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Investigation of particle transport in deuterium and helium plasmas on EAST tokamak

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ITER will operate with hydrogen or helim-4 plasmas in it's low activation phase. The study of helium-4 plasmas provides valuable information for several physical and technical issues. The operation in helium plasmas have been demonstrated for the first time on EAST under the condition of pure RF-heating and ITER-like tungsten divertor, which will advance physical understanding in support of the ITER non-nuclear operational phase.

To achieve the same line-averaged density, more particles are injected into deuterium plasmas compared with helium plasma, since the retention of helium particles is serious. After switching off all the gas fueling, the density decay time is totally different for helium and deuterium plasmas, which means the particle confinement is different at all plasma position. The pheripheral chords of interferometer have longer density decay time than the central chords due to the recycling effect at plasma edge in helium plasmas. The results indicate that the particle confinement is better or the recycling due to low pumping rate is strong in helium dominant plasmas. Density modulation experiments have been done in both helium and deuterium plasmas. The comparison of perturbed transport coefficients and neoclassical ones in helium and deuterium plasma indicates the particle transport is both turbulence dominant. No obvious discrepancy of particle transport coefficient is found in D and He plasmas.

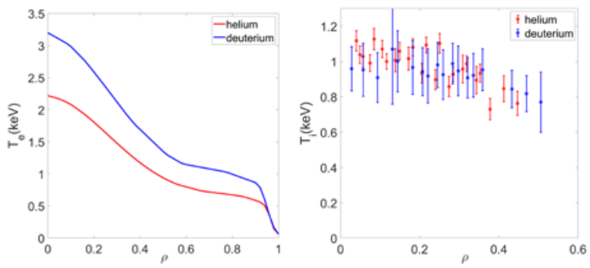

Figure 1. Electron and ion temperature profiles in helium and deuterium dominant plasmas with the same LHW and ECRH power. Plasma current 500kA, line-averaged density $4\times10^{19}m^{-3}$. Electron temperature provided by TS, and ion temperature by XCS.

Helium and deuterium dominant plasmas with the same heating scheme and line-averaged density show totally different behavior. The ion temperature is nearly the same while the electron temperature in deuterium plasma is larger than that in helium plasma. Since the mass of helium ions is twice that of deuterium, heat exchange between ion and electron is different for helium and deuterium plasmas. Besides, tearing mode appeared in helium plasma which has mode number m/n=2/1. This model has the potential to worsen confinement.

Further analysis on density and temperature gradient shows that convective flux is driven by the temperature gradient with the same q95. Recent simulation indicates that the transport is TEM dominant and more simulation are underway using GS2 and TRANSP.

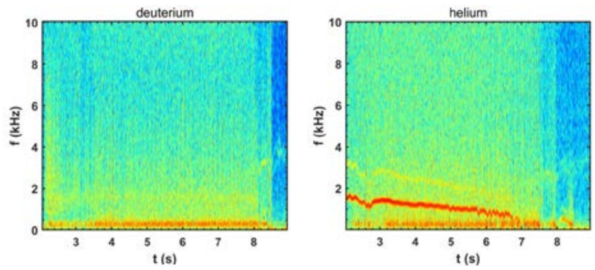

Figure 2. magnetic fluctuation signal show the tearing mode in helium plasma.

References

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