An Introduction to Astronomy
Presentation II
Fall 2018
Physics Department –SUT
Shant Baghram

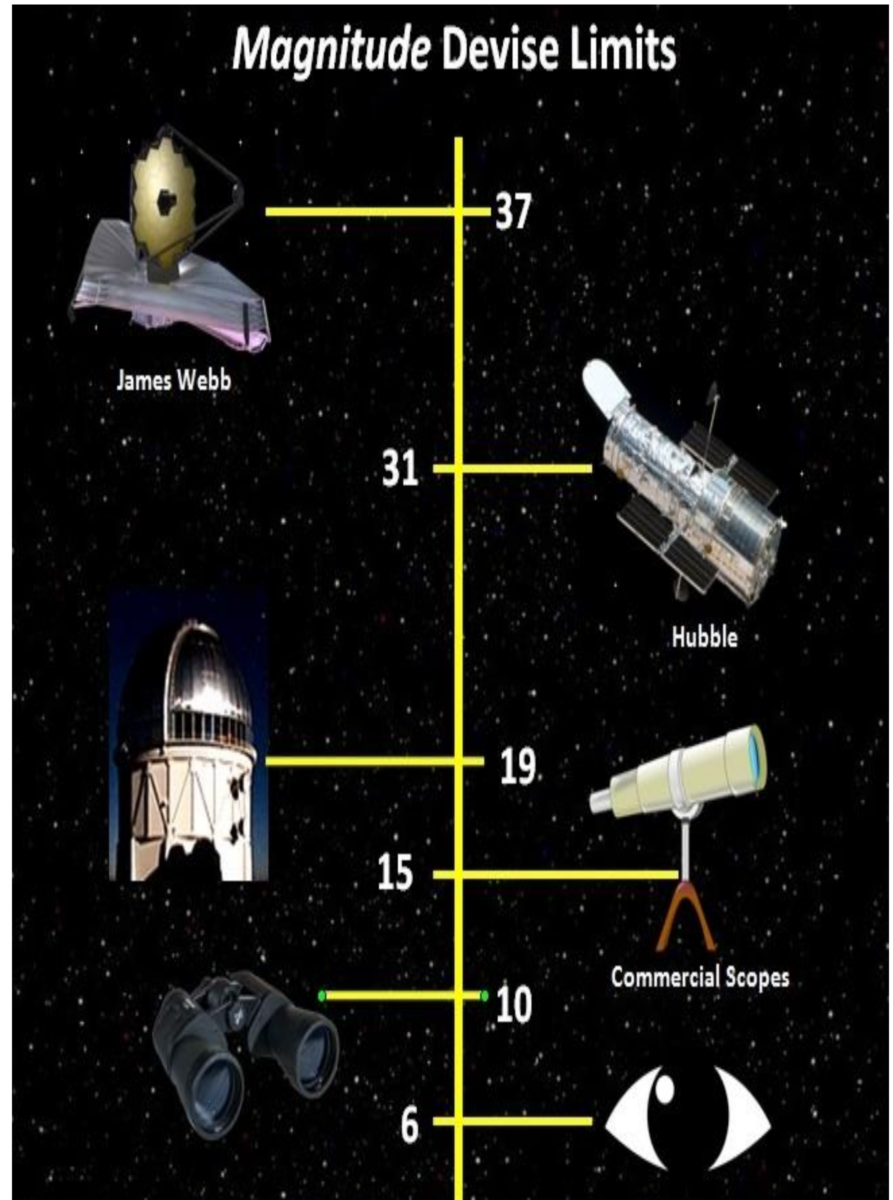
Claude Monet, Impression soleil levant, 1872
The Starry Night by Vincent van Gogh 1889

Star Magnitude Story - Hipparchus,

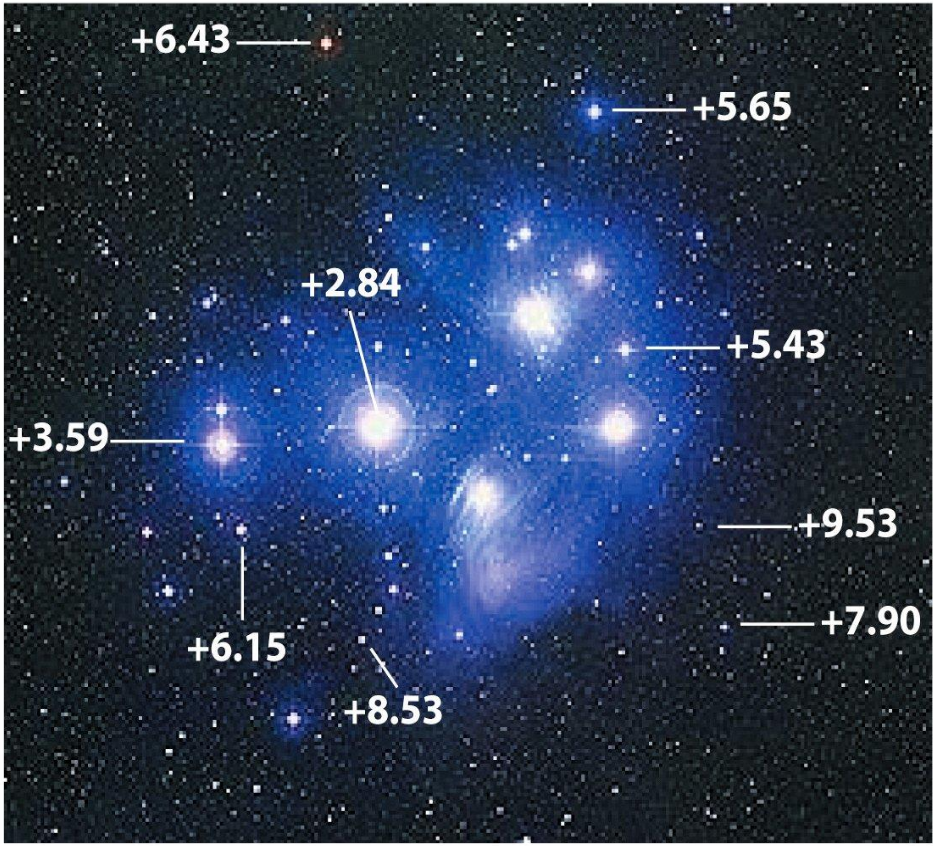
Magnitude	Appearence	Random Examples
One		Aldebaran Spica Antares Pollux
Two		Hamal Algieba Deneb Kaitos Saiph
Three		Cor Caroli Tau Ceti Epsilon Eridani Mu Herculis
Four		Alpha Cancri Epsilon Indi Zeta Tucanae Gamma Pavonis
Five		61 Cygni A 61 Ursae Majoris 41 G. Arae Chi Draconis B
Six		61 Cygni B HD 50281 Groombridge 1830 Fomalhaut B

