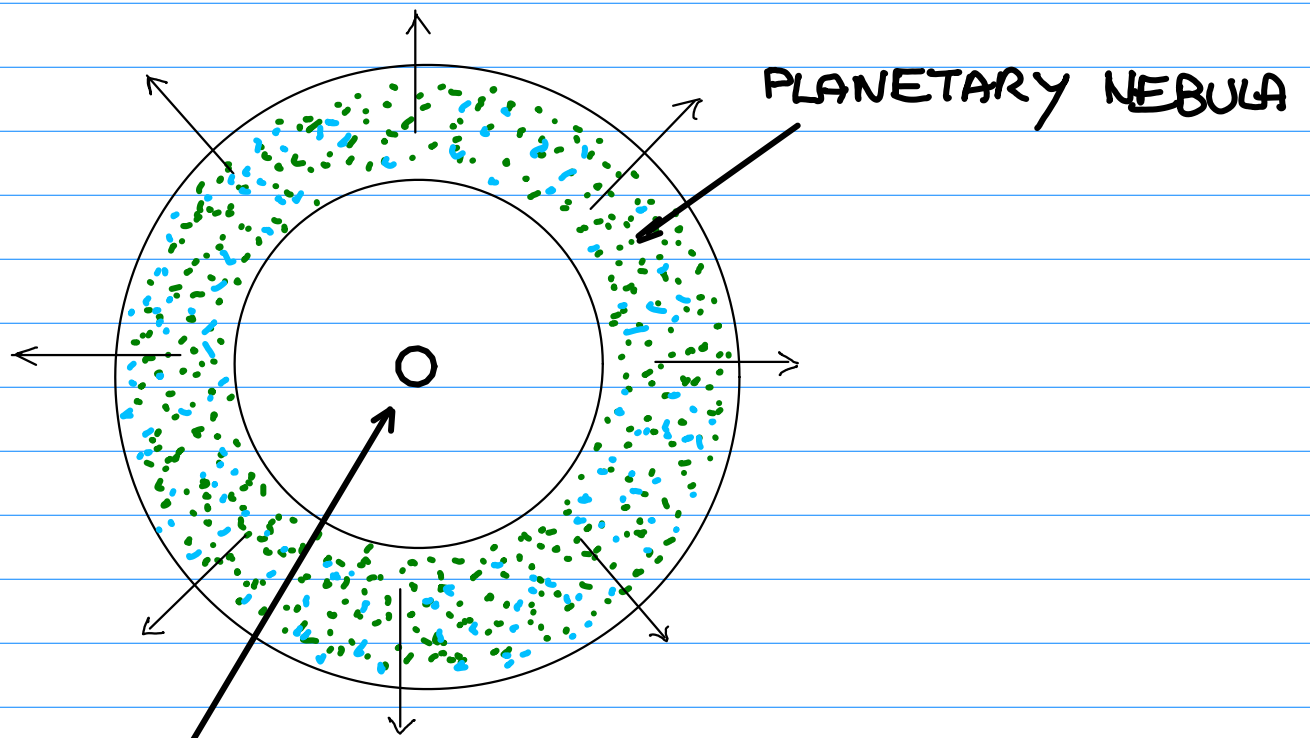


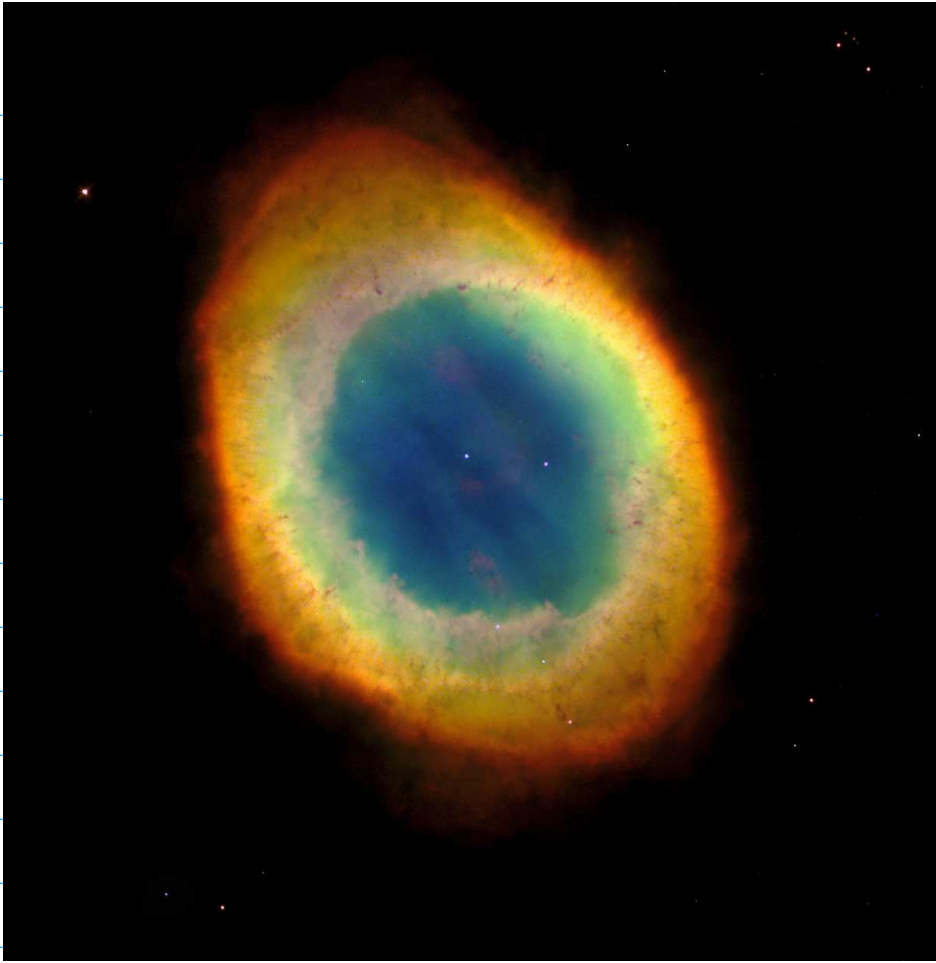
THE REMNANTS OF A MEDIUM MASS ( $0.5M_{\odot} < M < 8M_{\odot}$ )  
STAR:

PLANETARY NEBULA: A SPHERICAL SHELL OF  
THE STAR'S MATERIAL PUSHED OUT BY THE  
THERMAL AND RADIATION PRESSURE DURING THE  
FINAL RED GIANT STAGE



WHITE DWARF = "DEAD" (i.e. NON-FUSING)  
CORE COMPOSED OF  $^{12}\text{C}$   
AND SOME  $^{16}\text{O}$

EXAMPLES OF PLANETARY NEBULAE:

