

# Understanding the parallaxes of Long Period Variables

C. Babusiaux & A. Jorissen

- Understanding the revised Hipparcos parallaxes
- The case of the parallaxe of Betelgeuse
- Models for Gaia

# The Long Period Variables

Asymptotic giant branch stars crossing the instability strip

Population tracers. Chemical evolution. Standard candles?

Pulsation mode? Period-luminosity relation?

Major improvement expected from Gaia !

# Astrometric observations of LPVs

Very red colours  $\Rightarrow$  difficult chromaticity correction

Colour variability  $\Rightarrow$  epoch colour index of chromaticity corr.

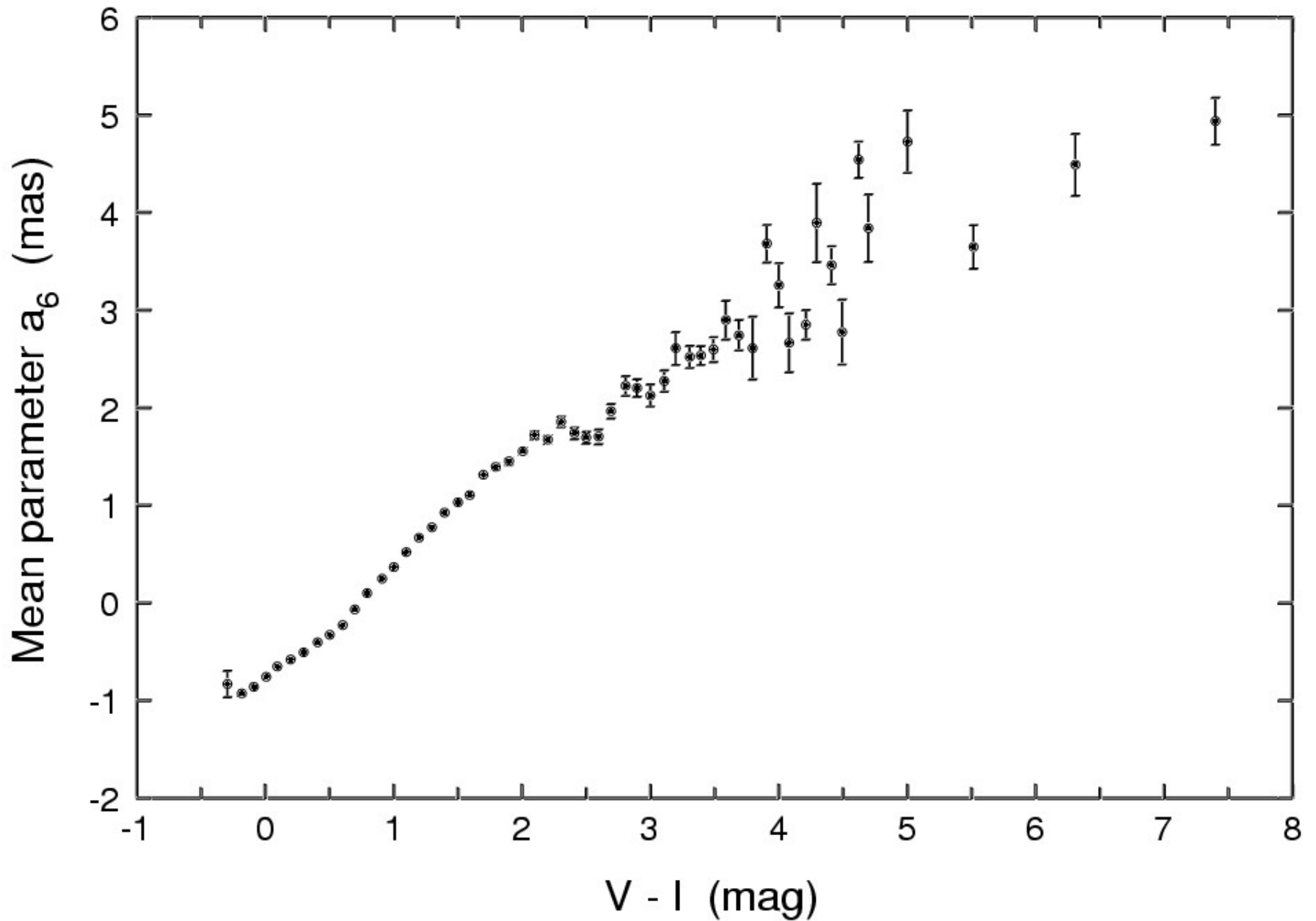
Large radii  $\Rightarrow$  extended sources for Gaia

