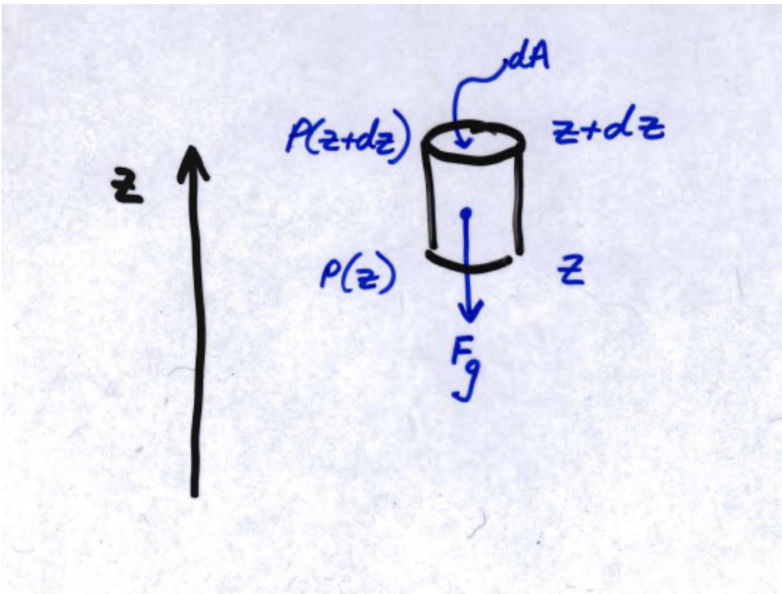
Review: hydrostatic equilibrium

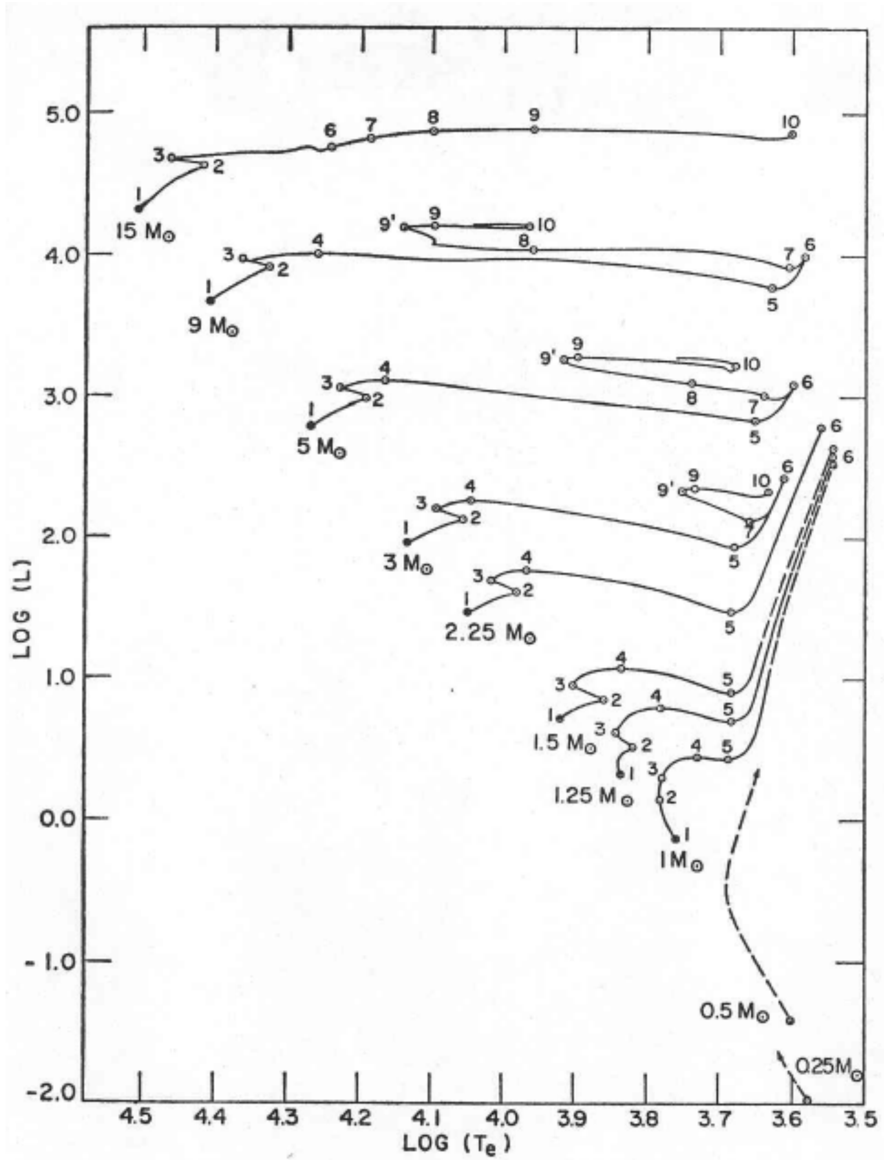


$$\frac{dP}{dz} = -\rho g_z$$

In a star, the downward force of gravity is balanced by the gradient in pressure

Q: why does this concept explain why the CNO process, which burns H to He at a higher density, temp and pressure than the p-p chain, only happens in cores of massive main sequence stars?

