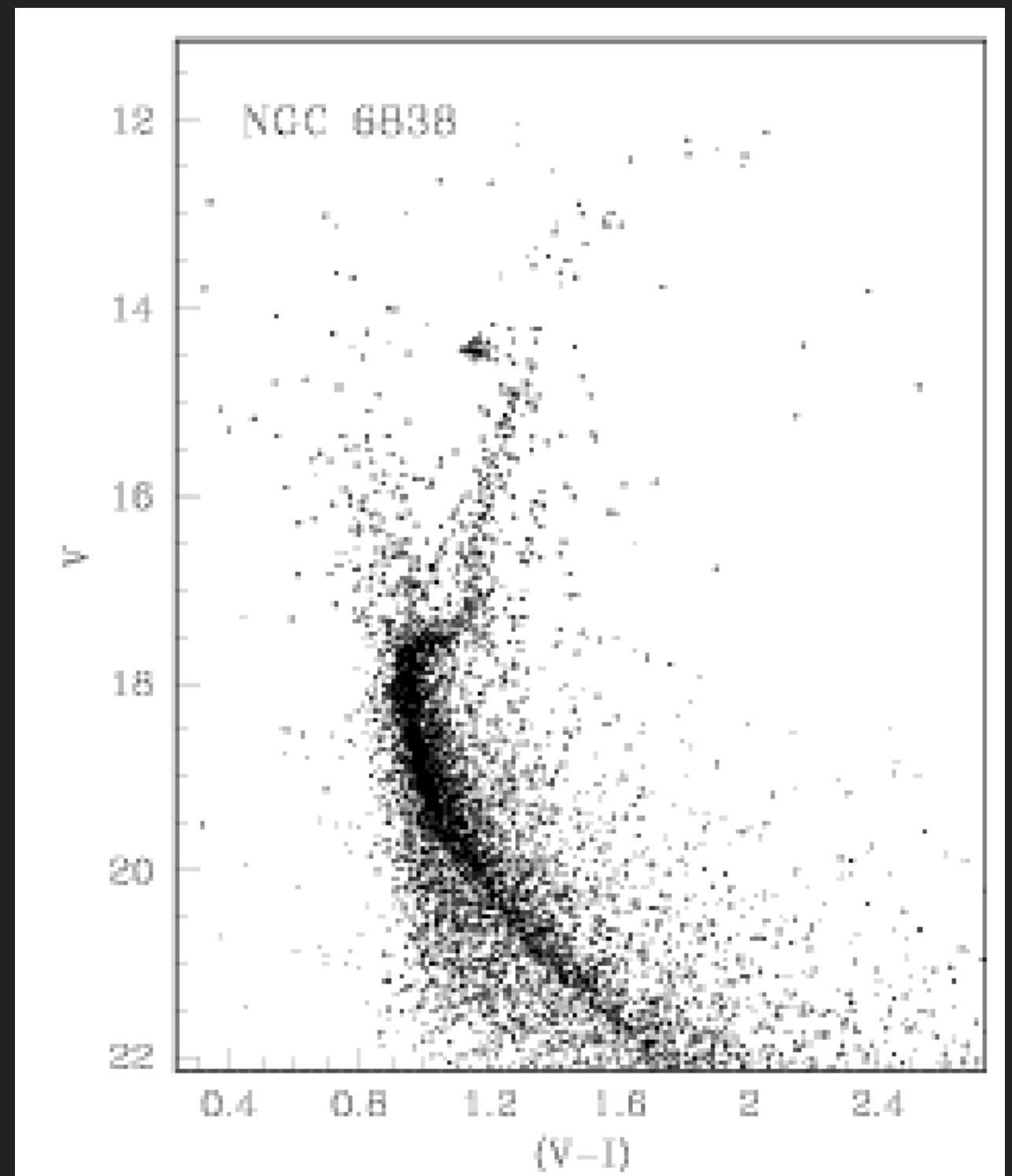
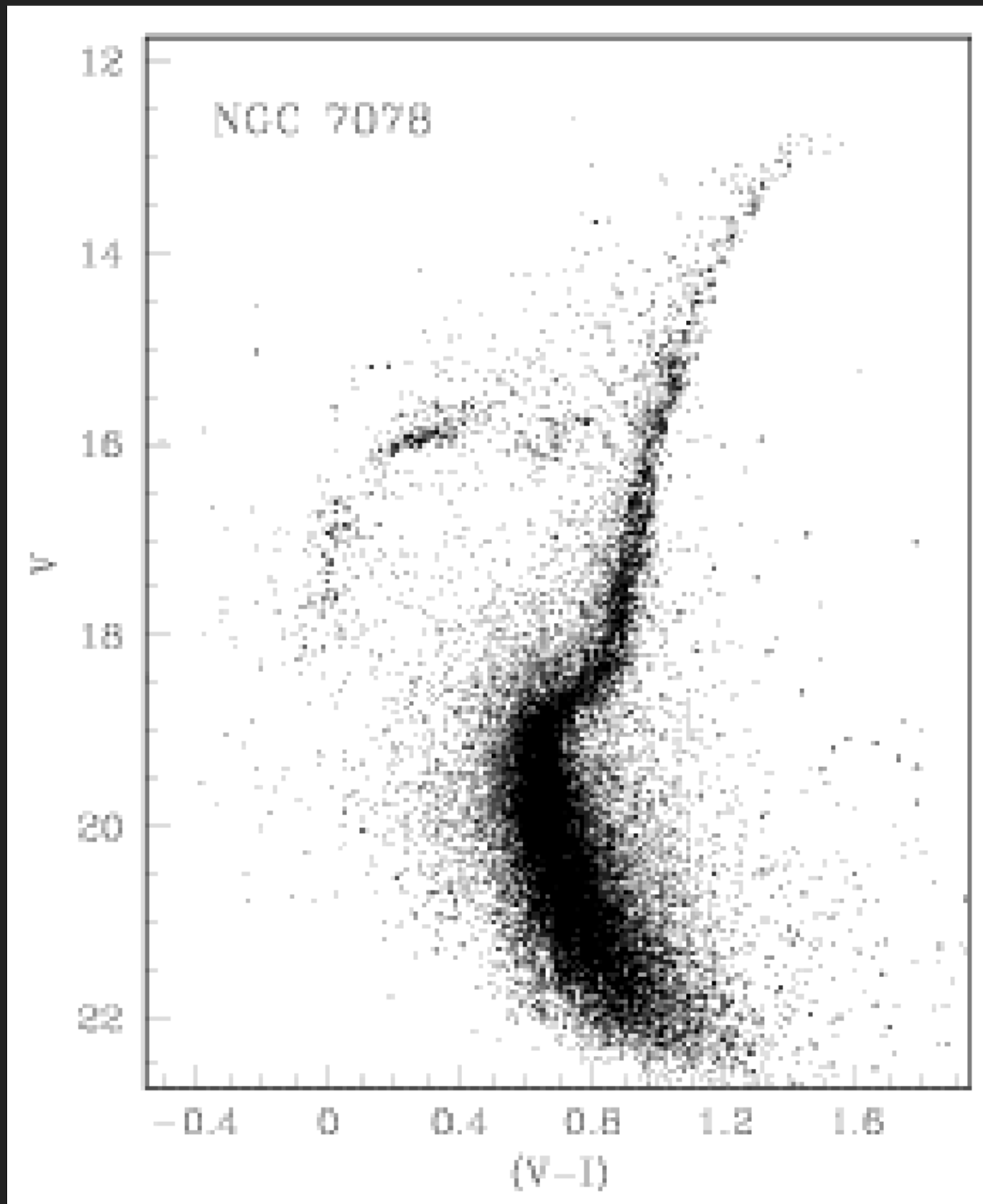