Time-varying brightness asymmetries  $\Rightarrow$  degradation of parallax



*Betelgeuse*

40 mas



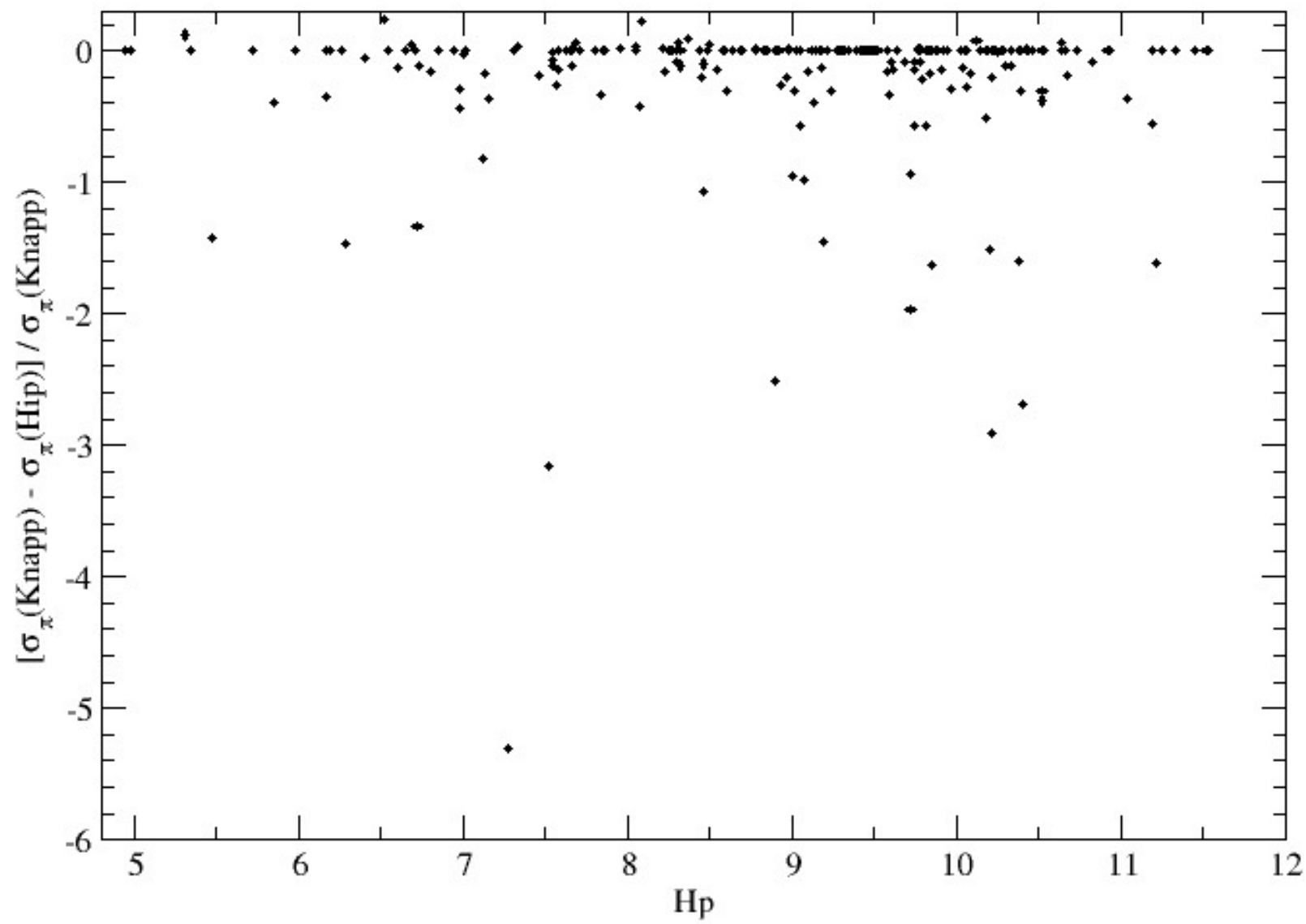
*Hipparcos Vol.3 figure 16.3: the chromaticity effect*