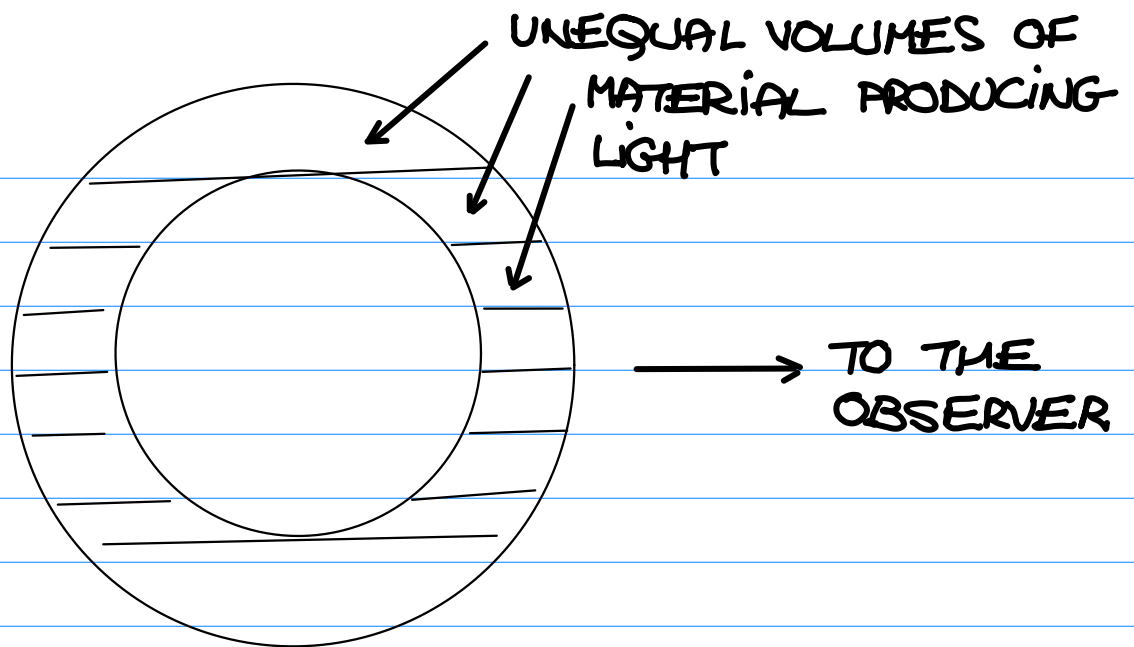


RING  
NEBULA



HELIX NEBULA

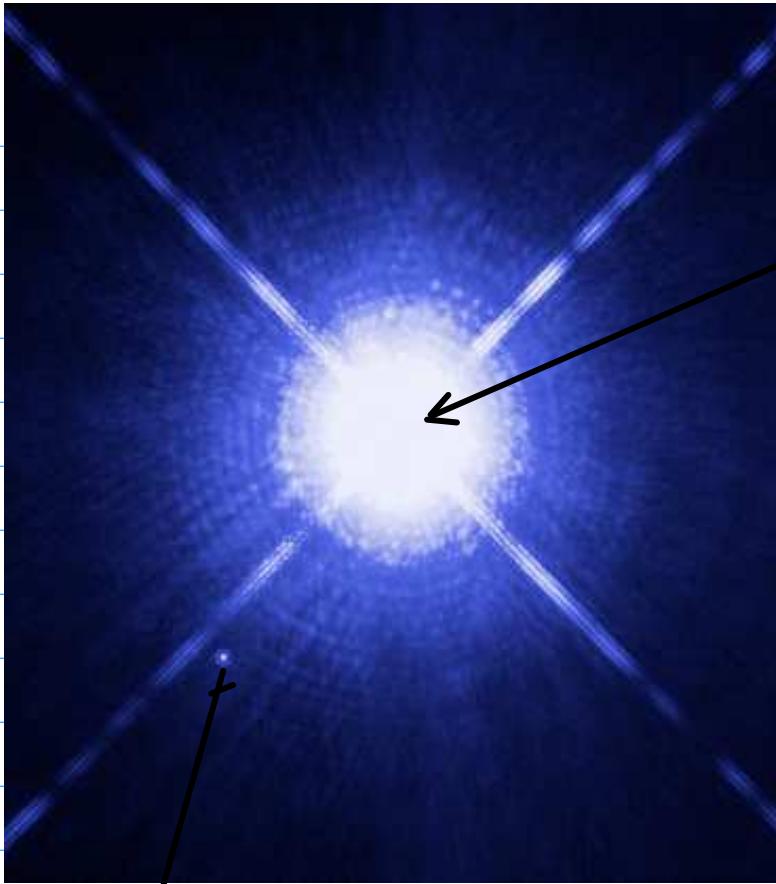
THE CENTRAL OBJECT (WHITE DWARF) IS SO HOT THAT IT EMITS A LOT OF ENERGY IN UV. THE UV-PHOTONS CAUSE THE MATERIAL IN THE NEBULA TO FLUORESCENCE.



WE SEE THE NEBULA AS A RING INSTEAD OF A SPHERICAL SHELL.

