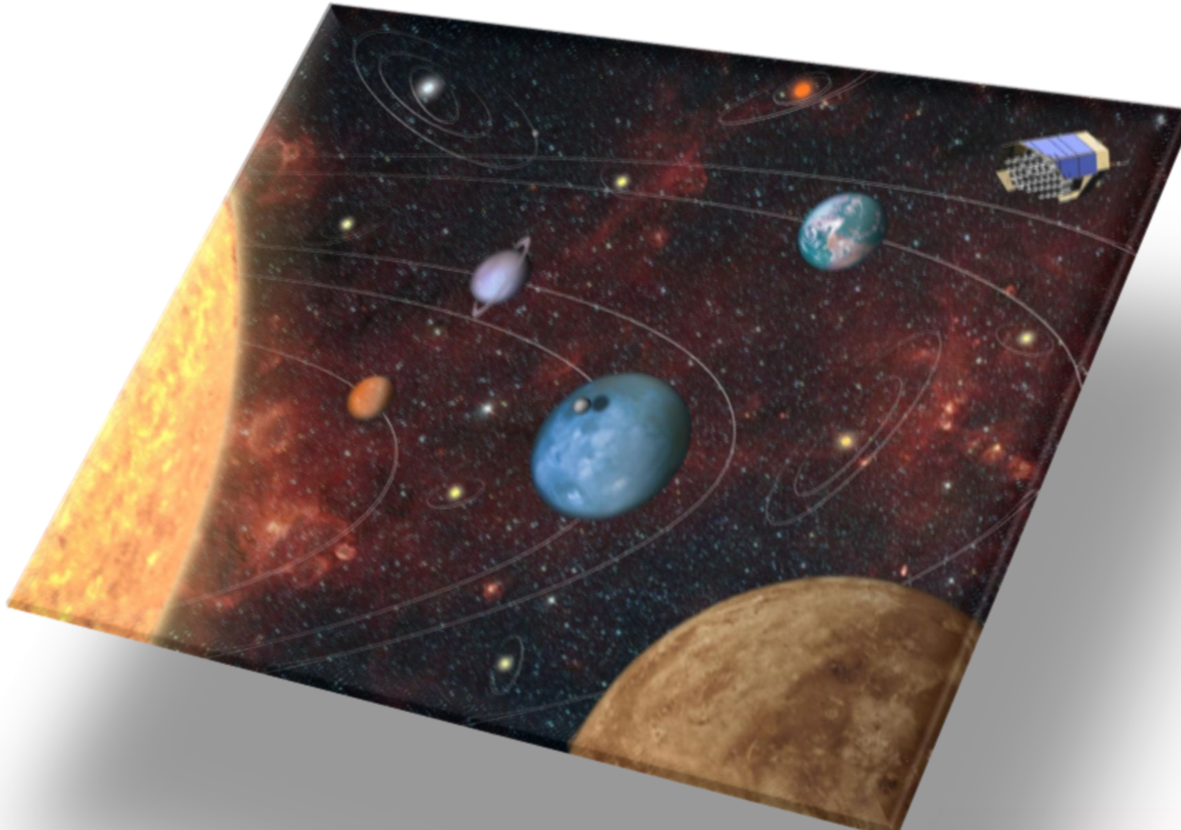
P1, P2 and P5 samples: target selection criteria



Marco Montalto

and the

WP130 (PSM) and

WP340 (PDC) teams

Università di Padova

PLATO input catalog (PIC) workshop (I)

Padova, 24-26 Sep 2019

Agenzia Spaziale Italiana

PIC1.0.0

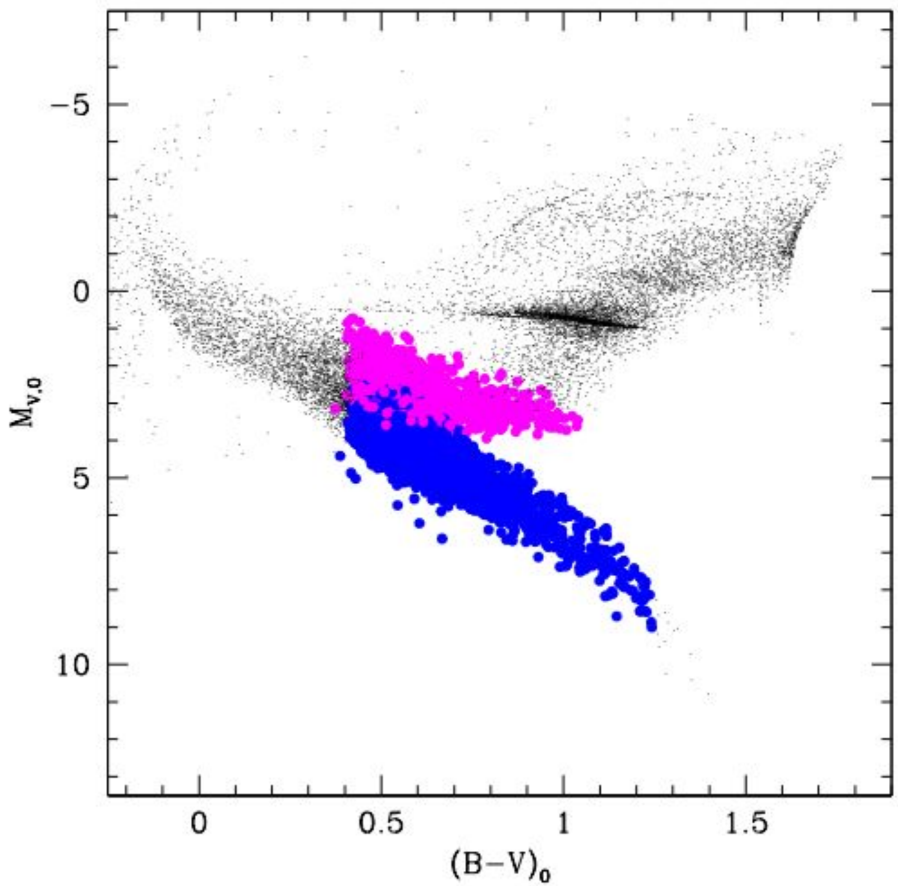
PIC1.0.0: parallax based selection (Gaia-DR2)

Dwarf and subgiant stars with spectral type between F5 and K7

DWARFS (blue):
log g > 4, 4050 K < T_{eff} < 6510 K, V<13

SUB-GIANTS (magenta):
3.5 < log g <4.0, 4050 K < T_{eff} < 6510 K, V<1

(Pecaut & Mamajek (2013), ApJS, 208, 9)



TRILEGAL

PIC1.0.0: parallax based selection (Gaia-DR2)

Dwarf and subgiant stars with spectral type between F5 and K7

RAVE DR5 used as proxy to check the region in the CMD occupied by dwarfs and subgiants with spectral type between F5 and K7.

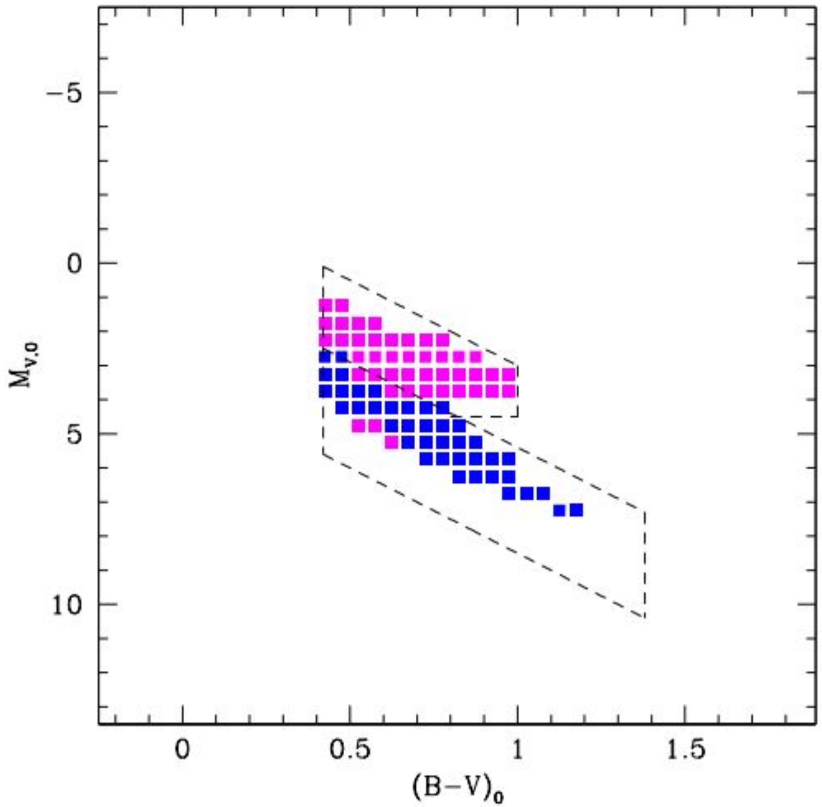
DWARFS:

$0.42<(B\text{-}V)_0\leq1.38$ AND $M_{v,0}\geq5(B\text{-}V)_0+0.4$ AND $M_{v,0}<5(B\text{-}V)_0+3.5$

SUBGIANTS:

$0.42<(B\text{-}V)_0<0.8$ AND $M_{v,0}<5(B\text{-}V)_0+0.4$ AND $M_{v,0}>5(B\text{-}V)_0-2$

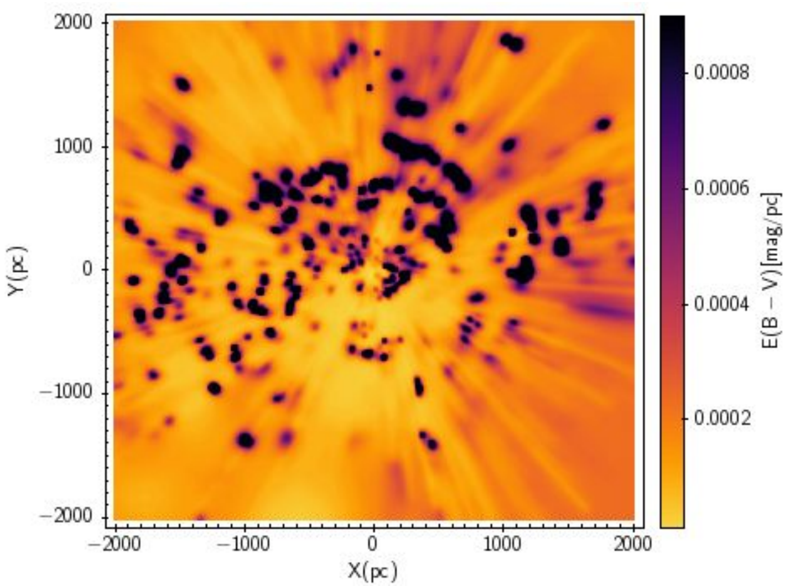
$0.8\leq(B\text{-}V)_0<1$ AND $M_{V,0}<4.5$ AND $M_{V,0}>5(B\text{-}V)_0-2$