Review: stellar evolution



Iben 1967

Review: HR diagram

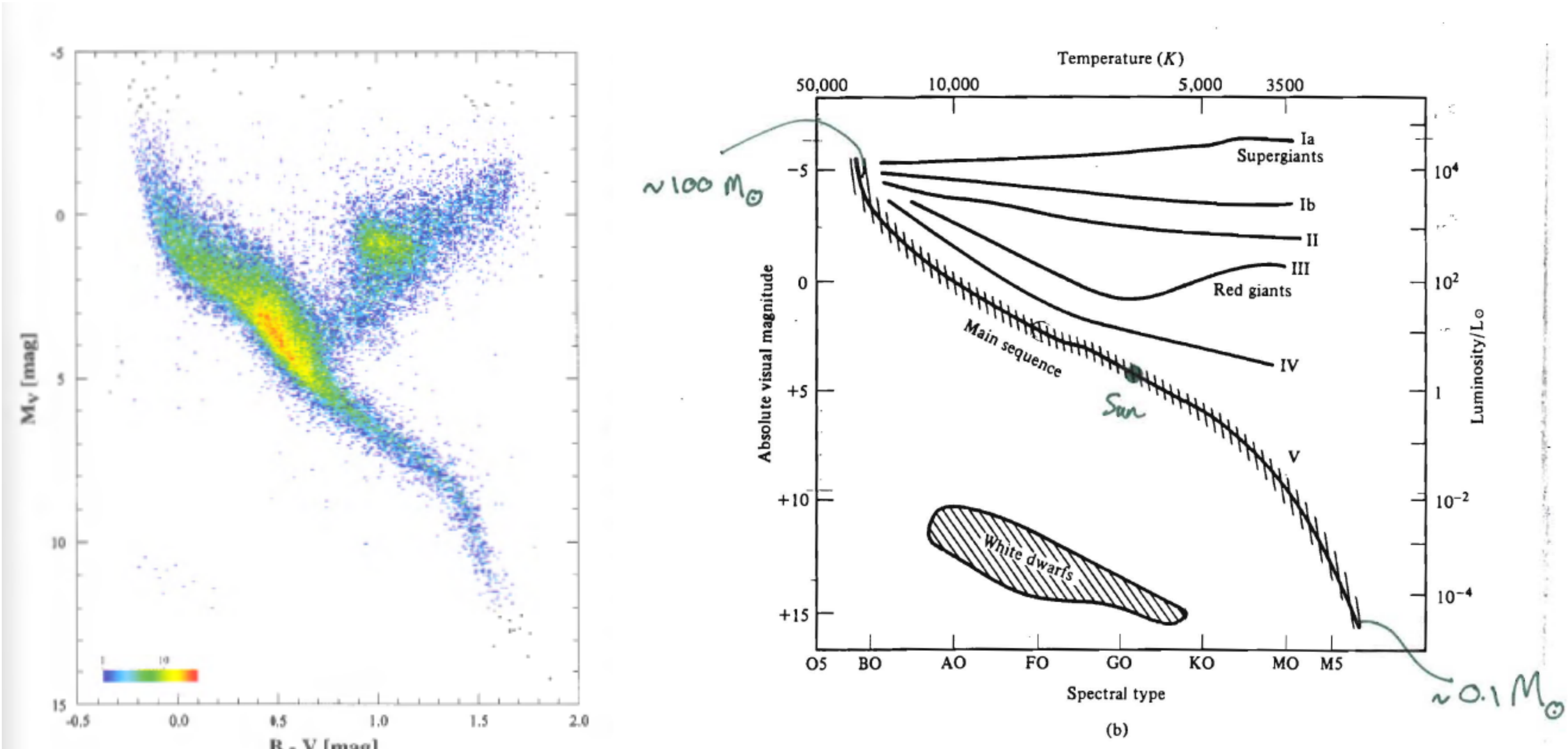
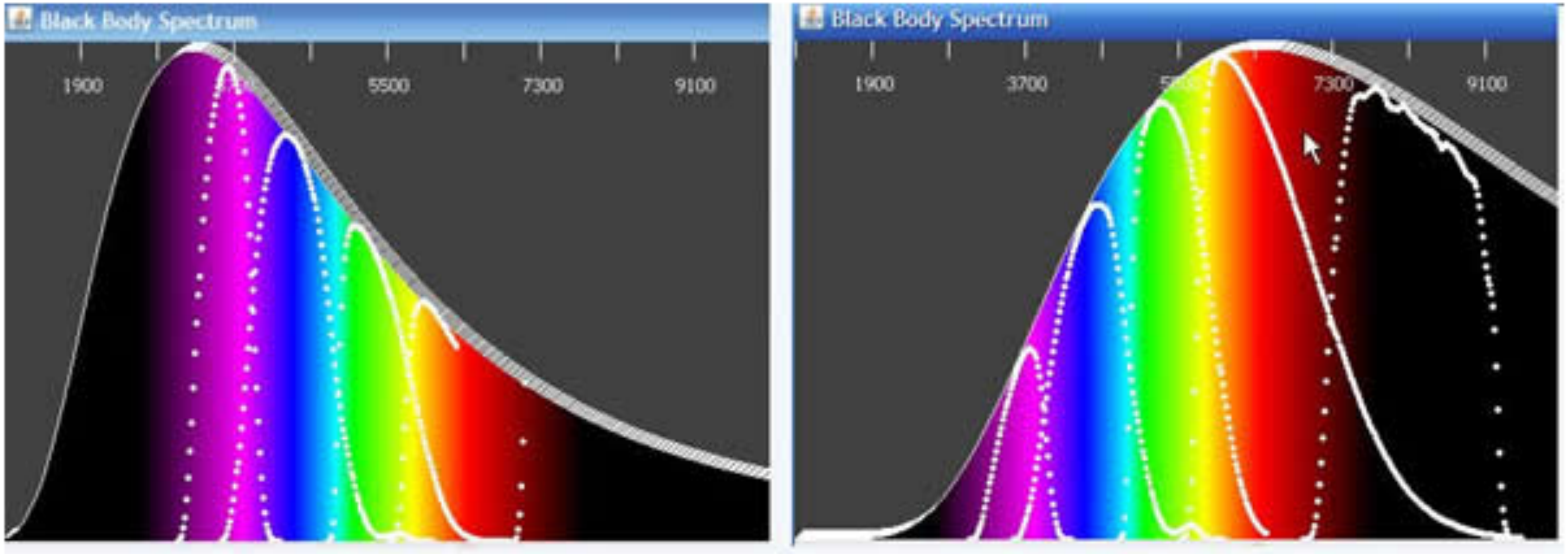


Figure 3.11 (a) *H–R* diagram. (b) Schematic *H–R* diagram. Luminosity classes are indicated by Roman numerals.

