Avalanching fast ion losses in KSTAR and implications to energetic particle transport process

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Energetic particles (EP) confinement is one of the most important topics in magnetically confined fusion plasmas. It is of great importance to understand the transport mechanism in order to control the EP particle confinement. In this work, we perform a statistical analysis of the fast ion loss signal associated with the three representative cases: toroidal Alfvén eigenmodes (TAE), fishbone instability, and resonant magnetic perturbations (RMP) in KSTAR. Sets of time series data are acquired from the photomultiplier tube (PMT) of a fast ion loss detector (FILD) system. Statistical analyses show that avalanching fast ion losses prevail for all the cases. In particular, the probability density function (PDF) analysis shows that the deviation from the Gaussian distribution is strongest during the fishbone burst. The aspects of the avalanching process are found to be rather different. The fast ion losses under the TAE and the fishbone instabilities show broad-band spectra and an exponential law for all the range of quiet times. This lack of the power-law feature in the power spectra implies that neither avalanches driven by the self-organized criticality (SOC)-like dynamics nor the diffusive transport mechanism may be applicable in these cases. In contrast, the fast ion loss due to the applied RMP shows a 1/f-like power spectrum in the relatively low frequency (< 1kHz) range and has a quiet time distribution (QTD) following a power law, which is the signature of an SOC-like behavior. Implications of the observations on fast ion transport will be discussed in the conference.