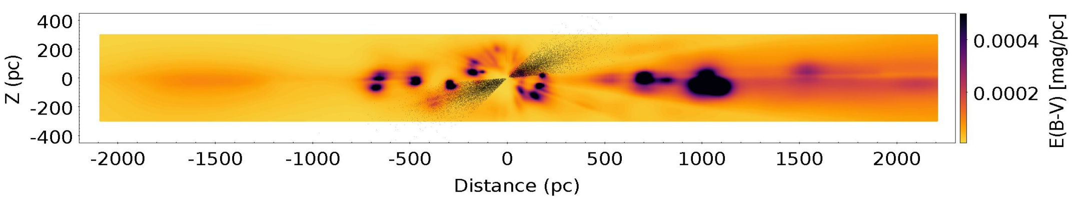
Reddening in PIC1.0.0

We used the 3D reddening map presented in Lallement et al. (2018), Capitanio et al. (2017)

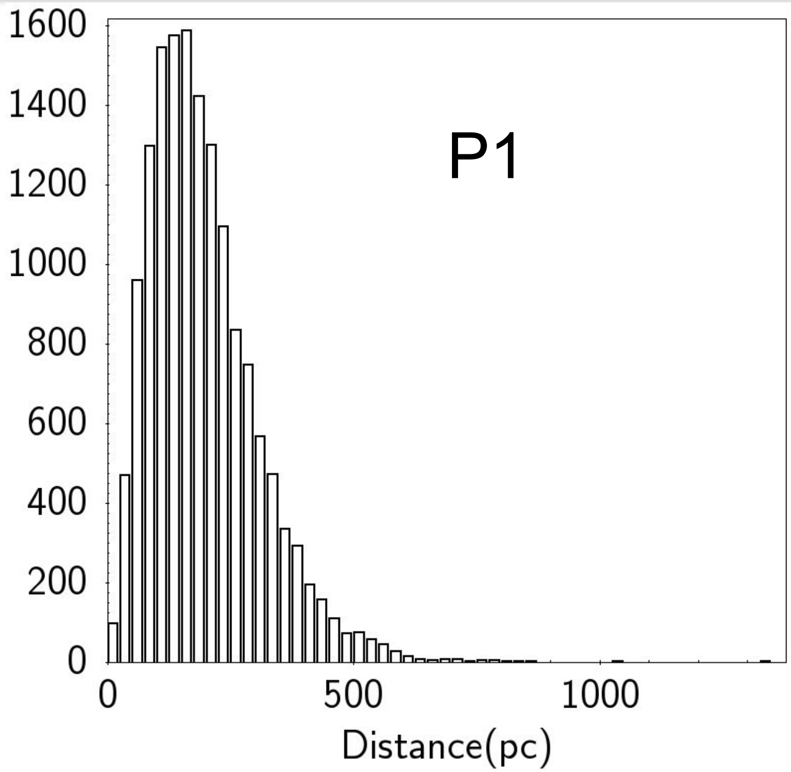
Galactic plane projection

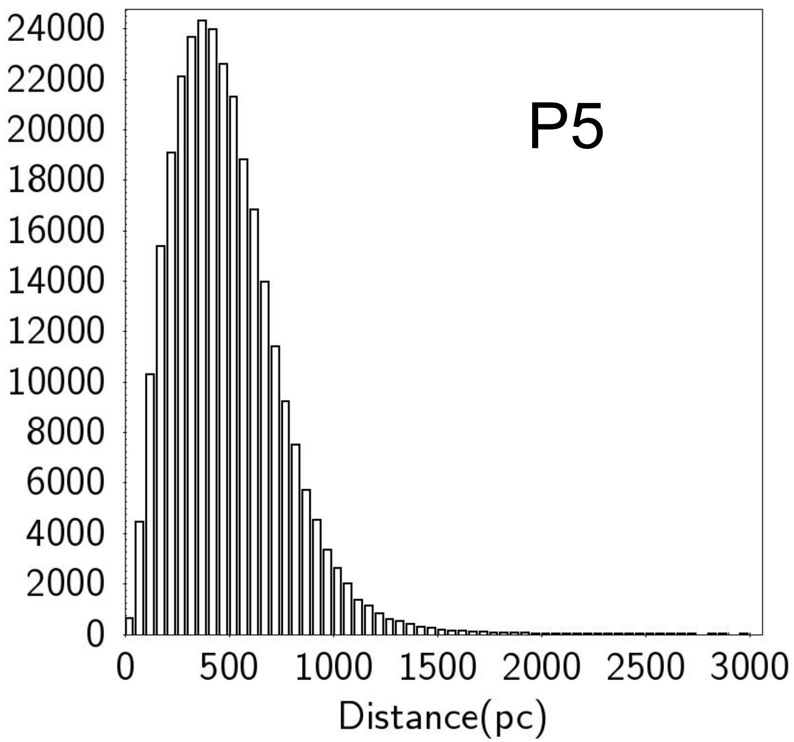


Projection orthogonal to the Galactic plane



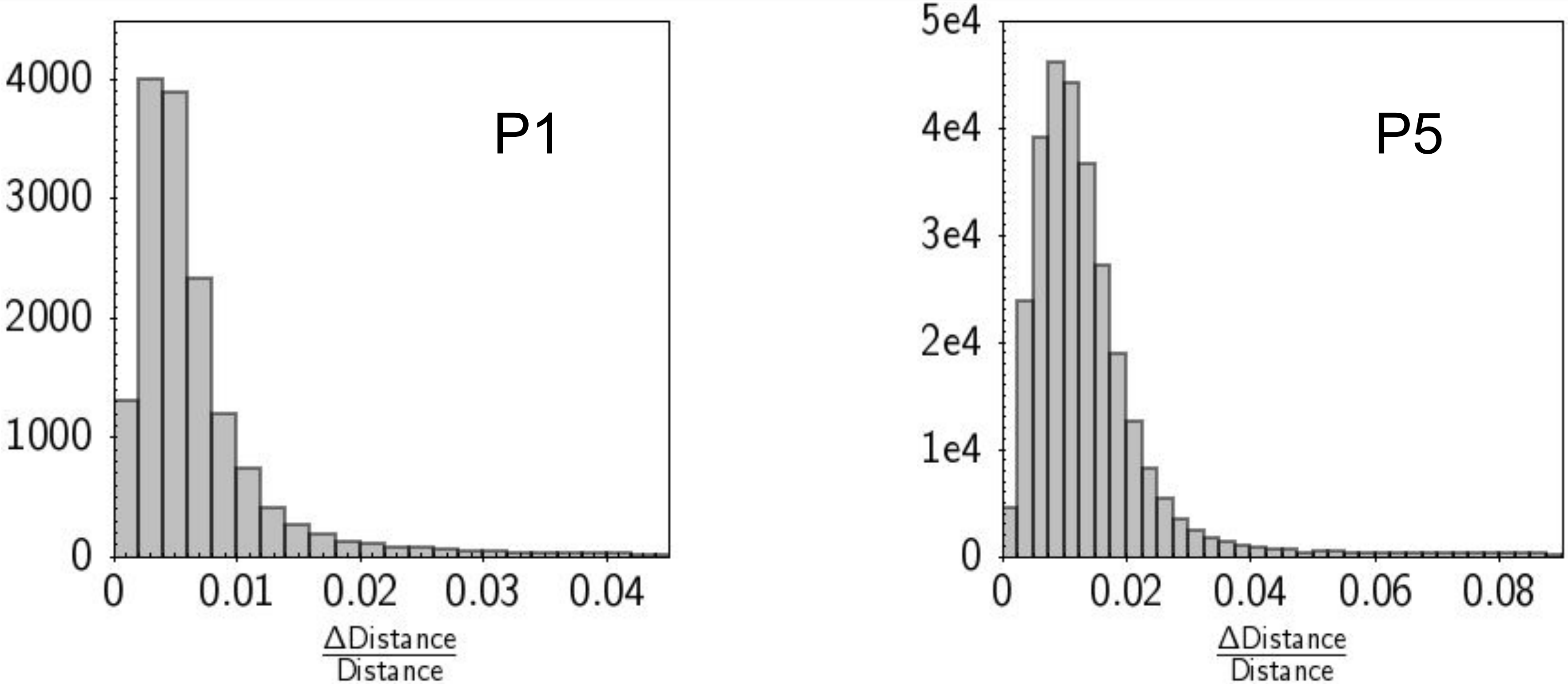
Distance distribution in PIC1.0.0





	Q1	Median	Mean	Q3
P5	301	**452**	489	632
P1	117	**178**	197	255

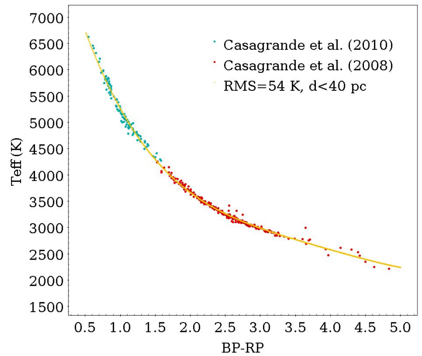
Distance relative error distribution in PIC1.0.0



	Q1	Median	Mean	Q3
P5	0.008	**0.012**	0.022	0.018
P1	0.003	**0.005**	0.010	0.008

Stellar parameters estimation

Color-effective temperature relation



$T_{eff}=f(G_{bp}-G_{rp})$

From E(B-V) to A_G, $E(G_{BP}-G_{RP})$

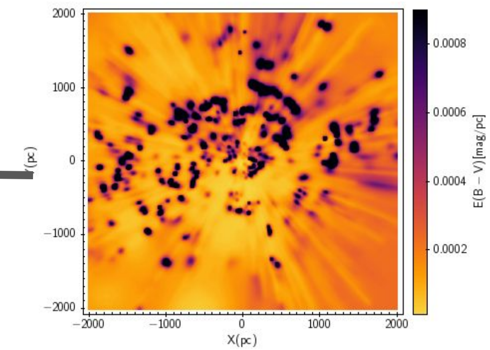
$E(G_{BP} - G_{RP}) = f(T_{eff})\, E(B - V)$

$A_G=f(T_{eff})\, E(B - V)$

$5250\ K<T_{eff}<7000\ K$

Casagrande & VandenBerg (2018)

E(B-V) estimation



Lallement et al. (2018)