Note enormous range in absolute magnitude: more than 10^6 in luminosity

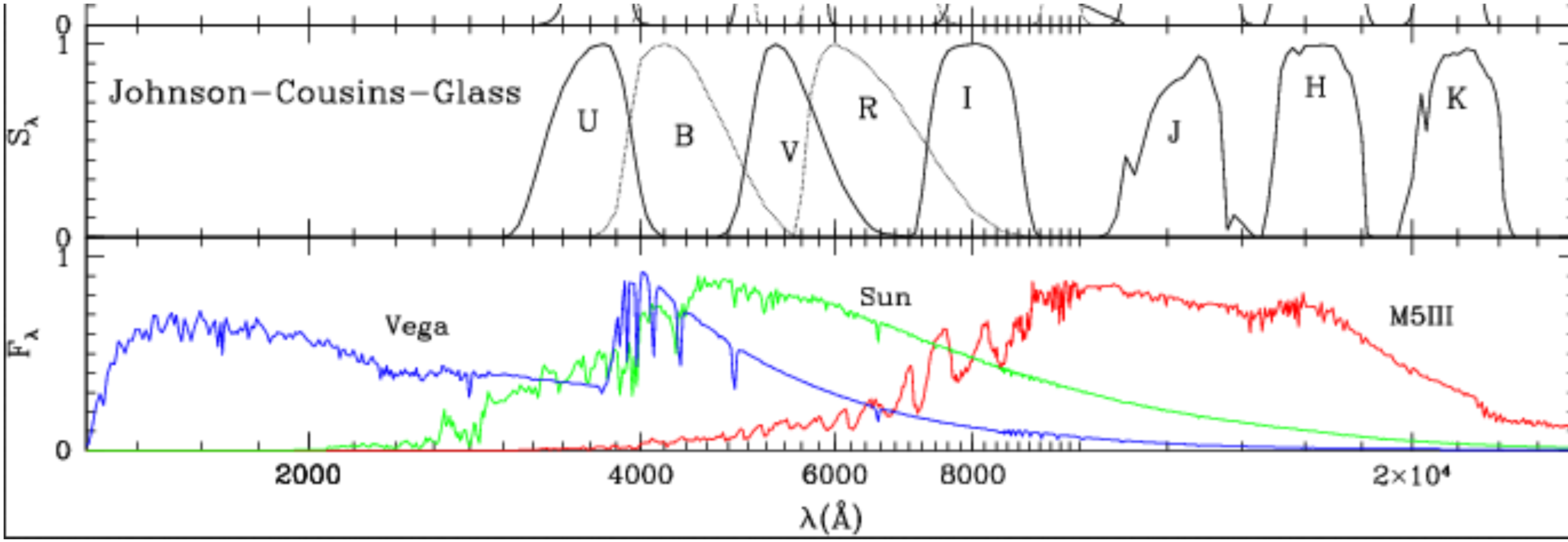
Photometric passbands



Greg Bothun U Oregon

Stars are (with some exceptions) well approximated by blackbodies. We use the ratio of brightness in different filters to measure temperature. The blackbody curves above are for 9000K (left) and 4500K (right) and the UBVRI filters are overplotted