STELLAR EVOLUTION

ASTROPHYSICS

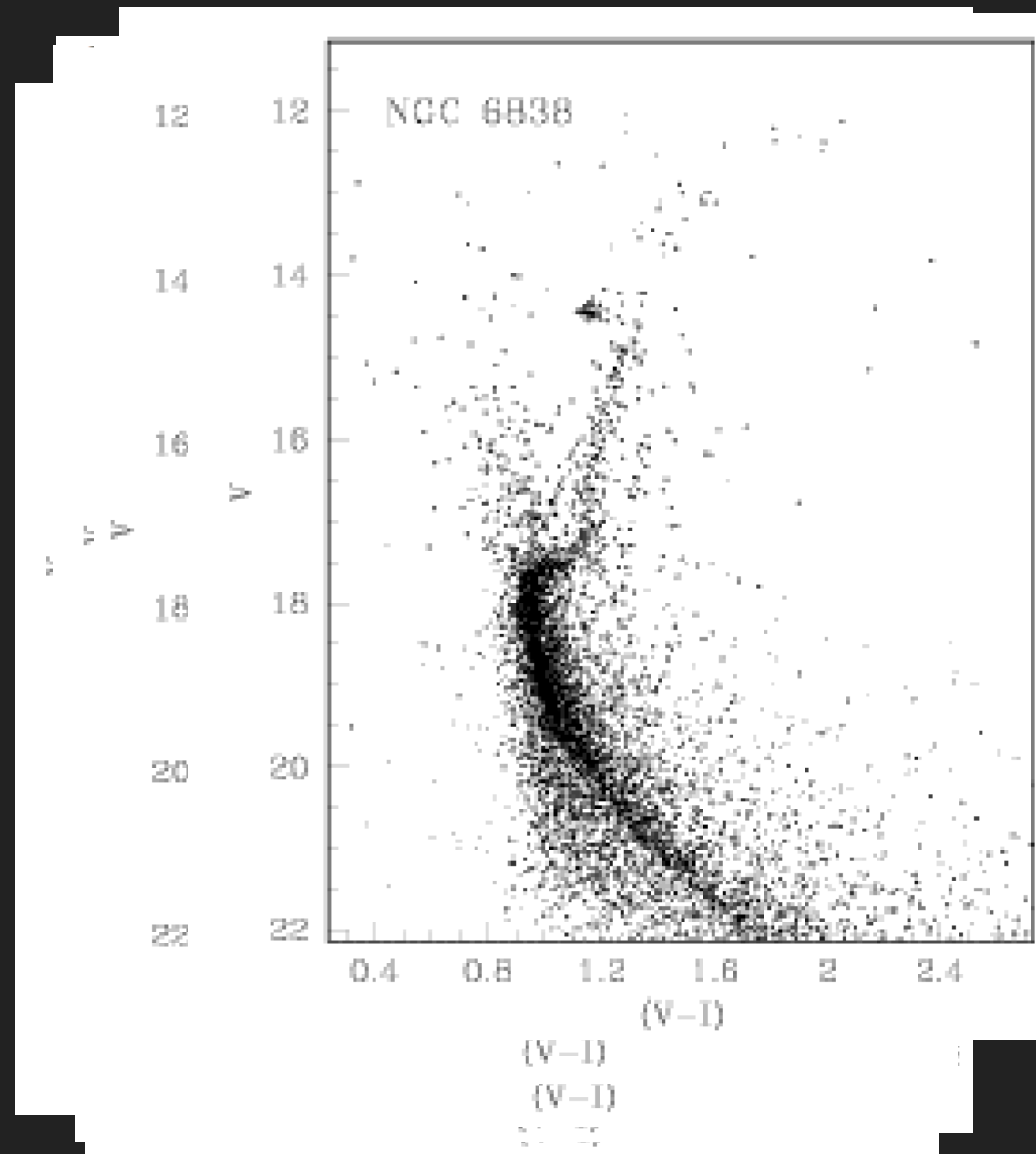
Dr H.T.Sener

HOMEWORK



- Try to find the turn off point and put into an age order

HOMEWORK



NEUTRON STARS



Neutron Star

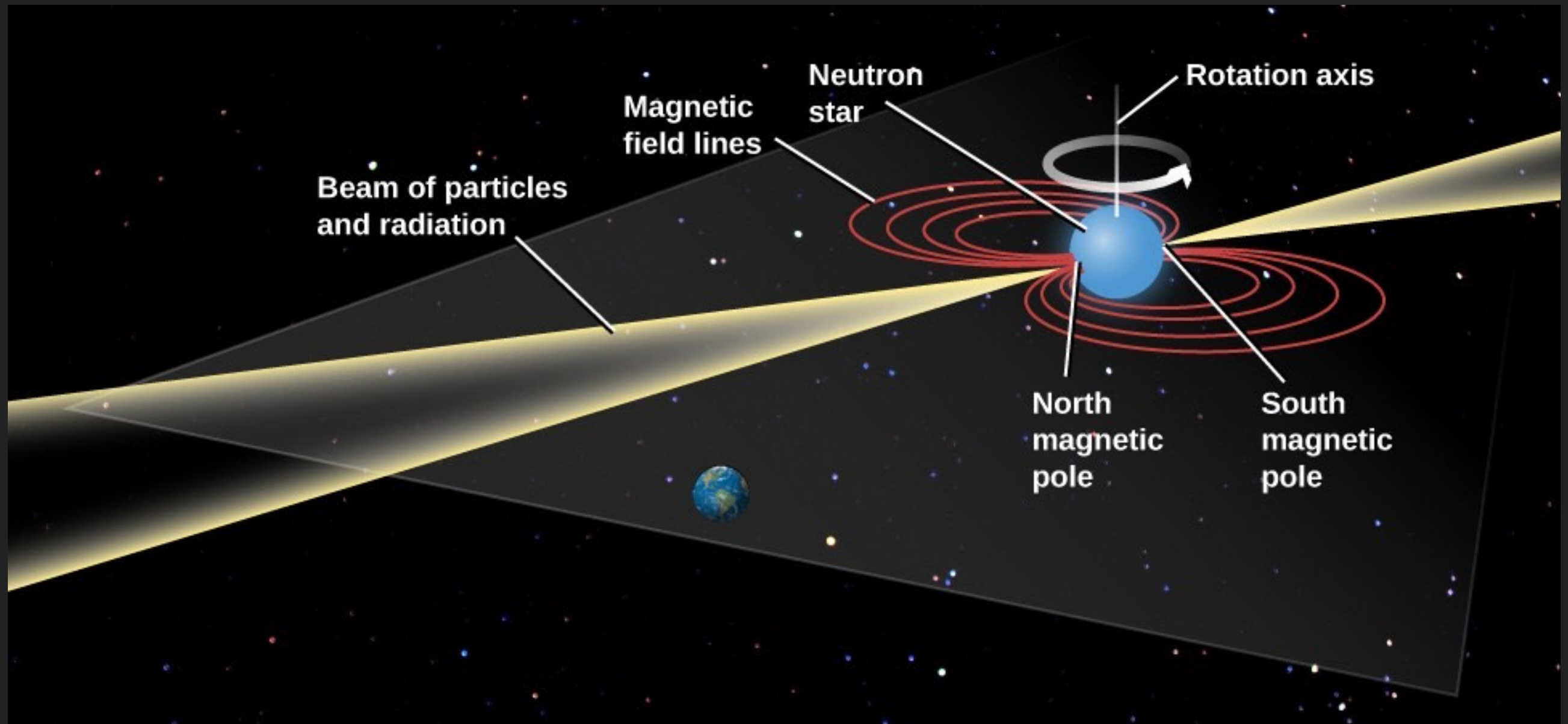
NEUTRON STARS



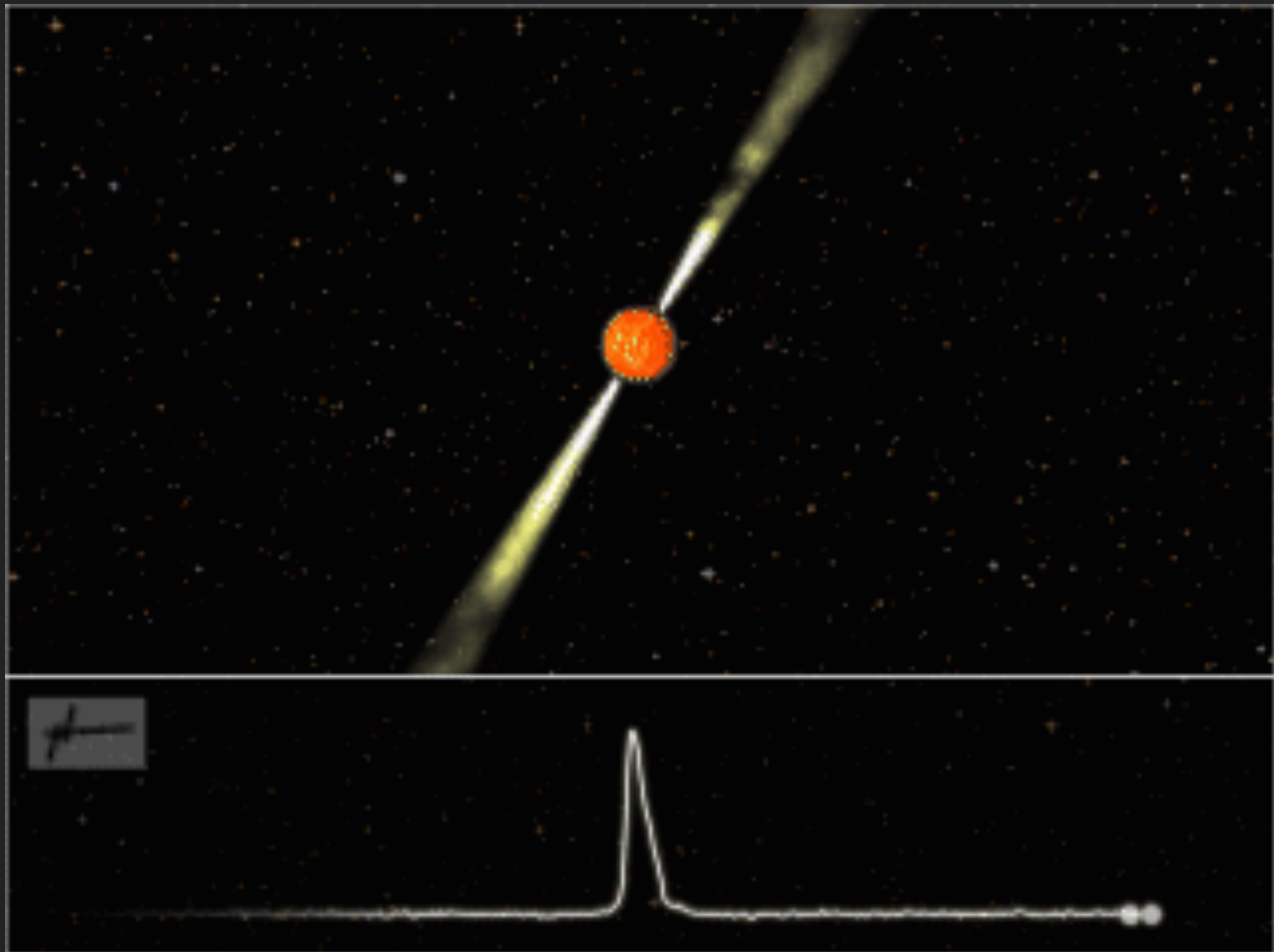
NEUTRON STARS



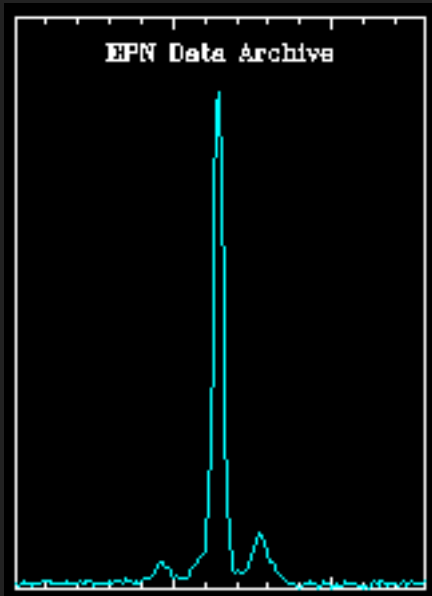
NEUTRON STARS



PULSARS

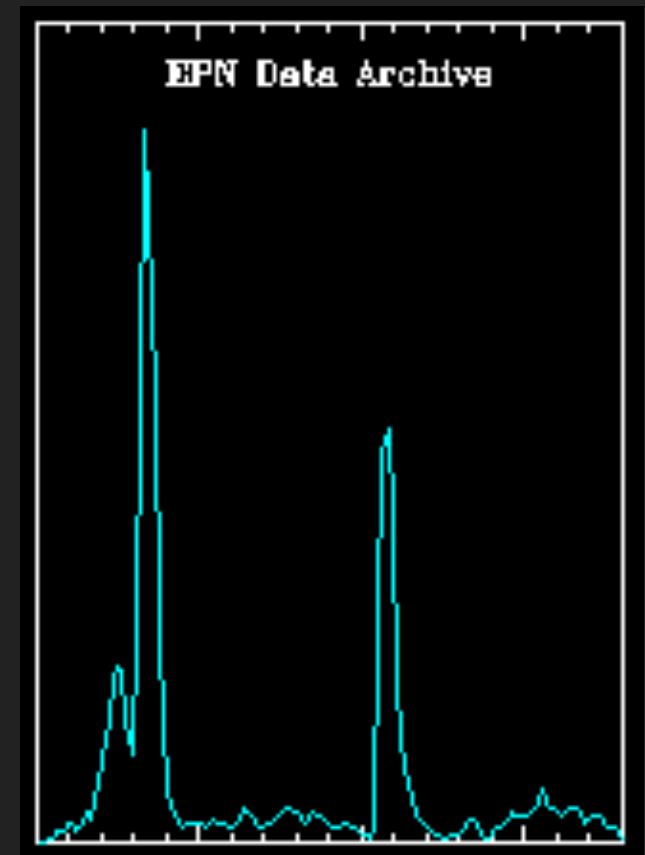


PULSARS



- ▶ PSR B0329+54
- ▶ This pulsar is a typical, normal pulsar, rotating with a period of 0.714519 seconds, i.e. close to 1.40 rotations/sec.

- ▶ PSR B0531+21, The Crab Pulsar
- ▶ This is the youngest known pulsar and lies at the centre of the Crab Nebula, the supernova remnant of its birth explosion, which was witnessed by Europeans and Chinese in the year 1054 A.D. as a day-time light in the sky. The pulsar rotates about 30 times a second.