Intrinsic color

$(G_{BP} - G_{RP})_0 = (G_{BP} - G_{RP}) - E(G_{BP} - G_{RP})$

$A_G,\ E(G_{BP} - G_{RP})\ ,\ T_{eff}$

$BC_G= f(T_{eff})$
Andrae et al. (2018)

$$M_G = G - 5\log(d) + 5 - A_G$$

$$\frac{L}{L_\odot} = 10^{-0.4(M_G + BC_G - M_{BOL,\odot})}$$

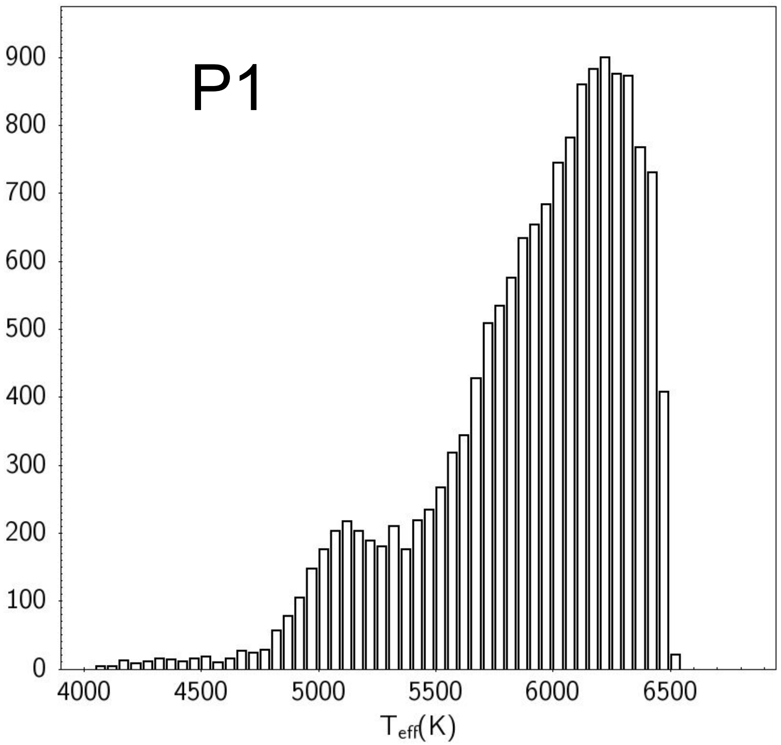
Radius and Mass estimation

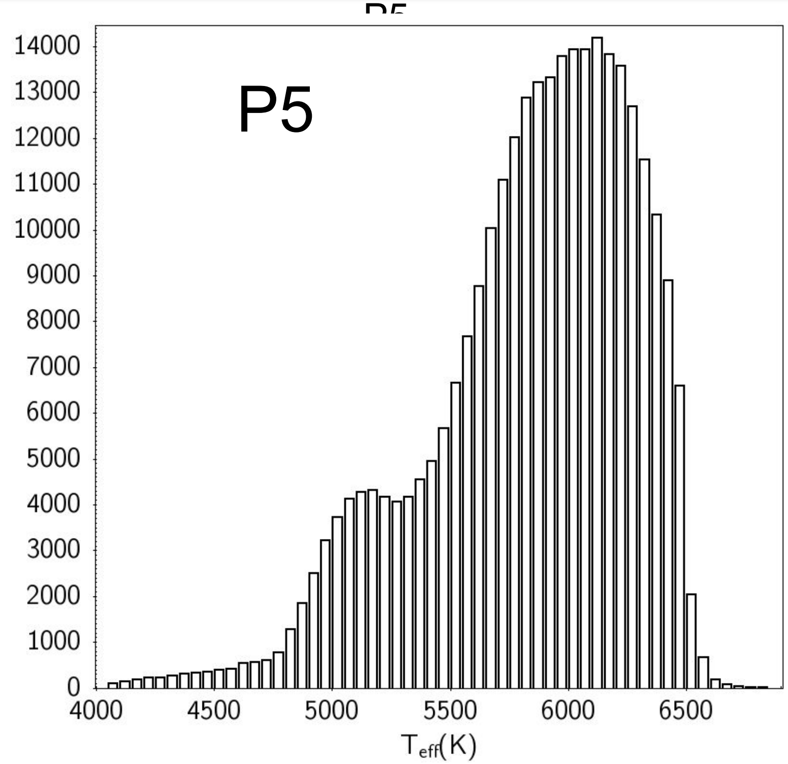
$$\frac{R}{R_\odot} = \left(\frac{T_{eff}}{T_{eff,\odot}}\right)^{-2}\sqrt{\frac{L}{L_\odot}}$$

$$\frac{M}{M_\odot} = f(L, T_{eff})$$

Moya et al. (2018, ApJS, 237, 21)

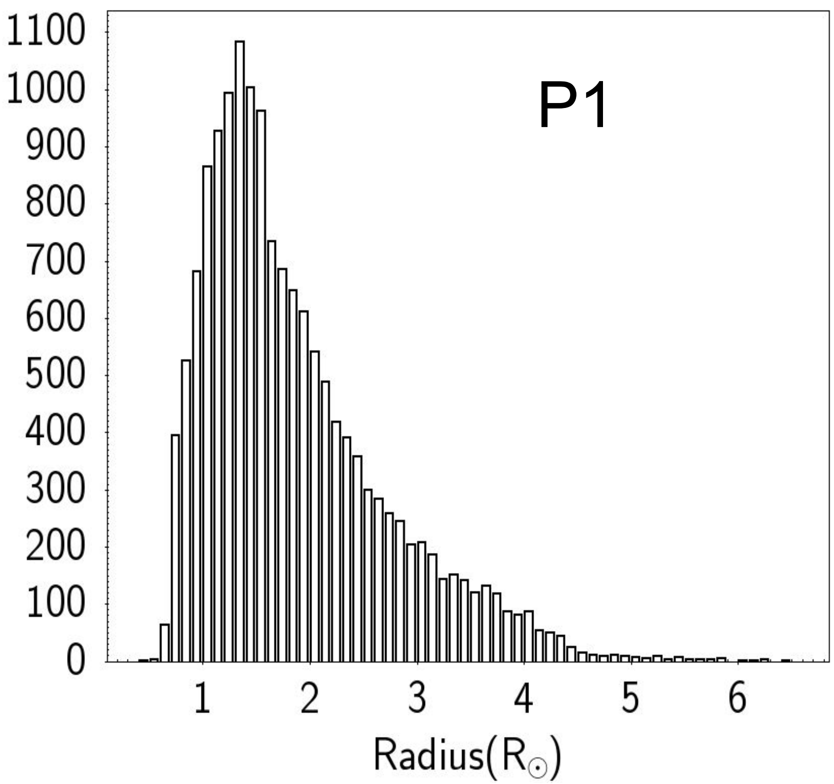
Effective temperature distribution in PIC1.0.0