UBVRI JHK filters

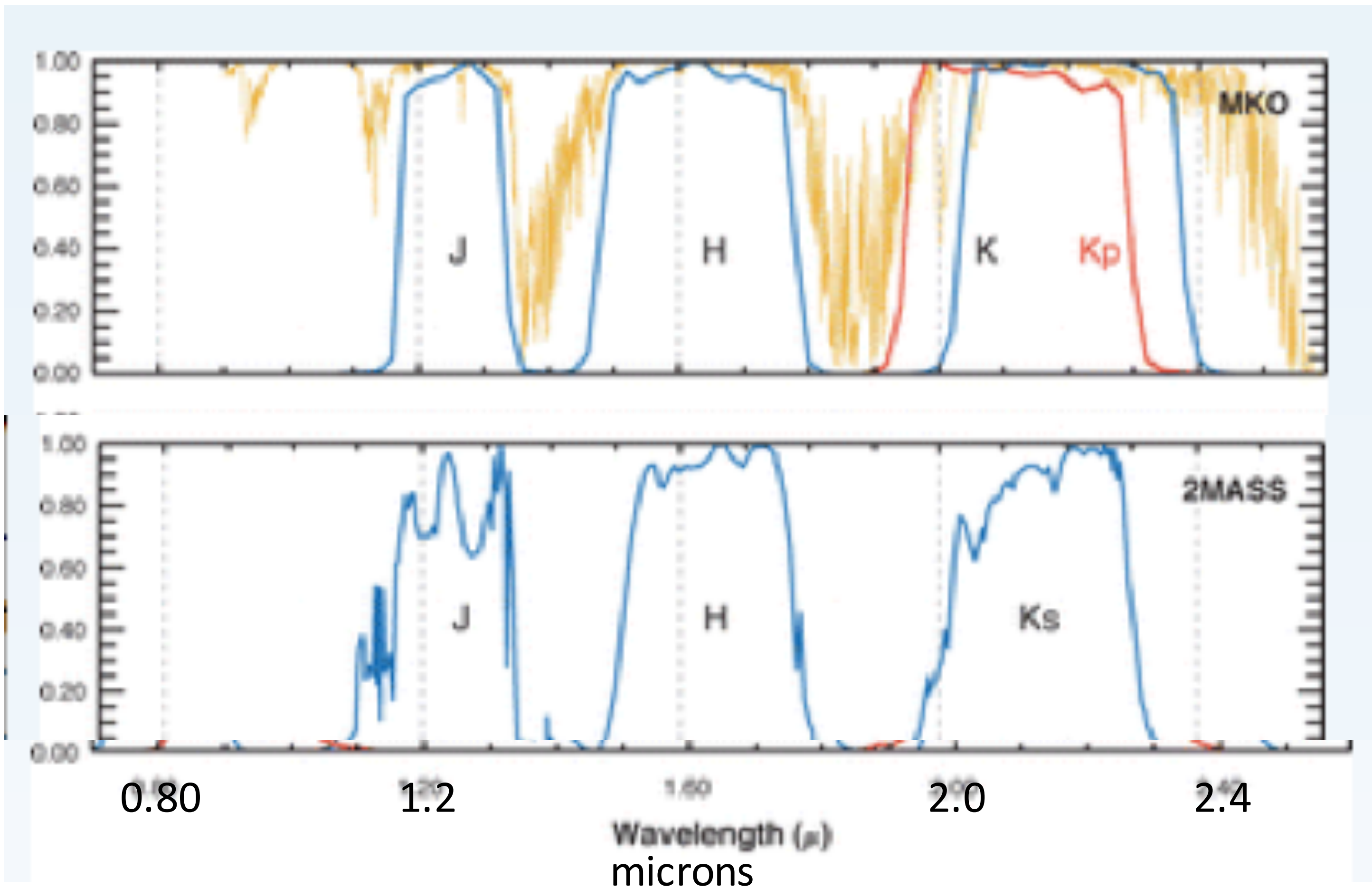


Leo Girardi

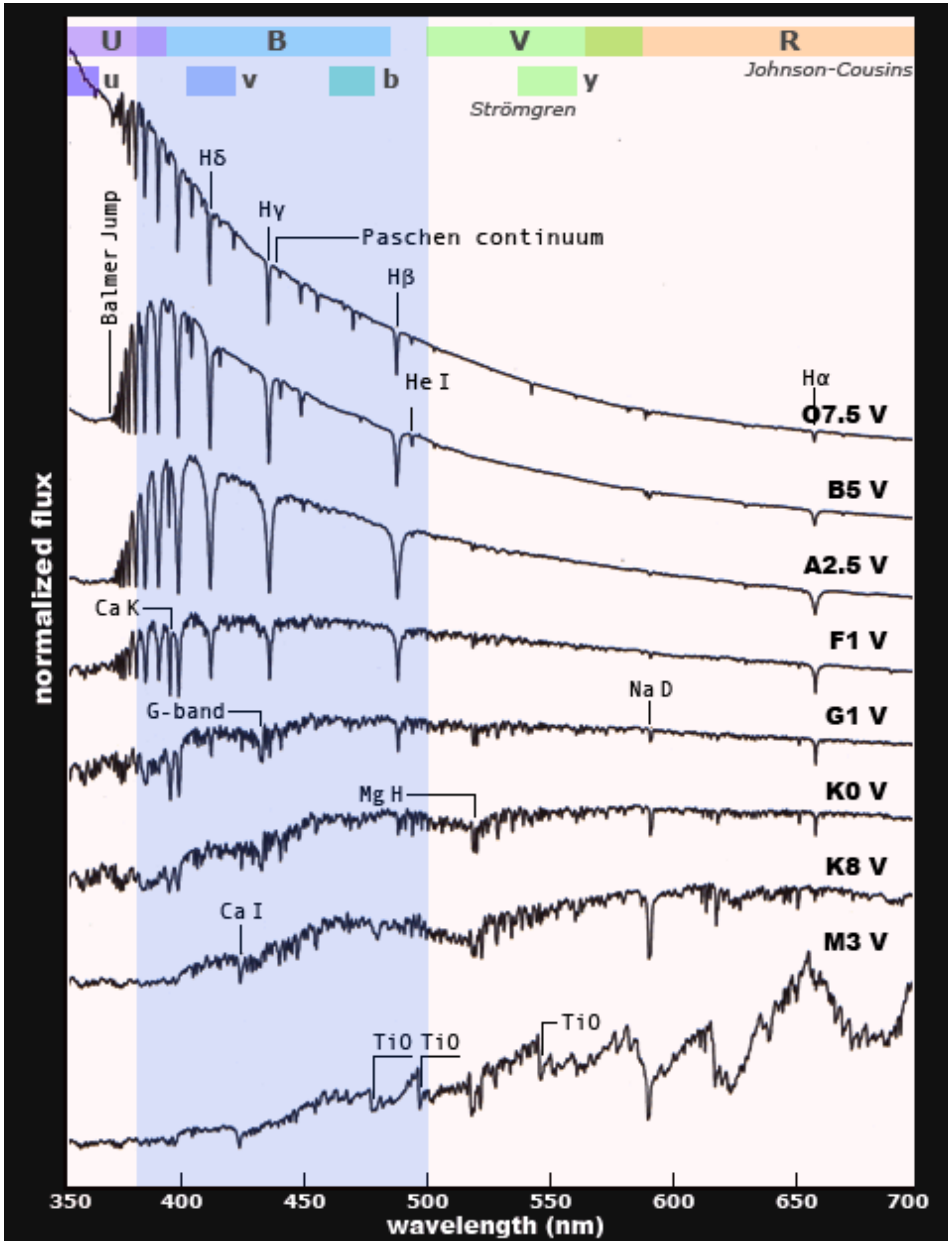
UBVRI are within the visual part of the spectrum, while J, H and K are from the near IR

