

General information

The exercise sessions will be held as blackboard sessions, where the participants will present their solutions to the group. As such, the problems should be set up and solved before the session. The focus of the exercises lies on analyzing and discussing the task at hand together with the group: thus, a perfect solution is not required to be awarded points. A point will be awarded for each question, and a person will be chosen to present their solution from the pool.

Exercise 1.

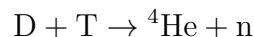
Deuterium-Tritium Fusion

- Explain why deuterium (D) and tritium (T) is expected to be used as fuel for fusion reactors compared to other species (H, He-3, Li, B, etc).
- In the context of the fusion reaction, what are the challenges for D-T?
- Provide examples of fusion reactions that are immune to or less affected by the challenges previously mentioned. Explain the difficulty in using these reactions.

Exercise 2.

Tritium self-sufficiency

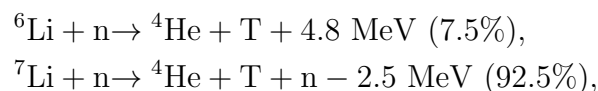
- List the natural and artificial sources of tritium and their estimated inventory/production rates.
- Show that the energy released in deuterium-tritium (D-T) fusion is 17.6 MeV



- Calculate the consumption rate of tritium per year for 1 GW of fusion power. Assume full continuous operation. How does this compare to the world tritium inventory?

Exercise 3.

Tritium is a radioactive isotope of hydrogen with $T_{1/2} = 12.32$ a, making its natural abundance small. Instead, tritium can be bred from lithium according to



where the parentheses refers to the natural occurrence of the isotopes.

- a) Show how fusion reactors can utilize lithium as a tritium source.
- b) What is the fundamental challenge in generating tritium in a fusion reactor?
- c) What can be done to overcome this challenge?
- d) What are the main considerations in designing tritium generation technologies?

Exercise 4.

Outline the main positive and negative aspects on the safety of a deuterium-tritium fusion reactor,

- a) What specific challenges are related to the safety of operating a tritium-fuelled fusion power plant?
- b) What can be done to overcome those challenges?