Log scale of magnitude

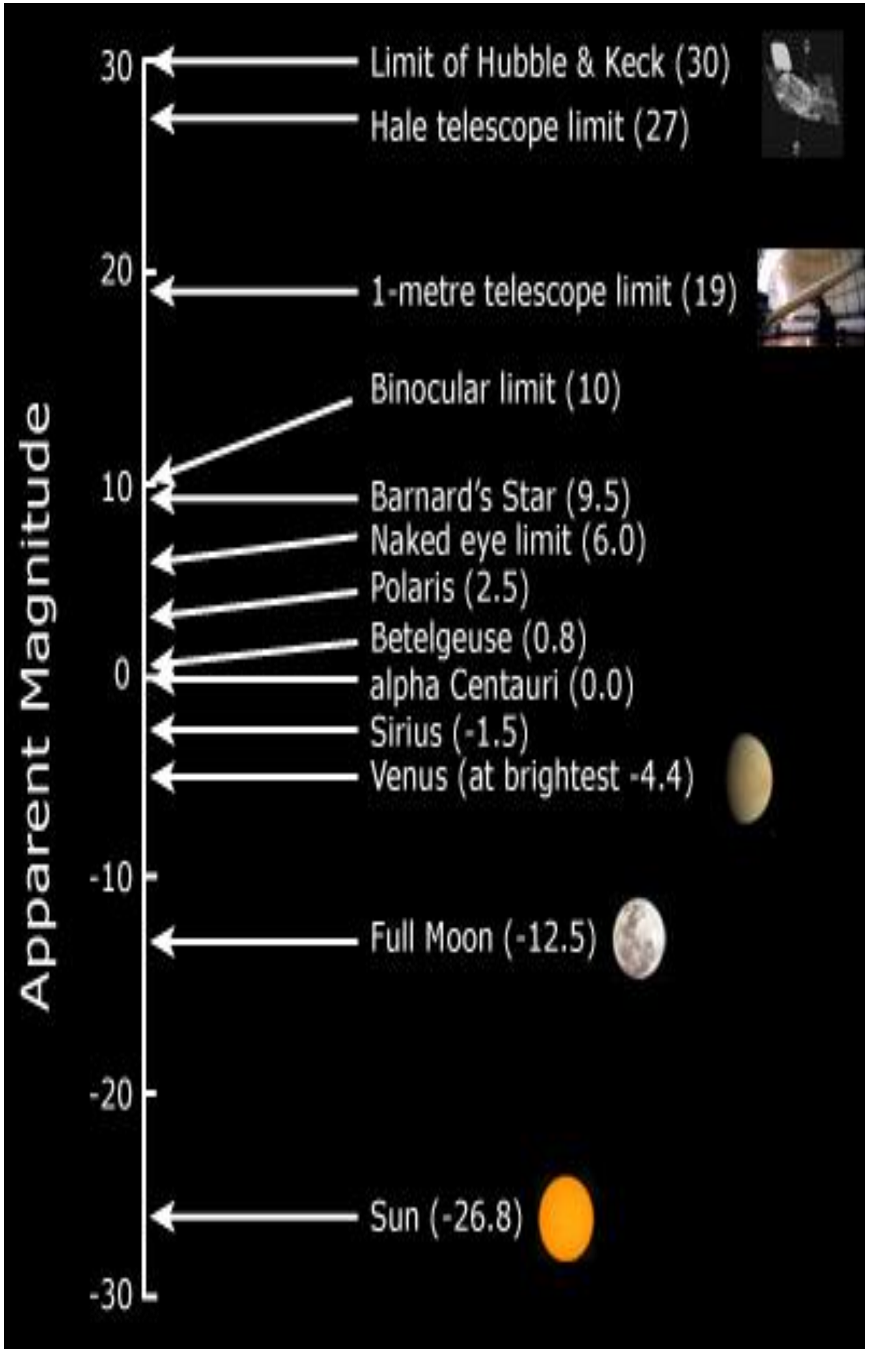
Magnitude	Brightness Comparison to a 6th Magnitude Star	Logarithmic scale
One	100 x	2.51 x 2.51 x 2.51 x 2.51 x 2.51
Two	39.8 x	2.51 x 2.51 x 2.51 x 2.51
Three	15.8 x	2.51 x 2.51 x 2.51
Four	6.3 x	2.51 x 2.51
Five	2.51 x	2.51 x
Six	—	—