# Revised Hipparcos parallaxes for LPVs

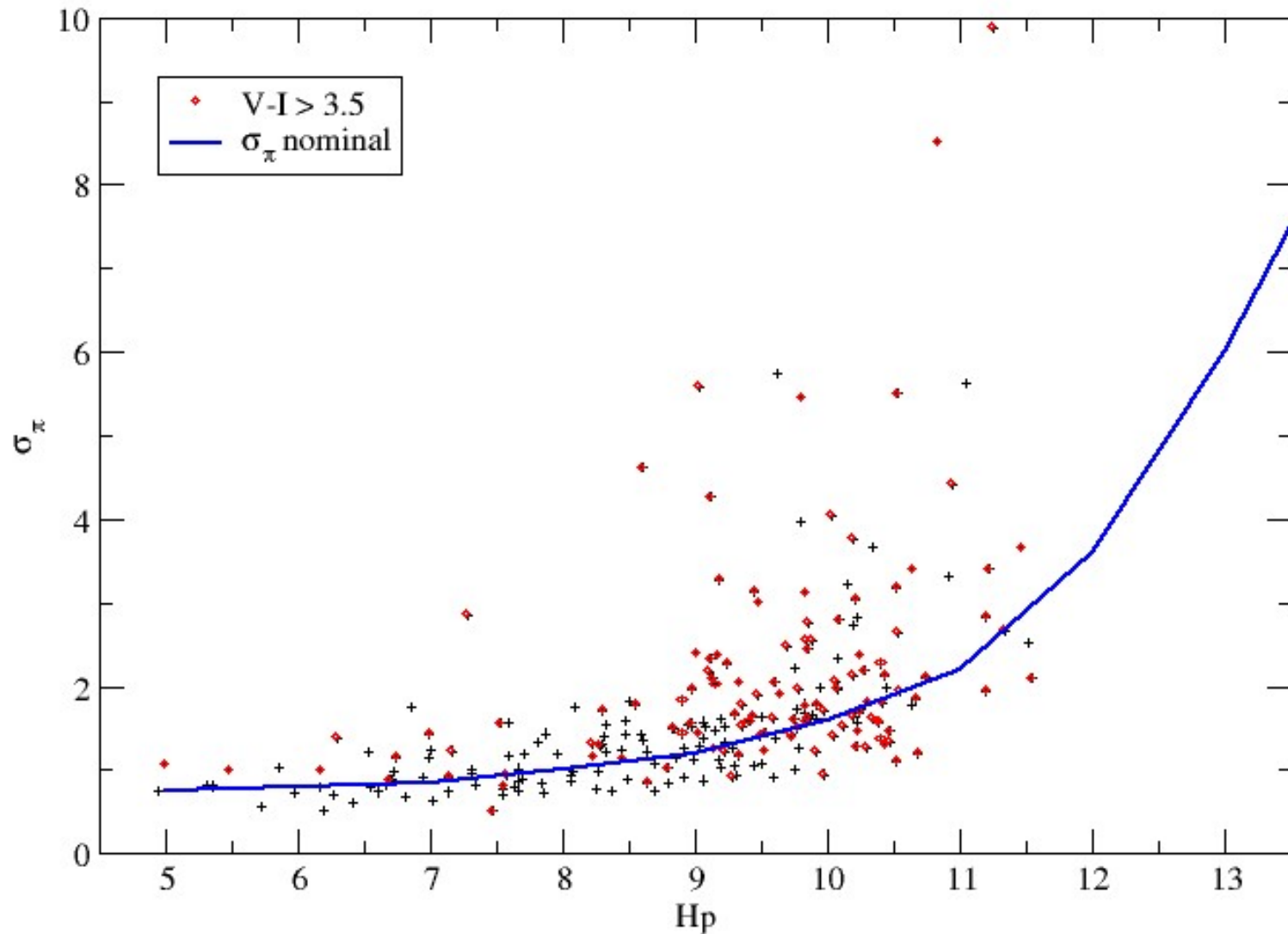
chromaticity correction with epoch V-I using  $H_p$  and  $V_T$