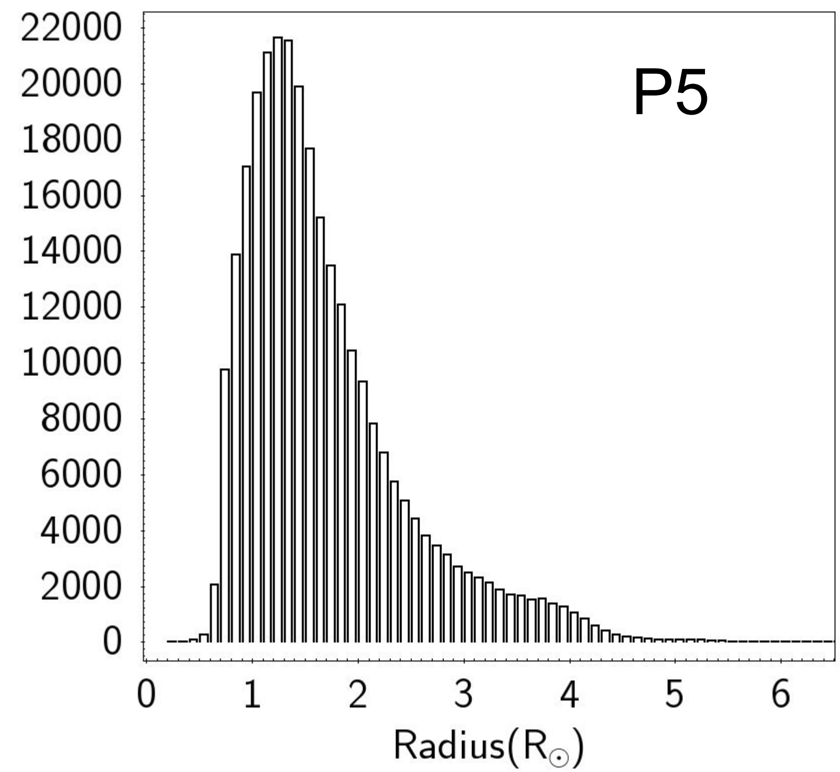




	Q1	Median	Mean	Q3
P5	5600	5917	5843	6178
P1	5688	6009	5910	6241

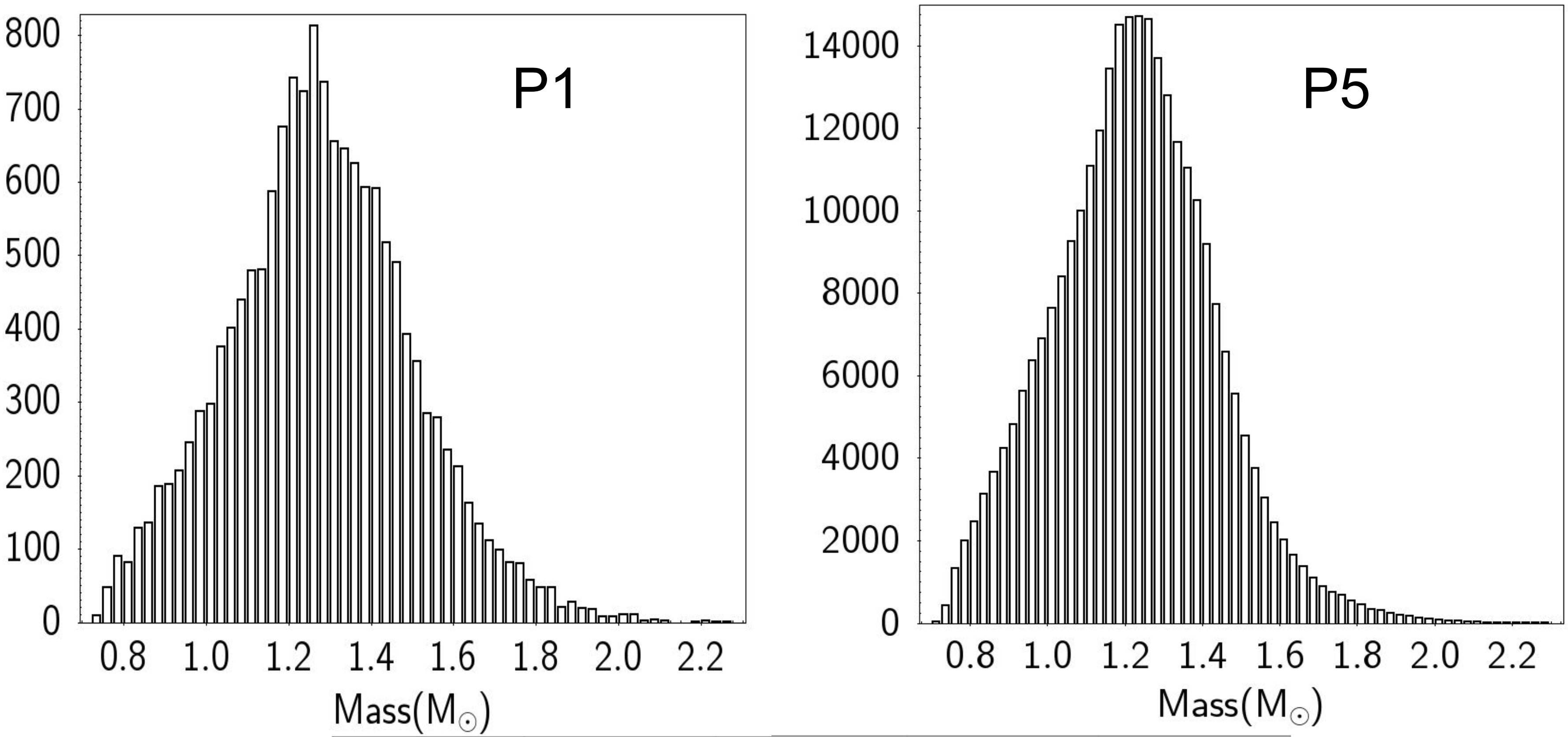
Radius distribution in PIC1.0.0





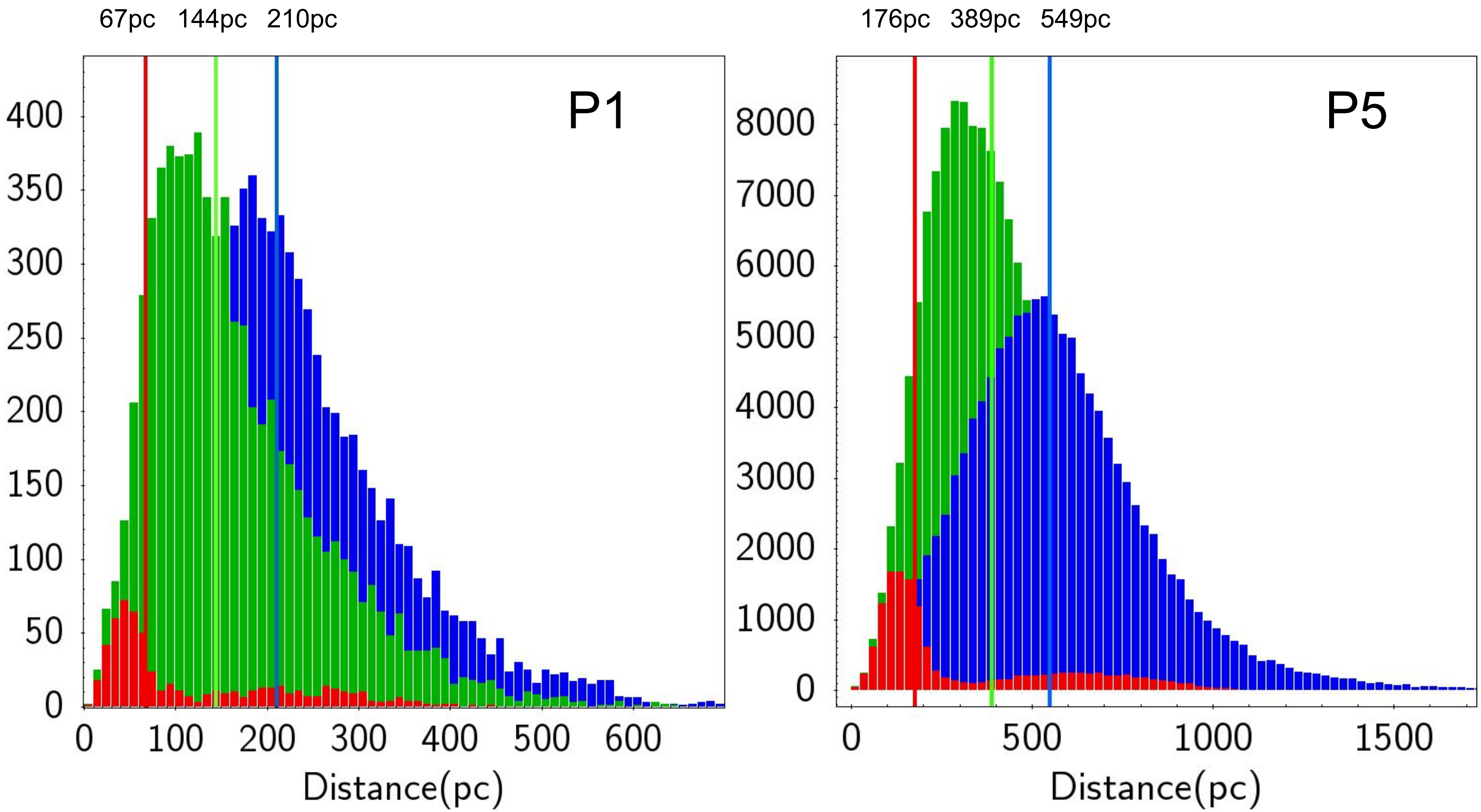
	Q1	Median	Mean	Q3
P5	1.15	1.49	1.69	2.02
P1	1.24	1.62	1.85	2.28

Mass distribution in PIC1.0.0



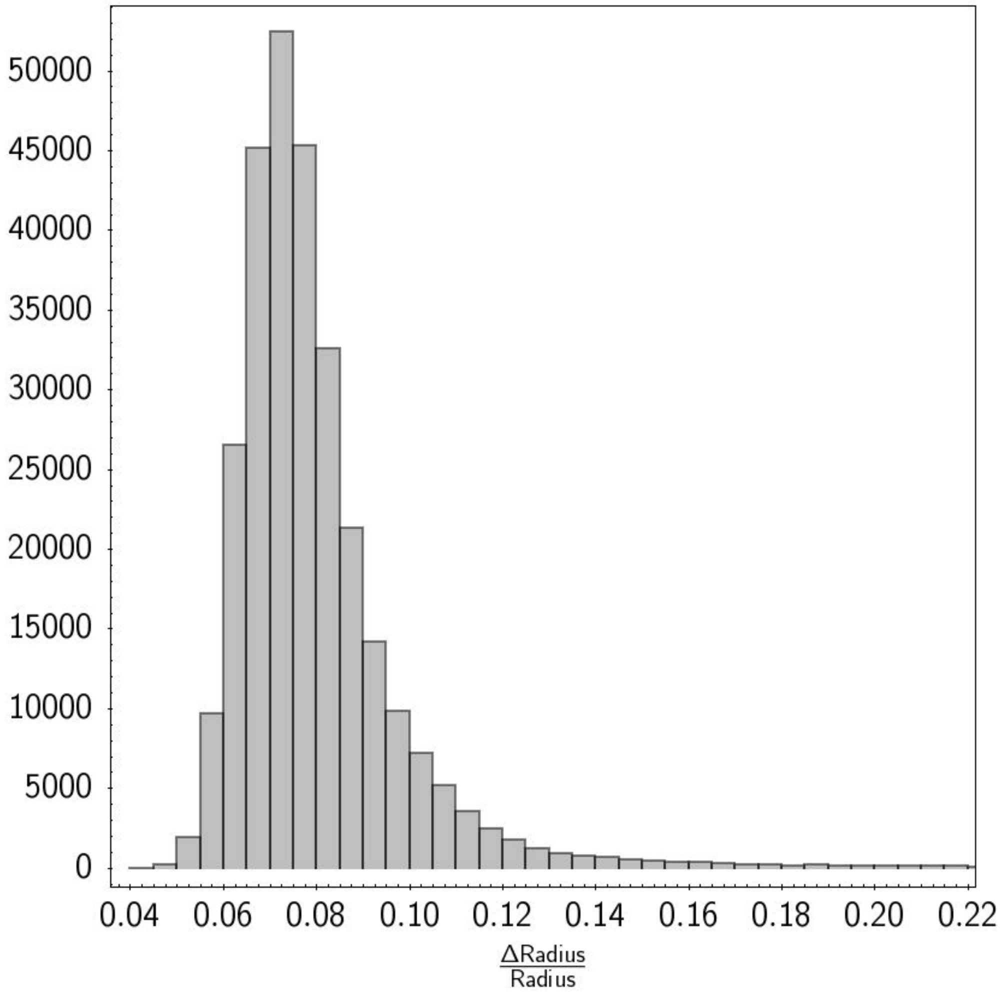
	Q1	Median	Mean	Q3
P5	1.09	1.23	1.23	1.36
P1	1.14	1.27	1.28	1.42

