Brightness asymmetries of evolved stars with the VLTI/AMBER

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INTRODUCTION

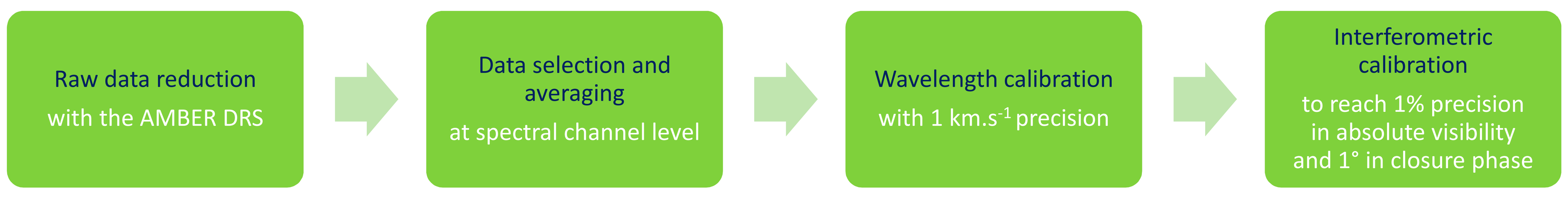
Stellar surface brightness asymmetries can be revealed thanks to the performance in stability and precision of the VLTI/AMBER. To reach that goal, 15 full nights have been allocated under the Belgian VISA-GTO, for the observation of 11 O-rich giants, 2 supergiants, 4 C-rich giants, and 15 O-rich giants used as calibrators, using 3 ATs and the FINITO fringe tracker, in the MR-K mode (R=1500). The partial results presented in the present poster are extracted from a more detailed paper under submission to A&A (contact pierre.cruzalebes@oca.eu).

Target	Sp. Type	m_K	Dist (pc)	NOB	TIT (s)	AT Config.
α Car	F0II	-1.3	95	8	2000	D0H0K0/H0K0G1
β Cet	K0III	-0.3	30	5	1750	D0I1G1/D0I1H0/K0I1G1/K0I1A0
α TrA	K2II	-1.2	120	16	3780	H0D0A0/D0H0K0/H0K0G1
α Hya	K3II-III	-1.1	55	5	1000	D0H0K0/H0K0G1
ζ Ara	K3III	-0.6	149	7	1900	H0D0A0
δ Oph	M0.5III	-1.2	53	11	3440	H0D0A0/D0H0K0/H0K0G1
γ Hyi	M2III	-1.0	66	2	700	D0H0I1/D0G1I1
o_1 Ori	M3III	-0.7	204	1	350	D0H0K0
σ Lib	M3.5III	-1.4	88	2	400	D0H0K0
γ Ret	M4III	-0.5	144	5	1750	D0H0I1/D0G1I1
CE Tau	M2Iab-b	-0,9	561	22	7700	D0H0K0/D0I1G1/D0I1H0/G1I1A0/K0I1A0/K0I1G1
L_2 Pup	M5IIIe	-1.8	64	11	2146	D0H0K0/H0K0G1
T Cet	M5.5Ib/II	-0.8	275	7	2080	D0H0K0
TX Psc	C7,2(N0)(Tc)	-0.5	292	13	4270	D0H0K0/D0I1G1/H0I1G1/D0I1H0/K0I1G1/K0I1A0
W Ori	C5,4(N5)	-0.5	392	5	1750	D0H0K0
R Scl	C6,5ea(Np)	-0.1	474	5	1536	D0H0K0
TW Oph	C5,5(Nb)	+0.5	273	8	3420	H0D0A0

Table 1. Scientific targets contained in our programme. NOB is the number of observing blocks obtained, and TIT is the total integration time for each target.

DATA PROCESSING AND CALIBRATION

Robust and accurate estimates of the science target true observables, with their statistical uncertainties, are computed with the numerical processing tool SPIDAST© (SPectro-Interferometric Data Analysis Software Tool), specifically developed to process and calibrate the AMBER observations, and interprete them using model fitting algorithms.



