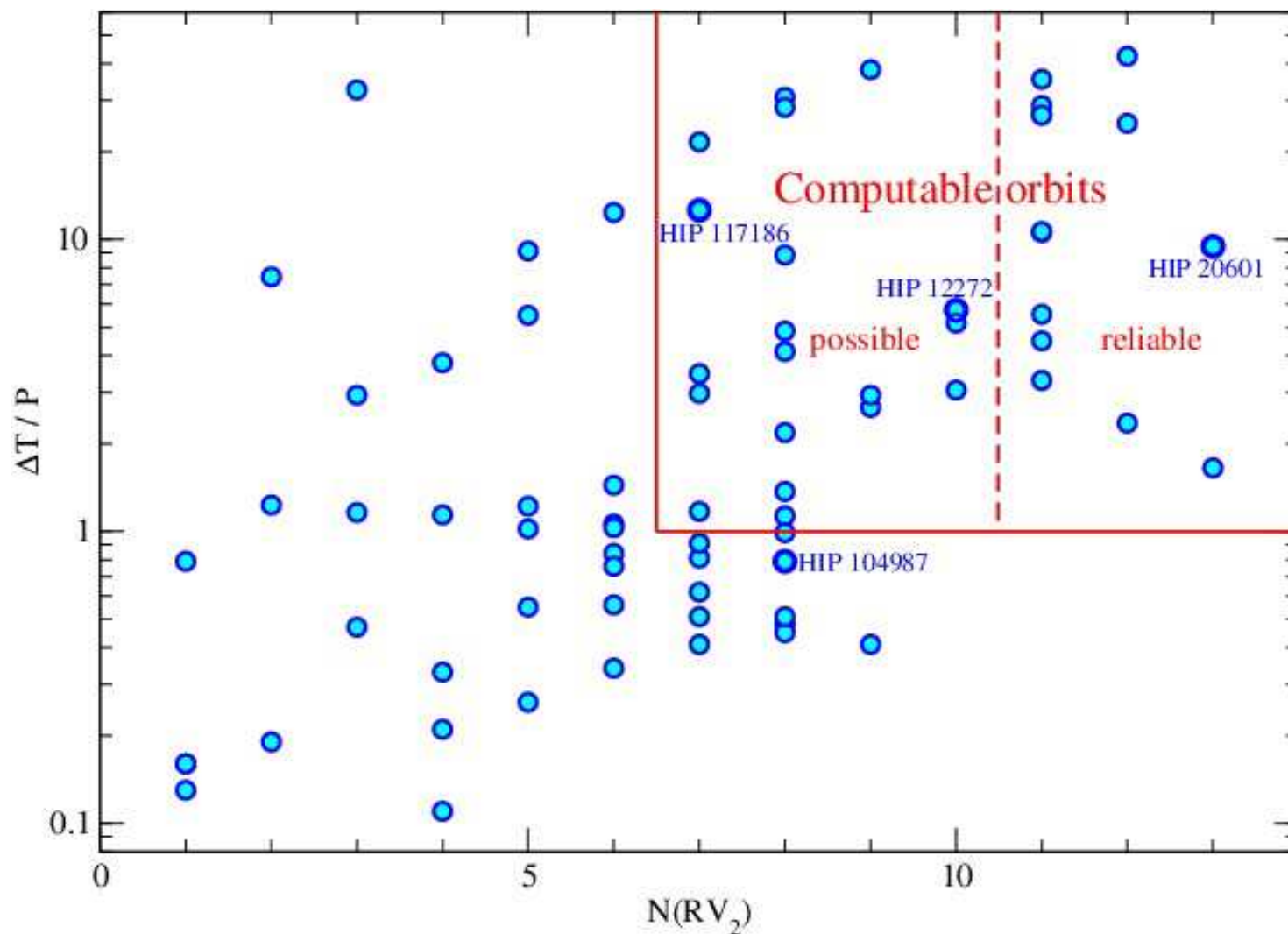
Progress of the OHP program

12 SB2 with

- $\Delta T > P$
- $N(RV_2) \geq 11$

MNRAS (in prep.)