Who is S. Jocelyn Bell Burnell

Singularity

At the very centre of a black hole, matter has collapsed into a region of infinite density called a singularity. All the matter and energy that fall into the black hole ends up here. The prediction of infinite density by general relativity is thought to indicate the breakdown of the theory where quantum effects become important.

Event horizon

This is the radius around a singularity where matter and energy cannot escape the black hole's gravity: the point of no return. This is the "black" part of the black hole.

Photon sphere

Although the black hole itself is dark, photons are emitted from nearby hot plasma in jets or an accretion disc (see below). In the absence of gravity, these photons would travel in straight lines, but just outside the event horizon of a black hole, gravity is strong enough to bend their paths so that we see a bright ring surrounding a roughly circular dark "shadow".

Relativistic jets

When a black hole feeds on stars, gas or dust, the meal produces jets of particles and radiation blasting out from the black hole's poles at near light speed. They can extend for thousands of light-years into space.

Innermost stable orbit

The inner edge of an accretion disc is the last place that material can orbit safely without the risk of falling past the point of no return.

Accretion disc

A disc of superheated gas and dust whirls around a black hole at immense speeds, producing electromagnetic radiation (X-rays, optical, infrared and radio) that reveal the black hole's location. Some of this material is doomed to cross the event horizon, while other parts may be forced out to create jets.

