Topic C	Requested: ☐ Oral ☒ Poster	Panel suggestion: ☐ Oral ☐ Poster

Neutral Particle Dynamics in DIII–D*

R.J. Colchin,† R. Maingi,† L.W. Owen,† M.R. Wade,† S.L. Allen,‡ and C.M. Greenfield

General Atomics, P.O. Box 85608, San Diego, CA 92186-5608

Neutral particle studies have been carried out in the upper divertor and comparisons have been made with measurements in the lower divertor of DIII–D. The lower divertor of DIII–D has a relatively "open" pumping geometry for neutral particles. The initial steps toward installing a "closed" upper divertor in DIII–D were made prior to the 1997 run campaign, when a cryo-pump and additional baffling were added on the outboard side. In order to quantify the divertor exhaust and the pressure compression ratio between the divertor and the midplane, fast pressure gauges were installed in the upper divertor plenum and at the midplane during the 1997 campaign.

The maximum upper plenum pressure buildup is comparable to that of the lower plenum under comparable discharge conditions with the pump turned off. We have studied the global neutral particle balance using the following equation:

$$dN_e/dt = S_{gas} + S_{NBI} - Q_{cryo} - S_{wall} \qquad (1)$$

where dN_e/dt is the plasma electron inventory change rate, S_{gas} is the gas fueling rate, S_{NBI} is the NBI fueling rate, Q_{cryo} is the cryopump exhaust rate, and S_{wall} is the wall pumping rate. We estimate the cryopump exhaust rate as the product of the measured plenum neutral pressure and measured pumping speed (determined off-line): $Q_{cryo} = P_{plenum} * S_{pump}$. We infer S_{wall} by measuring all of the other quantities in Eq. (1). Integration of Eq. (1) with time yields the net change in wall inventory, Δ_{wall}. We have found conditions under which $\Delta_{wall} < 0$ at the end of the discharge; this means that the wall is a net source of particles. This condition was observed early in the campaign while the upper divertor was being conditioned. A strong density reduction in H–mode ($\bar{n}_e$ reduced from 0.6*Greenwald limit to less than 0.3*Greenwald limit) was achieved during discharges only when the wall was conditioned and it became a net particle sink, *i.e*. $\Delta_{wall} > 0$.

Finally we have made comparisons of midplane neutral pressures and divertor/midplane compression ratios for the open (lower) and closed (upper) divertor configurations. Initial measurements indicate that the midplane neutral pressure is approximately a factor of 2 lower in the closed divertor configuration under comparable discharge conditions, including energy confinement time. Edge plasma and neutrals transport calculations with the b2.5 and DEGAS code have been initiated to help interpret the observed changes of the midplane neutral pressure, compression ratio, and D_α emission. Details of these calculations will be presented.

---

*Work supported by U.S. Department under Contract Nos. DE-AC03-89ER51114, DE-AC05-96OR22464, and W-7405-ENG-48.

†Oak Ridge National Laboratory.
‡Lawrence Livermore National Laboratory.