Interferometric
measurements
(ESO/PIONIER)
for 4 SB2
+2 SB2
(SB9+Hermes)



Diapositive 4

oa11

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RV + PIONIER observations

Orbital elements of SB2 $\Rightarrow$

- $\mathcal{M}_1 \sin^3 i, \mathcal{M}_2 \sin^3 i$
- $a_1 \sin i$ (km), $a_2 \sin i$ (km)

PIONIER observations of interferometric binaries :
+ i , $a=a_1+a_2$ (mas), ΔH (mag)

SB2 + PIONIER $\Rightarrow \mathcal{M}_1, \mathcal{M}_2, \varpi, \Delta H$

RV : 4 SB2 of the OHP programme + 2 SB2 from SB9+Hermes

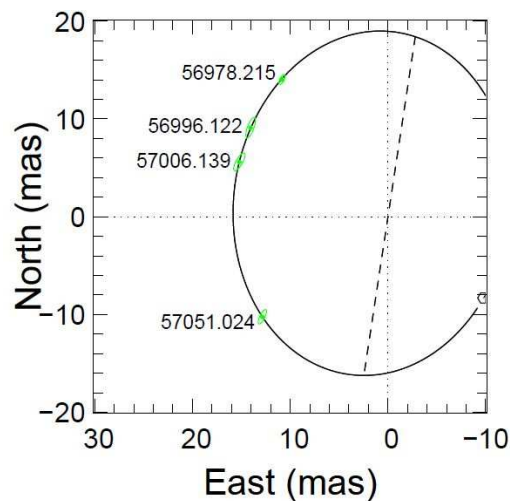
PIONIER : 3 binaries sufficiently observed, preliminary results for the 3 others.