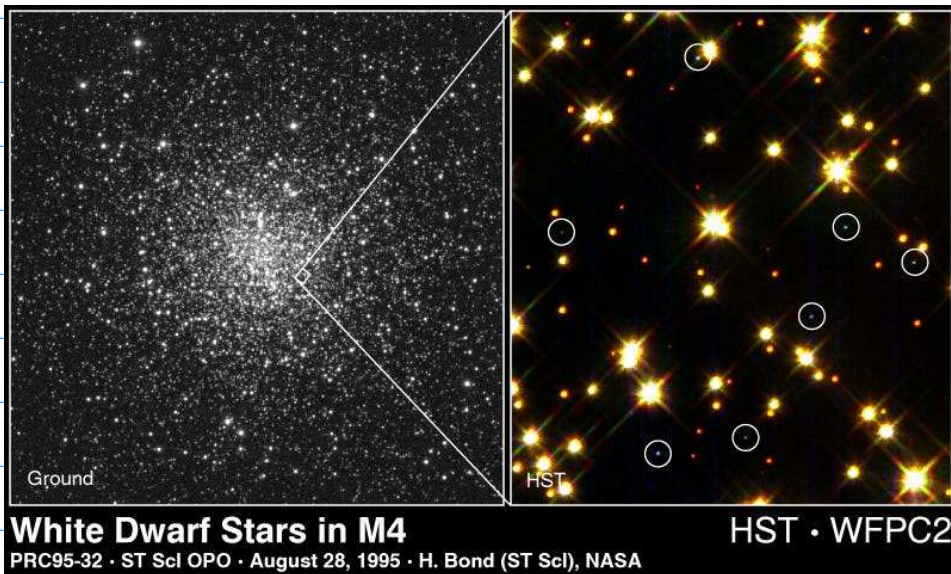
THEIR NAME ("PLANETARY") COMES FROM THE FACT THAT WHEN THEY ARE VIEWED THROUGH A SMALL TELESCOPE THEY APPEAR AS BLUE-GREEN, JUST LIKE THE PLANETS URANUS AND NEPTUNE. HOWEVER, THEY HAVE NOTHING TO DO WITH PLANETS OR WITH PLANETARY FORMATION.

EXAMPLES OF WHITE DWARFS:



SIRIUS A  
(A NORMAL  
MAIN SEQUENCE  
STAR)

SIRIUS B (A WHITE DWARF)



