6th Asia-Pacific Conference on Plasma Physics, 9-14 Oct, 2022, Remote e-conference

Investigation of particle transport in I-mode plasma on EAST tokamak

S.X. Wang[1], H. Q. Liu[1], P.J. Sun[1], X. Han[1], Y.F. Jin[2], X.M. Zhong[2], G.S. Li[1], Y.X. Jie[1], H. Lian[1], J.S. Geng[2], and EAST team.
[1] Institute of Plasma Physics, Chinese Academy of Sciences, Hefei
[2] University of Science and Technology of China, Hefei
e-mail : wangshouxin@ipp.ac.cn

In this talk, we report the particle transport in I mode. Dedicated I-mode discharge experiment has been performed on EAST at the beginning of July 2021. Density modulation experiment has been utilized to obtain the diffusion coefficients and convective velocity in different WCM strength situation.
In the experiment, one shot has been chosen to study the difference between particle transport in L-, I-, H-mode. Particle confinement and density peaking factor are almost the same in L-/I- mode, while energy confinement in H-mode is better but density peaking factor is lower compared with L- and I-mode. Further analysis shows that I mode has lower current density gradient and higher temperature gradient in the plasma core, which may be the reason that I mode and L mode has the same density profile in non-inductive case. Preliminary TRANSP simulation results indicate that the effective diffusion coefficients is nearly the same in I mode and L mode at the plasma edge, while the thermal diffusion coefficients is higher in L mode, indicating the decoupling of particle and thermal transport. Diffusion becomes larger in the plasma core in I mode, this is consistent with the strong particle flux in I mode than L mode and H mode. Density modulation experiment has been done in I mode with different WCM strength. The result shows that the diffusion and convection become smaller and the particle flux into the lower divertor target is reduced with weak WCM. Also, compared with I mode, L mode has smaller diffusion coefficient and inward convection.

Density profile becomes more peaked with decreasing collisionality in I mode, like L mode and H mode. But in the same shot, I mode has higher temperature than L mode and lower density than H mode, which makes the I mode has lower collisionality. This means the turbulence level is different in I mode. From the CO2 laser collective scattering diagnostic, I mode has higher turbulence (k = 12 cm^{-1} and k = 22 cm^{-1}) level than L mode and H mode. TGLF simulation also shows the electron-scale turbulence in I mode is higher than L mode.

References

[1] A.E. White et al 2014 Nucl. Fusion 54 083019
[2] P. Manz et al 2015 Nucl. Fusion 55 083004
[3] D.G. Whyte et al 2010 Nucl. Fusion 50 105005
[4] P. Manz et al 2020 Nucl. Fusion 60 096011

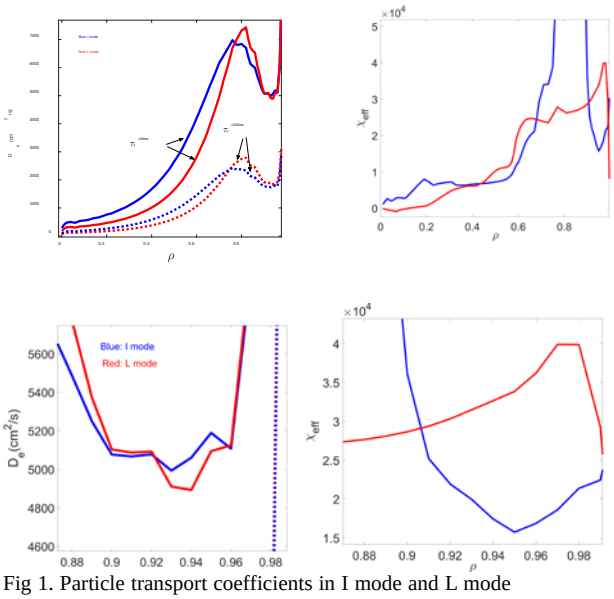

Fig 1. Particle transport coefficients in I mode and L mode

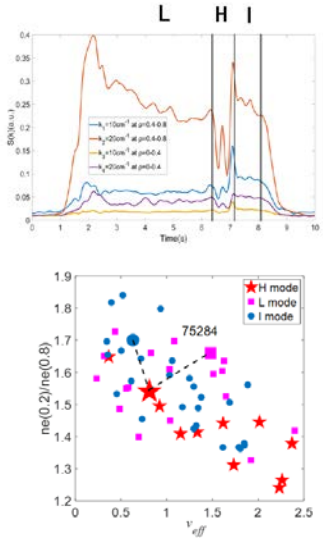

Fig 2. Density peaking and turbulence measured by CO2 laser collective scattering in L-, H- and I-mode mode.