Physics/Astro 562/ Peterson: Problem Set #4
Due: Tuesday, 4/2/2024
Galactic High Energy Astrophysical Objects

Supernovae: A supernovae explodes with kinetic energy of 2×10^{51} ergs s^{-1}. It ejects 2 Solar masses of material. What is the velocity of the ejecta right after the explosion? If the density of the ISM is 2×10^{24} g cm^{-3}, how long does it take to sweep up another 2 Solar masses of plasma?

Neutron Stars: Imagine a star like the sun with mass of 2×10^{30} kg and radius of 7×10^{8} m shrinks and becomes a neutron star with radius of 10 km. If the Sun normally rotates with a period of 26 days, what will be its period afterwords assuming conservation of momentum. If the sun has a magnetic field of about 40 Gauss what will be the magnetic field intensity afterwords assuming conservation of magnetic flux ($B4\pi R^2$).

Black Holes and Accretion: A ten Solar mass black hole swallows up a cloud of rock the mass of the Earth. Assume the rock falls from infinity and then fall directly reaches the event horizon at $\frac{2GM}{c^2}$. How much energy will be produced during this accretion event? How does this compare to the energy liberated if 0.7 % of the rest mass of the rock was released during Hydrogen fusion?