Distance distribution in PIC1.0.0 vs SpType



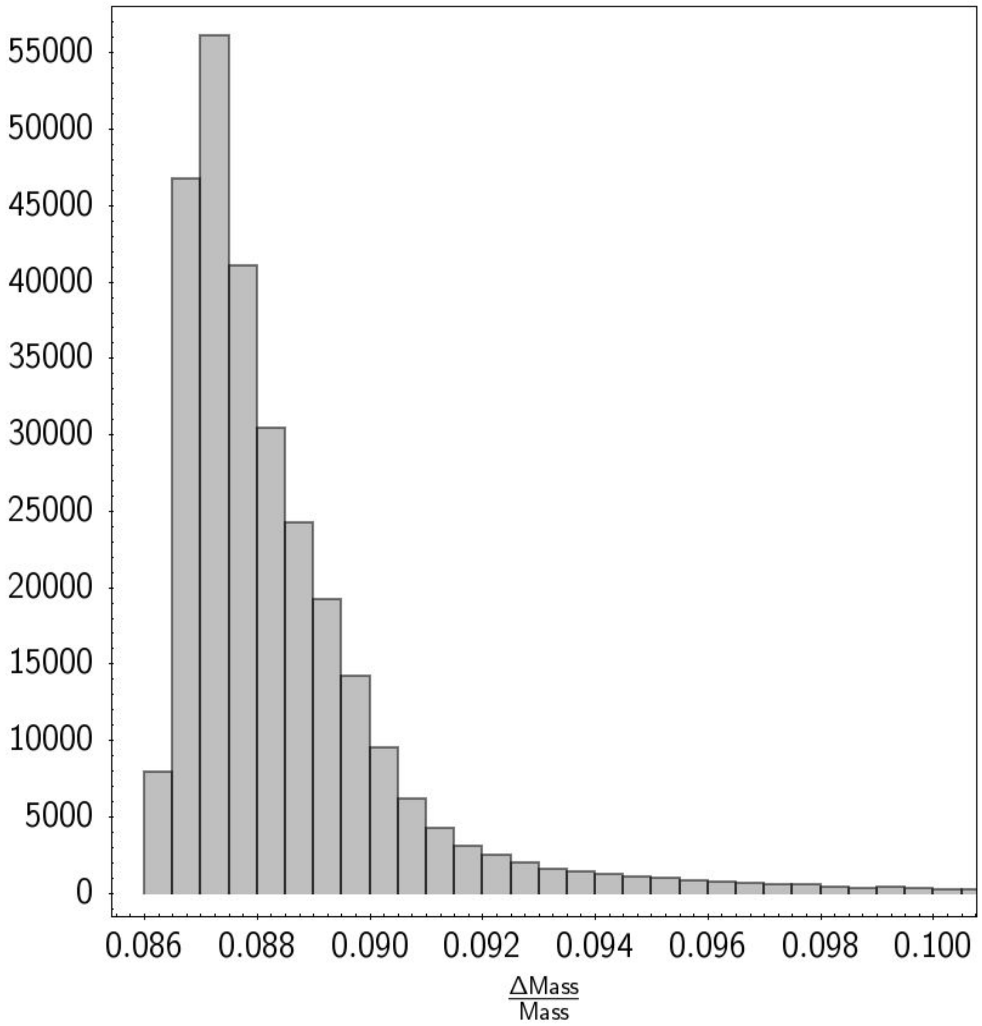
SpType: K, G, F

Distribution of radii relative errors



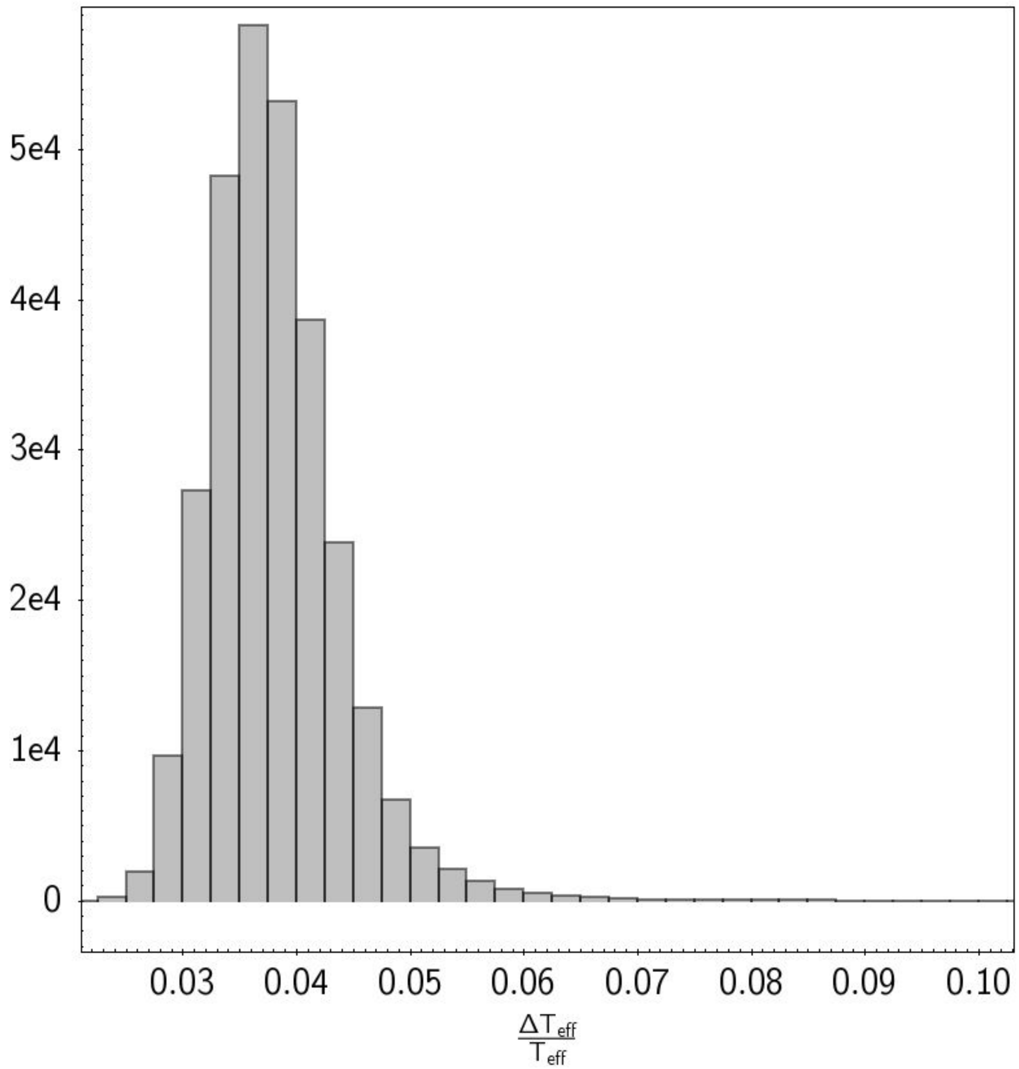
Q1	0.069
Median	0.076
Mean	0.085
Q3	0.086

Distribution of masses relative errors



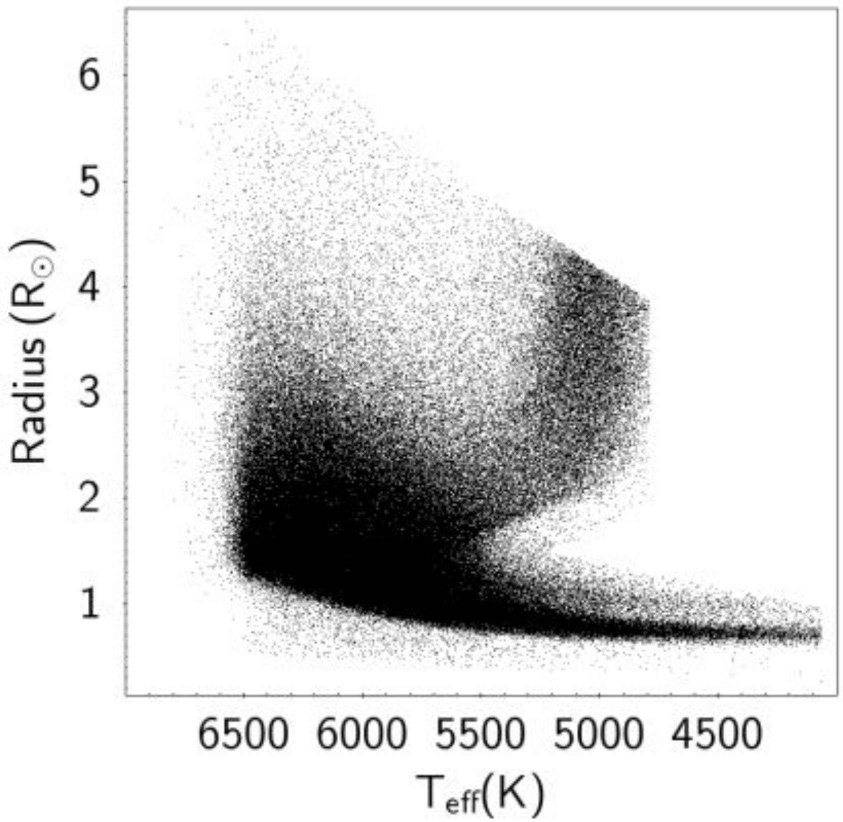
Q1	0.087
Median	0.088
Mean	0.090
Q3	0.089

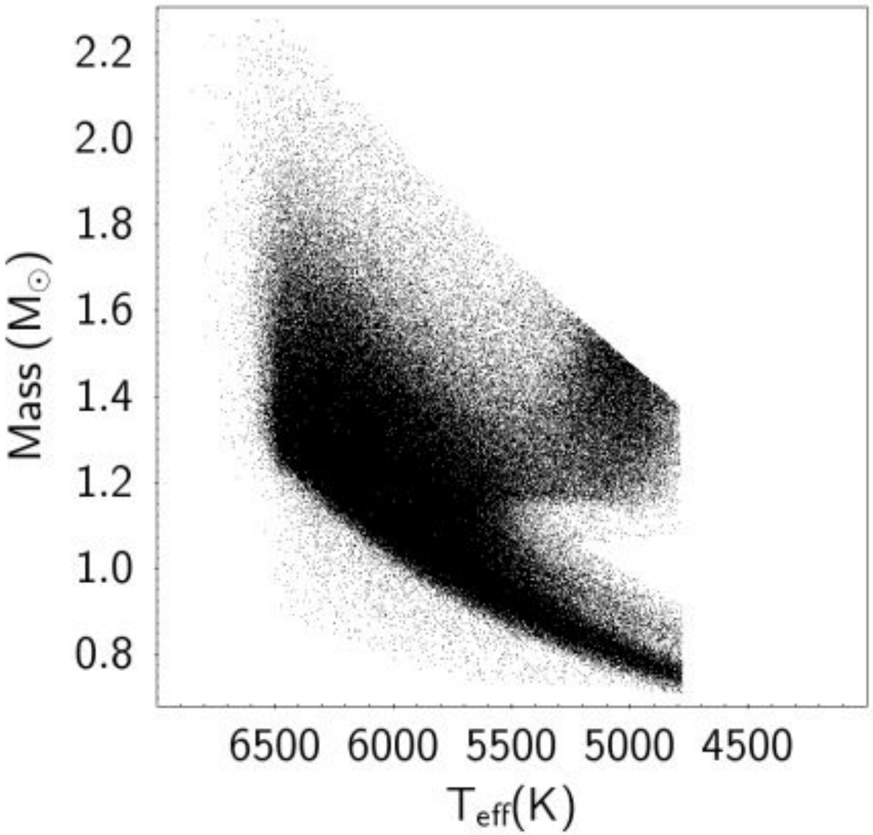
Distribution of effective temperatures relative errors