Spectra of an A, G and M type star are also shown

JHK passbands: near infrared orange line is atmospheric transmission



2MASS all-sky survey has J,H and Ks

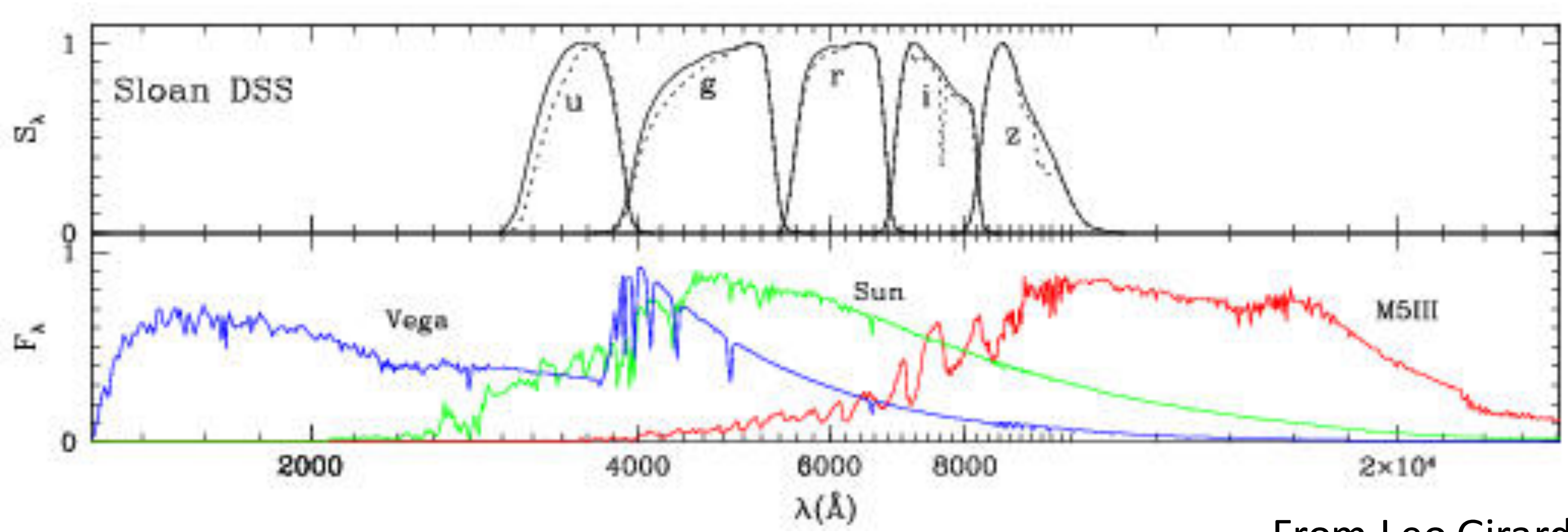


Review of Spectral Classification

Note:

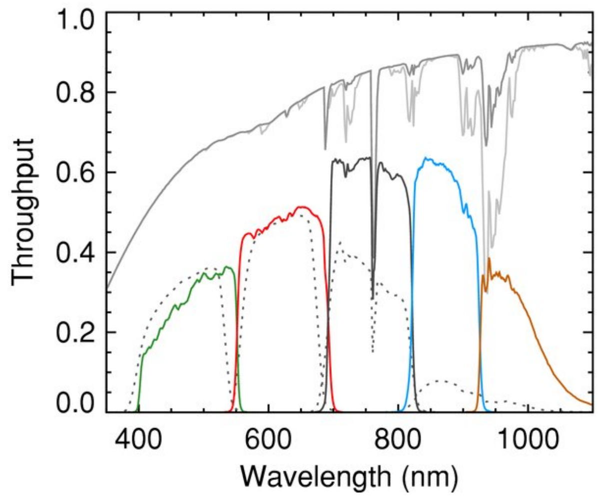
- He lines
- Balmer series and Balmer jump
- Metal lines from Ca,Na
- Molecular features such as G band (CH), MgH, and TiO

SDSS *ugriz* filters, Pan-STARRS filters



From Leo Girardi

SDSS covers 1/3 of sky with *ugriz* filters
Pan-STARRS covers 3/4 of sky with *grizy* filters, *g* band in particular is unlike SDSS one



Dust, extinction and reddening

When light from a star passes through dust, it suffers extinction which is different in different wavelengths, and stronger at blue wavelengths