*(Platais et al. 2003, Pourbaix et al. 2003, Knapp et al. 2003)*

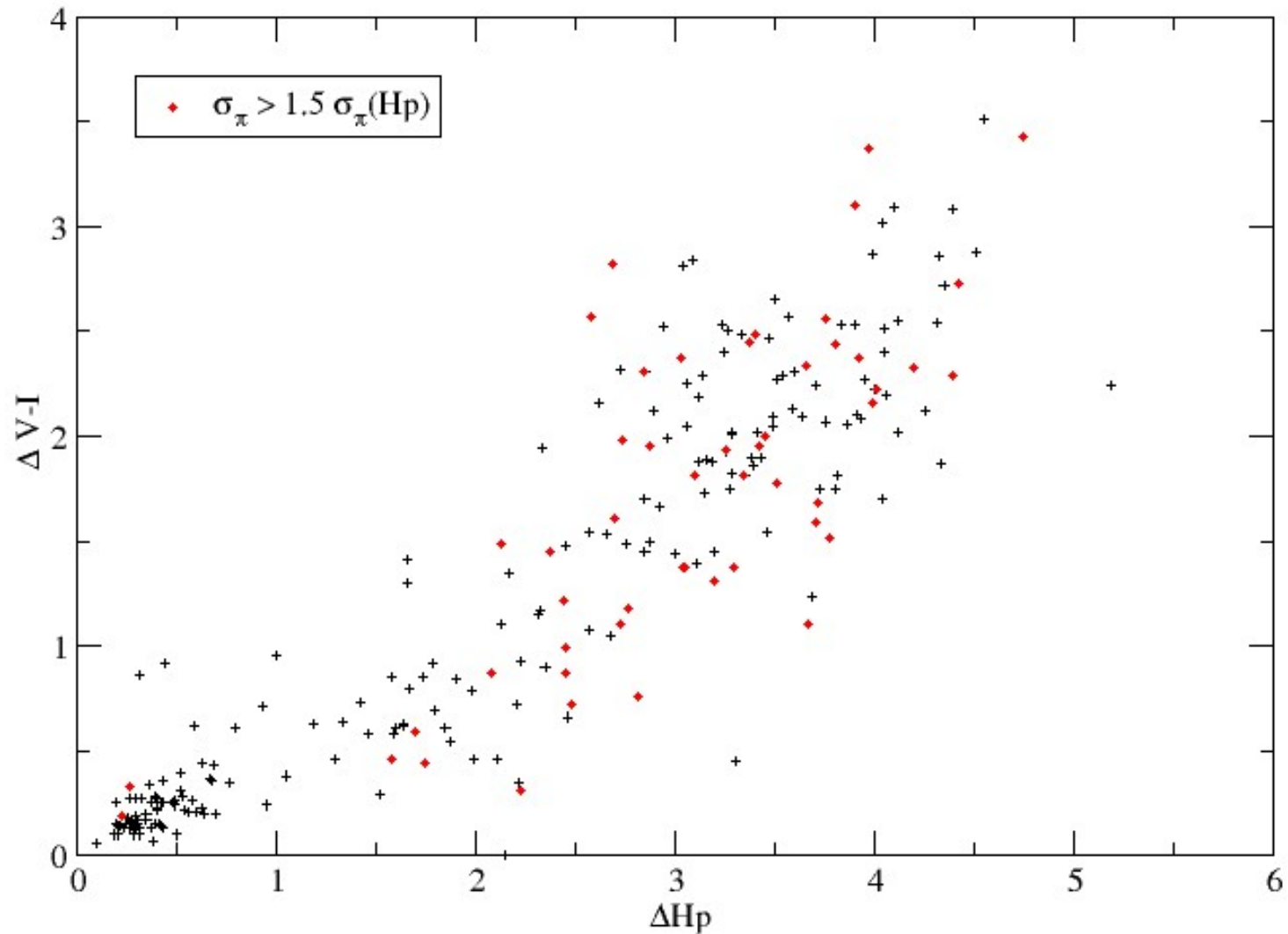
- Much improved parallaxes
- Detection of false VIMs (47%)