Accretion disc

Event horizon

Relativistic Jet

Singularity

Photon sphere

Innermost stable orbit

EVENT HORIZON / SCHWARZSCHILD RADIUS



<https://welovetheearth.org/>

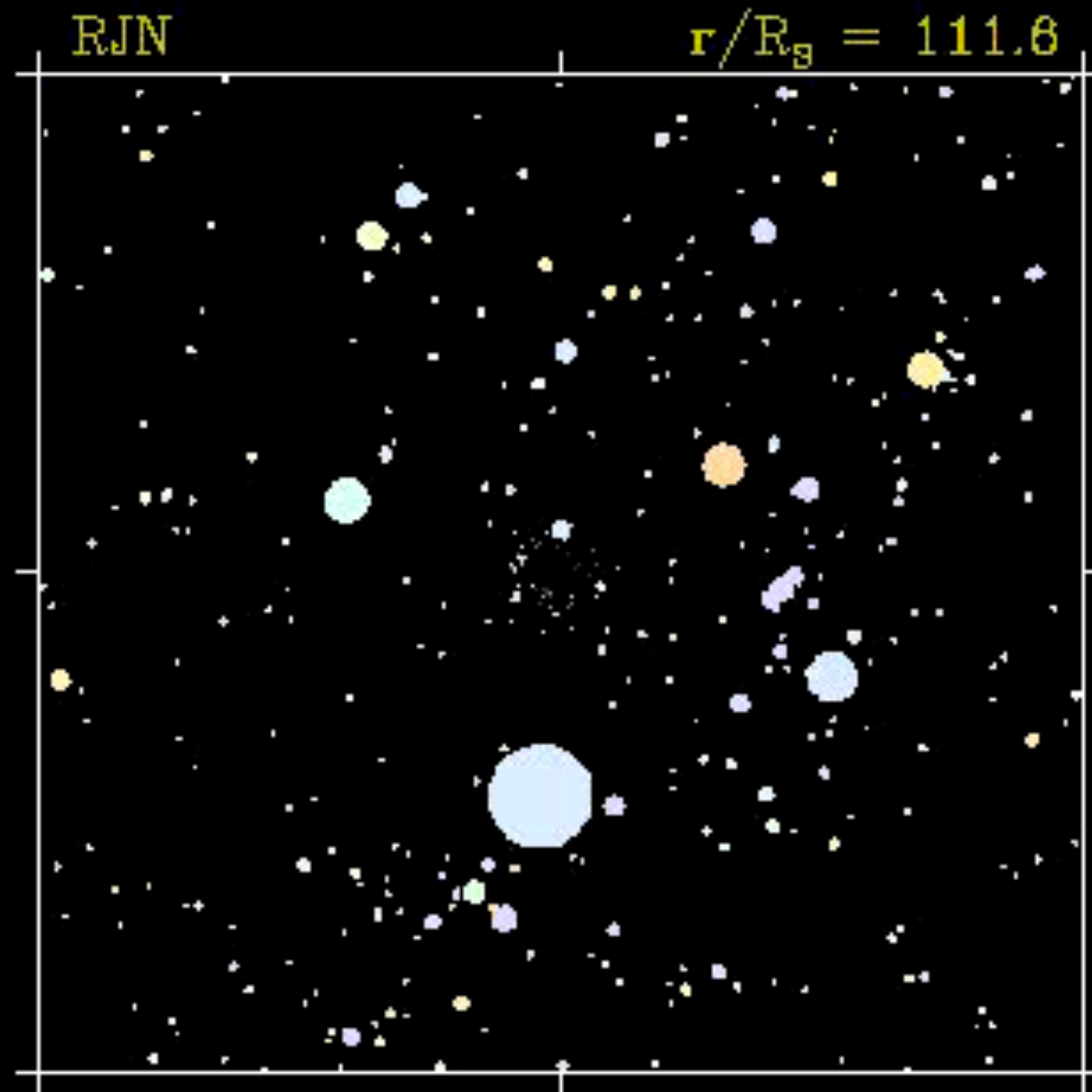
$$\frac{1}{2}mv^2 = \frac{GMm}{r}$$