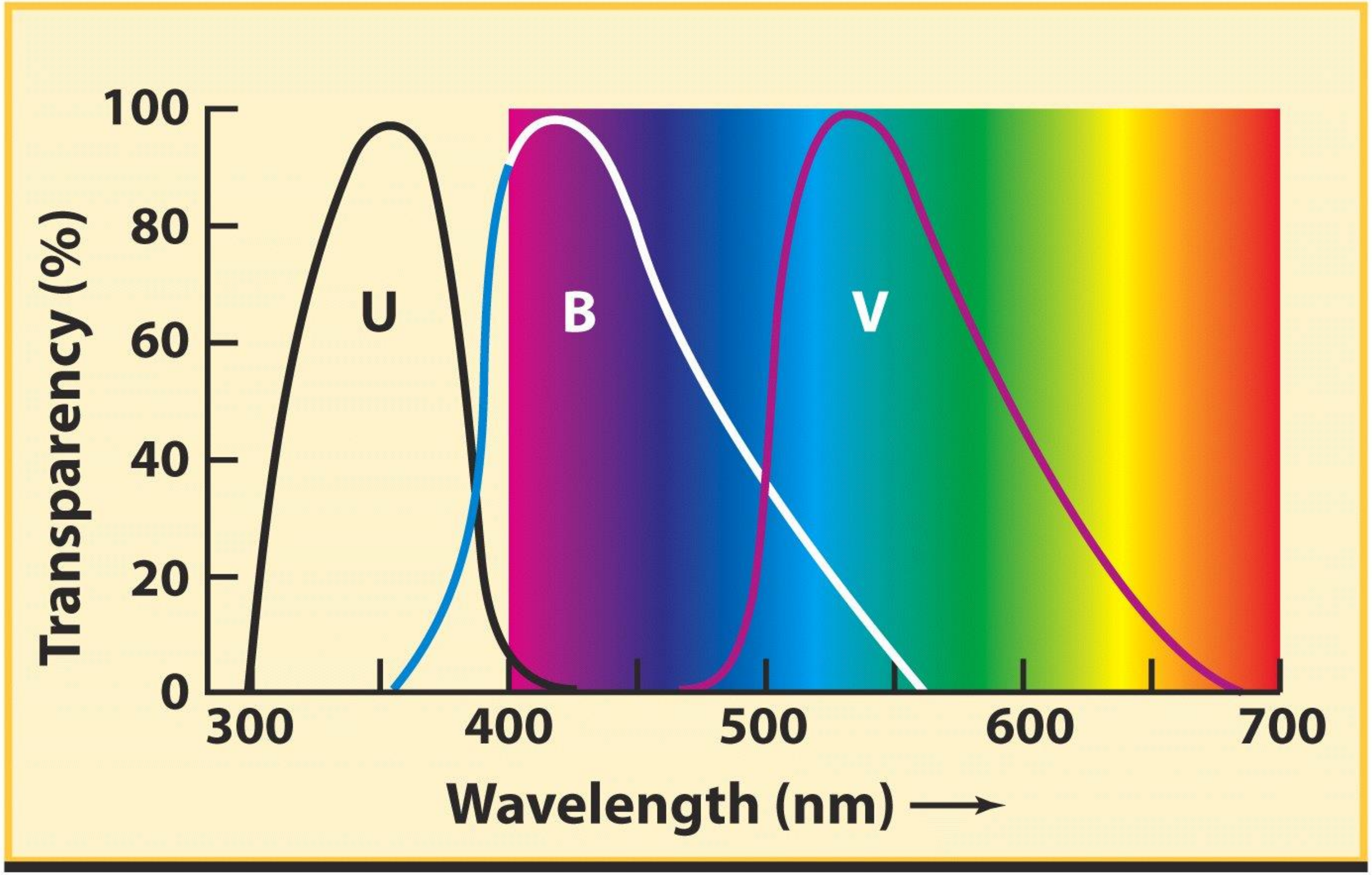
Apparent Magnitude



Apparent magnitudes of stars in the Pleiades

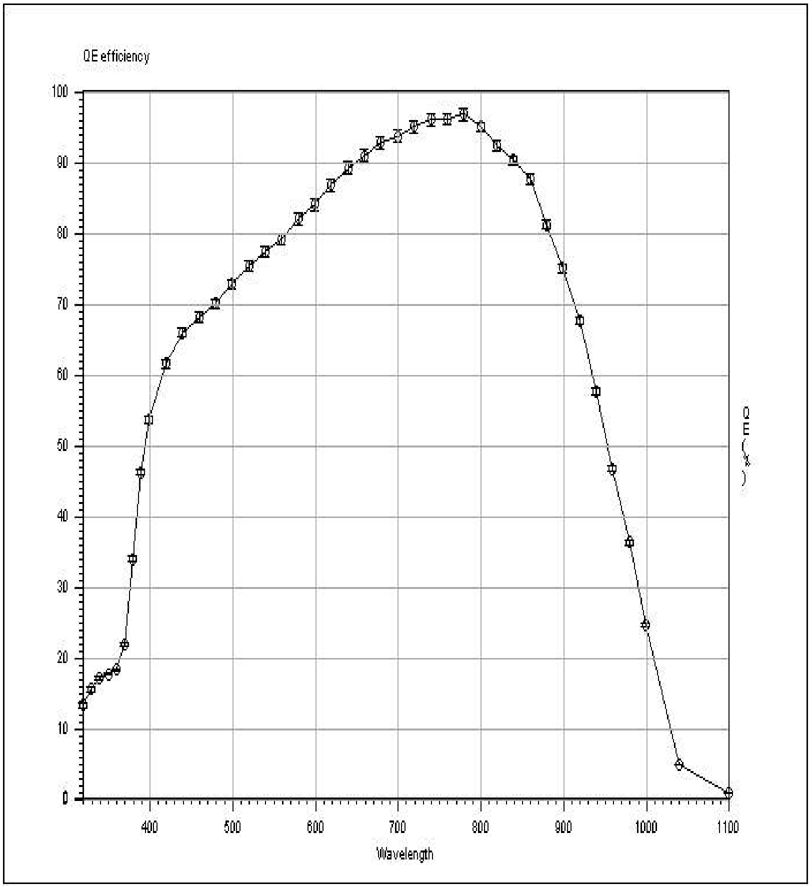


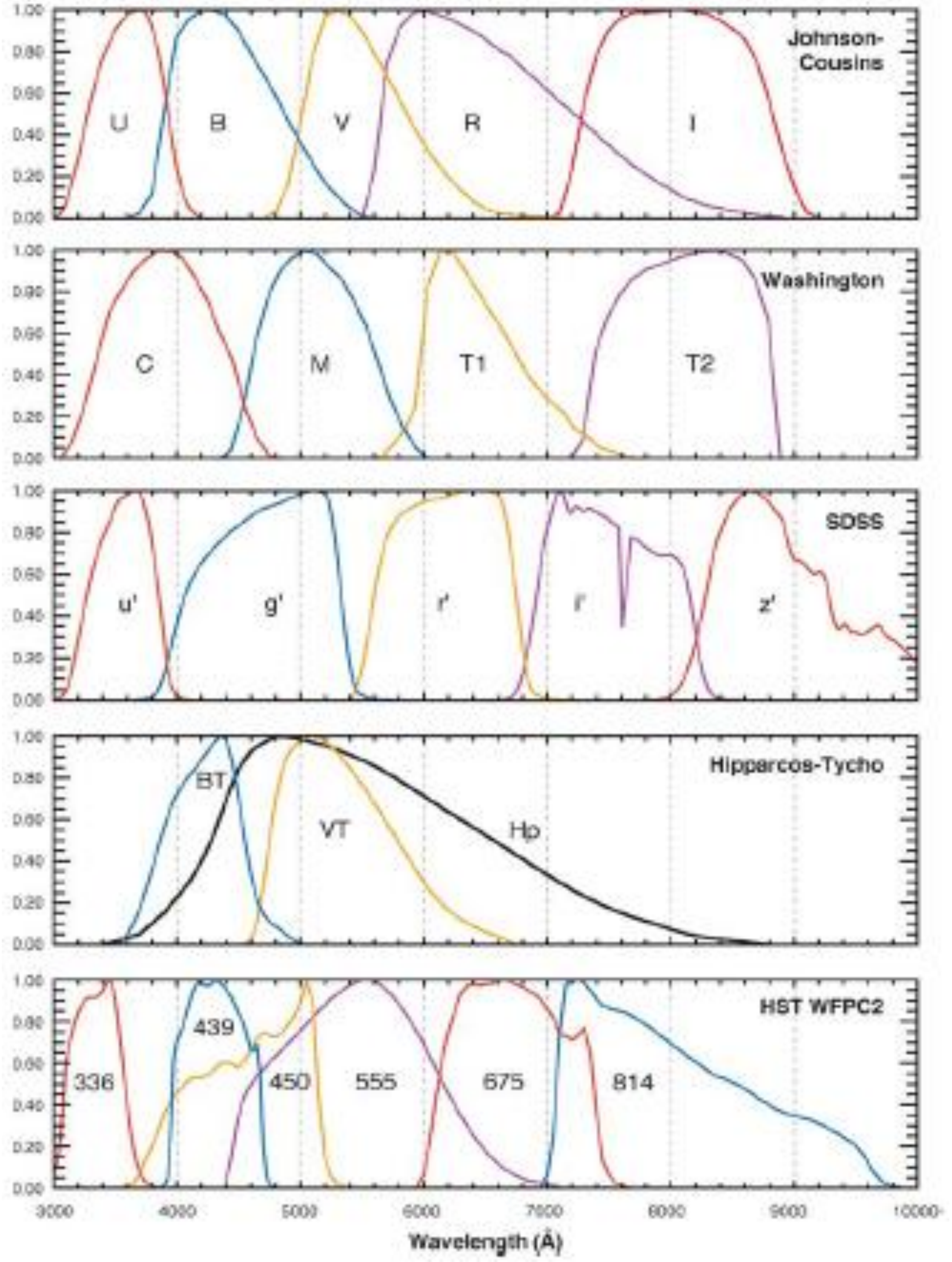
Photometry and Color Ratios



- Photometry measures the apparent brightness of a star
- The color ratios of a star are the ratios of brightness values obtained through different standard filters, such as the U, B, and V filters
- The color ratios are a measure of the star's surface temperature

Filters


QE efficiency
Wavelength
QE(%)


Johnson-Cousins
U
B
V
R
I
Washington
C
M
T1
T2
SDSS
u'
g'
r'
i'
z'
Hipparcos-Tycho
BT
VT
Hp
HST WFPC2
336
439
450
555
675
814
Wavelength (Å)

Exposure time

ISAAC NEWTON GROUP OF TELESCOPES

LA PALMA

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Home > Astronomy > *Exposure Time Calculator*