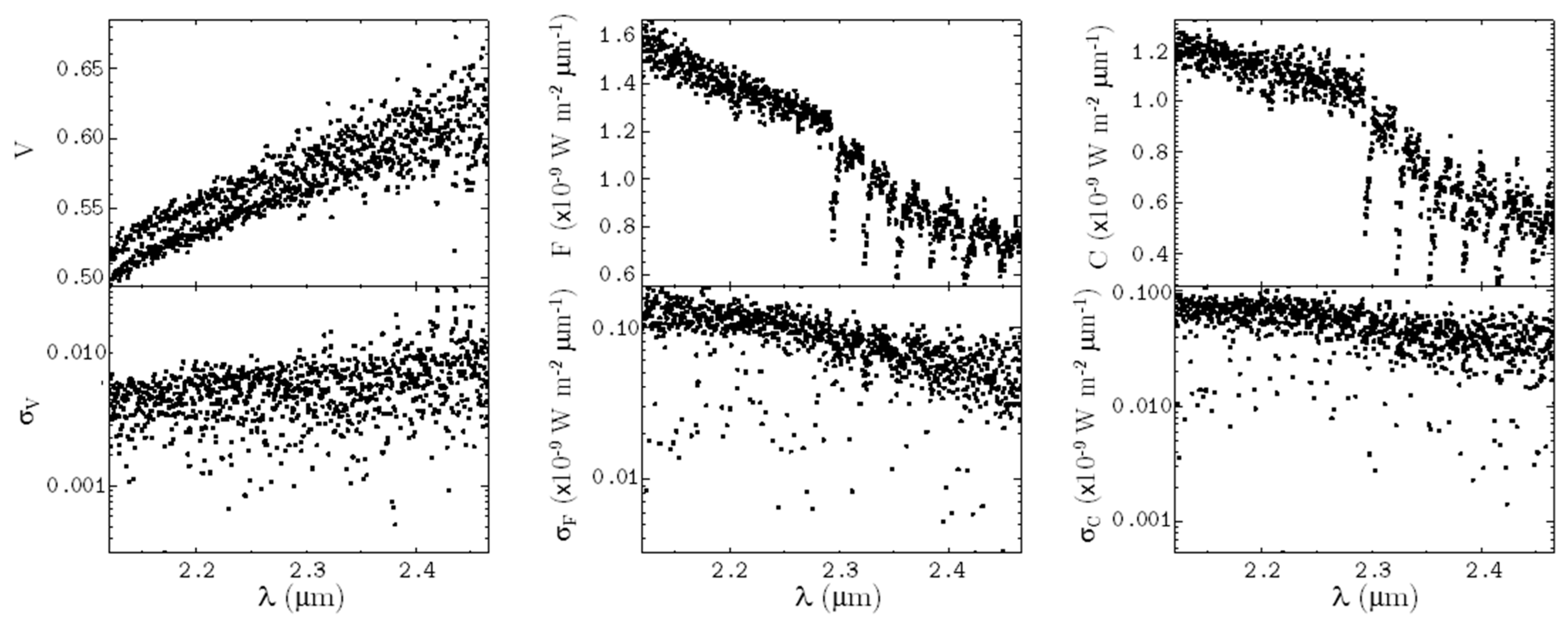


Fig 1. One example of the true visibility (top left), the flux (top middle), and the coherent flux (top right), obtained with 2 successive OBs on δ Oph (M0.5III), with the AT baseline A0-D0 (32m). The final errors are shown in the bottom panels. Note the CO lines, appearing at wavelenghts longer than 2.3μm, in the flux and coherent flux profiles.

