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The assessment of the neutron yield and the toroidal distribution of neutron emission on deuterium beam-plasma interaction dominated KSTAR operation

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The importance of neutron emission measurements and modeling at present nuclear fusion device rely on its usage for designing future reactor for shielding as well as the fact that it has the information about the plasma property. Especially a small amount of nuclear heating on SC magnet impacts heavily on safe operation of machine due to tight temperature margin of quenching.
Since the successful first operation in 2008, the plasma performance of KSTAR has been enhanced and duration of H-mode for deuterium plasma is extended to over 50 seconds surpassing the current conventional tokamak operation. In addition to long-pulse operation, the plasma performance is further extended on the high betap discharge characterizing the fully non-inductive discharge over 10 seconds. So there is a lot of production of fast neutrons coming from D(d,n)3He reaction. It is found that most of neutrons are 2.45 MeV neutrons coming from deuterium beam plasma interaction and total fluence for a campaign is about 10ˆ19. Especially, several Ni activation samples are installed in 2015 campaign inside the vacuum vessel and total accumulated neutron flux is calculated from gamma emission measurement after the campaign. The preliminary results show that the neutron activation both inside and outside the vacuum vessel has non-uniform distribution and it has larger neutron flux around poloidal limiter area. Considering the prompt ion loss at nominal KSTAR operation w/wo RMP including the high betap operation, prompt loss ions from 100 keV neutral ion beams hit the specific position on three poloidal limiters, the resulting neutron emission is calculated and compared with the measurements. In addition, 14 MeV neutron from DT reaction is analyzed by neutron activation analysis method using Si and Cu samples whose threshold energy is over 10 MeV. It is estimated that the amount of 14 MeV neutrons is less than 0.5% of that of 2.45 neutrons for 2015 KSTAR campaign.
Including above topics, the presentation will address the recent results on neutron energy spectra using neutron spectrometer based on proton telescope and post radioactive activation measure based on gamma analysis from neutron induced activation on SC tokamak including thermal shield and magnet.

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