# Large errors of the revised parallaxes

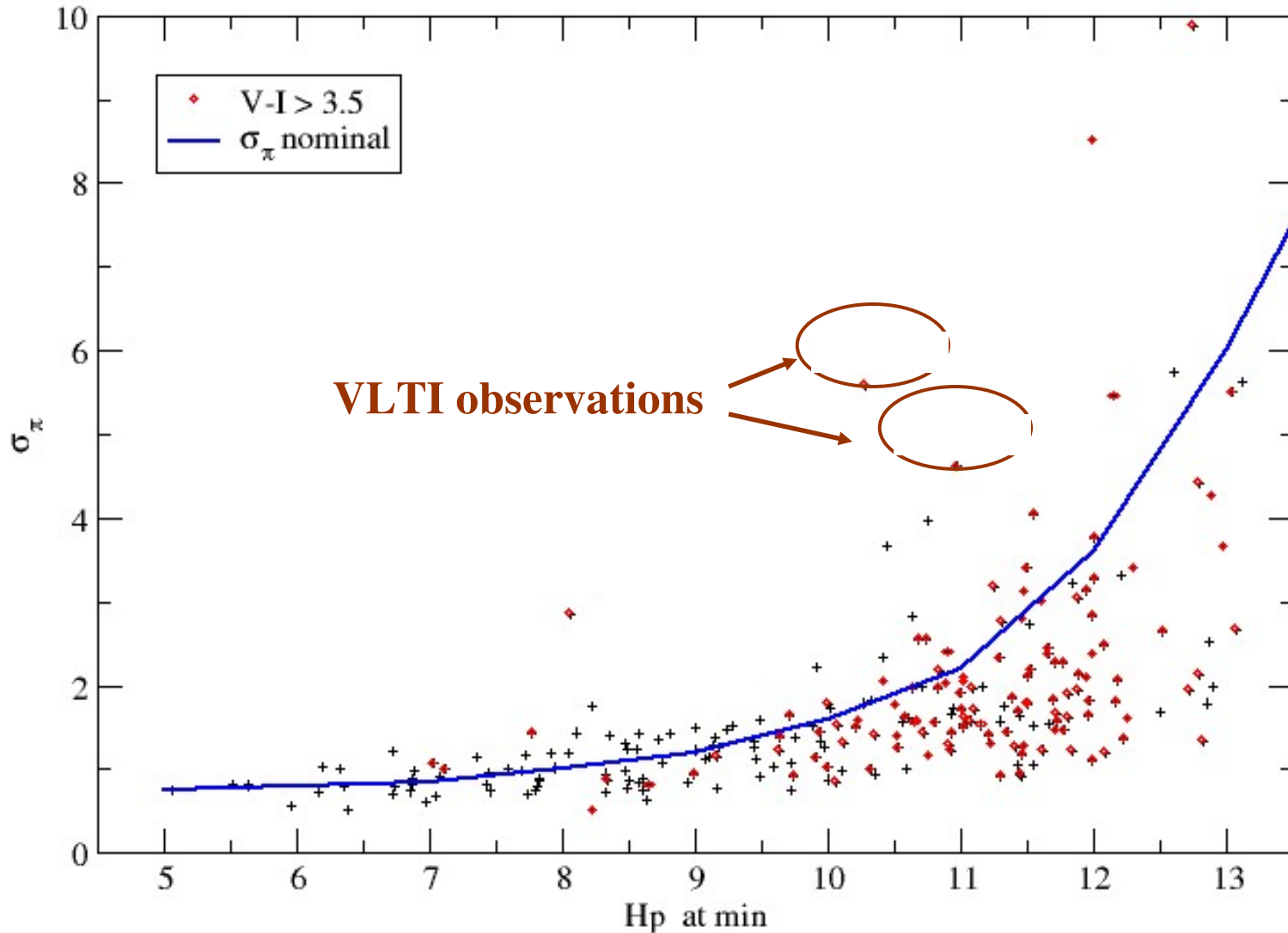


# Large errors of the revised parallaxes

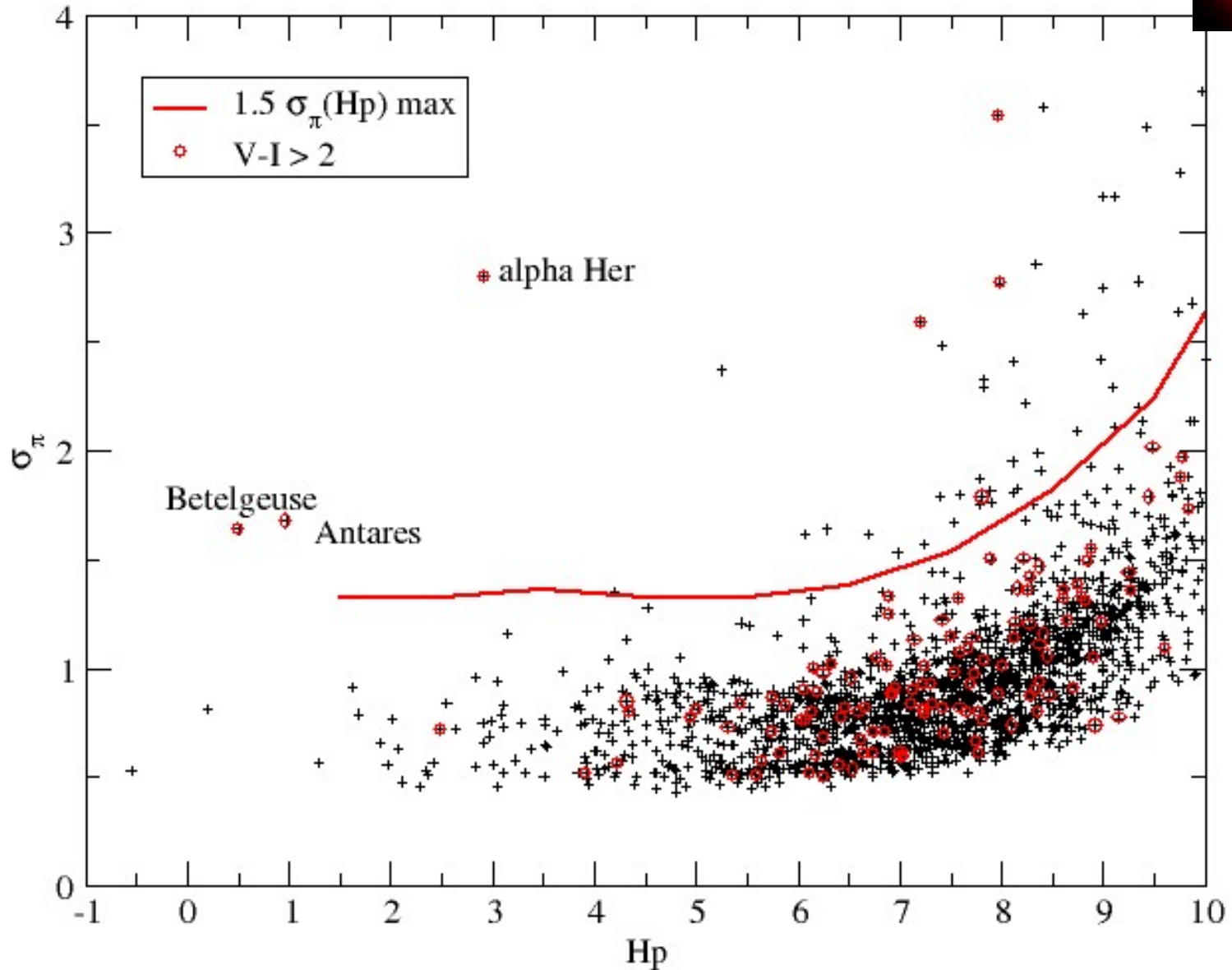
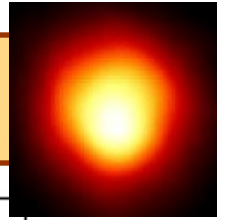




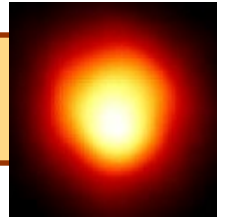
# Large errors of the revised parallaxes



# The case of Betelgeuse



# The case of Betelgeuse



Unresolved feature on the surface of Betelgeuse are known and should be of the order of its parallax

V-I = 2.3, no variation.

$R = M_2/M_1 = 0.31 = 10\%$  of the point source value,

not expected for a 40 mas diameter (*Hestroffer & Mignard 97*)

Binarity ? Components at 0.1 and 0.5 arcsec (*Karovska 86*)