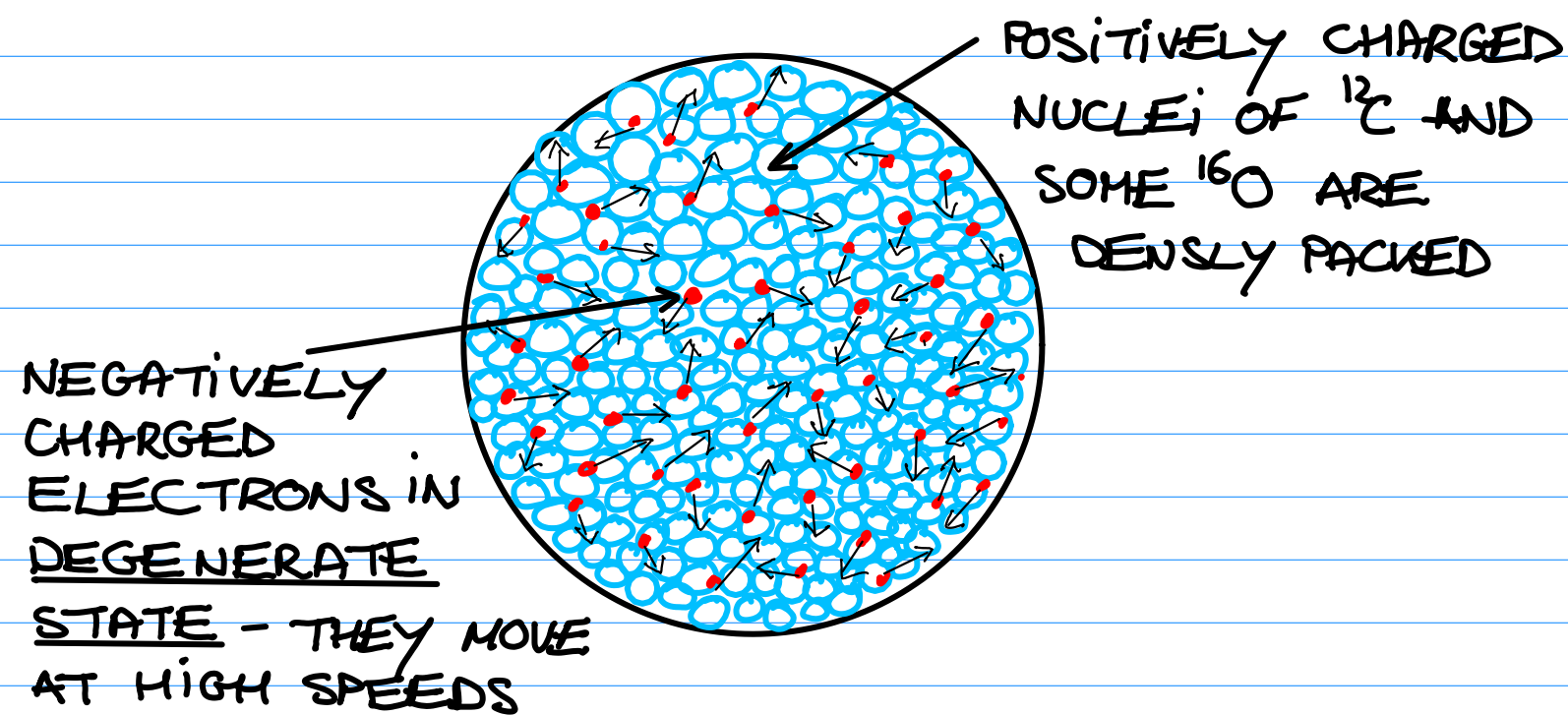
**White Dwarf Stars in M4**

PRC95-32 · ST ScI OPO · August 28, 1995 · H. Bond (ST ScI), NASA

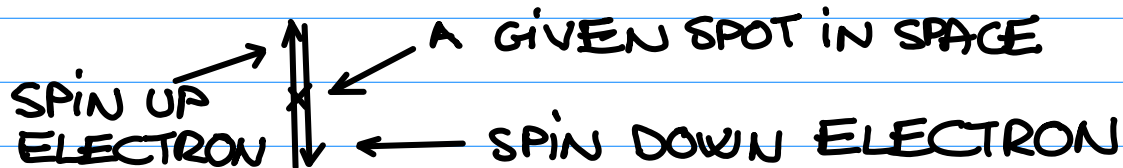
HST · WFPC2

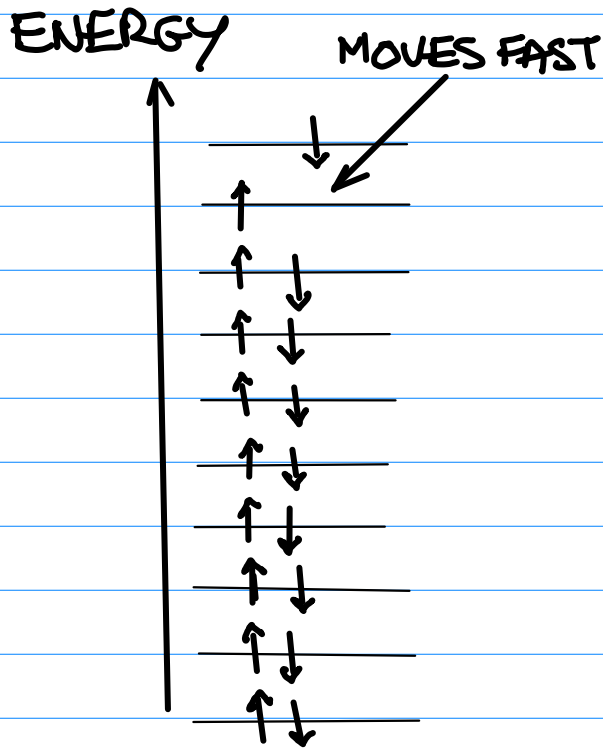
WHITE DWARFS ARE VERY DENSE : DENSITY =  $= 1000 \frac{\text{kg}}{\text{cm}^3}$ . WHY DOESN'T A WHITE DWARF COLLAPSE UNDER ITS OWN GRAVITY (IT STOPPED GENERATING ENERGY VIA FUSION)? IT IS SUPPORTED BY THE ELECTRON DEGENERACY PRESSURE.