$$v_{\text{escape}} = \sqrt{\frac{2Gm}{R}}$$

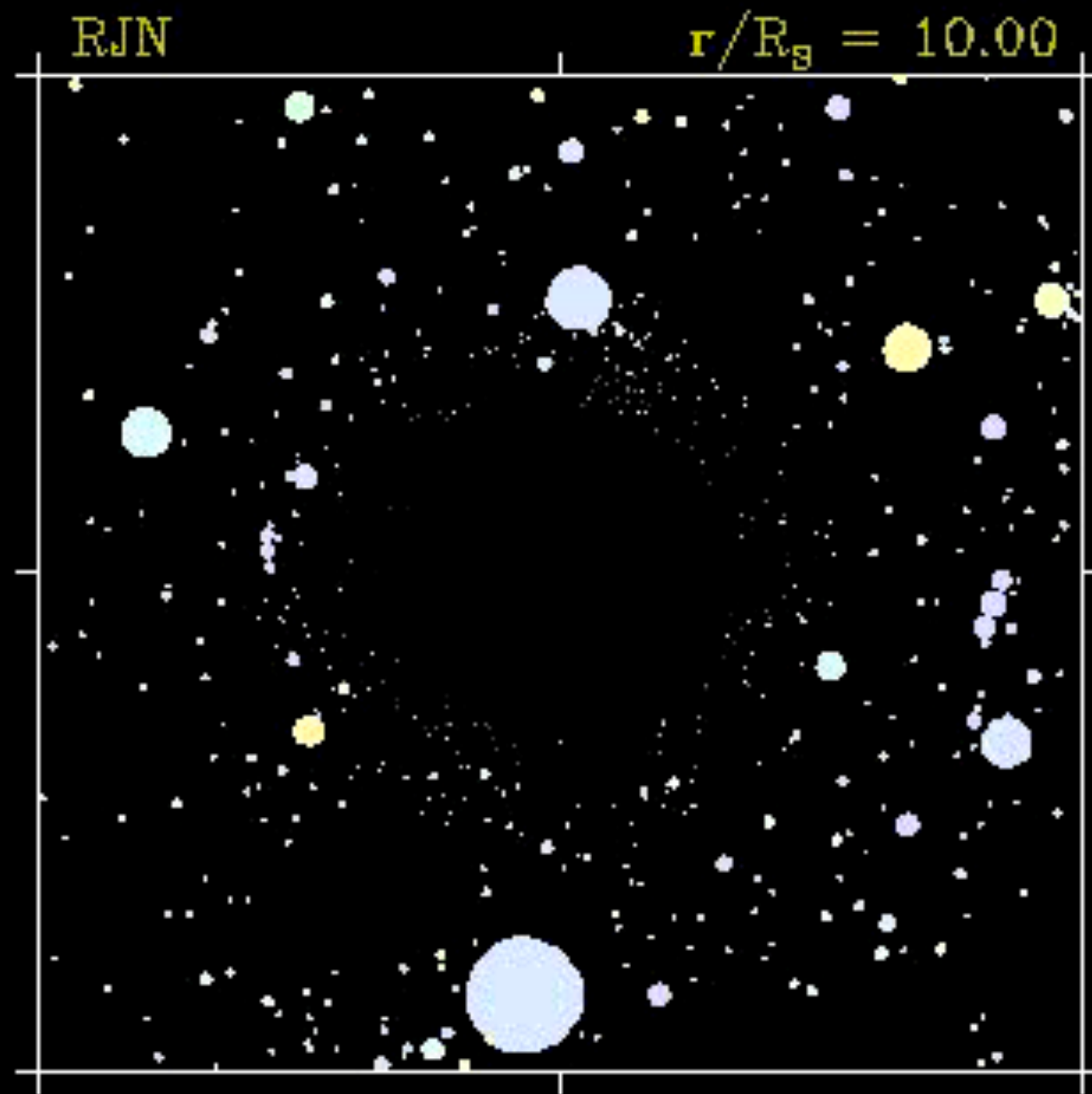
●

$$v = c \quad R = \frac{2GM}{c^2}$$

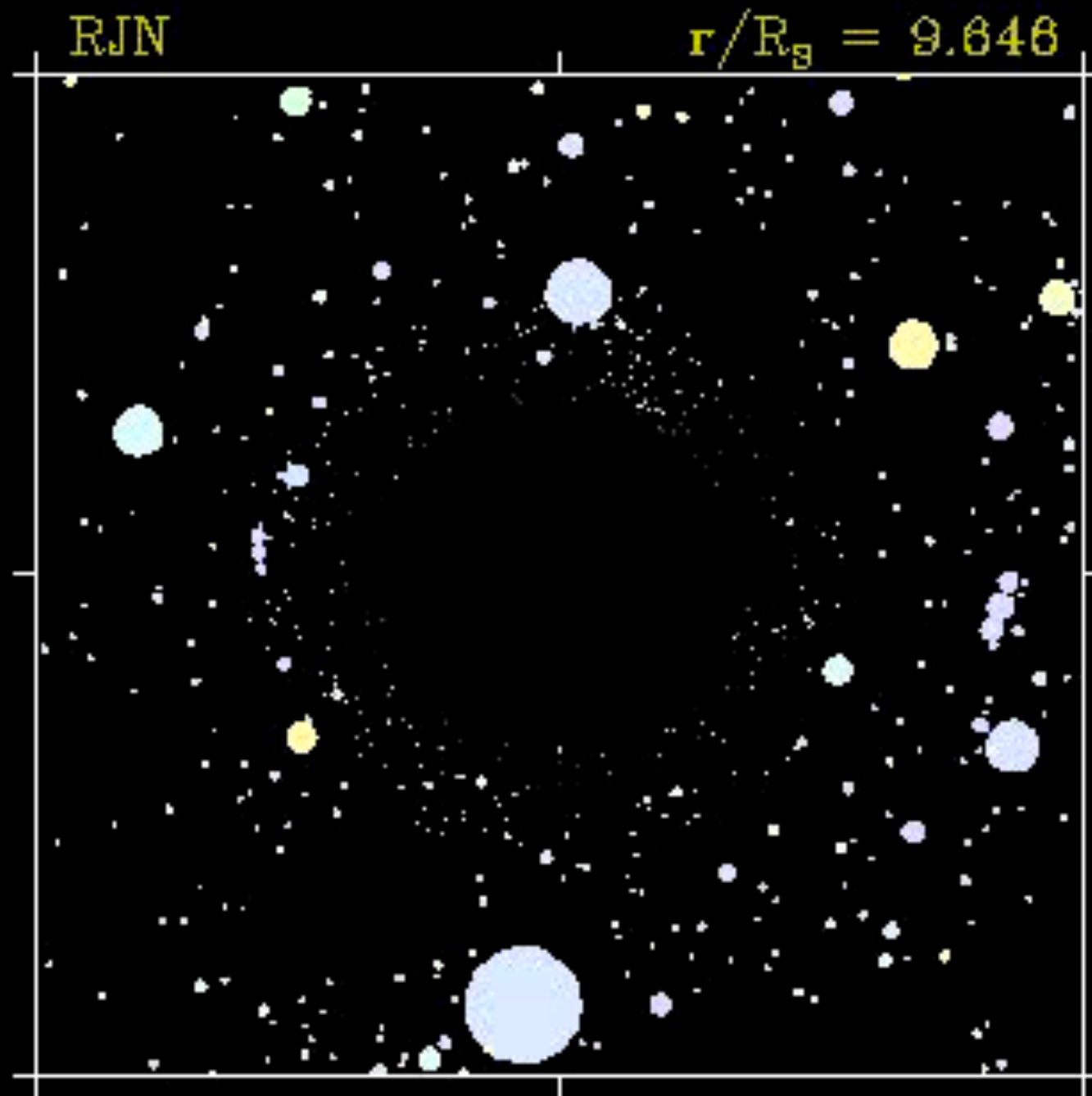
APPROACHING A BLACKHOLE



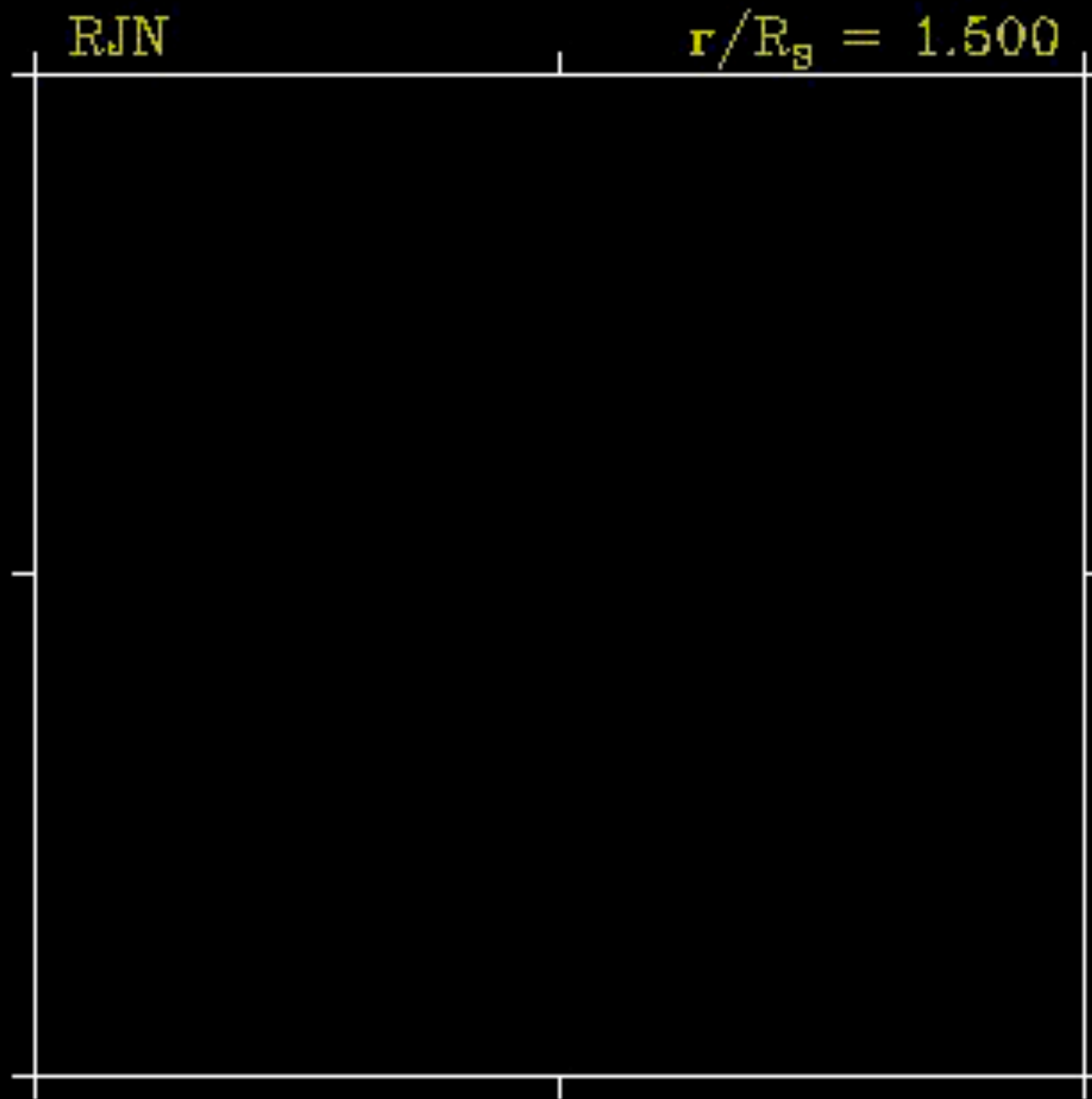
CIRCLING THE BLACKHOLE