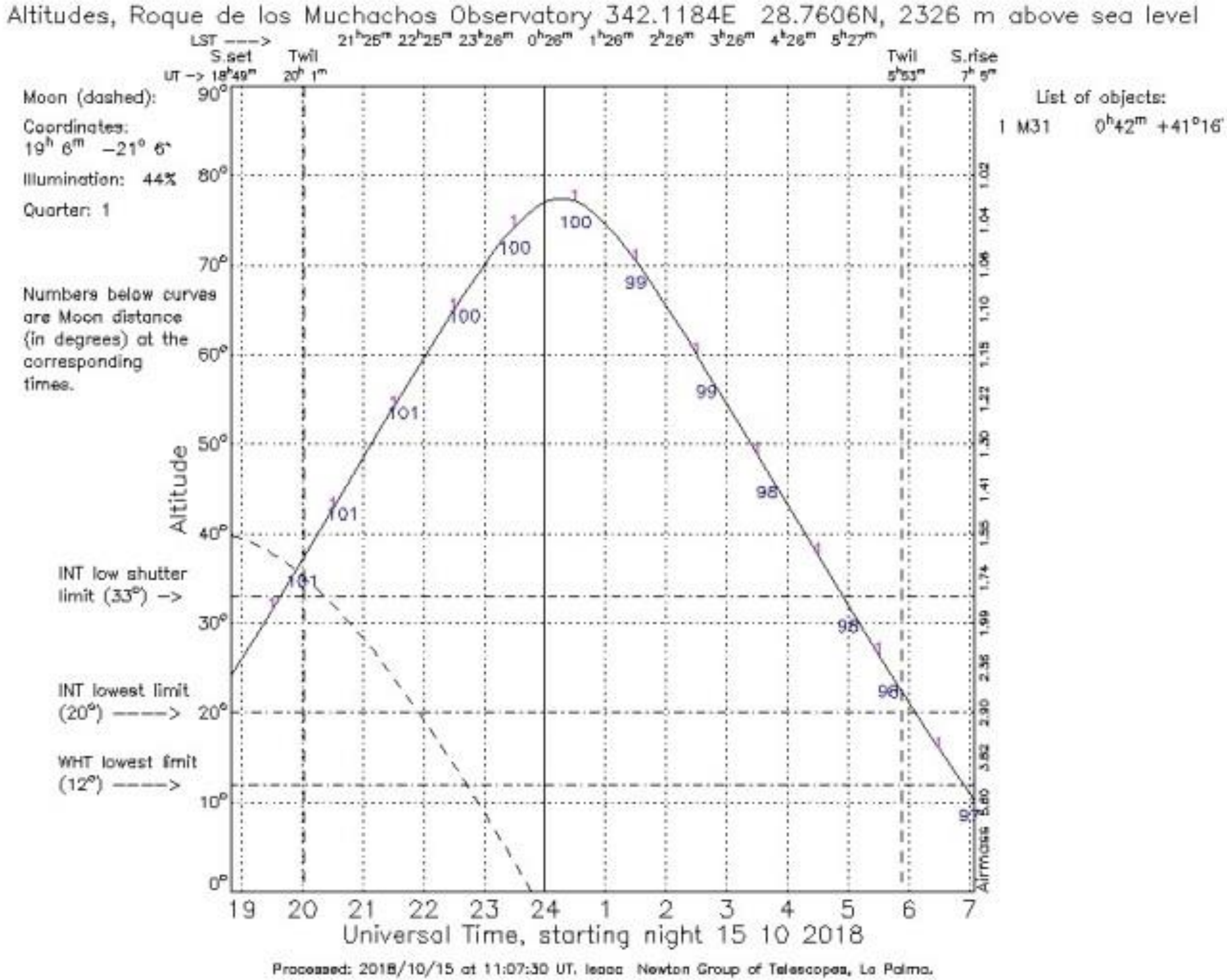
Exposure Time Calculator – SIGNAL

SIGNAL calculates the number of object and sky photons which will be detected during an imaging or spectroscopic exposure of a point or extended source with one of the common-user instruments of the Isaac Newton Group of Telescopes. For LIRIS, please use IAC's LIRIS S:N calculator.

Instrument	Instrument: WHT ISIS Detector: EEV12 2048*4100 (for ISIS) Grating: NONE Band: V (5500A) Bandwidth: 0 Slit width, or fibre or lenslet diameter (arcsec): 1.00 Exposure time (sec): 100
Object	Object: Point Apparent magnitude: 20 (/arcsec^2 if extended)
Sky	Seeing (FWHM in arcsec): 1.00 Airmass: 1.00 Extinction(mag/airmass): 0 Sky brightness: (mag/arcsec^2) D (D, G or B for typical dark, grey or bright; or 0 for darkest sky on La Palma)
Output format	Format: Text Graph: S/N vs Exposure time from 50 to 200 Multiple curves Parameter: None Values: Curve 1 Curve 2 Curve 3

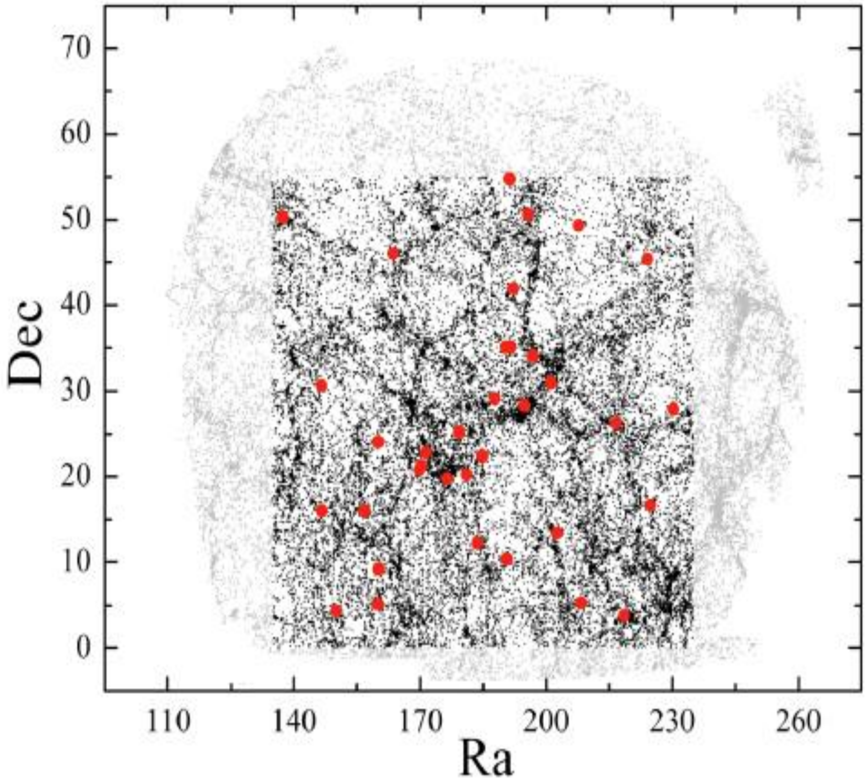
CLEAR CALCULATE

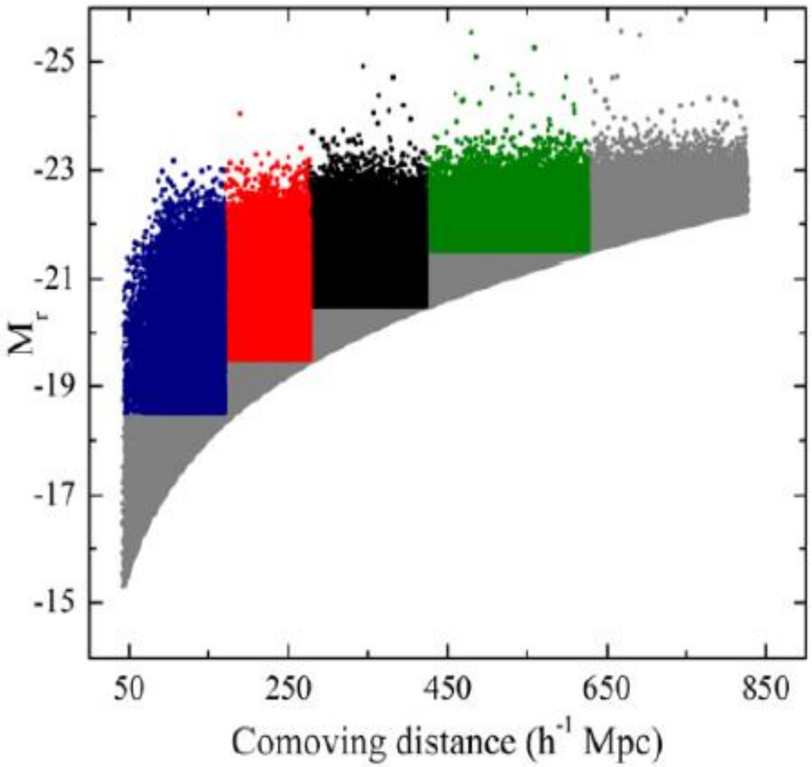
Optional retrieving / saving of parameters input to SIGNAL	Retrieve *Name of previously-saved parameter set.* Save *Name for saved parameter set (if left blank, name is generated automatically).* Comments to accompany saved parameters:



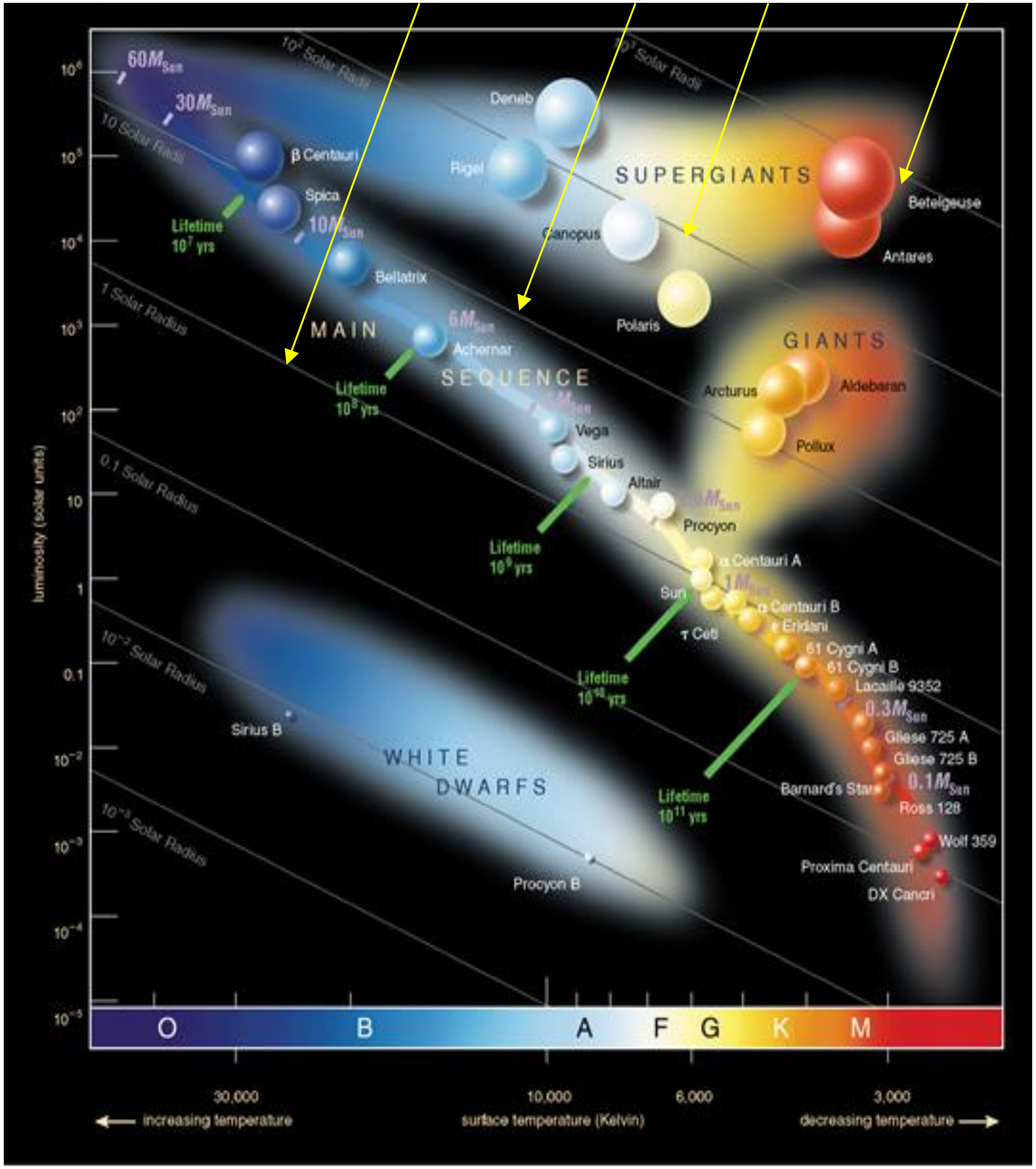
Altitudes, Roque de los Muchachos Observatory 342.1184E 28.7606N, 2326 m above sea level
LST --->
21h25m 22h25m 23h26m 0h26m 1h26m 2h26m 3h26m 4h26m 5h27m
S.set
Twil
UT -> 18h49m
20h 1m
Twil
5h53m
S.rise
7h 5m
Moon (dashed):
Coordinates:
19h 6m -21° 6'
Illumination: 44%
Quarter: 1
Numbers below curves are Moon distance (in degrees) at the corresponding times.
INT low shutter limit (33°) ->
INT lowest limit (20°) ---->
WHT lowest limit (12°) ---->
List of objects:
1 M31 0h42m +41°16'
Altitude
Airmass
Universal Time, starting night 15 10 2018
Processed: 2018/10/15 at 11:07:30 UT. Isaac Newton Group of Telescopes, La Palma.

Data for structures and Sne – Volume limited





Sizes scale 1 R_{sun} 10 R_{sun} 100 R_{sun} 1000 R_{sun}

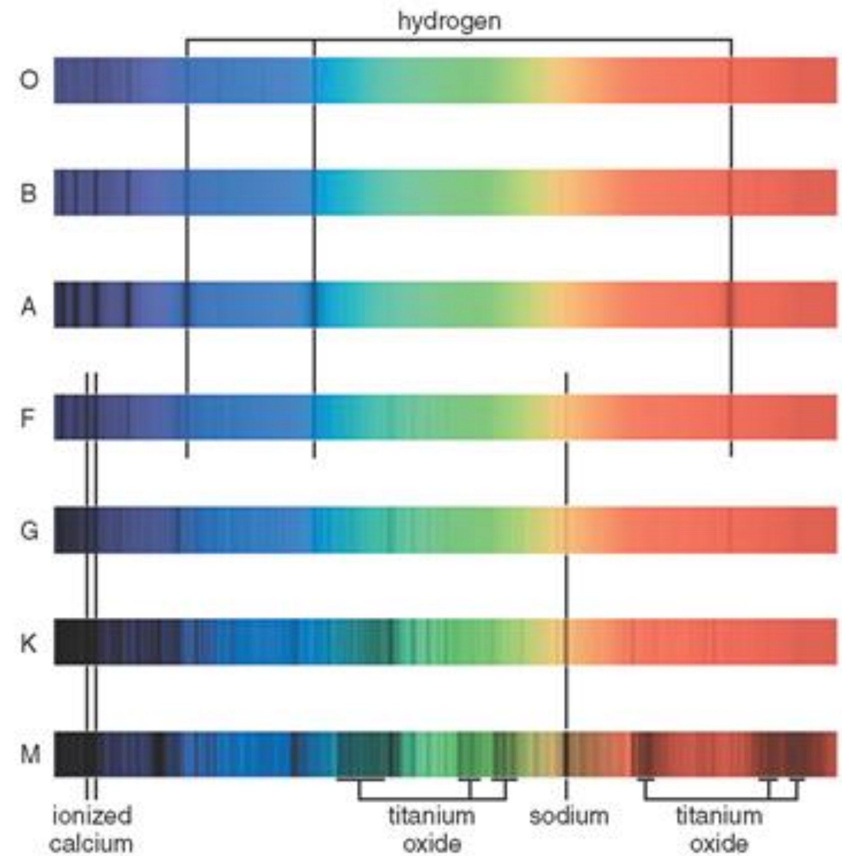


Spectral Type of Stars

TABLE 11.1 *The Spectral Sequence*

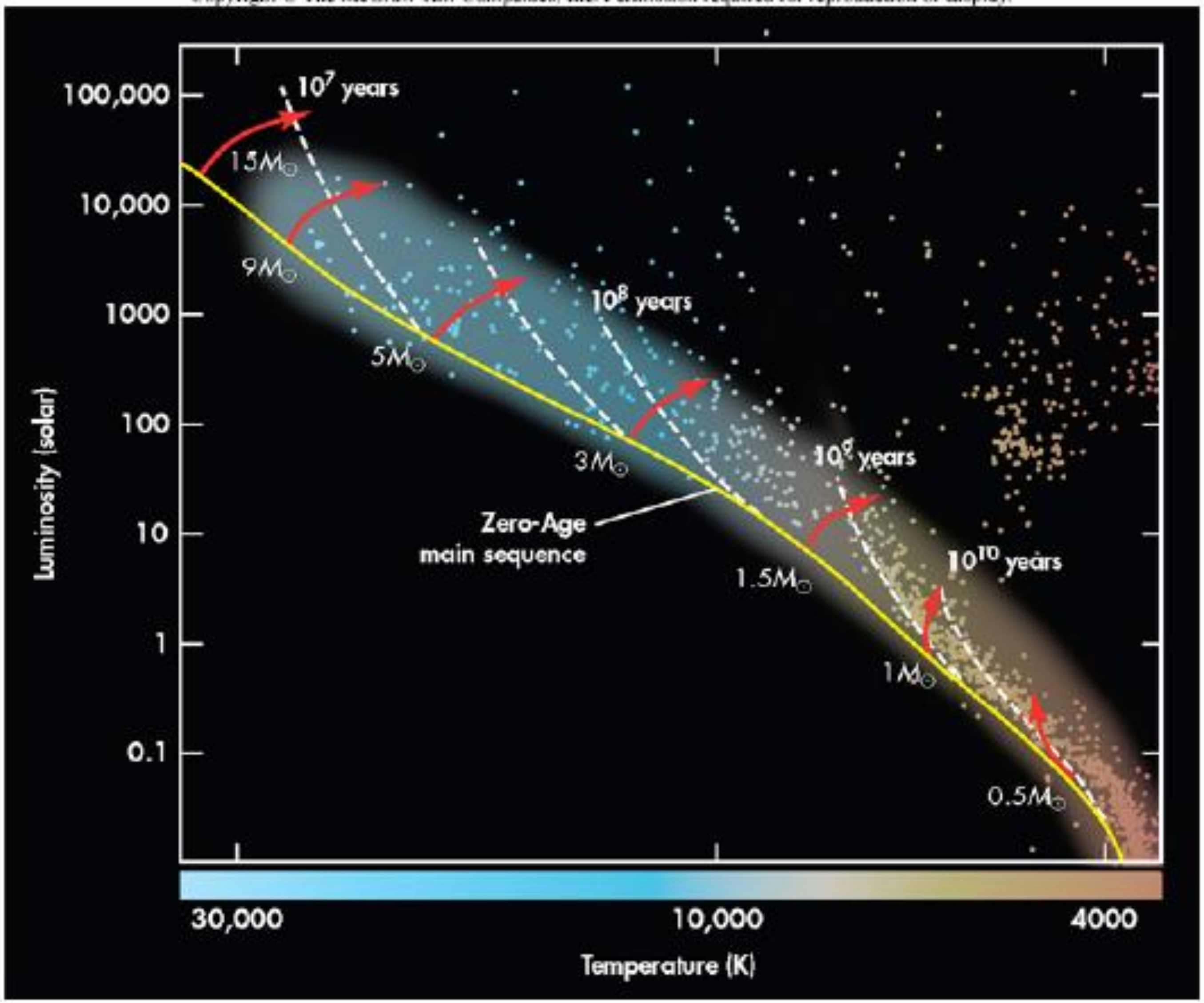
Spectral Type	*Example(s)*	*Temperature Range*	*Key Absorption Line Features*	*Brightest Wavelength (color)*
O	Stars of Orion's Belt	7 30,000 K	Lines of ionized helium, weak hydrogen lines	6 97 nm (ultraviolet)*
B	Rigel	30,000 K–10,000 K	Lines of neutral helium, moderate hydrogen lines	97–290 nm (ultraviolet)*
A	Sirius	10,000 K–7,500 K	Very strong hydrogen lines	290–390 nm (violet)*
F	Polaris	7,500 K–6,000 K	Moderate hydrogen lines, moderate lines of ionized calcium	390–480 nm (blue)*
G	Sun, Alpha Centauri A	6,000 K–5,000 K	Weak hydrogen lines, strong lines of ionized calcium	480–580 nm (yellow)
K	Arcturus	5,000 K–3,500 K	Lines of neutral and singly ionized metals, some molecules	580–830 nm (red)
M	Betelgeuse, Proxima Centauri	6 3,500 K	Molecular lines strong	7 830 nm (infrared)