Diapositive 5

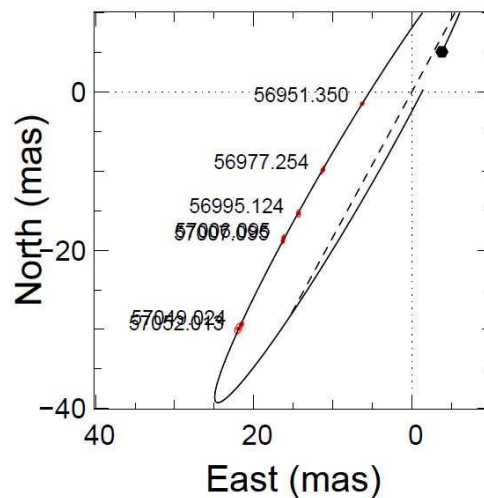
oa16

observatoire astronomique; 03/06/2013

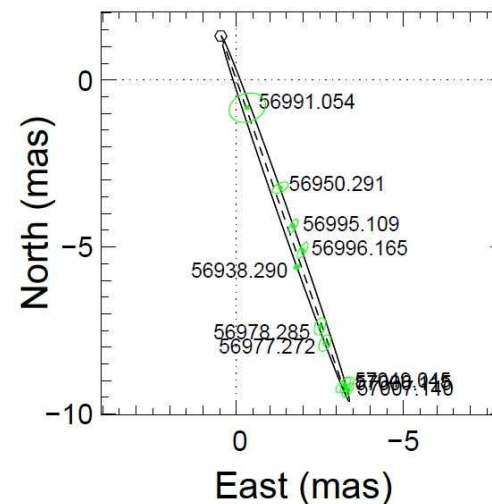
The visual orbits observed with PIONIER



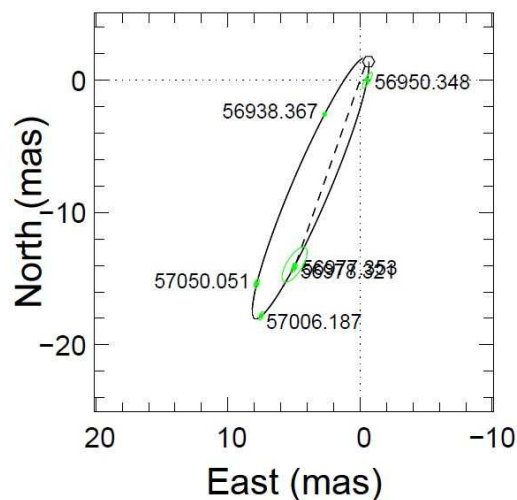
HIP 12272



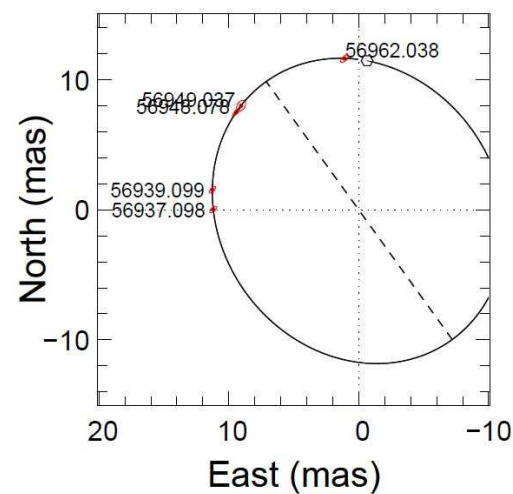
HIP 14124



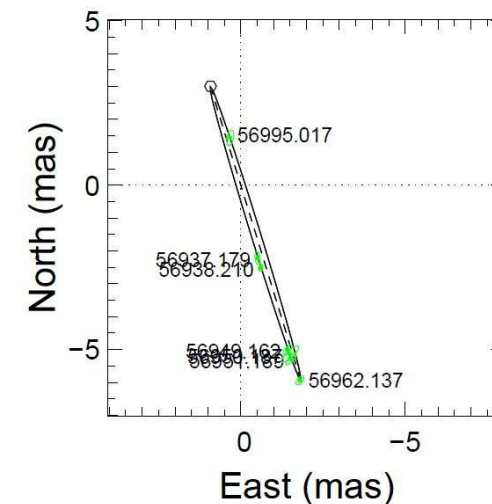
HIP 14157



HIP 20601



HIP 104987



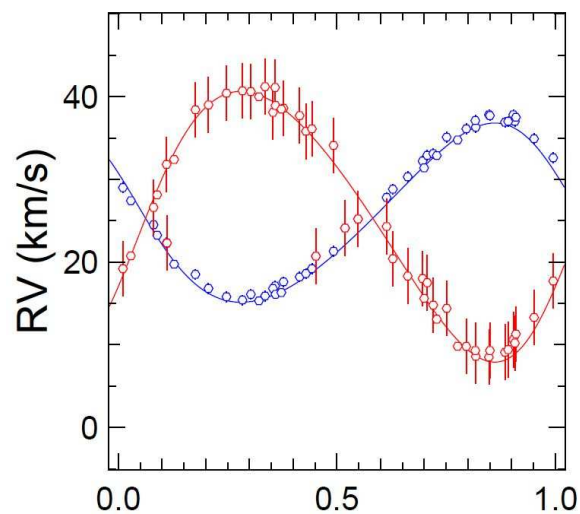
HIP 117186

Diapositive 6

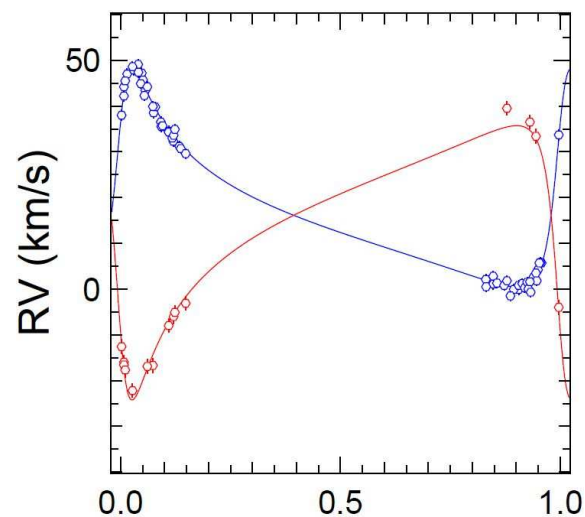
oa8

observatoire astronomique; 03/06/2013

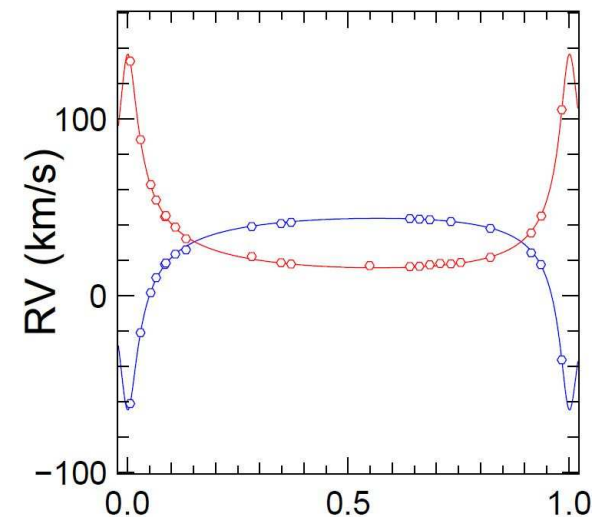
