

## U3A-GROUP ASTRONOMY (27-1-2006)

### STARS

Universe appears to be very stable and unchanging. But there is a lot going on:

- Stars have life-cycles: they are born and die;
- the Universe expands, everything moves away.

Stars show a large variation in:

\* *size* – from >Jupiter's orbit to Earth-size

\* *mass* – from 100 x the mass of the Sun to c. 1/12 of the Sun

\* *density* – from 100,000 smaller to 1 mln times larger than the density of water

\* *colour* – brown and white dwarves, red giants etc. In general: blue = hot, red = cool .

Units to measure sizes of/distances between objects in the sky:

*Arc minutes, -seconds* (1/60 or 1/3600 of a degree)

Units to measure brightness as seen from Earth:

*Magnitude* – logarithmic scale; the higher the magnitude, the lower the brightness.

Naked eye can see stars of magnitudes 1-6; brighter objects have negative magnitudes:

Moon: -12, Sun: -27. Large telescopes can 'see' magnitudes up to + 30 (=very faint).

### The life-cycle of stars

Sometimes ball-shaped concentrations develop in nebulae: *protostars*. Ever more gas is attracted and pulled inwards → higher temperatures and pressure in the star's core. When temperatures reach 10 mln °C, nuclear fusion starts: H → He + energy. Then for billions of years there is a balance between gravitational forces (inwards) and produced energy (outwards). Balance is finally disturbed when all the H has been used. The core contracts and gets hotter. As a result the H in the shell around the core starts to burn: the star expands and becomes a *red giant*. After that it shrinks to a *white dwarf*. If it has an extremely large mass, it can develop into a *black hole* (enormously dense, escape velocity > 300,000 km/sec → nothing escapes from it, not even light). Black holes are known thanks to their gravitational pull on neighbouring stars.

Sometimes a dying star explodes: *supernova*. For a short period of time temperatures of 100 mln.° C or more develop. Very important, for only then nuclear fusion can lead to the formation of the heavier elements (= c.1 % of all matter in the Universe; all the rest is H and He).

The bigger a star, the shorter its life (nuclear fusion goes much faster in big stars).

### Spaceflight News

Mars Rovers Spirit and Opportunity celebrate their second anniversary this month. They were expected to operate for c. 3 months and so far have traversed 12 kilometres.

Spacecraft New Horizons was launched on 19-1, to study Pluto and some objects in the Kuiper Belt. It will reach Pluto in 2015, thanks to an increase of speed when it will travel past Jupiter in 2007 ('gravitational slingshot').

Spacecraft Stardust landed safely in the Utah desert on 15-1. It was launched in 1999 to visit Comet Wild 2. It got there in 2004, took pictures and collected dust from the comet's tail. Its return capsule contained over a million particles, which will be studied by astronomers all over the world. It is material that remained almost unaltered since the Solar System was formed c. 4.6 billion years ago.