Typical Spectrum

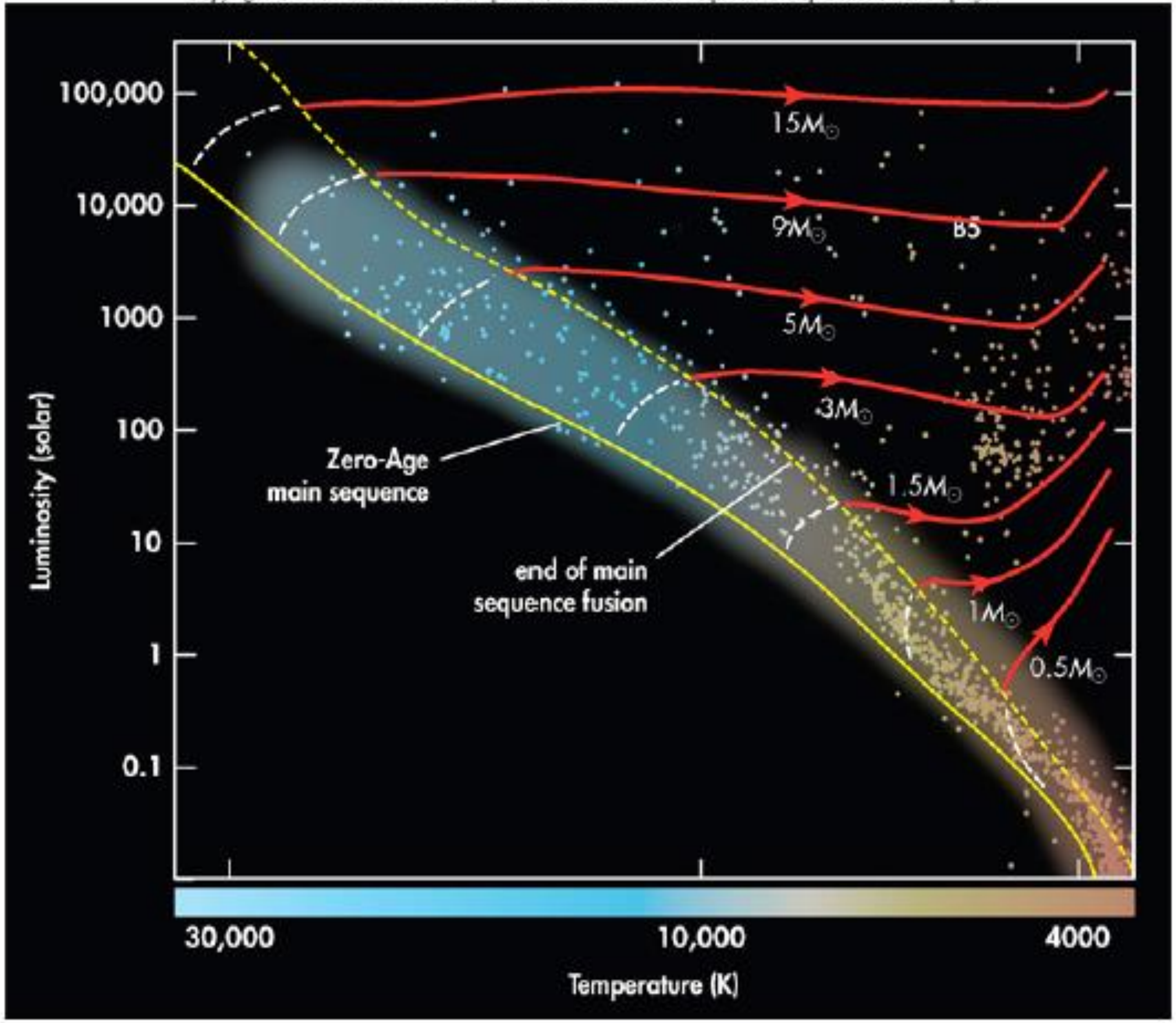


* All stars above 6,000 K look more or less white to the human eye because they emit plenty of radiation at all visible wavelengths.

