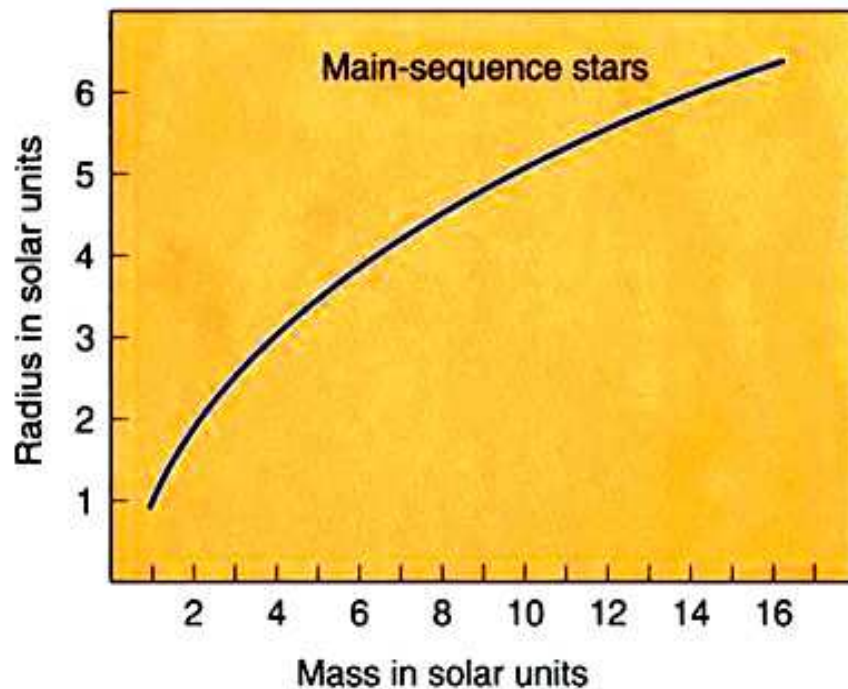


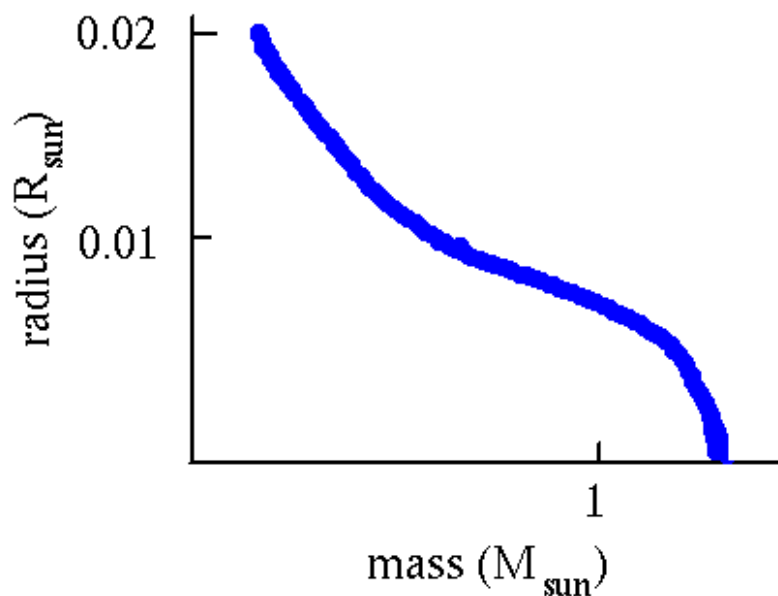
DEGENERATE MATTER HAS UNUSUAL PROPERTIES:

- 1) THE PRESSURE DOES NOT DEPEND ON TEMPERATURE (LIKE IN THE NORMAL MATTER/GAS) BUT ONLY ON DENSITY (IT INCREASES WITH INCREASING DENSITY).
- 2) LARGER MASS HAS SMALLER RADIUS/SIZE.

NORMAL
MATTER
(E.G. A MAIN
SEQUENCE
STAR)



DEGENERATE
MATTER (E.G.
A WHITE DWARF)



CHANDRASEKHAR LIMIT: THE MAXIMUM
MASS OF A DEGENERATE OBJECT/BODY.

FOR A WHITE DWARF IT IS $1.4 M_{\odot}$

THE RANGE OF THE OBSERVED RADII OF WHITE
DWARFS IS:

$$0.008 R_{\odot} - 0.02 R_{\odot}$$

(THE RADIUS OF THE EARTH IS $0.009 R_{\odot}$).