The spectroscopic orbits



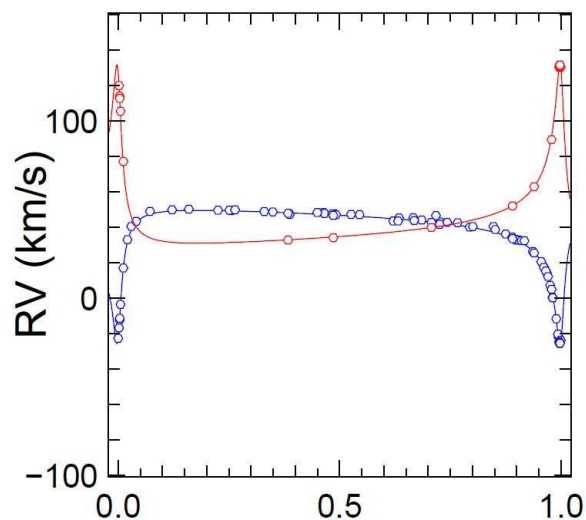
HIP 12272



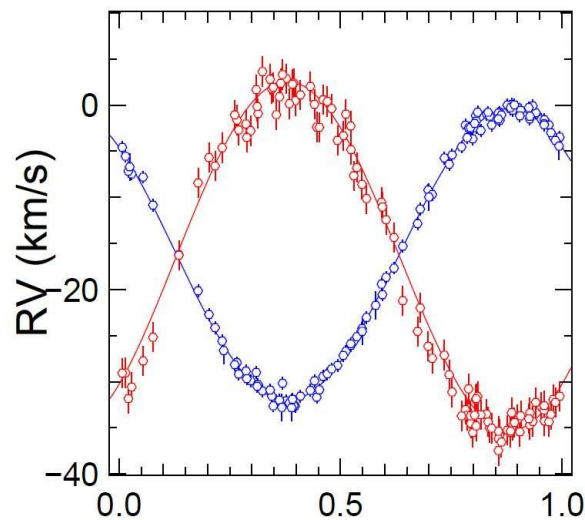
HIP 14124



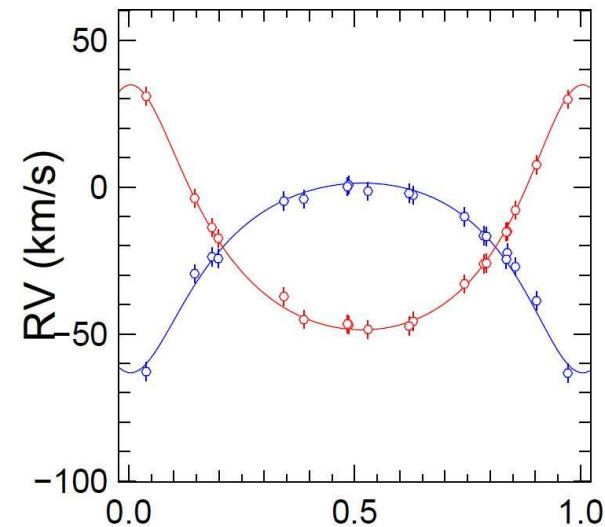
HIP 14157



HIP 20601



HIP 104987



HIP 117186

Diapositive 7

oa14

observatoire astronomique; 03/06/2013

Our best combined solution

HIP 20601 (G5 V)

RV :

63 + 4 by Griffin et al. (1985)

σ_{O-C} : 0.95 km/s, 2.38 km/s

13 +13 from Sophie

σ_{O-C} : 0.023 km/s, 0.285 km/s

- $\mathcal{M}_1 \sin^3 i = 0.926 \pm 0.005 \mathcal{M}_0$

- $\mathcal{M}_2 \sin^3 i = 0.679 \pm 0.003 \mathcal{M}_0$

PIONIER :