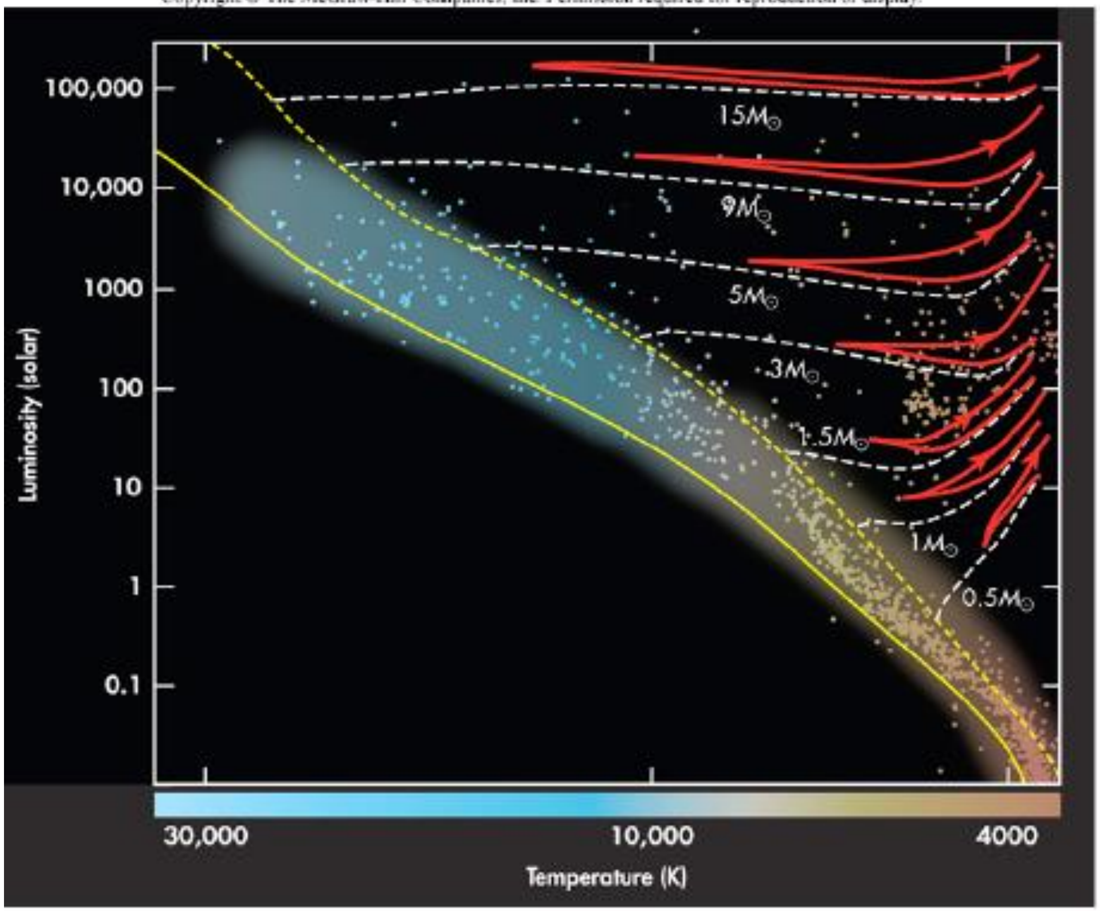
Stellar Evolution on the Main Sequence



Evolutionary tracks of giant stars

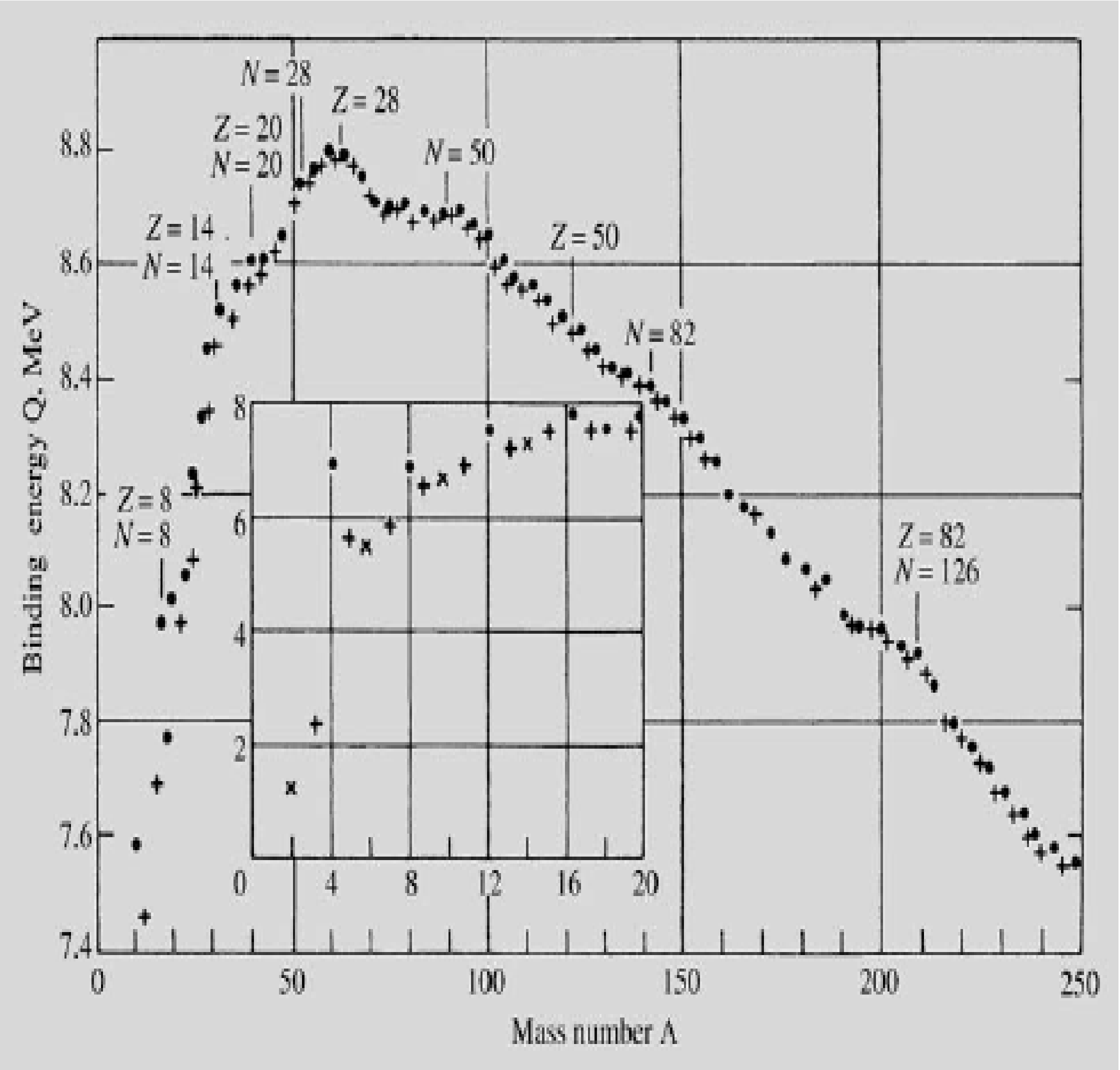


A (temporary) new lease on life



- The triple-alpha process provides a new energy source for giant stars
- Their temperatures increase temporarily, until the helium runs out
- The stars cool, and expand once again
- The end is near…

Fig. 10.4. The nuclear binding energy per nucleon as a function of the atomic weight. Among isotopes with the same atomic weight the one with the largest binding energy is shown. The points correspond to nuclei with even proton and neutron numbers, the crosses to nuclei with odd mass numbers. Preston, M.A. (1962): *Physics of the Nucleus* (Addison-Wesley Publishing Company, Inc., Reading, Mass.)