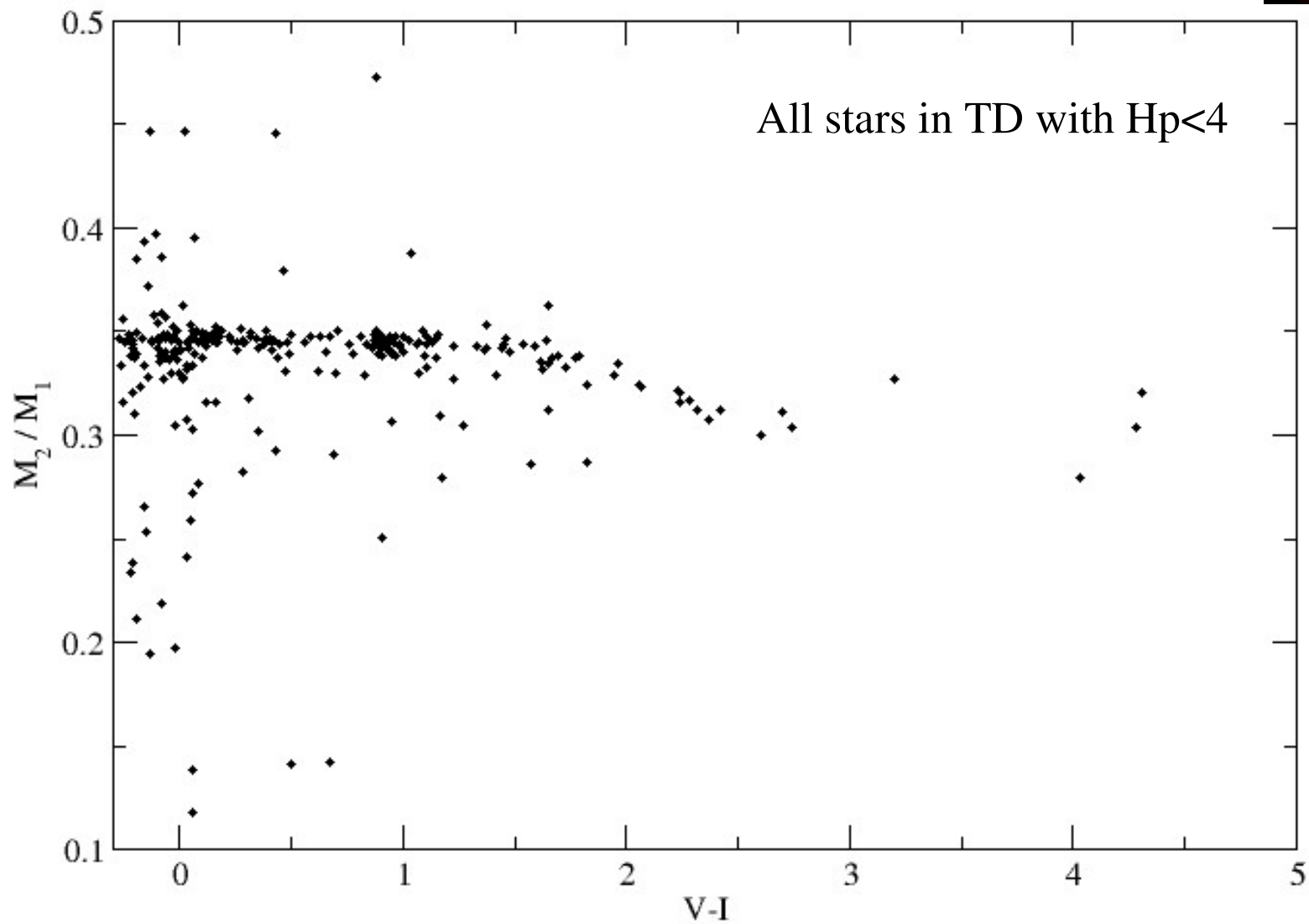
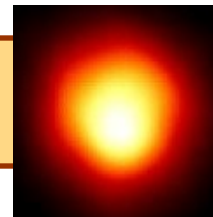
too faint : about 3 and 4.5 magnitude differences with respect to the primary.

Nothing in the Transit Data cleaned imaged (*Quist & Lindegren 99*)

No variation of R with observation angle.

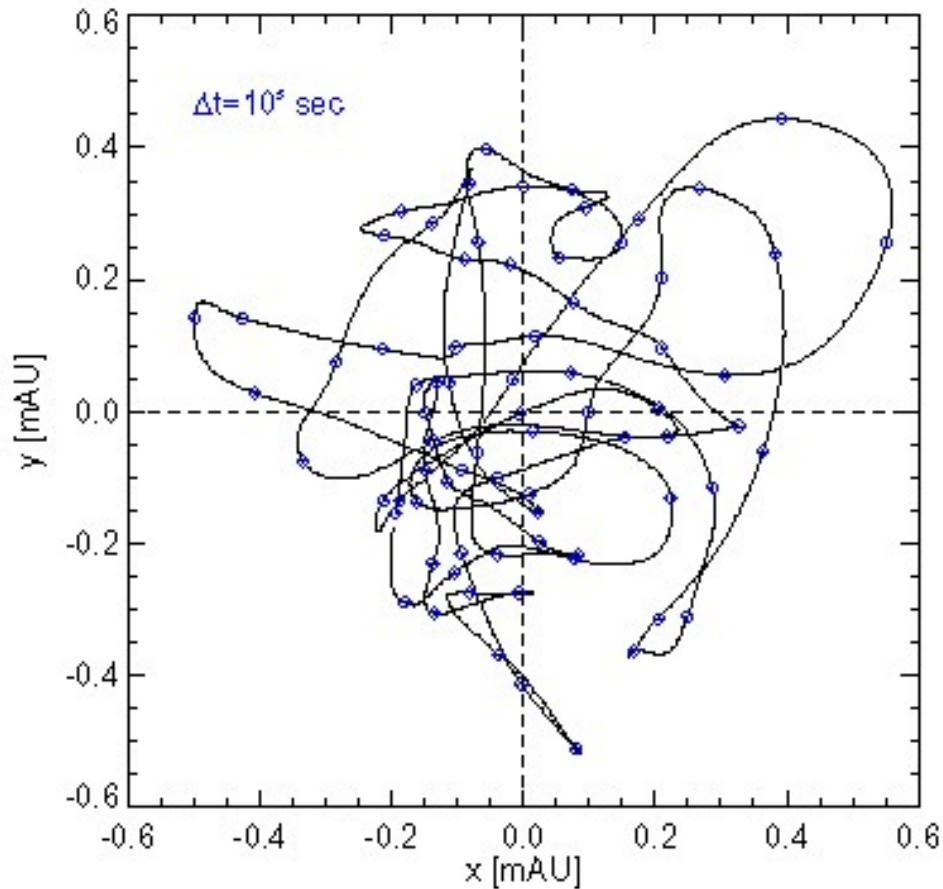
V-I correction ? Hipparcos vol 1: R rather insensitive to the colour...

