

Homework #4

1. Draw lines of constant dE/dt in the pulsar $P - \dot{P}$ diagram, and find the highest observed value of dE/dt . What are the characteristic age and B -field of this pulsar?
2. Estimate the spin period of the Crab pulsar at the time of its birth in the supernova of 1054 AD. The present period of the pulsar is $P = 0.0334$ s, and $\dot{P} = 4.20 \times 10^{-13}$ s s⁻¹. Do the calculation under each of the following assumptions:
 - (a) The spindown rate $\dot{\Omega}$ was always proportional to $-\Omega^n$, with the braking index $n = 3$ in the magnetic dipole approximation.
 - (b) The braking index has always been $n = 2.51$ (the currently measured value).
3. Estimate the energy at which an electron of $\gamma = 10^7$ radiates if it travels along the first open field line (the one tangent to the speed-of-light cylinder) in the Crab pulsar. (Hint: it will be γ -rays.) For the purpose of this problem, you may approximate the shape of the field line as a circle.