Q1	0.034
Median	0.037
Mean	0.038
Q3	0.041

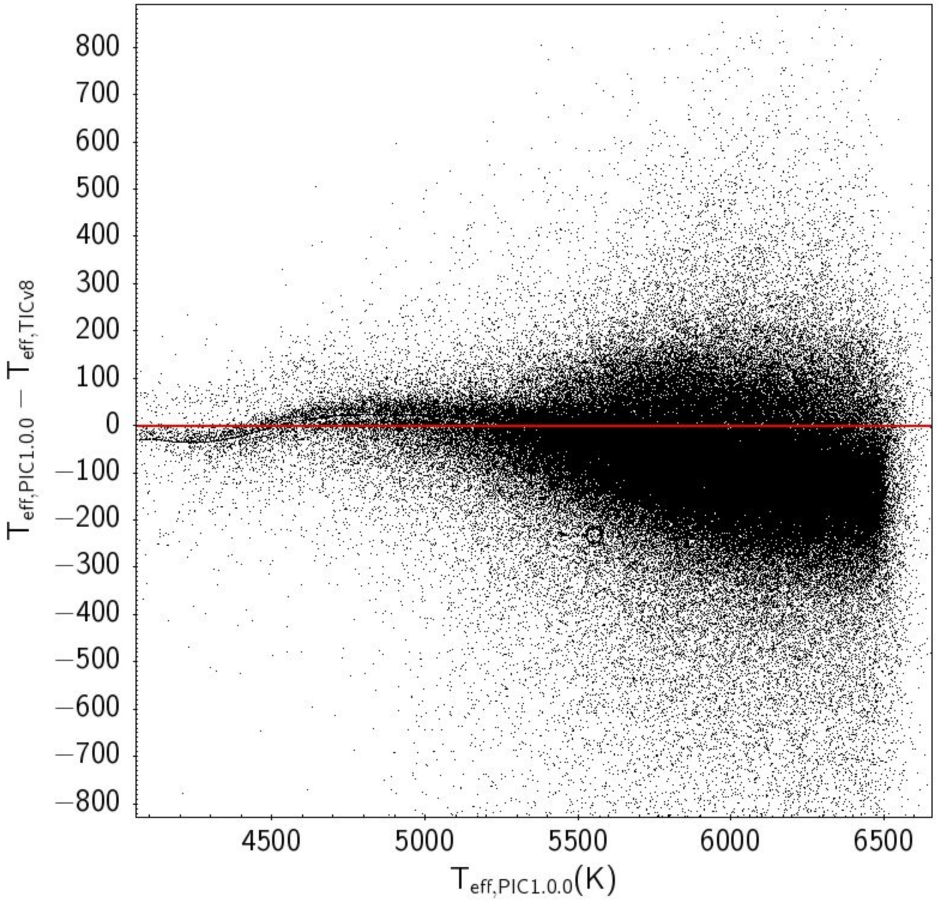
Temperature - radius - mass diagrams

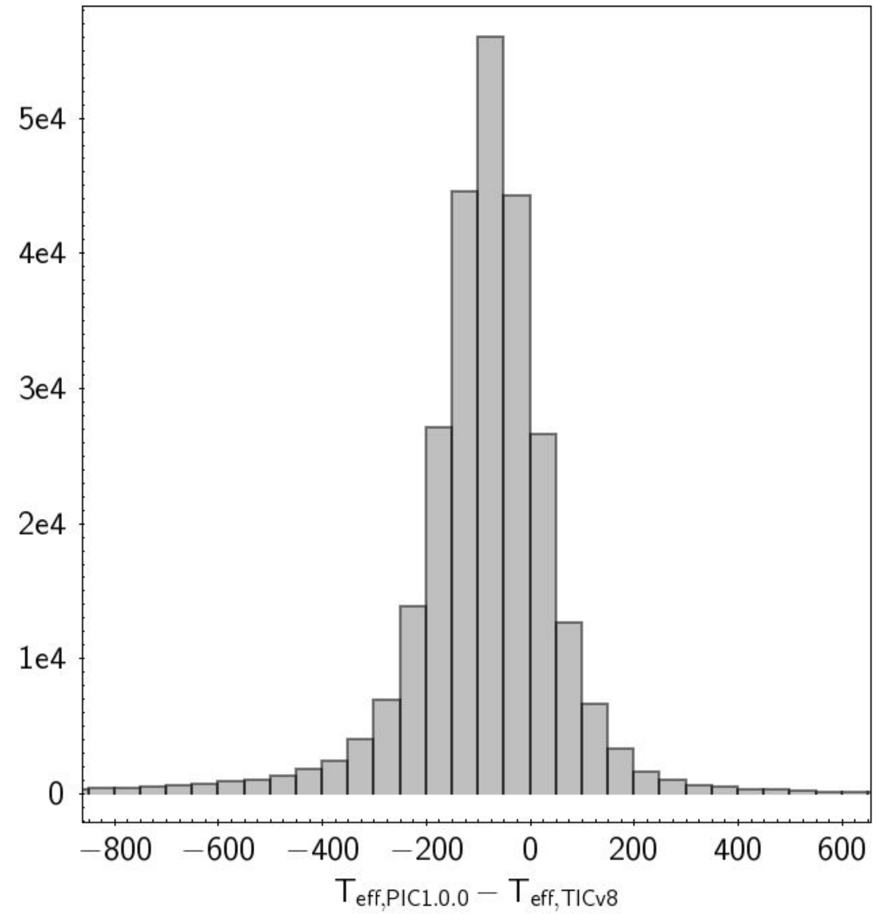




Comparison between PIC1.0.0 and TIC(CTL)v8

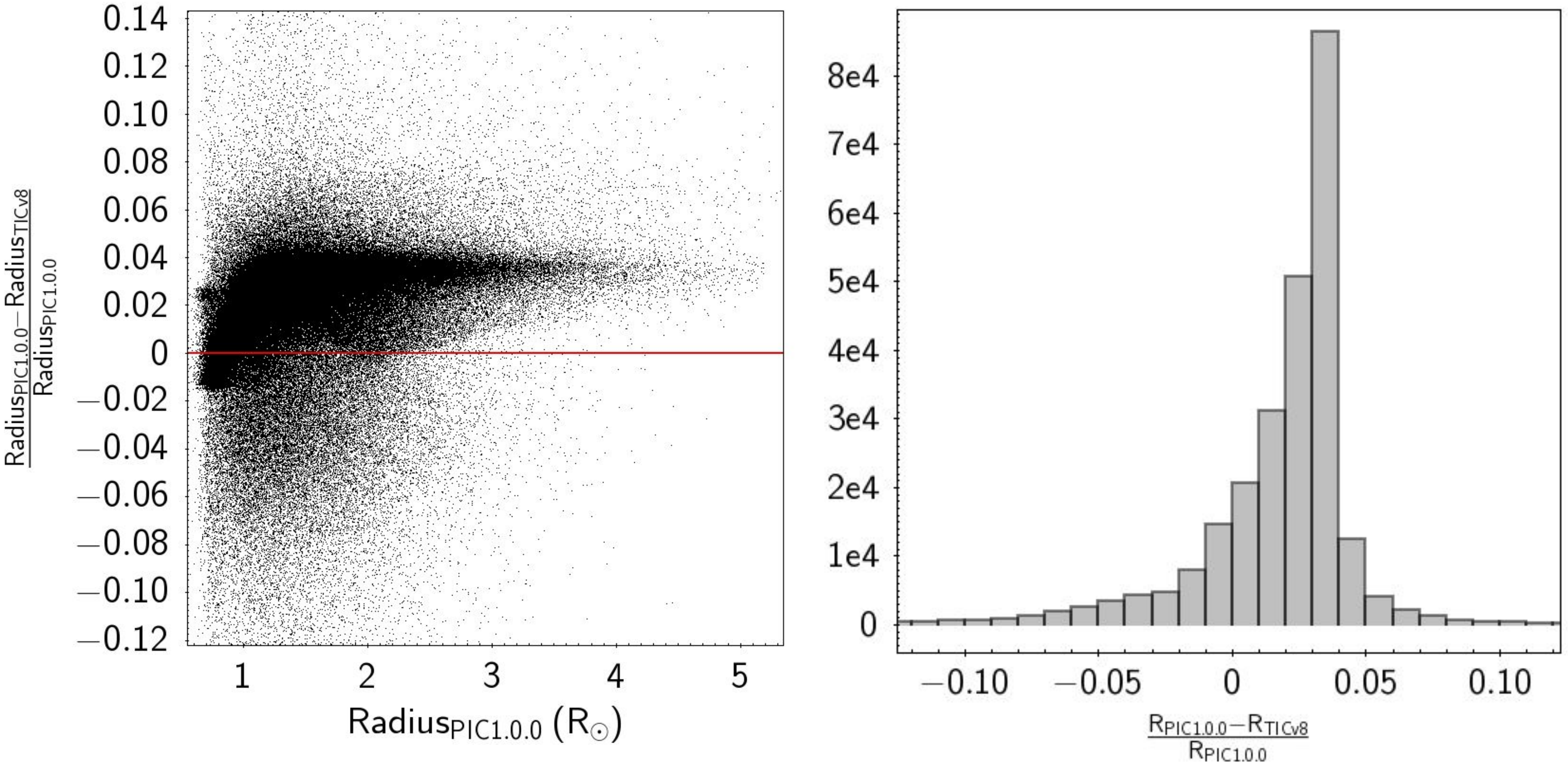
T_{eff} PIC1.0.0 vs TICv8





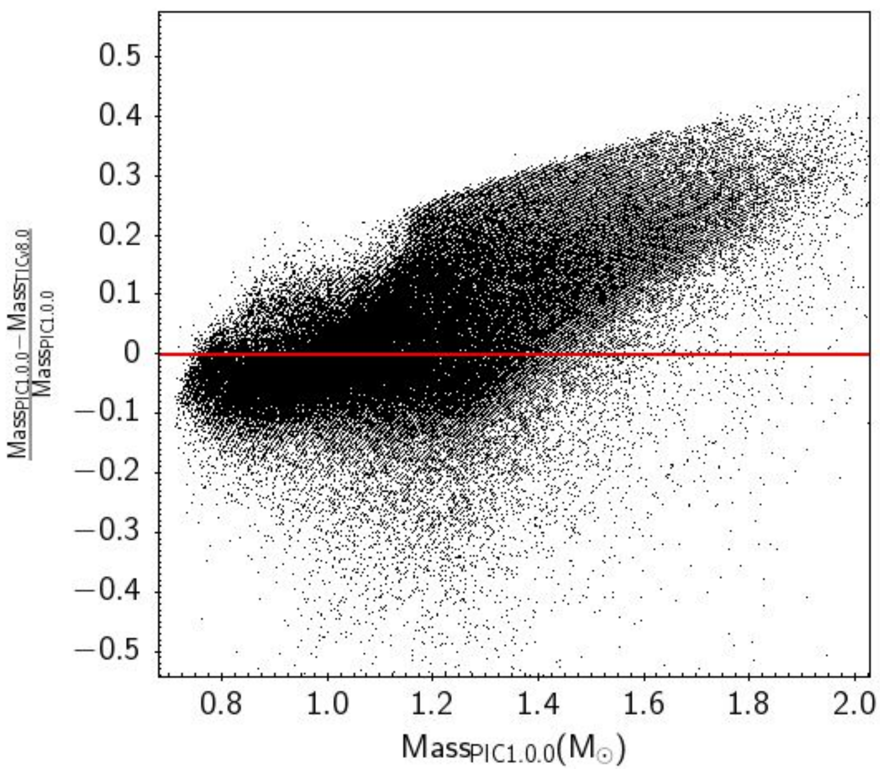
1st Qu.	Median	Mean	3rd Qu.
-148	-80	-99	-16

