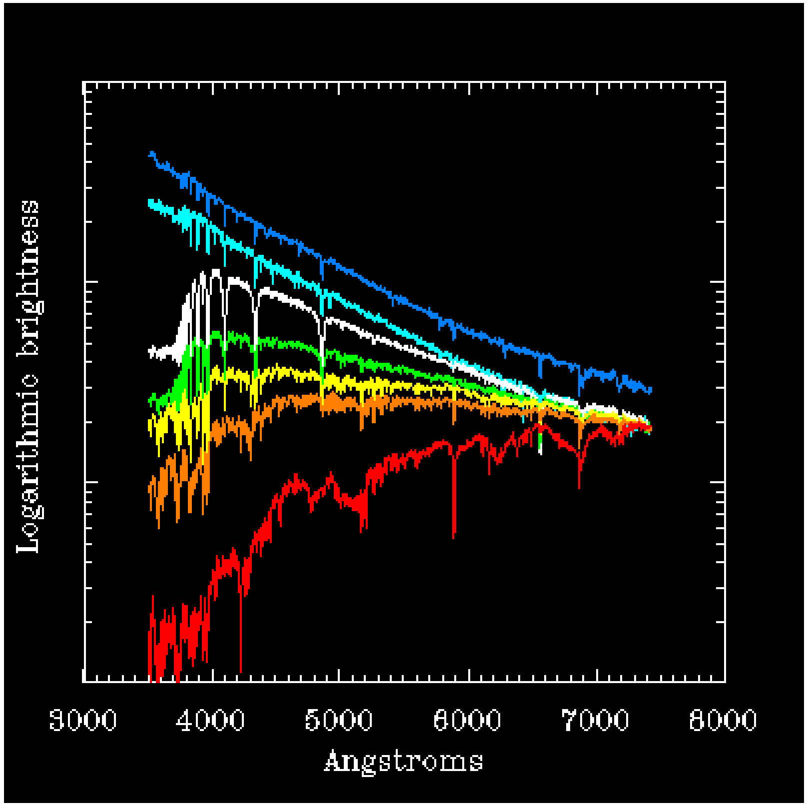
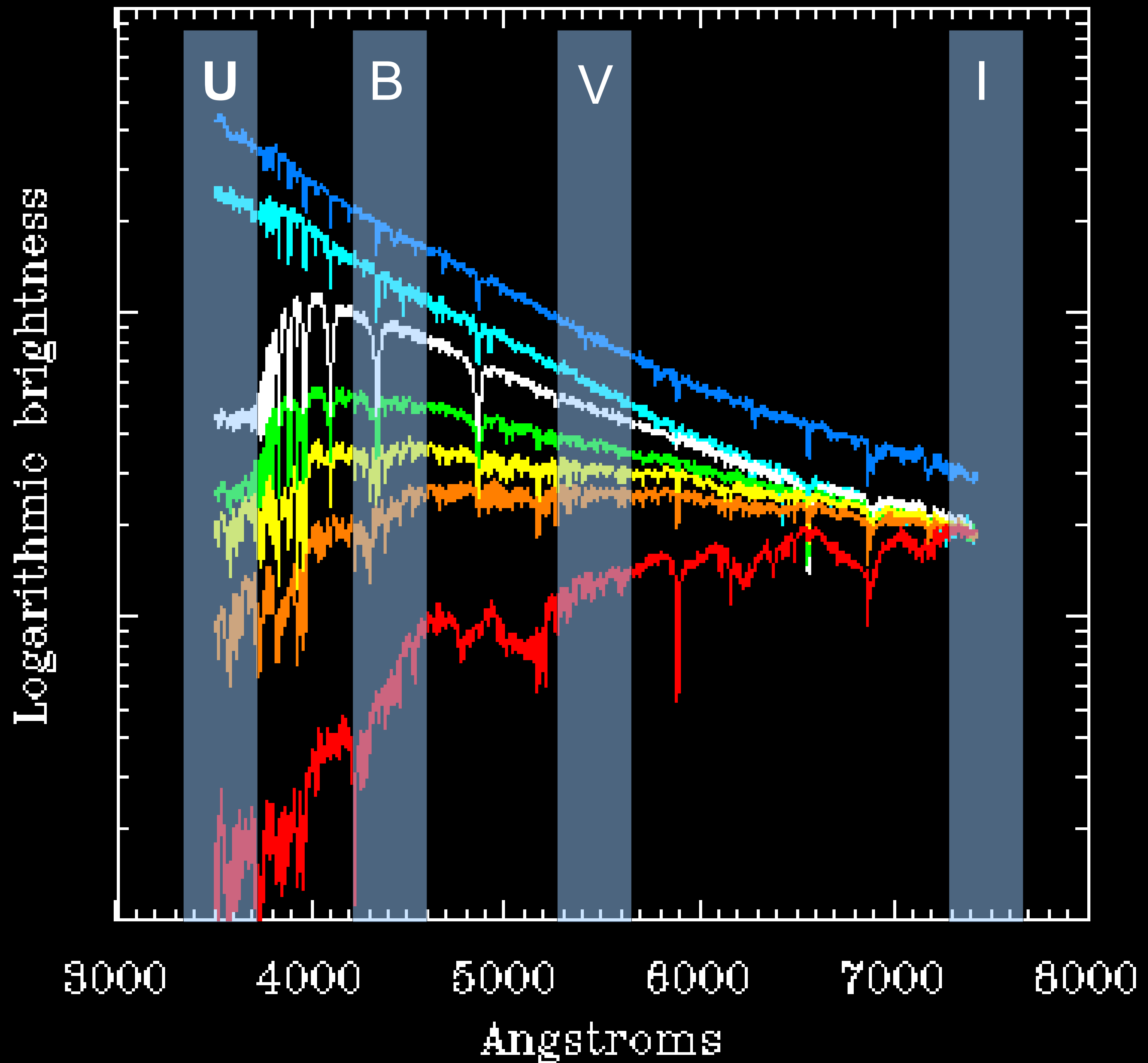
Photometric temperature estimation

