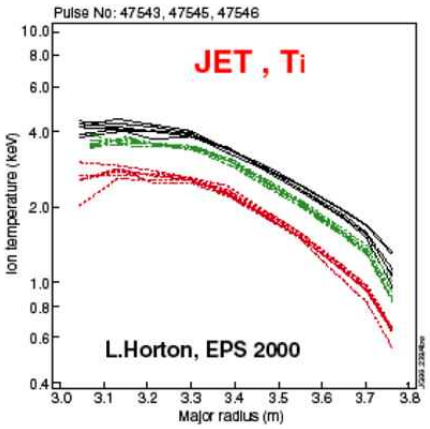
Fusion Reactor Engineering 1 (459.760)

Final Examination

19 June, 2014

1. (1) (10 points) Explain why heat diffusivities in a tokamak can be presented as a form of following;

$$\chi = T^{3/2}\left[\xi_0 + \xi_{TG} G\left(R/L_T - R/L_{T,c}\right)\right]$$



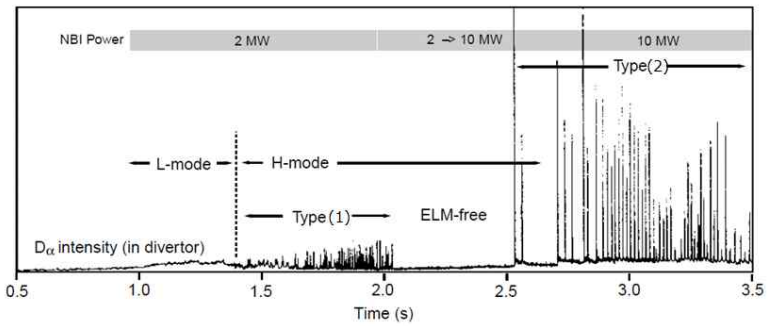
(2) (10 points) Explain why the temperature profiles behave as shown in the figure on the left hand side based on the equation of (1).

(3) (10 points) How can one produce a plasma governed only by neoclassical transport in a tokamak?

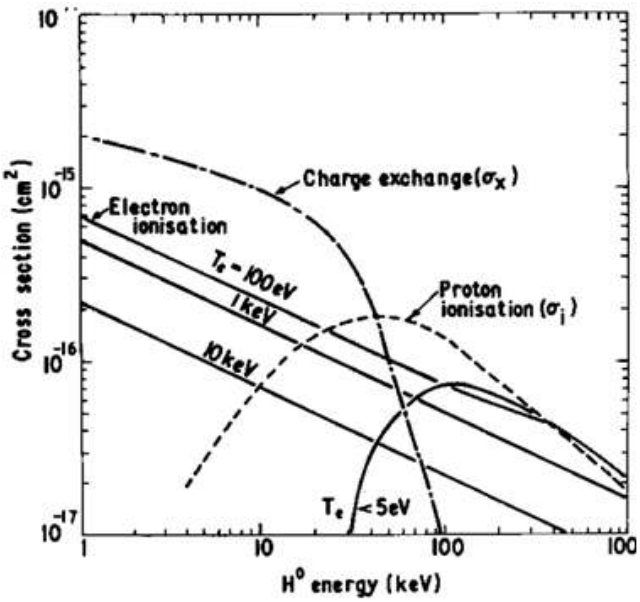
2. (10 points) Why is the fishbone activity crucial in fusion reactors?

3. (1) (10 points) Describe and explain the cycle of the type-I edge localised mode (ELM) in terms of the normalised edge current density and the normalised edge pressure gradient.

(2) (10 points) Fill in the type of ELMs for (1) and (2) in the figure shown below.



4. (20 points) Find the path length of neutral beam injection with the beam energy of 70 keV where the beam intensity I_0 is reduced to (1/e)I_0, assuming that the plasma density and the electron temperature are $10^{20}m^{-3}$ and 1 keV.



5. (10 points) What are the two driving mechanisms of electron cyclotron current in tokamaks?

6. Evaluate the statements: O if correct, X otherwise.

(1) (5 points) It seems unlikely that tokamaks that would lead to practical reactors can be heated to thermonuclear temperatures by Ohmic heating mainly because the plasma resistivity increases as the plasma temperature increases.

(2) (5 points) The magnetic boundary between confined plasma and edge/divertor plasma is separatrix which is called as last closed flux surface.

한 학기 동안 모두들 수고 많으셨습니다.
좋은 결과 얻으시길 바랍니다.

"So we fix our eyes not on what is seen, but on what is unseen. For what is seen is temporary, but what is unseen is eternal." (2 Corinthians 4:18)