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Global Particle Balance and Recycling Properties in Aditya-U Tokamak Plasmas

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Requirement for future fusion reactor is to achieve steady-state plasma operations. Particle balance plays an important role in this type of operation. It is seen in plasma devices that the fuel recycling is an inevitable part of tokamak operation, it also plays an important role in determining the global particle balance. Global particle balance is balance between fuel source and sink during discharge. The source and sink terms specify particles that go into the vessel exhaust, main plasma and into PFC wall/ limiter surfaces. The wall pumping which is the difference between influx and outflow from the wall and material surfaces and reclycling, the ratio of influx and outflux influence the global particle balance in tokamak. Hydrogen influx to the different plasma surfaces can be measured by spectroscopic technique and particle outflux can be obtained by Langmuir probe measurement [1].

In Aditya-U tokamak, which is regularly operated with 350 ms of plasma duration the influx and outflux are measured for both static and dynamic plasma operations i.e. without and with gas puff, using above mentioned diagnostic. In static case, it is been observed that during the initial phase of campaign outflux to the wall is more compare to influx, and the wall has acted as plasma sink. Values of recycling coefficient are within 0.5 to 1.0. But as later as campaign progresses, the outflux to the wall started to reduce and influx from the wall increased, finally wall is acting as particle source for the main plasma and recycling coefficient increases by more than 1 [2]. The particle confinement times are also estimated for static and dynamic plasma operation in presence of external gas. The particle confinement time is observed to be in the range of ~ 5 to 20 ms. In dynamic condition, the particle confinement time, which is the decay time in electron density just after gas puff, has been estimated and compared with that during static condition. The difference between recycling properties in both type of plasma operation is presented.

References:

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