

PROBLEM 5: STELLAR MAGNETIC FLUXES

- Estimate (order-of-magnitude) magnetic fluxes Φ_B across:
 - a molecular cloud ($B \sim 0.4$ mG, $R \sim 0.1$ pc);
 - a low-mass (T Tau) protostar ($B \sim 200$ G, $R \sim 0.05$ AU);
 - a low-mass ($0.1M_{\odot}$) M star ($B \sim 1$ kG);
 - the Sun ($B \sim 2.5$ G);
 - a high-mass ($2.5M_{\odot}$) Ap star ($B \sim 30$ kG);
 - a white dwarf ($B \sim 10^8$ G);
 - a pulsar ($B \sim 10^{12}$ G);
 - a magnetar ($B \sim 10^{15}$ G).

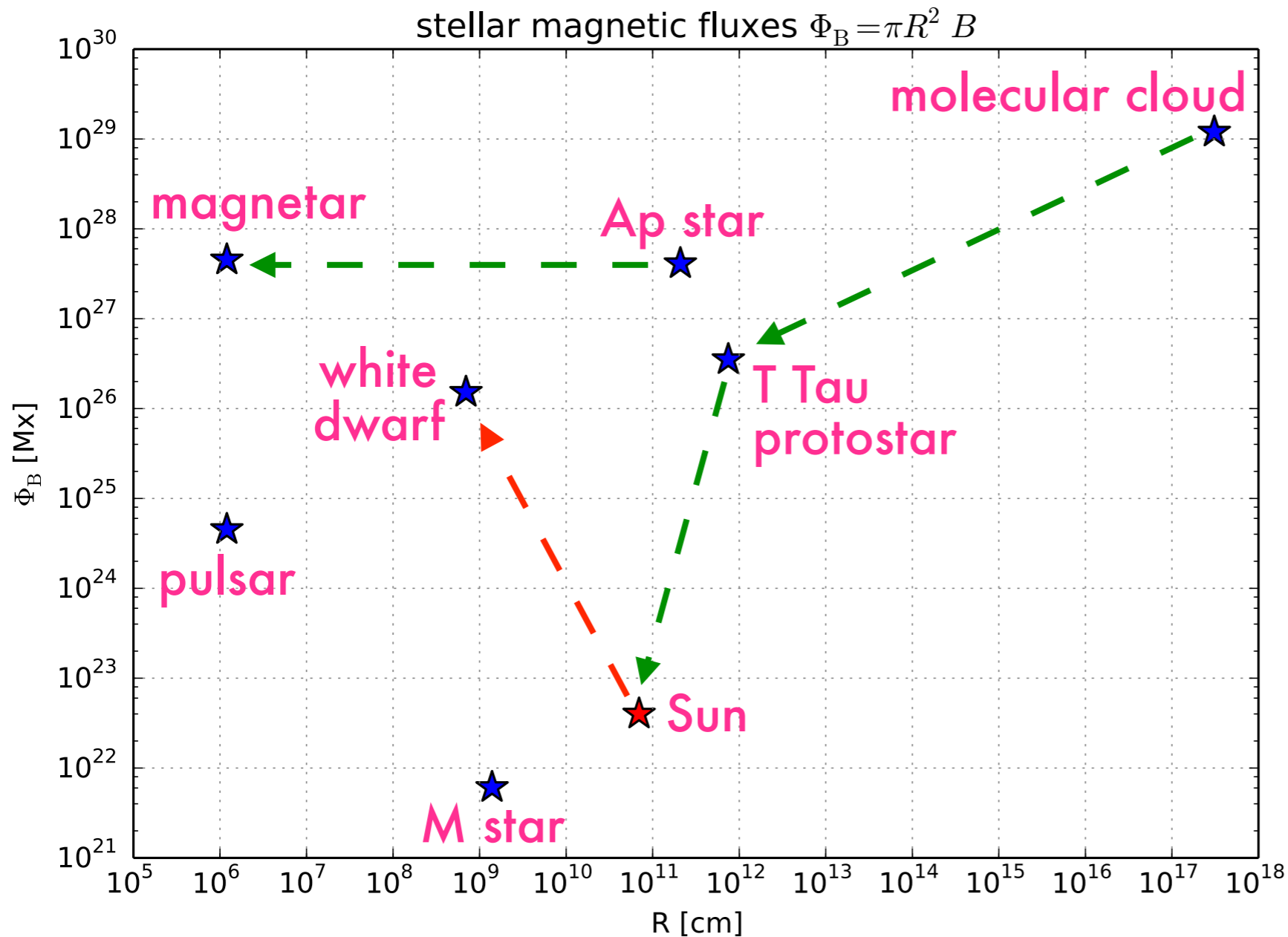
Stellar radii R can be read from the HR diagram.

For neutron stars adopt $R \simeq 12$ km.

- Create a log-log diagram of magnetic flux Φ_B vs radius R . What basic conclusions can be made?

This problem is worth 5 points. Solutions should be sent as 1-page PDF files to knalew@camk.edu.pl before the next lecture.

$$\Phi_B = \pi R^2 B \text{ vs } R$$



- Strong reduction of Φ_B from magnetic cloud to a T Tau protostar to a low-mass star (Sun).
- The solar Φ_B insufficient for a highly magnetized white dwarf.
- The Φ_B of Ap stars sufficient for a magnetar.