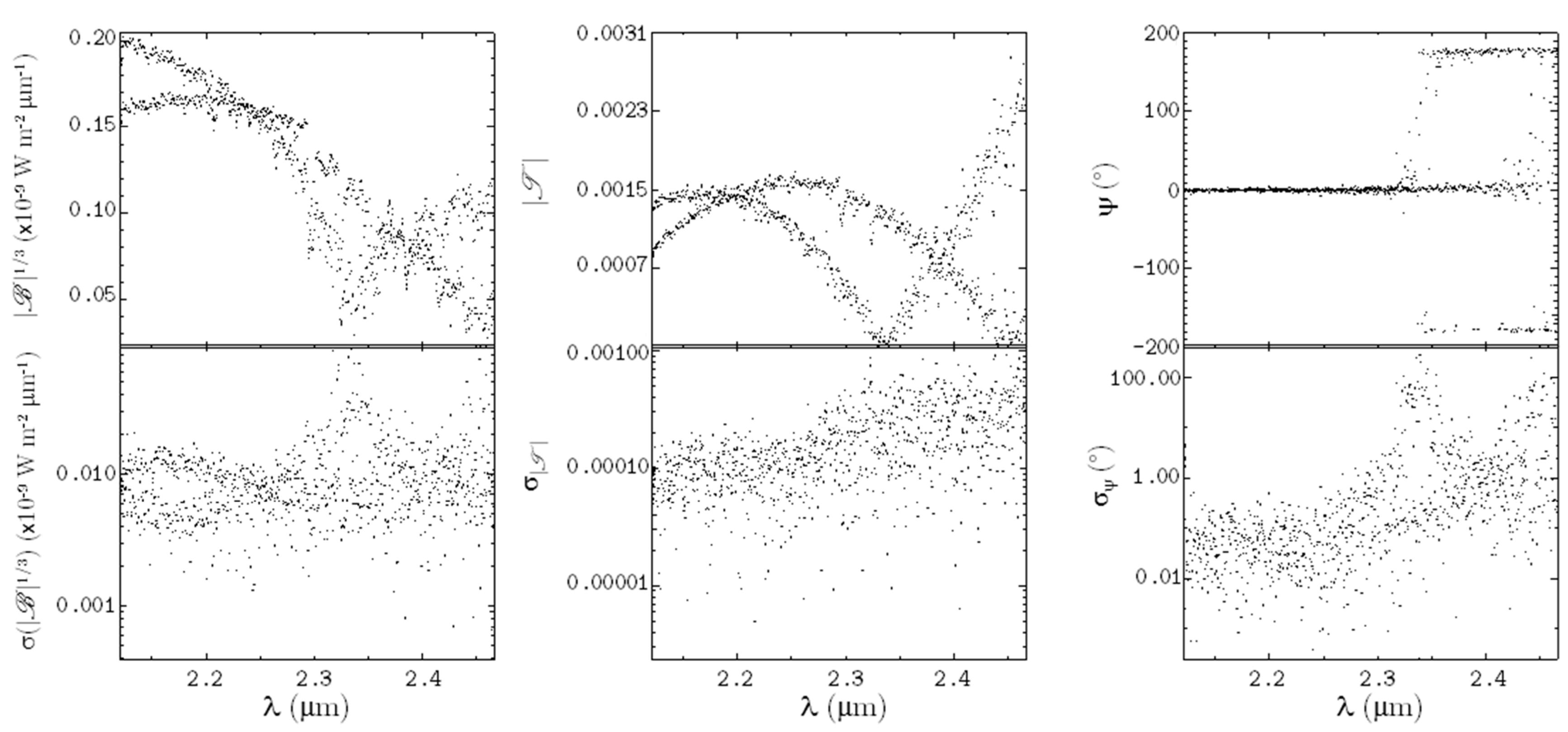


Fig 2. One example of cubic root of true bispectrum modulus (top left), the triple product modulus (top middle), and the closure phase (top right) for the same target δ Oph (errors in bottom panels). The 3-AT configuration is H0-A0-D0 (64-32-96m). Note the 180° shift of the closure phase when the triple product crosses zero.