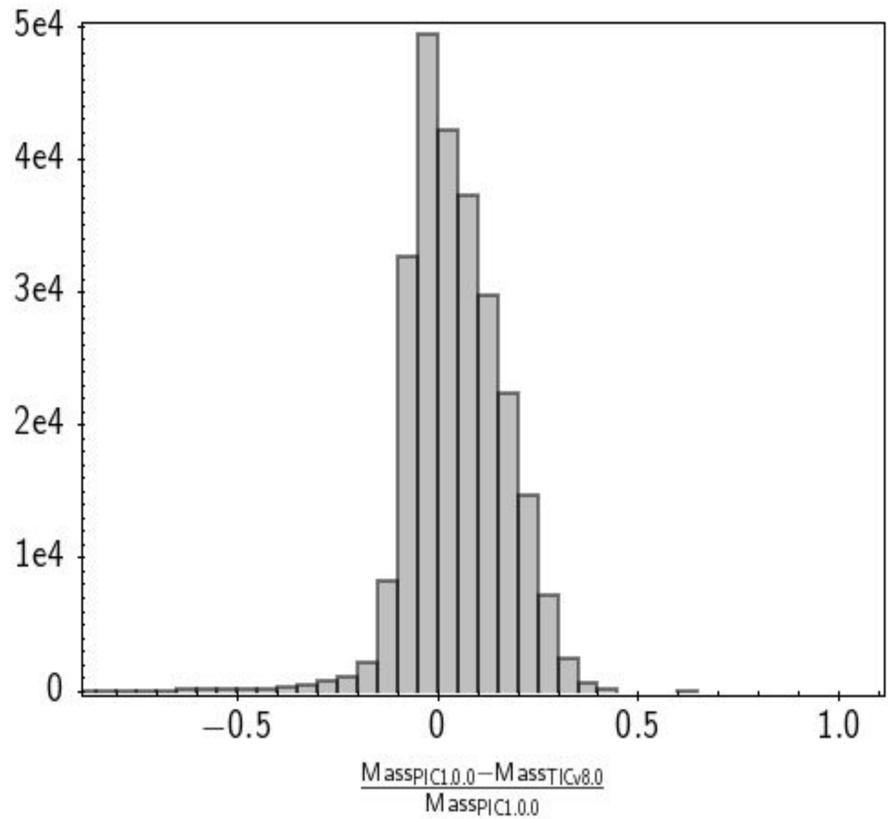
Radius PIC1.0.0 vs TICv8



1st Qu.	Median	Mean	3rd Qu.
0.009	0.027	0.020	0.035

Mass PIC1.0.0 vs TICv8





1st Qu.	Median	Mean	3rd Qu.
-0.033	0.036	0.047	0.12

From PIC1.0.0 to PIC1.1.0

PIC1.0.0 includes P1, P2 and P5 samples

PIC1.1.0 will include also the P4 sample

From PIC1.0.0 to PIC1.1.0 ...

1. Connection between PLATO samples: P1, P2 and P5 limited to K7, while P4 starts from M0.

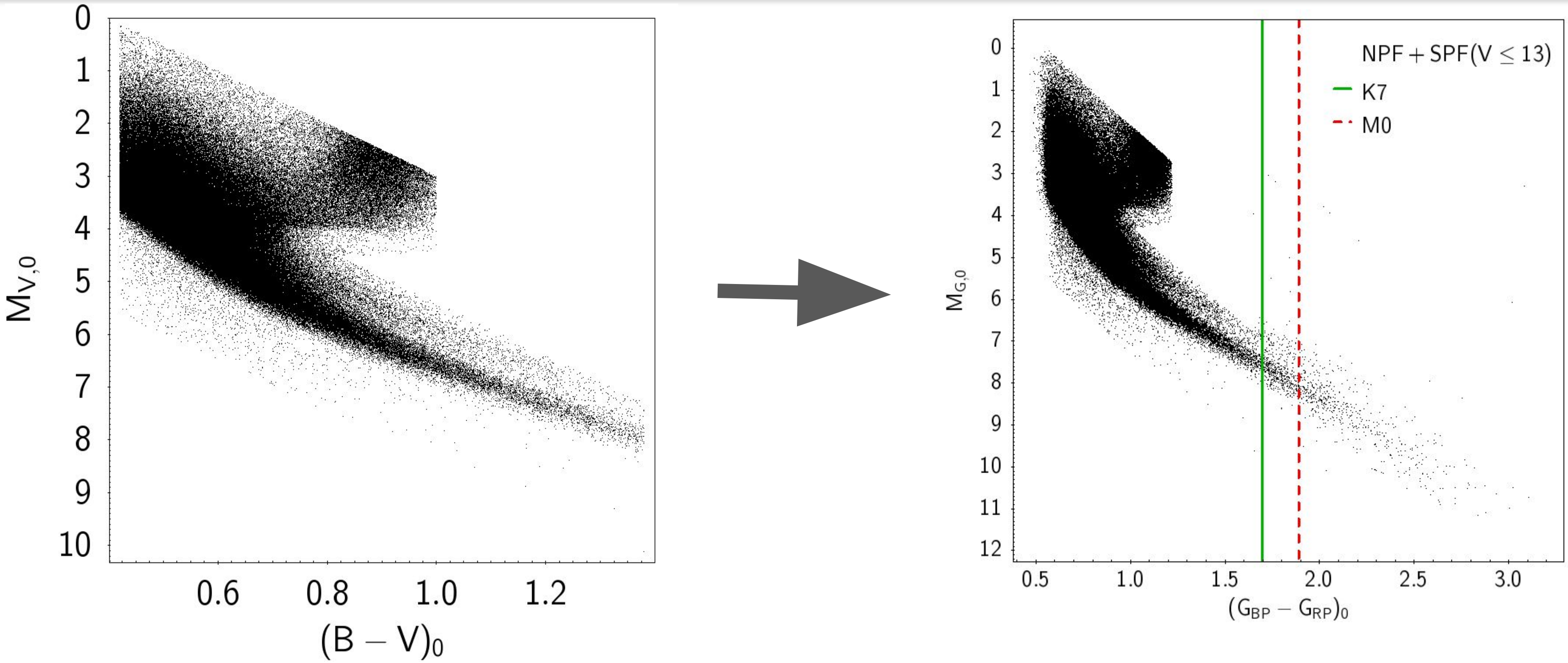
2. The (B-V) color is not appropriate for the M dwarfs selection. It is possible to homogenize sample selection using the (G_{BP}-G_{RP}) color.

3. Extension of validity range of temperature dependent extinction coefficients

4. Extended extinction map

5. New calibration of the V-band magnitude for M-dwarfs

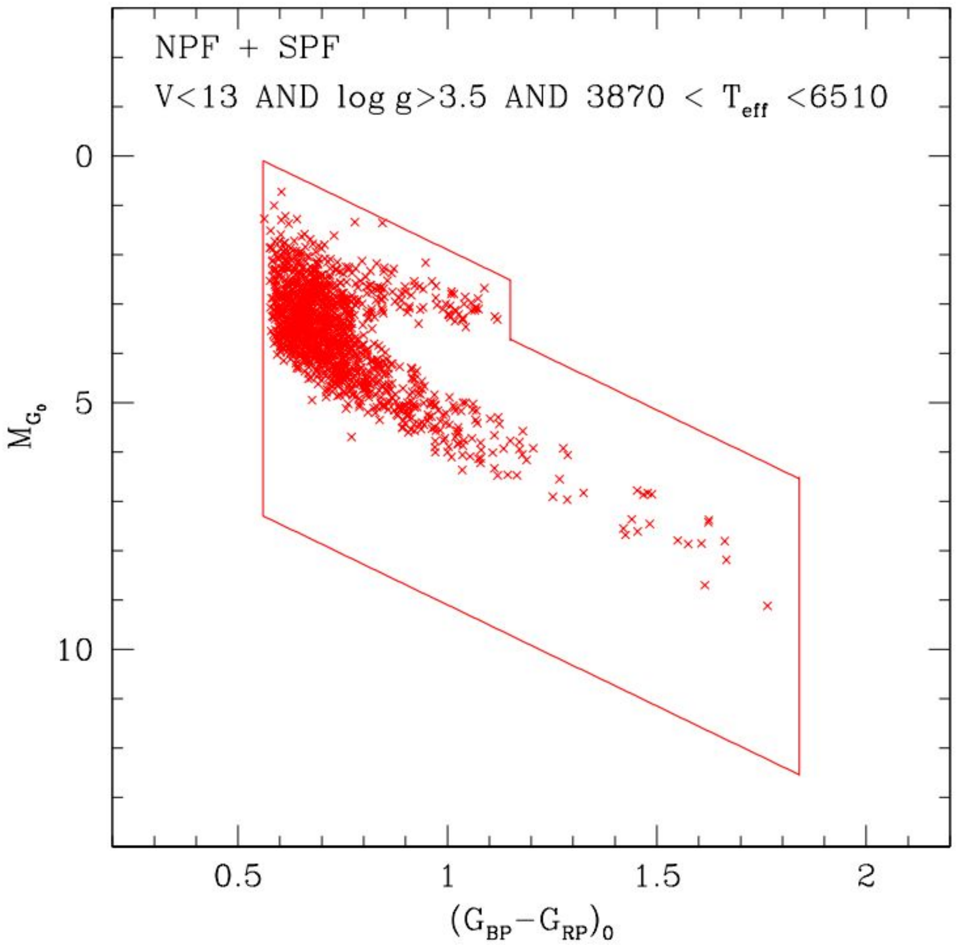
1) Connection between PLATO samples: P1, P2 and P5 limited to K7, while P4 starts from M0.



Calculate intrinsic color $(G_{BP}- G_{RP})_0$ and split P1, P2, P5 from P4 at $(G_{BP}- G_{RP})_0 = 1.84$

$(G_{BP}-G_{RP})_0 < 1.84$	$(G_{BP}-G_{RP})_0 \geq 1.84$
FGK (F5-M0)	(M) (later than M0)

2) The (B-V) color is not appropriate for the M dwarfs selection. It is possible to homogenize sample selecton using the (G_{BP}-G_{RP}) color.