THE STRUCTURE OF A WHITE DWARF :

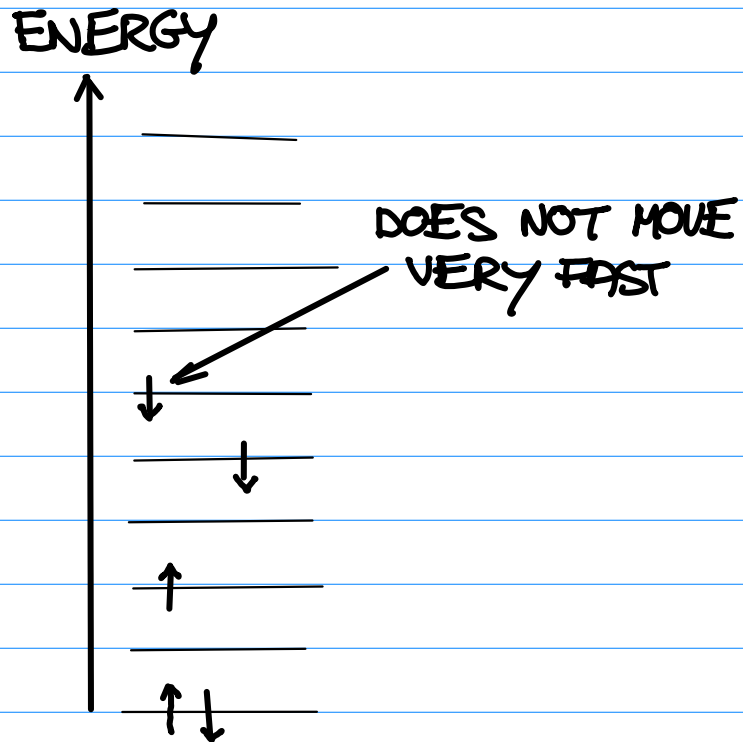


QUANTUM MECHANICS : ELECTRONS OBEY THE PAULI PRINCIPLE - NO TWO ELECTRONS CAN BE IN THE SAME STATE INCLUDING SPIN :





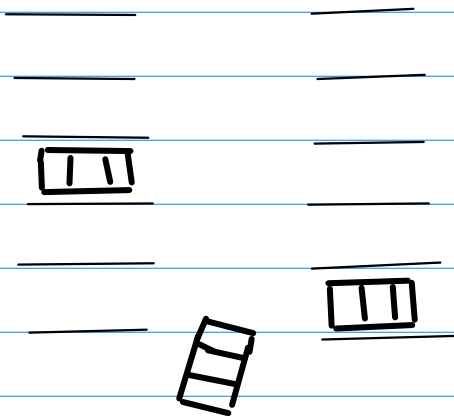
DEGENERATE  
ELECTRONS



NONDEGENERATE (NORMAL)  
ELECTRONS

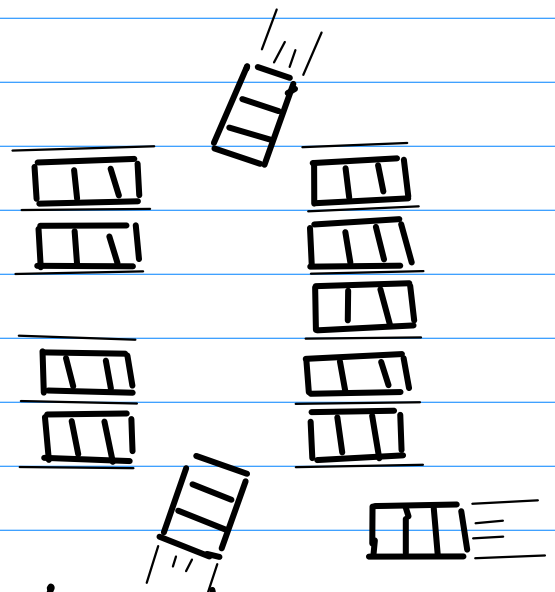
ANALOGY:

NEARLY EMPTY PARKING LOT



THE INCOMING CAR  
MOVES SLOWLY AS THERE  
ARE MANY PARKING SPOTS  
(STATE OF NORMAL ELECTRONS)

NEARLY FULL PARKING LOT



THE INCOMING CARS ARE  
RACING TO FIND A FREE  
PARKING SPOT (STATE  
OF DEGENERATE ELECTRONS)