Photometry = (very) low-resolution spectroscopy

Slope of continuum can be used as measure of temperature (think black-body/Plank function).

Measure 'appropriate' slope -> T_{eff}





U
B
V
I
Logarithmic brightness
3000
4000
5000
6000
7000
8000
Angstroms

General approach:

T_{eff} = f(colour, [M/H]) + table of corrections

... functional form of 'f' is usually a polynomial.

Many calibrations exist in literature.

Reference temperature for deriving the calibration
Is usually from the IRFM.

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The effective temperature scale of giant stars (F0-K5)

II. Empirical calibration of $T_{\rm eff}$ versus colours and [Fe/H]

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Abstract:

We present calibrations of the effective temperatures of giant stars versus [Fe/H] and colours (*U-V*), (*B-V*), (*R-I*), (*V-R*), (*V-I*), (*V-K*), (*J-H*), (*J-K*), (*I-K*), (*V-L*'), (*b-y*) and (*u-b*). These calibrations are based on a large sample of field and globular cluster stars which roughly cover spectral types from F0 to K5. Their effective temperatures, scaled to *direct* $T_{\rm eff}$ determinations via reliable angular diameter measurements, were derived by applying the infrared flux method. The empirical relations have been fitted to polynomials of the form $\theta_{\rm eff} = P({\rm colour}, [{\rm Fe/H}])$ by using the least squares method. The precision of the fits ranges from 40 K for (*V-K*)to 170 K for (*J-H*). We tabulate intrinsic colours of giant stars in the ranges: 3500 K $\leq T_{\rm eff} \leq$ 8000 K; -3.0 $\leq [{\rm Fe/H}] \leq +0.5$. We also present the calibration of BC(V) as a function of log $(T_{\rm eff})$ and metallicity. Finally, we compare the resulting scale of temperatures with previous works.