6 observations, O-C = 0.032 mas

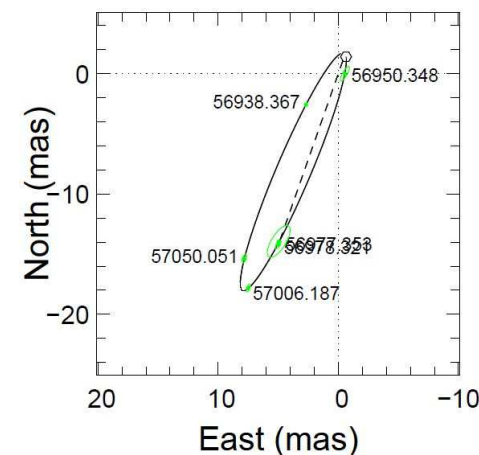
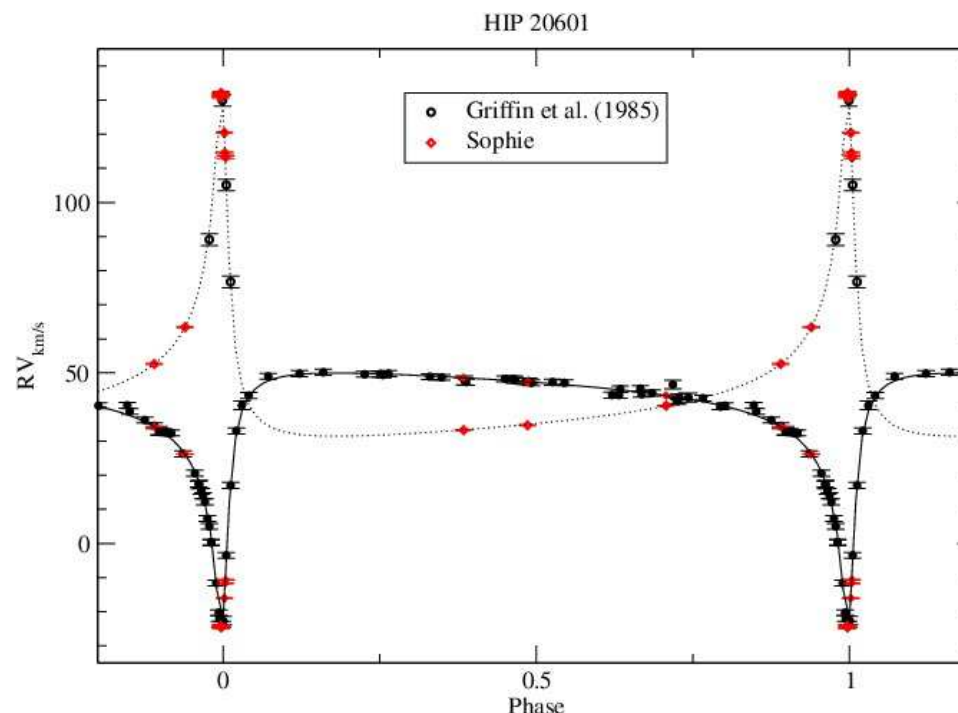
$a = 11.34$ mas, $i = 103.3 \pm 0.2$ deg,

