Effects of impurity seeding on divertor detachment
Up-down asymmetry of divertor particle and heat loads

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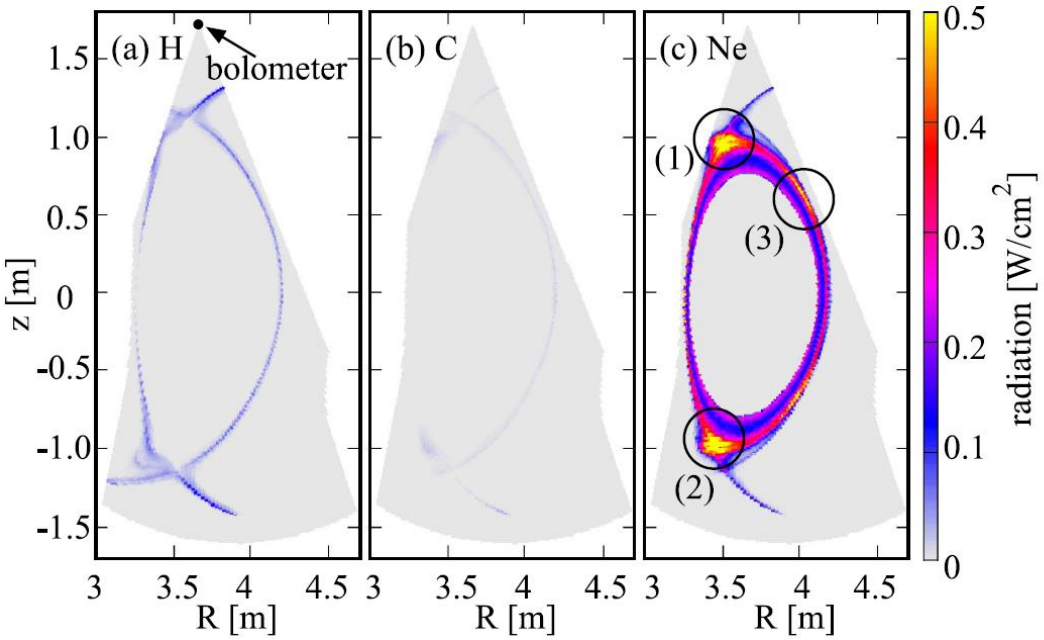
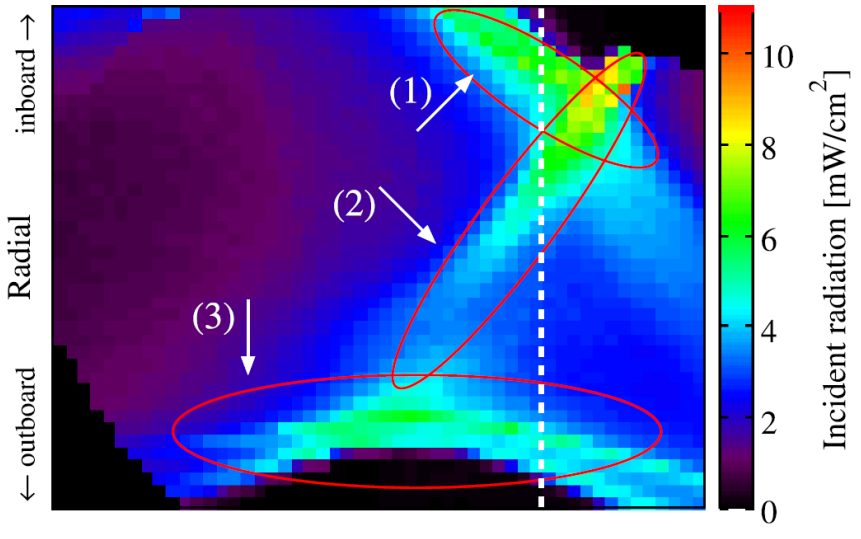
Impurity seeding experiment