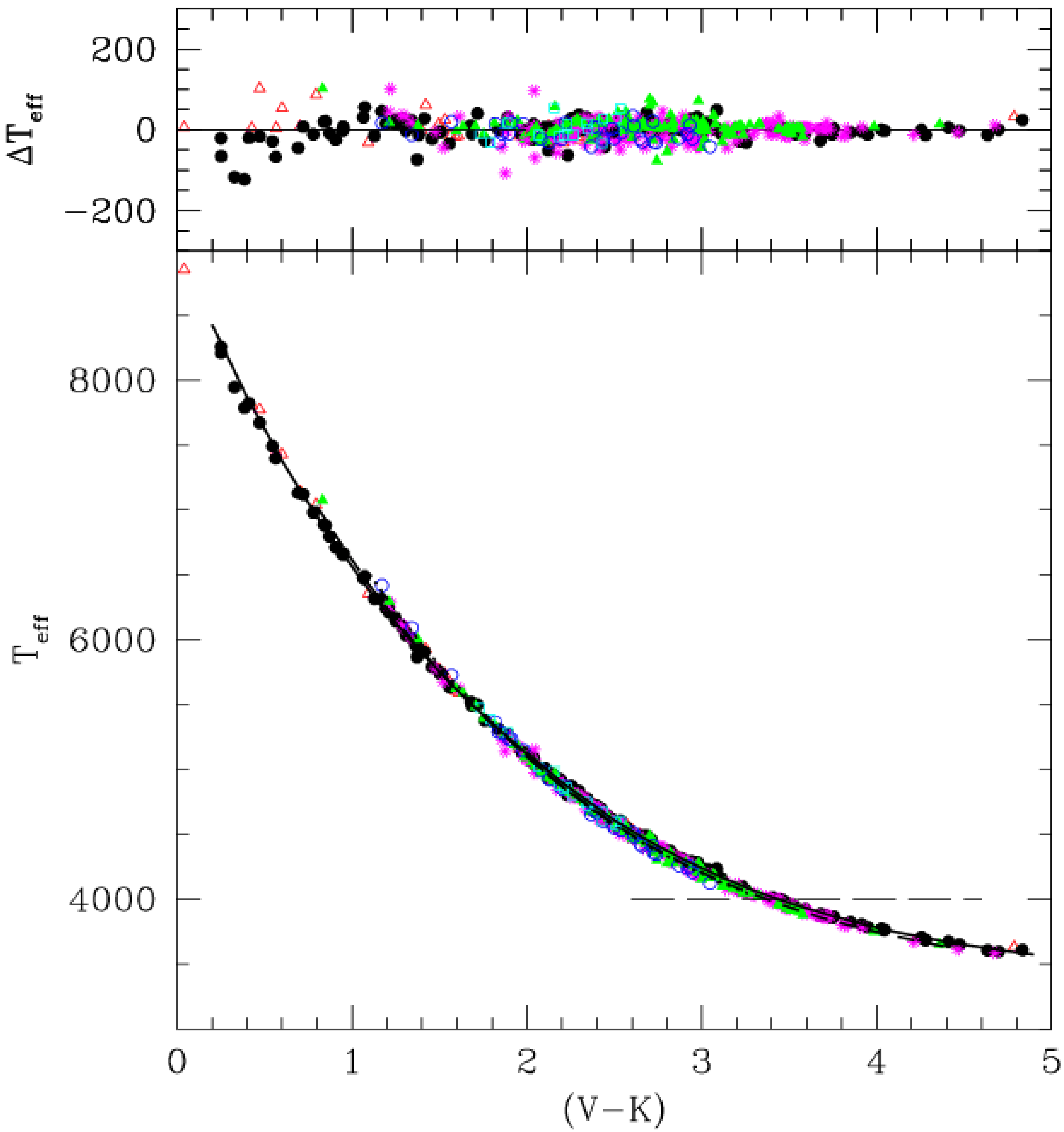
Key words: stars: fundamental parameters -- stars: Population II -- stars: giants -- stars: atmospheres -- stars: general