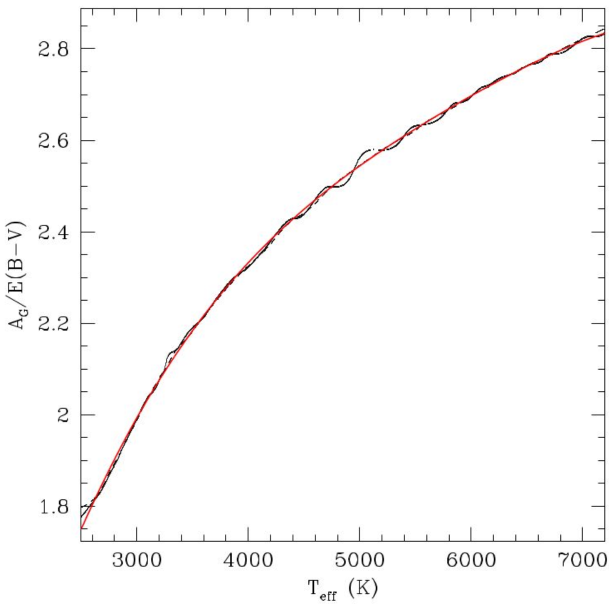


TRILEGAL simulation

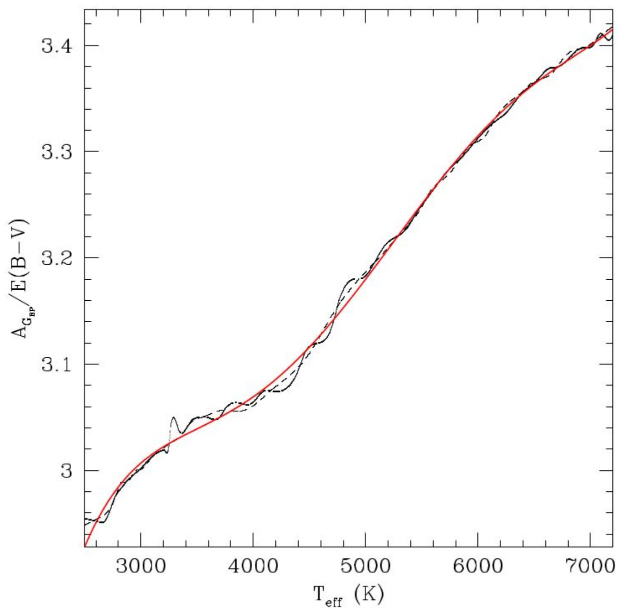
3) Extension of validity range of temperature dependent extinction coefficients

In PIC1.0.0 limited to 5250 K ...

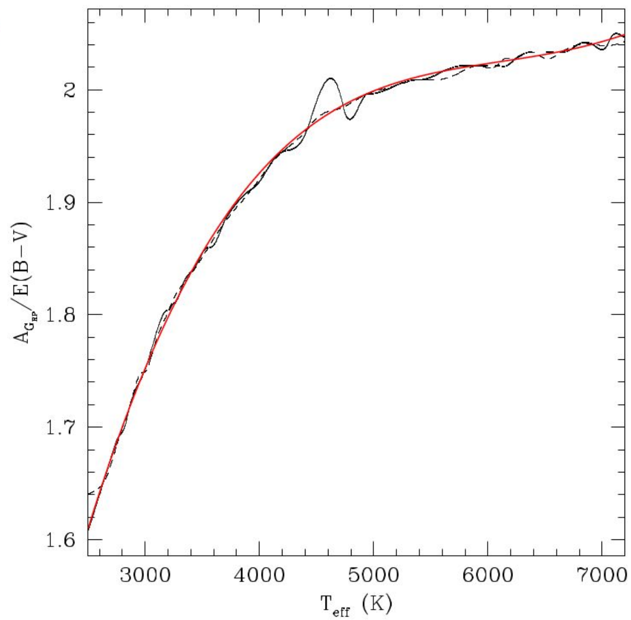
$$\frac{A_G}{E(B-V)}$$



$$\frac{A_{G_{BP}}}{E(B-V)}$$

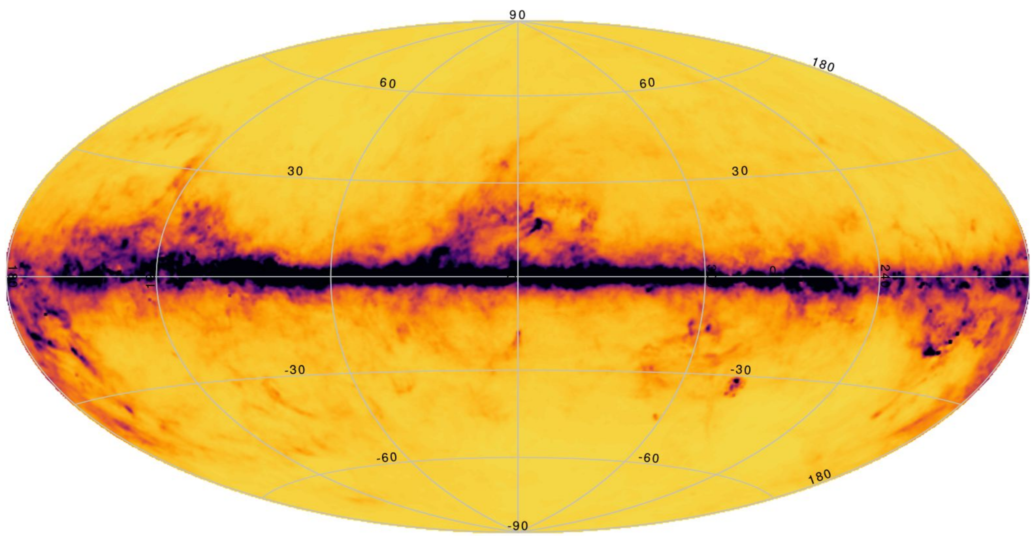


$$\frac{A_{G_{RP}}}{E(B-V)}$$



(2500 K < T_{eff} < 7000 K)

4) Extended extinction map



Schlegel, Finkbeiner & Davis 1998, ApJ, 500, 525
Schlafly & Finkbeiner 2011, ApJ, 737, 103

$$\rho(R, z) = \exp\left(\frac{R_0 - R}{h_R} - \frac{|z - z_w|}{k_{fl} h_z}\right)$$

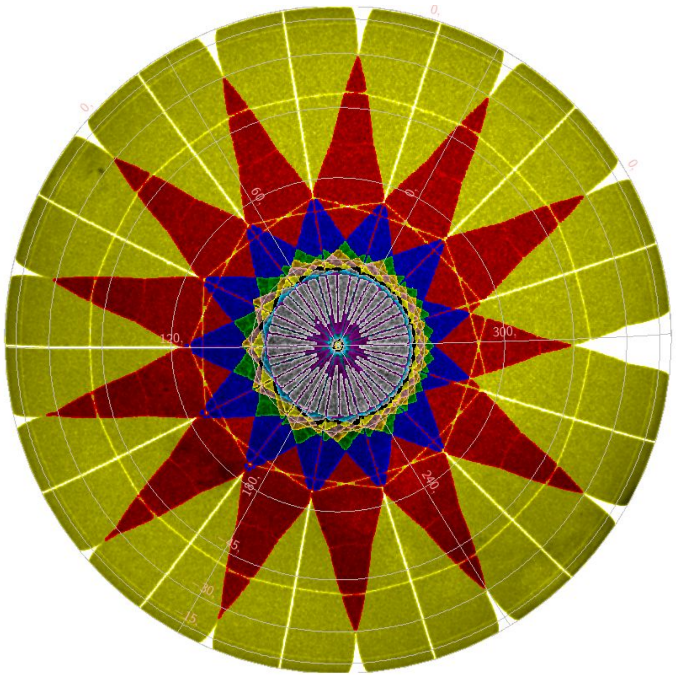
$$k_{\mathrm{fl}}(R) = 1 + \gamma_{\mathrm{fl}} \min(R_{\mathrm{fl}}, R - R_{\mathrm{fl}})$$
$$z_{\mathrm{w}}(R, \phi) = \gamma_{\mathrm{w}} \min(R_{\mathrm{w}}, R - R_{\mathrm{w}}) \sin\phi.$$

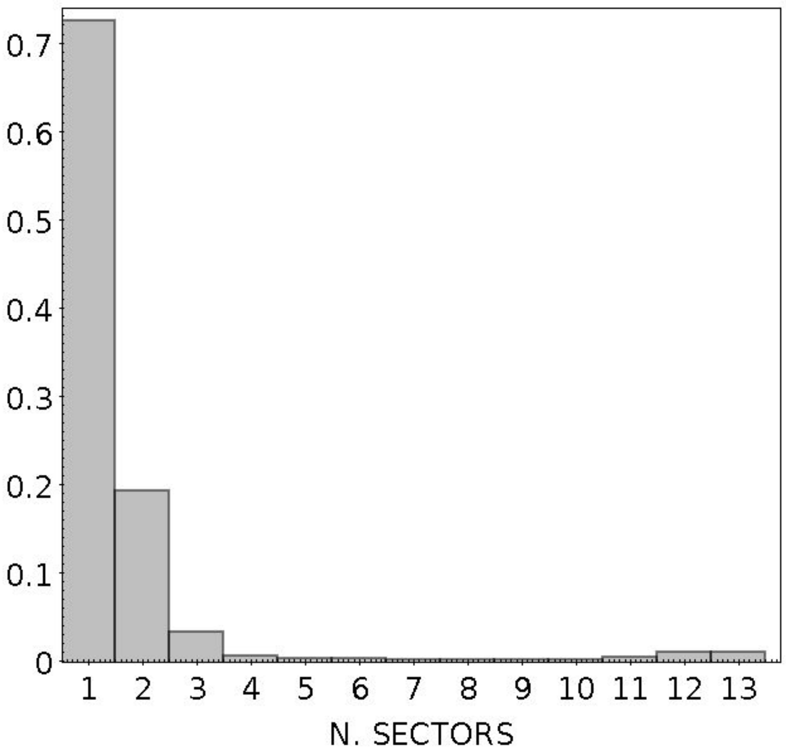
Binney et al. 2014, 437, 351

Work in progress ...

Delivery of PIC1.1.0 expected for December 2019 ...

Using TESS to characterize PLATO Targets ...





1.3 million FGKM dwarfs and subgiants multi-sector LCs in Sector 1-Sector 13 TESS **Full Frame Images (FFIs)**

- Search for transiting planets
- Characterization of the variability properties of PLATO targets

Conclusions

PIC1.0.0 contains samples P1, P2 and P5 in the currently defined North PLATO Field (NPF) and South PLATO Field (SPF).

Dwarf and subgiants are selected using intrinsic absolute color magnitude diagrams constructed from Gaia DR2 data.

Interstellar extinction is accounted for using 3D reddening maps.

Stellar parameters of FGK stars are estimated with an overall uncertainty (internal+external) of 4% in stellar temperatures, 7% in stellar radii and 11% in stellar masses.

PIC1.1.0 will be delivered in December 2019 and it will include the first version of the sample P4.