# The case of Betelgeuse

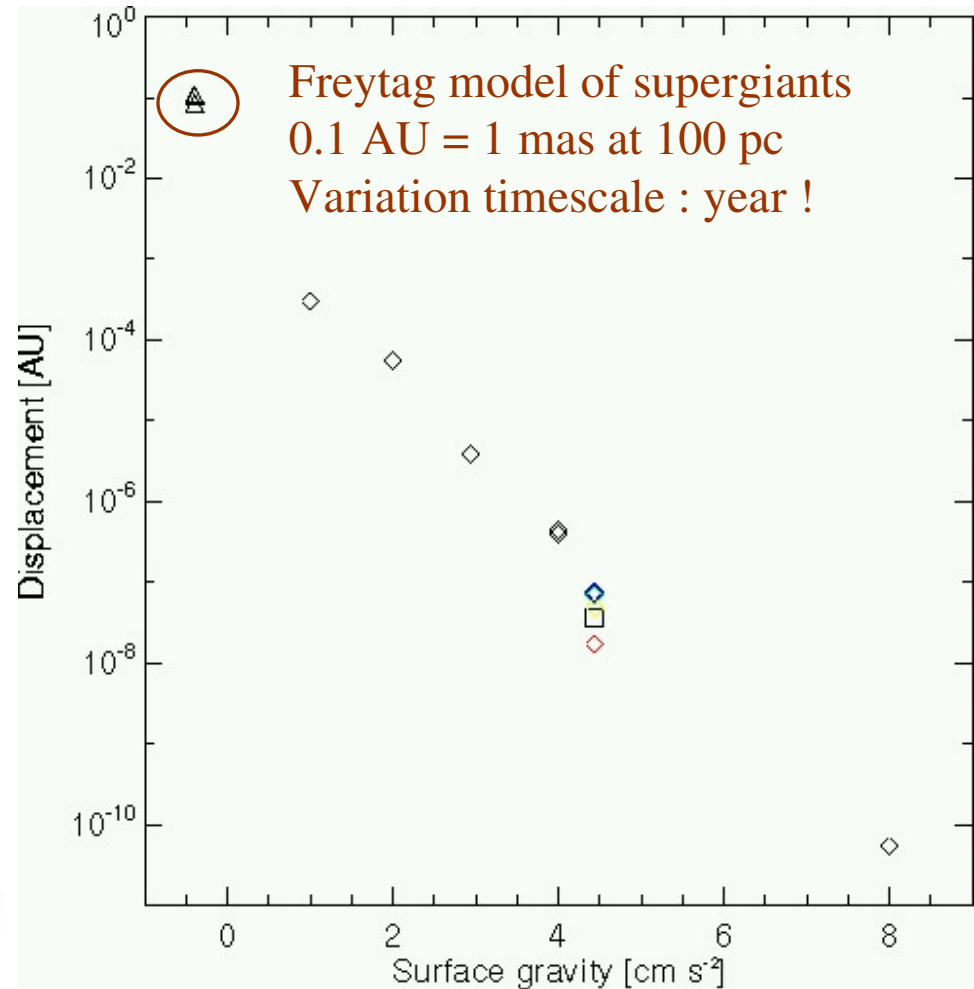


# Models for Gaia : convection models

Giant star model:  
Variation timescale = day



*Svensson & Ludwig 05*



*Ludwig 05, in preparation*

# Models for Gaia : hotspots observations

Tuthill, Haniff & Baldwin (1997) interferometric observations of  $\alpha$  Ori (Betelgeuse),  $\alpha$  Sco (Antares) and  $\alpha$  Her:

- Flux : between 5 and 20%
- Colours : similar to the disk
- Variation timescales : a few months
- Hipparcos : parallaxes of 5-8 mas.
- Spots at about 5 and 20 mas  $\rightarrow$  about 0.7 and 2.6 AU