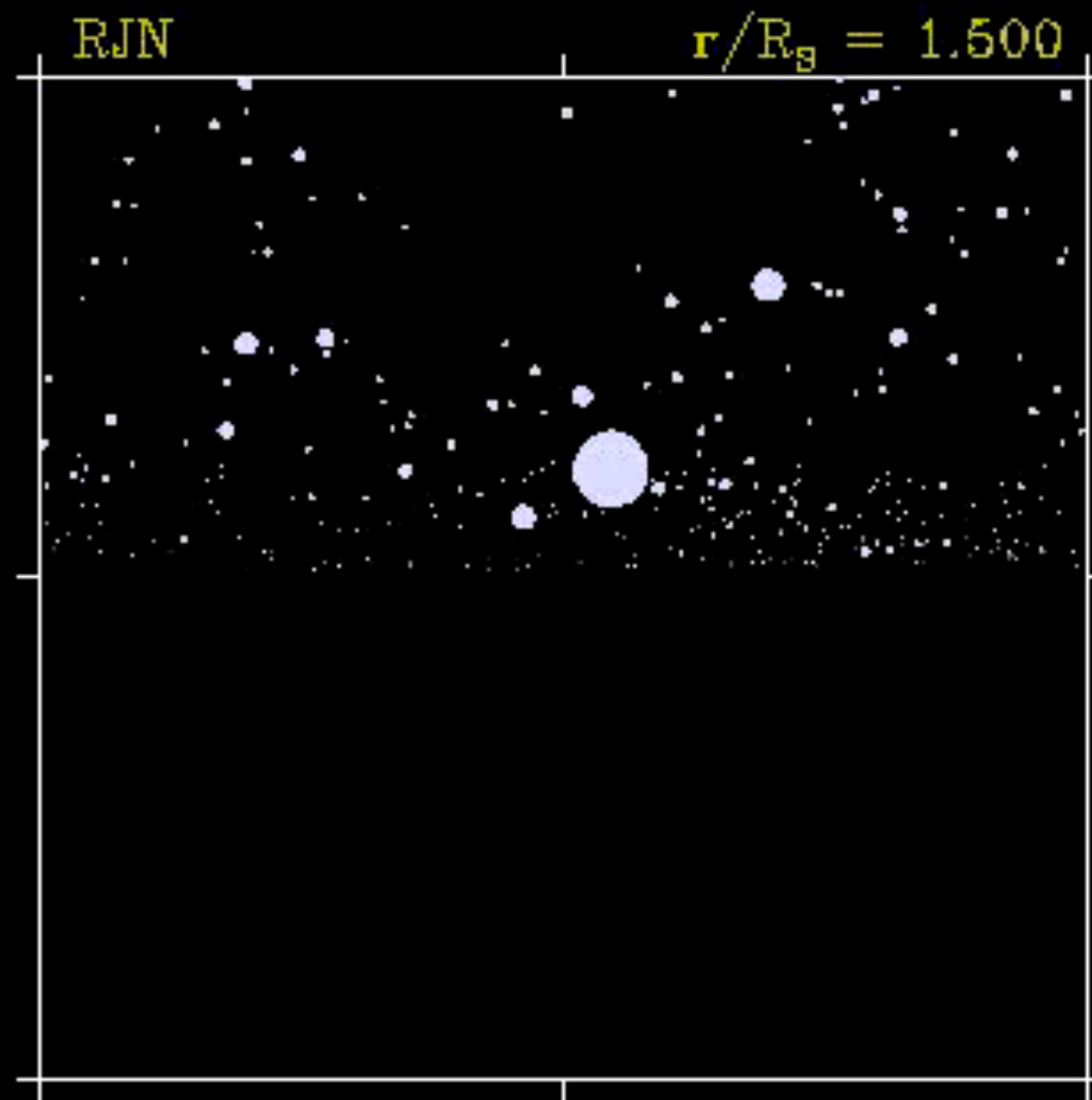
DOWN TO PHOTOSPHERE



LOOKING UP TO PHOTON SPHERE



BACK TO PHOTON SPHERE



FIRST REAL IMAGE OF A BLACK HOLE



EVENT HORIZON TELESCOPE





FIRST REAL IMAGE OF A BLACK HOLE



WHY NOT MILKYWAY?



FIRST REAL IMAGE OF A BLACK HOLE