FITS ON VISIBILITIES

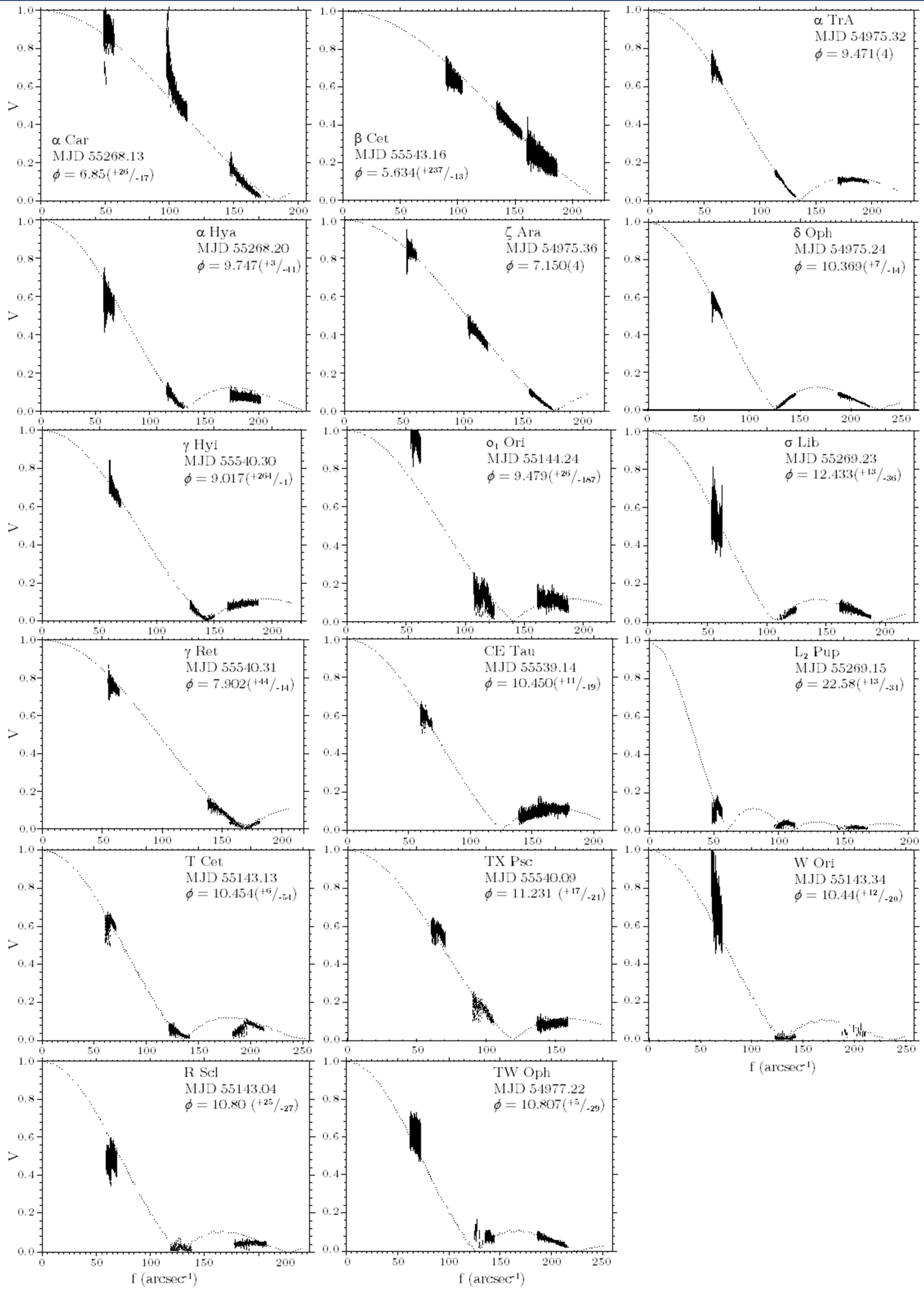


Fig 3. Best MARCS-model fits obtained with visibility data. MJD (Modified Julian Day) is the central date of the OB used for the fit. The best-fit angular diameters φ are in mas (note that the errors are reported using the concise notation). V is the visibility, and f is the spatial frequency.

CENTROSYMMETRY

We introduce the centrosymmetry parameter CSP as

$$CSP = \frac{\sum_k [|\Re\mathcal{T}(\lambda_k)| - |\Im\mathcal{T}(\lambda_k)|]}{\sum_k |\mathcal{T}(\lambda_k)|}$$

where $\Re\mathcal{T}$ and $\Im\mathcal{T}$ are the real and imaginary parts of the complex triple product $\mathcal{T}$ (normalized bispectrum). The CSP values close to unity are an indication of centrosymmetry.