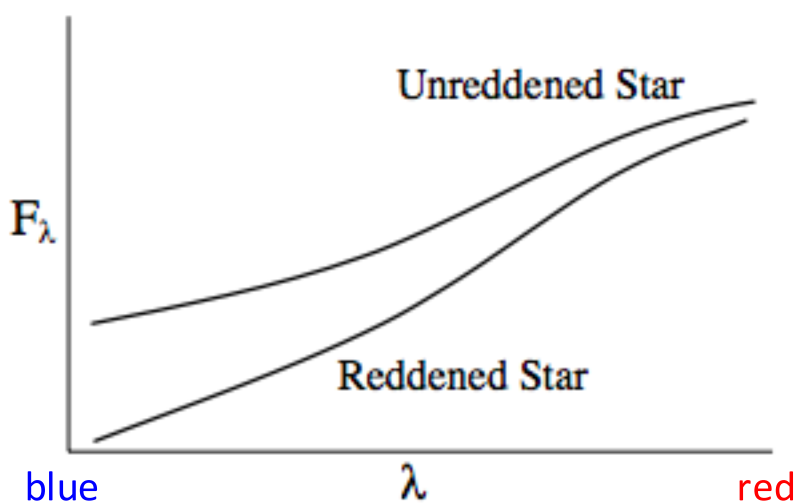


Figure IV-1: Effect of extinction on a stellar spectrum. Extinction is both a total diminution of the stellar light, and is wavelength-selective, in the sense that bluer wavelengths are more extinguished than red wavelengths.

Rick Pogge, OSU

We use the terms A_{B}, A_{V}, A_g and A_r to describe the amount of extinction in the B,V ,g and r passbands respectively

- We use the term E(B-V) (the reddening):

$E(B\text{-}V) = A_B - A_V$

- We also use the subscript 0 to show when a magnitude or color has been de-reddened

So $(B\text{-}V)_0 = B\text{-}V - E(B\text{-}V)$

$V_0 = V - A_V$

An important resource for reddening for field stars is Schlegel, Finkbeiner and Davis (1998)

They give estimates of E(B-V) for all over the sky and also (in the Appendix) have a table which gives formulae to convert E(B-V) to many other photometric systems

TABLE 6

RELATIVE EXTINCTION FOR SELECTED BANDPASSES

Filter	λ_{eff} (Å)	$A/A(V)$	$A/E(B-V)$	Filter	λ_{eff} Å	$A/A(V)$	$A/E(B-V)$
Landolt U	3372	1.664	5.434	Strömgren u	3502	1.602	5.231
Landolt B	4404	1.321	4.315	Strömgren b	4676	1.240	4.049
Landolt V	5428	1.015	3.315	Stromgren v	4127	1.394	4.552
Landolt R	6509	0.819	2.673	Strömgren β	4861	1.182	3.858
Landolt I	8090	0.594	1.940	Strömgren y	5479	1.004	3.277
CTIO U	3683	1.521	4.968	Sloan u'	3546	1.579	5.155
CTIO B.........	4393	1.324	4.325	Sloan g'	4925	1.161	3.793
CTIO V	5519	0.992	3.240	Sloan r'	6335	0.843	2.751
CTIO R.........	6602	0.807	2.634	Sloan i'	7799	0.639	2.086
CTIO I	8046	0.601	1.962	Sloan z'	9294	0.453	1.479
UKIRT J.......	12660	0.276	0.902	WFPC2 F300W......	3047	1.791	5.849
UKIRT H	16732	0.176	0.576	WFPC2 F450W......	4711	1.229	4.015
UKIRT K	22152	0.112	0.367	WFPC2 F555W......	5498	0.996	3.252
UKIRT L'	38079	0.047	0.153	WFPC2 F606W......	6042	0.885	2.889
Gunn g	5244	1.065	3.476	WFPC2 F702W......	7068	0.746	2.435
Gunn r..........	6707	0.793	2.590	WFPC2 F814W......	8066	0.597	1.948
Gunn i..........	7985	0.610	1.991	DSS-II g	4814	1.197	3.907
Gunn z..........	9055	0.472	1.540	DSS-II r	6571	0.811	2.649
Spinrad R_S......	6993	0.755	2.467	DSS-II i..............	8183	0.580	1.893
APM b_J.........	4690	1.236	4.035				

NOTE.—Magnitudes of extinction evaluated in different passbands using the $R_V = 3.1$ extinction laws of Cardelli et al. 1989 and O'Donnell 1994. The final column normalizes the extinction to photoelectric measurements of $E(B-V)$.

From Schlegel et al 1998

For ugriz use Sloan u' etc; Landolt UBVRI is the most common UVBRI system