Contribution ID: **78**   Type: **Poster**

Simulation study of large power handling in the divertor for CFETR phase II

Monday, 5 June 2017 13:40 (2 hours)

The Chinese Fusion Engineering Testing Reactor (CFETR) is the next device for the Chinese magnetic confinement fusion (MCF) program that aims to bridge the gaps between the fusion experiment ITER and the demonstration reactor DEMO. CFETR will be operated in two phases: Steady-state operation and tritium self-sustainment will be the two key issues for the first phase with a modest fusion power of up to 200 MW. The second phase aims for DEMO validation with a fusion power over 1 GW. For meeting both Phase I and Phase II targets and easily transitioning from Phase I to Phase II with the same machine, new design has been made by choosing a large machine with R = 6.6m, a=1.8m, BT= 6-7T since 2015. So far, most physics design are centered around the aims of phase I [1].

The ability to exhaust the plasma power loss is a critical issue to the successful production of a fusion power reactor. In fact, for phase I fusion power of ~200MW is less than ITER, it would not be a serious challenge with a ITER-like W/Cu divertor. However, during Phase II of CFETR, exhausted thermal heat from the core plasma (Psep) is expected to be larger than 200 MW, which is increased for the steady-state operation scenario since larger current drive power is injected into the core plasma. At the same time, the divertor heat load will extremely exceed the material tolerable limit (~10MW/m2), which could prevent the long pulse or steady state operation. Externally seeded impurities can help partially radiate the heat before it reaches the divertor. The seeded impurities however cannot be so large as to negatively impact the plasma performance in the core. We have simulated the baseline operation scenario parameters by using SOLPS5.0 (B2.5-EIRENE) code package for a standard lower single null (LSN) divertor configuration. The modeling shows that Ar (or Kr) puffing is highly effective in mitigation of the divertor peak heat flux. In addition, the radiation loss fraction inside the separatrix will enhances and leads a reduction of the power across the separatrix entering into scrape-off-layer region Psep as impurities puff rate increase. The edge effective charge Zeff and Psep which are experimentally proved to be closely related with core confinement factor H98 [2,3] are studied with Ar and Kr seeding as well. Comparison simulations of different divertor geometries will be performed in this work to optimize CFETR design.

Further work about advanced divertor configuration (field expansion and increase in connection length) together with technical improvement of heat load removal capacity will be study in future.

References:
[1] Y. X. Wan et al., 26th IAEA Fusion Energy Conference, Kyoto, Japan 17-22 Oct. 2016
[2] J. Schweinzer et al., Nucl. Fusion 51, 113003 (2011)
[3] A. Loarte et al., Phys. Plasmas 18,056105 (2011)

Eligible for student paper award?

No

Author: Dr LIU, Xiaoju (Institute of Plasma Physics, Chinese Academy of Sciences)

Co-authors: Prof. LI, Guoqiang (Institute of Plasma Physics, Chinese Academy of Sciences); Dr JIAN, Xiang (University of Science and Technology of China); Dr SHI, Nan (Institute of Plasma Physics, Chinese Academy of Sciences)

Presenter: Dr LIU, Xiaoju (Institute of Plasma Physics, Chinese Academy of Sciences)

Session Classification: M.POS: Poster Session M

Track Classification: Plasma-material interactions, plasma edge physics