FIRST REAL IMAGE OF A BLACK HOLE

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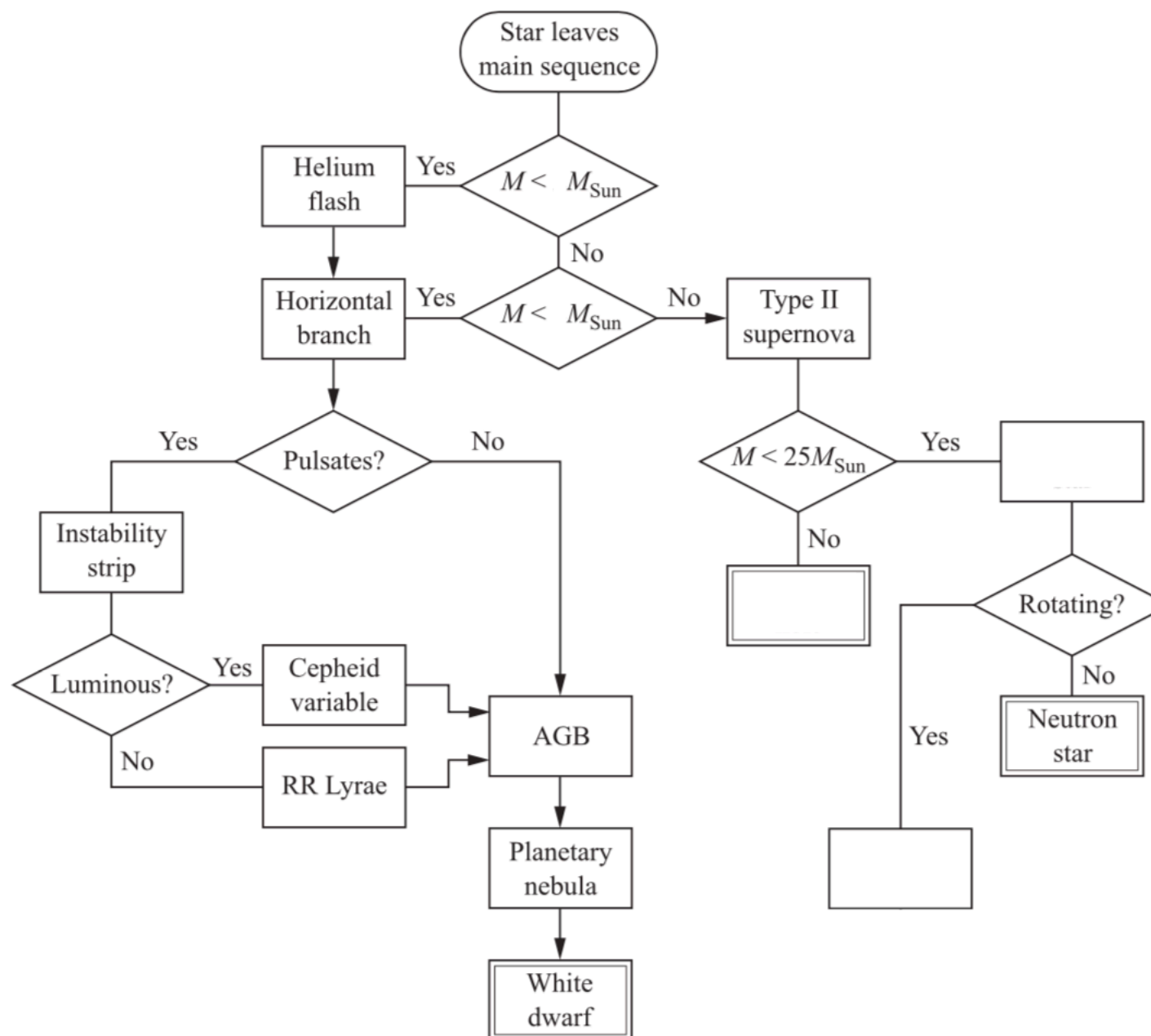
Relativistic Jet

Singularity

Photon sphere

Innermost stable orbit

HOMEWORK



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