SIMBAD Objects

Table 2: Coefficients for the fits of the form $\theta_{\rm eff} = a_0 + a_1 X + a_2 X^2 - a_3 X[{\rm Fe/H}] + a_4[{\rm Fe/H}] + a_5[{\rm Fe/H}]^2$, where X stands for the colour (Col. 2). The corresponding standard deviations $\sigma(\theta_{\rm eff})$ and $\sigma(T_{\rm eff})$, together with the number of stars considered, are also shown. Column 1 contains the equation number assigned to each fit in the text

Eq. #	Colour	a_0	a_1	a_2	a_3	a_4	a_5	$\sigma(\theta_{\rm eff})$	$\sigma(T_{\rm eff})$ (K)	N. of stars
1	(*U-V*)	0.6388	0.4065	-0.1117	-2.308e-3	-7.783e-2	-1.200e-2	0.023	164	127
2	(*U-V*)	0.8323	9.374e-2	1.184e-2	2.351e-2	-0.1392	-1.944e-2	0.020	80	283
3	(*B-V*)	0.5716	0.5404	-6.126e-2	-4.862e-2	-1.777e-2	-7.969e-3	0.020	167	122
4	(*B-V*)	0.6177	0.4354	-4.025e-3	5.204e-2	-0.1127	-1.385e-2	0.024	96	416
5	(*V-R*)	0.4972	0.8841	-0.1904	-1.197e-2	-1.025e-2	-5.500e-3	0.021	150	248
6	(*V-I*)*	$\theta_{\rm eff} = 0.5379 + 0.3981(V-I) + 4.432{\rm e}{-2}\,(V-I)^2 - 2.693{\rm e}{-2}(V-I)^3$						0.017	125	214
7	(*R-I*)	0.4974	1.345	-0.5008	-8.134e-2	3.705e-2	-6.184e-3	0.022	150	217
8	(*V-K*)	0.5558	0.2105	1.981e-3	-9.965e-3	1.325e-2	-2.726e-3	0.005	40	256
9	(*V-K*)	0.3770	0.3660	-3.170e-2	-3.074e-3	-2.765e-3	-2.973e-3	0.005	25	412
10	(*J-H*)	0.5977	1.015	-1.020e-1	-1.029e-2	3.006e-2	1.013e-2	0.023	170	505
11	(*J-K*)	0.5816	0.9134	-0.1443	0.0000	0.0000	0.0000	0.020	125	511
12	(*V-L'*)*	$\theta_{\rm eff} = 0.5641 + 0.1882(V-L') + 1.890{\rm e}{-2}\,(V-L')^2 - 4.651{\rm e}{-3}(V-L')^3$						0.009	65	122
13	$(I-K)_J$	0.5859	0.4846	-2.457e-2	0.0000	0.0000	0.0000	0.018	130	213
14	(*b-y*)	0.5815	0.7263	6.856e-2	-6.832e-2	-1.062e-2	-1.079e-2	0.013	110	118
15	(*b-y*)	0.4399	1.209	-0.3541	8.443e-2	-0.1063	-1.686e-2	0.018	70	169
16	(*u-b*)	0.5883	0.2008	-5.931e-3	5.319e-3	-1.000 e-1	-1.542e-2	0.021	110	181

* The functional expression of the fit for this colour is explicitly shown, since it differs from the general expression adopted.



200
0
−200
ΔT_eff
8000
6000
4000
T_eff
0
1
2
3
4
5
(V−K)

Recommendations/procedures..... loose ends, comments

- Decide on photometric system to use (make sure it matches the system for which the calibration was derived!!
- Obtain photometry for your objects (DIY or use catalogs.... assess the quality!! (2MASS, SDSS, Tycho.......)
- Beware of reddening!!
- Remember the validity range for the calibration you use