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Oral_14.2: Energetic-particle physics studies with an integrated set of neutron and energetic-particle diagnostics in LHD deuterium discharges

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The Large Helical Device (LHD) has been operated with deuterium gas since March 2017 [1]. One of primary objectives of the LHD deuterium operation is to demonstrate energetic-particle (EP) confinement in a toroidal magnetic field with three dimensionality, and to contribute to comprehensive understanding of EPs in toroidal magnetic confinement system. Because beam-driven DD neutron and secondary DT neutron resulting from burnup of DD-born 1 MeV triton become available in LHD as a new measurement object, LHD has been equipped with an integrated set of neutron diagnostics, e.g. in situ calibrated neutron flux monitor, neutron activation system, vertical neutron cameras etc. [2], and has been steadily extended year by year[3]. The maximum total neutron emission rate has reached 4.1×10^15 (n/s) in LHD. By using this system, change of DD neutron emission profile before and after EP-driven MHD instabilities, presence of beam ion trapped in a helical ripple well has been clearly observed. Confinement of DD-born 1 MeV tritons has been also demonstrated for the first time in heliotron/stellarator plasmas. Lately we have initiated neutron spectrometry to obtain further understanding of beam ions'kinematics [4]. In parallel to the upgrade of neutron diagnostic system, EP diagnostics, e.g. CVD diamond detector as a neutral-particle analyzer [5], Fast-ion D-alpha diagnostics often called FIDA [6] has been largely enhanced. Recent advances of neutron and EP diagnostics, and representative results from EP physics experiments in LHD will be presented.

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[4] S. Sangaroon et al., European Conference on Plasma Diagnostics (ECPD)2021, 7th-11th June, 2021, Virtual conference., room 14 in poster session 02.
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[6] Y. Fujiwara et al., Nucl. Fusion 60 (2020) 112014.

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