$\Delta H = 0.999 \pm 0.016$ mag

- $\mathcal{M}_1 = 1.0043 \pm 0.0049 \mathcal{M}_\odot$

- $\mathcal{M}_2 = 0.736 \pm 0.0026 \mathcal{M}_\odot$

- $\varpi = 16.592 \pm 0.039$ mas



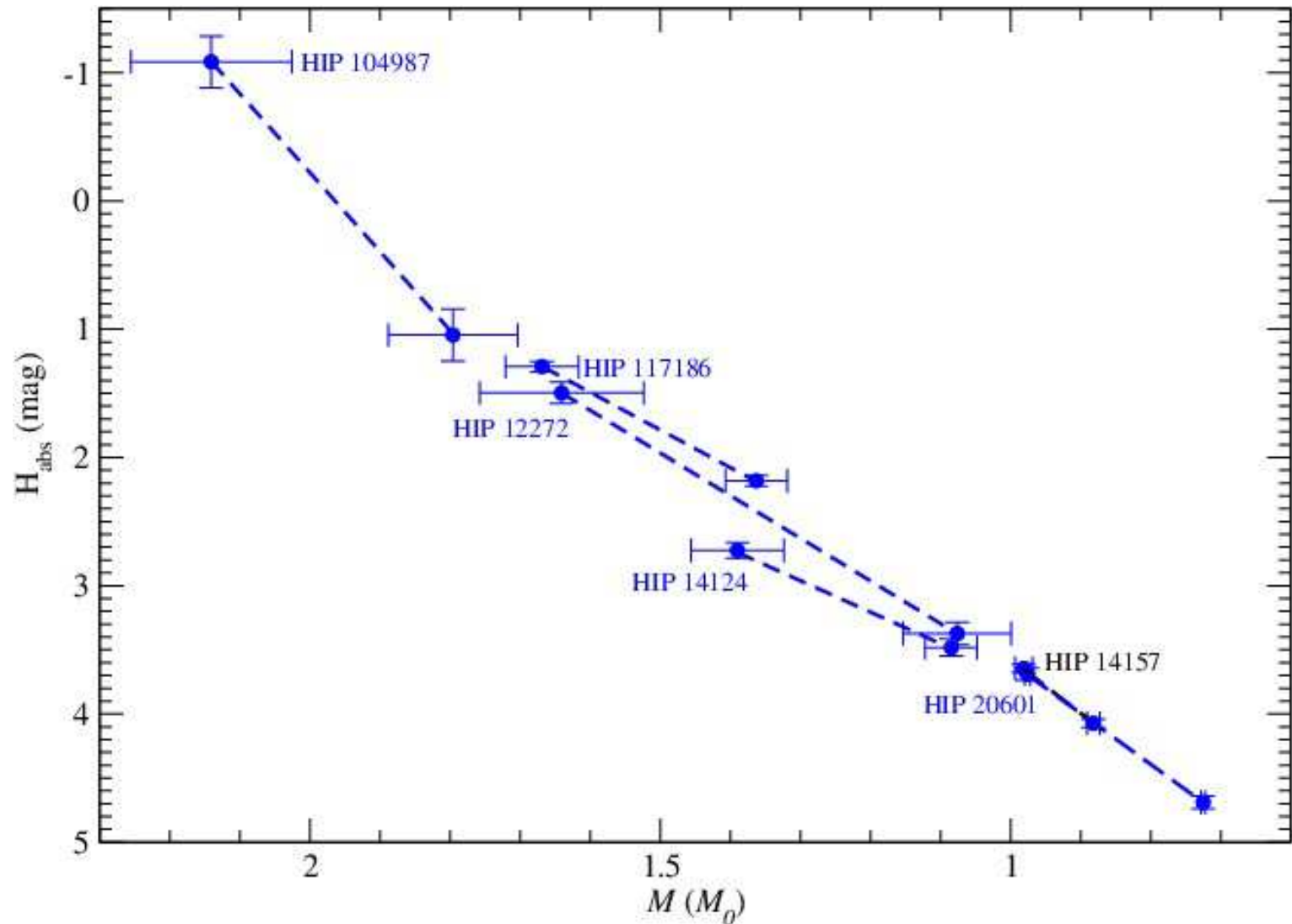
Diapositive 8

oa15

observatoire astronomique; 03/06/2013

Mass-luminosity relation

Much more accurate for low-mass = late-type stars than for heavy-mass = hot stars