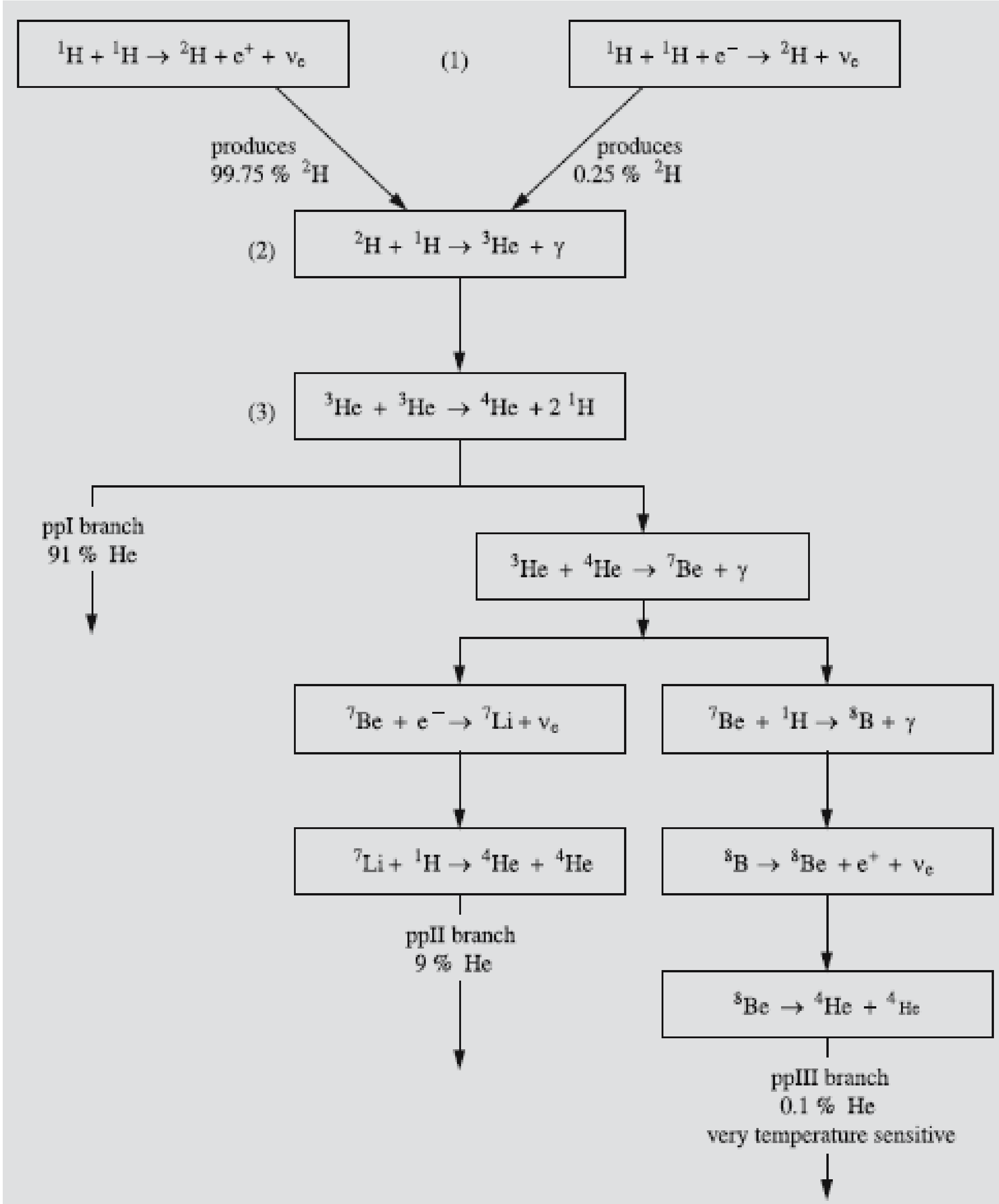


Fig. 10.5. The proton–proton chain. In the ppI branch, four protons are transformed into one helium nucleus, two positrons, two neutrinos and radiation. The relative weights of the reactions are given for conditions in the Sun. The pp chain is the most important energy source in stars with mass below 1.5 $M_\odot$

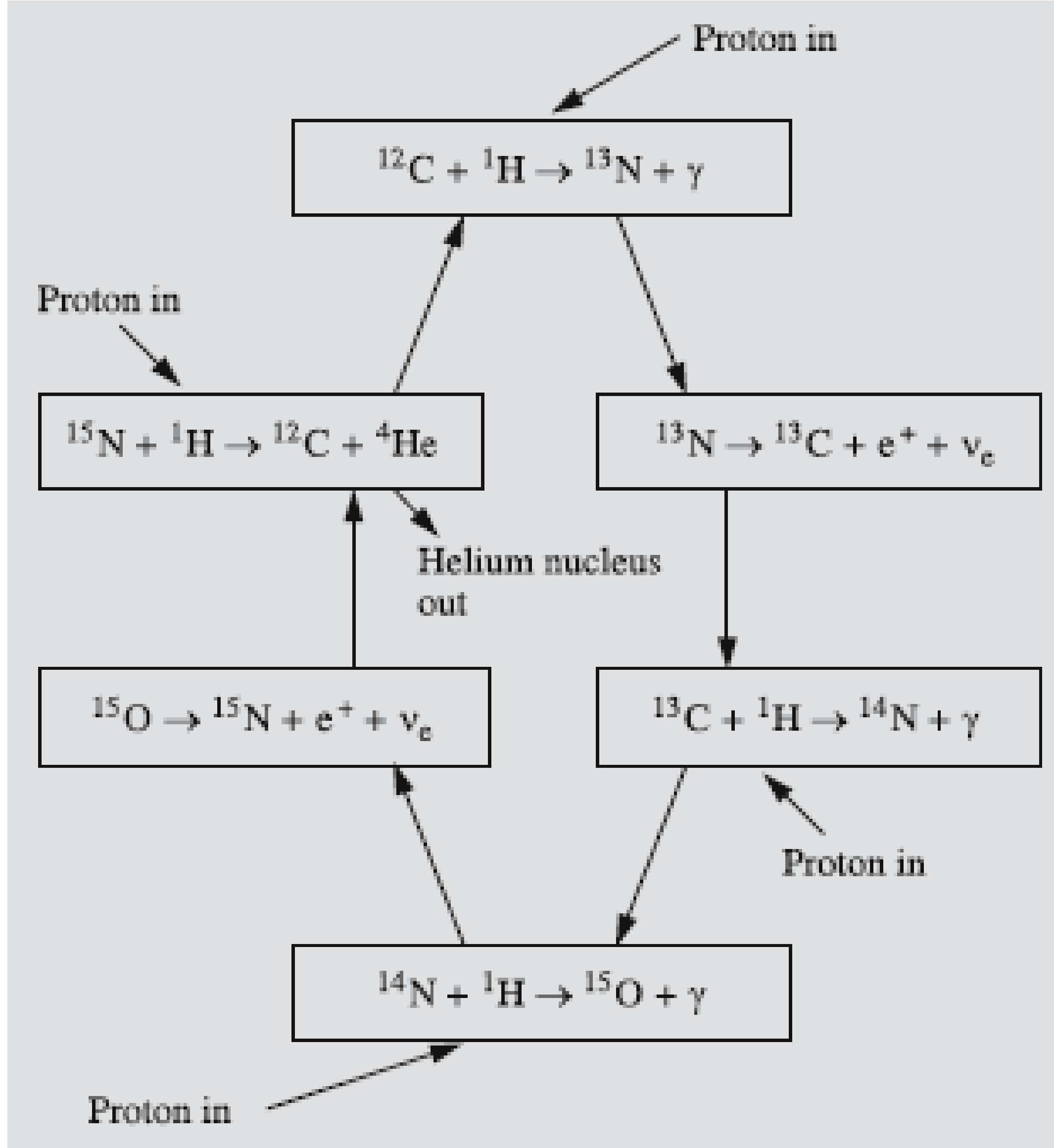
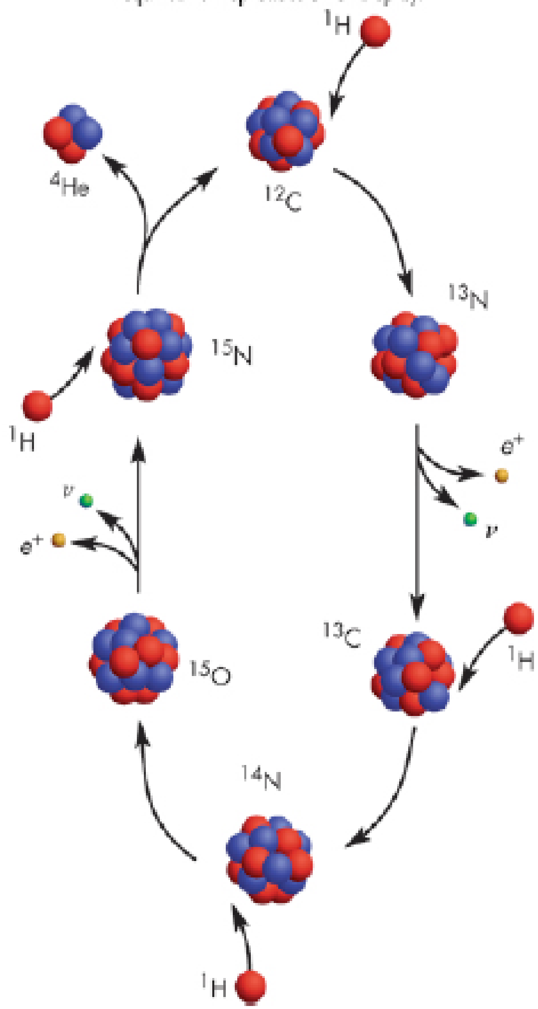


Fig. 10.6. The CNO cycle is catalysed by ^{12}C. It transforms four protons into a helium nucleus, two positrons, two neutrinos and radiation. It is the dominant energy source for stars more massive than $1.5\ M_{\odot}$

The CNO cycle



- Low-mass stars rely on the proton-proton cycle for their internal energy
- Higher mass stars have much higher internal temperatures (20 million K!), so another fusion process dominates
  - An interaction involving Carbon, Nitrogen and Oxygen absorbs protons and releases helium nuclei
  - Roughly the same energy released per interaction as in the proton-proton cycle. But it runs much faster!
  - The C-N-O cycle!