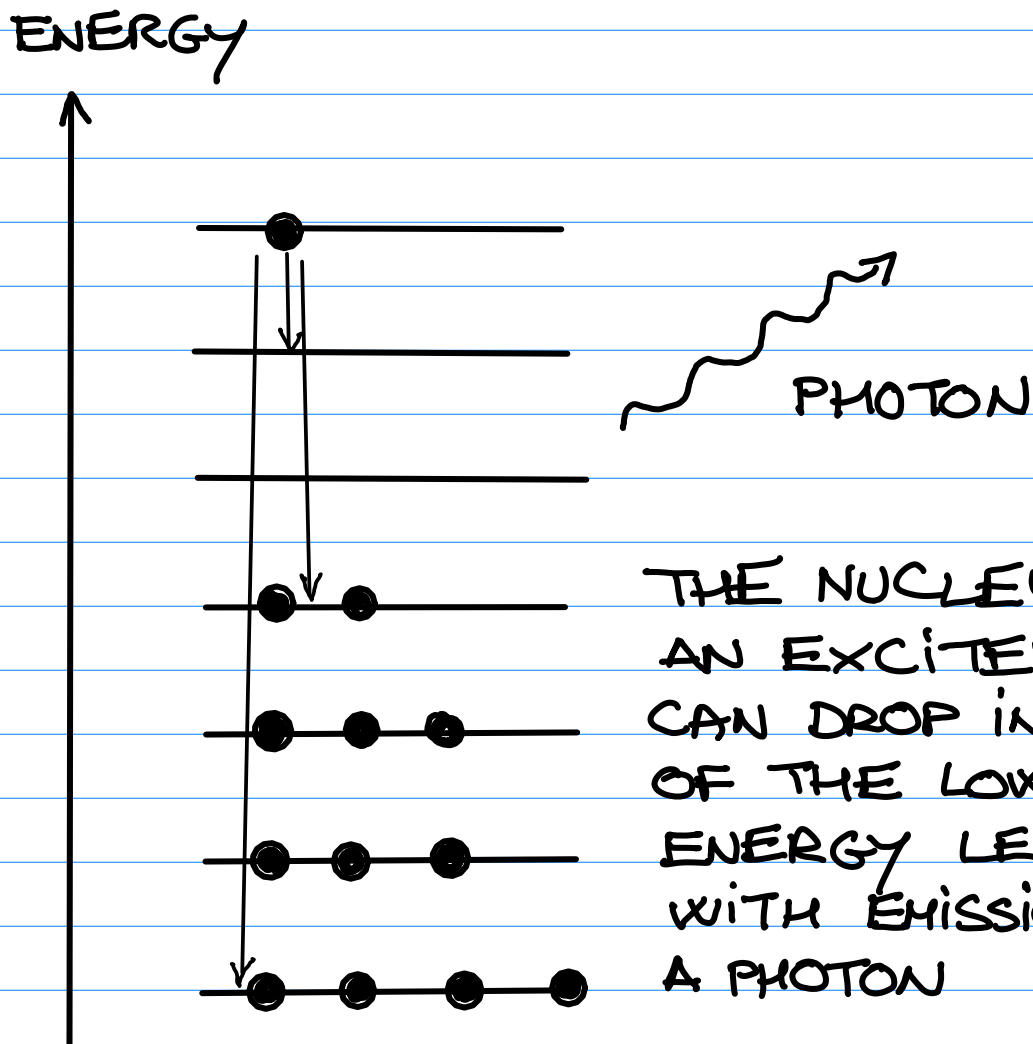
THE RANGE OF THE OBSERVED MASSES IS:

$$0.17 M_{\odot} - 1.33 M_{\odot}$$

MOST WHITE DWARFS HAVE MASSES FROM $0.5 M_{\odot}$ TO $0.7 M_{\odot}$.

WHY ARE WHITE DWARFS EMITTING LIGHT IF THEY DO NOT PRODUCE THE ENERGY VIA FUSION?

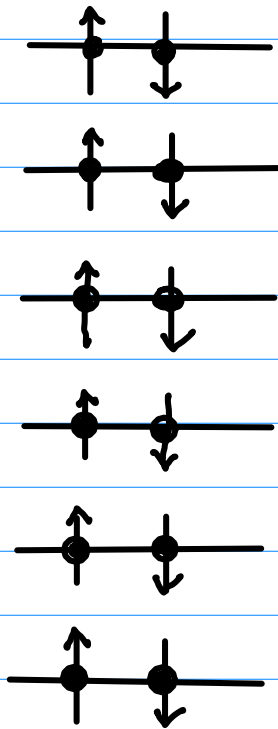
CARBON AND OXYGEN NUCLEI DO NOT OBEY THE PAULI PRINCIPLE: THE NUMBER OF NUCLEI IN A GIVEN ENERGY LEVEL IS NOT LIMITED.



THE NUCLEUS IN AN EXCITED STATE CAN DROP INTO ANY OF THE LOWER ENERGY LEVELS WITH EMISSION OF A PHOTON

DEGENERATE ELECTRONS:

ENERGY



ELECTRONS CANNOT
DROP INTO THE LOWER
ENERGY LEVELS BECAUSE
OF THE PAULI PRINCIPLE

EVENTUALLY, ALL CARBON (AND OXYGEN NUCLEI) WILL DROP INTO THE LOWEST ENERGY LEVEL AND THE EMISSION OF LIGHT WILL STOP. THE WHITE DWARF WILL BECOME A BLACK DWARF. THIS HAPPENS OVER A VERY LONG PERIOD OF TIME COMPARABLE TO THE AGE OF THE UNIVERSE.

WHITE DWARFS HAVE A VERY HIGH SURFACE TEMPERATURE OF SEVERAL TENS OF THOUSAND DEGREES. AS A RESULT THEY EMIT A LOT OF HIGH ENERGY UV-PHOTONS. THESE PHOTONS EXCITE THE ELECTRONS IN THE ATOMS OF THE PLANETARY NEBULA INTO THE HIGHER ENERGY LEVELS. AS THE ELECTRONS DROP BACK INTO THE LOWER ENERGY LEVELS THE PHOTONS ARE EMITTED (FLUORESCENCE). THAT IS HOW THE PLANETARY NEBULAE EMIT LIGHT.