Diapositive 9

oa9

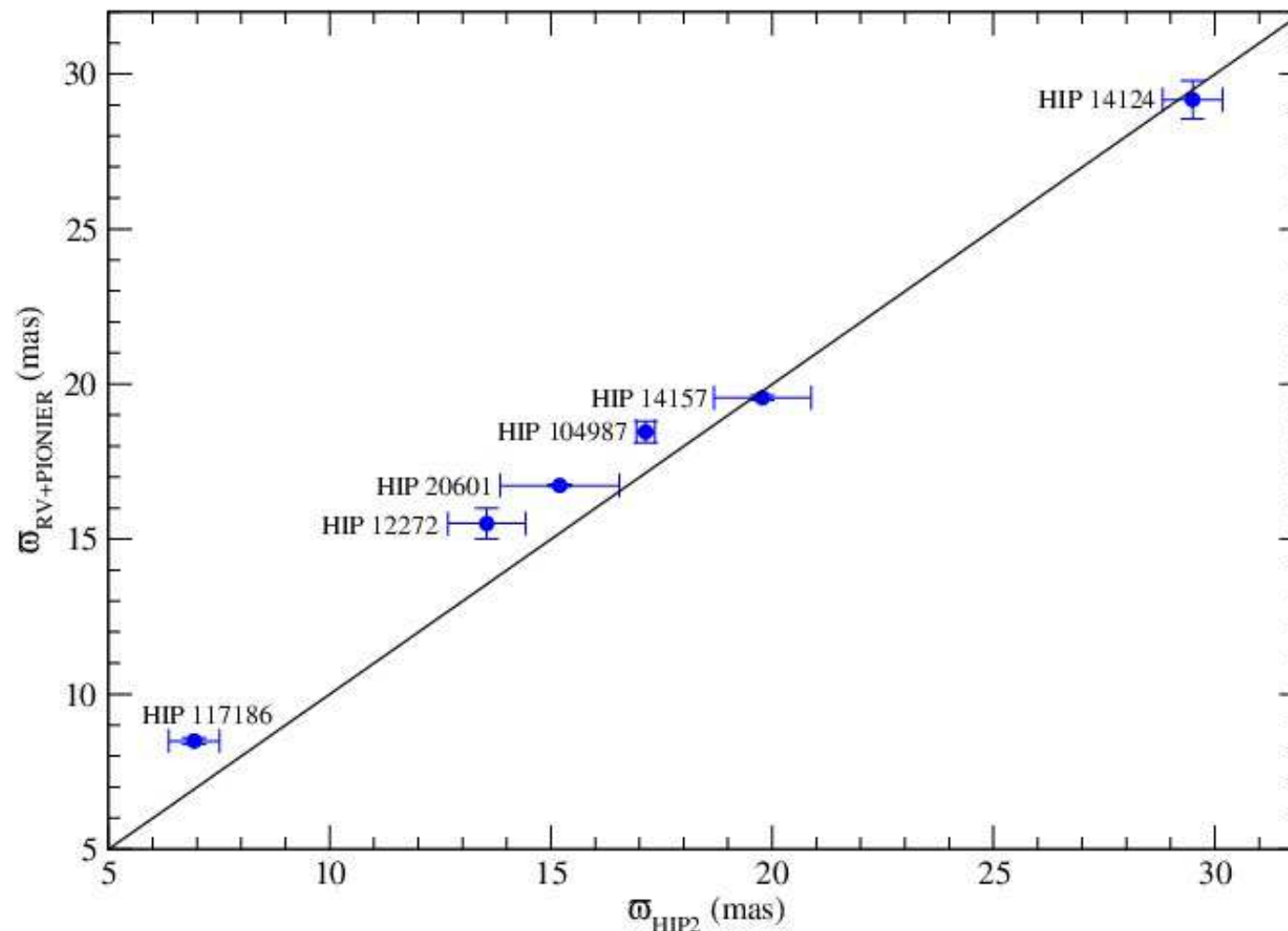
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Validation of the Hipparcos parallaxes

RV + PIONIER:
 $\sigma(\varpi)$: 0.039 – 0.61
mas

A few discrepancies
due to

- Preliminary estimations of the RV
- Orbital motion ignored in the derivation of Hipparcos parallaxes



Diapositive 10

oa7

observatoire astronomique; 03/06/2013

Conclusion

RV + PIONIER:

- 12 preliminary masses with accuracies between 0.4 and 7 %
- Errors of preliminary parallaxes between 0.039 and 0.61 mas; better than Hipparcos !
- Mass-luminosity relation in IR H-band

Diapositive 11

oa10

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The future

- OHP : More observations for 56 SB2, in order to derive all of the 68 SB2 orbits.
- PIONIER : More PIONIER observations for 3 binaries + observations for 2 more $\Rightarrow$ 16 stellar masses for validation
- GAIA mission until .. 2019 ? 2020 ? $\Rightarrow$ 136 stellar masses

Diapositive 12

oa13

observatoire astronomique; 03/06/2013