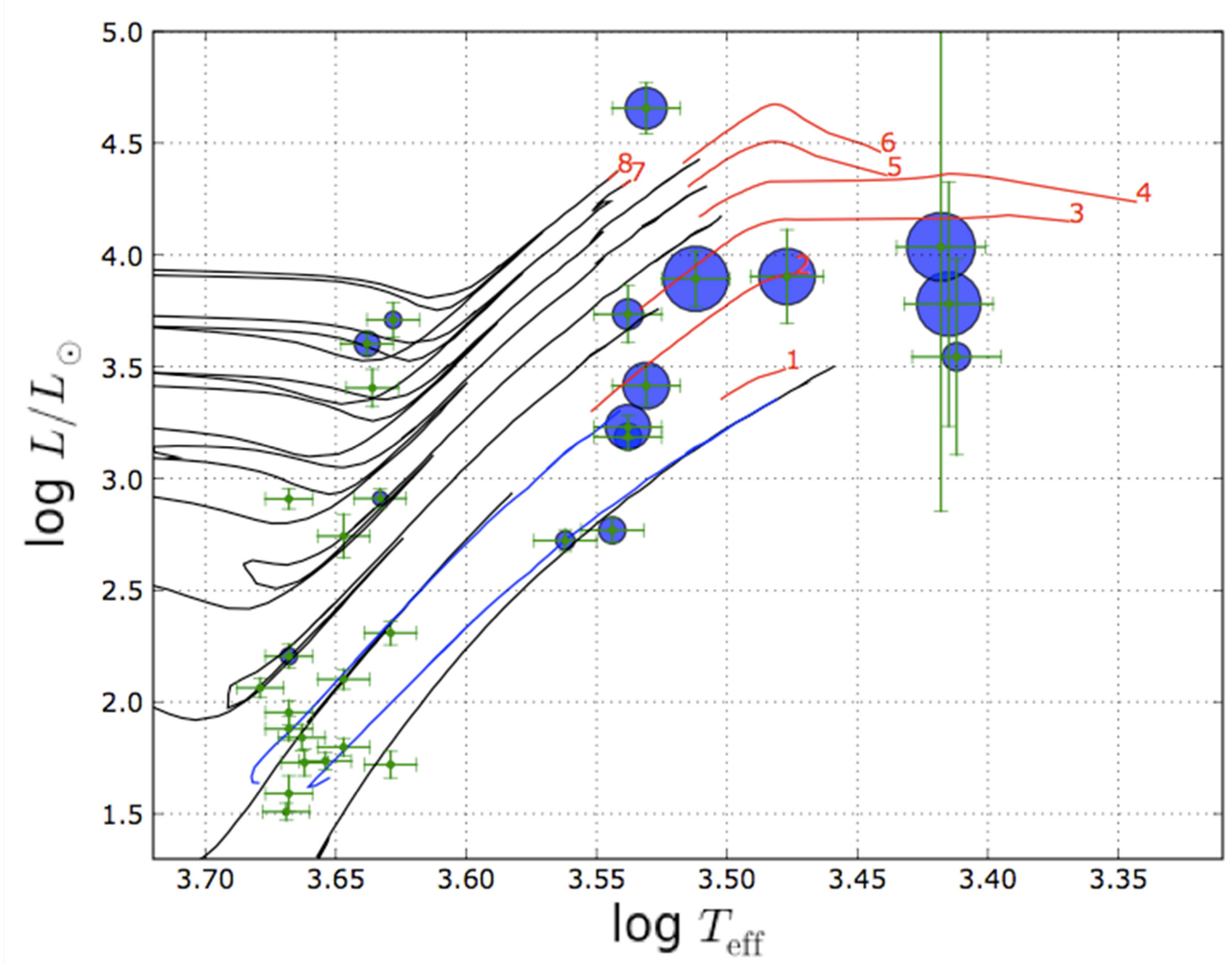


Fig 4. T_{eff}-L plane of the science and calibrator targets, deduced from our observations. The sizes of the blue circles are proportional to 1-CSP : sources with brightness distributions far from centrosymmetry show large circles. The red numbers are the initial masses (in solar mass unit) of the overplotted Padova evolutionary tracks.