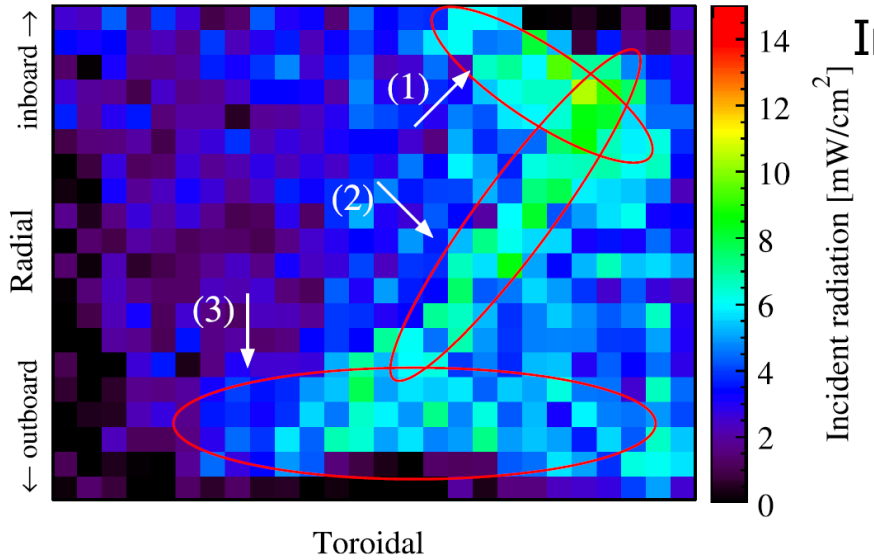
- To investigate the effects of impurity gas seeding on radiation enhancement and reduction of electron temperature.
  - ✓ Nitrogen, neon, argon, and xenon are considered.
  - ✓ Differences in radiation zone for each impurity will be measured by using the imaging bolometer and spectroscopy.
  - ✓ Toroidal asymmetry of divertor plasma behavior will be measured by using Langmuir probes embedded in divertor tiles and thermography.

Comparison of measured and simulated radiation profiles during Ne seeding in LHD





EMC3-Eirene

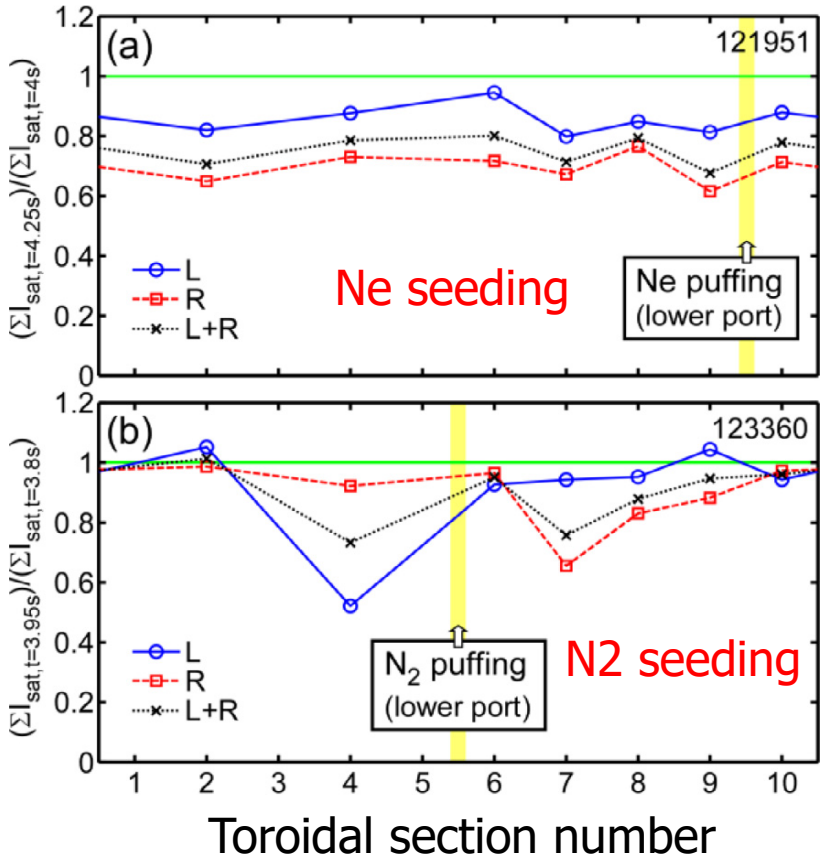


Imaging bolometer

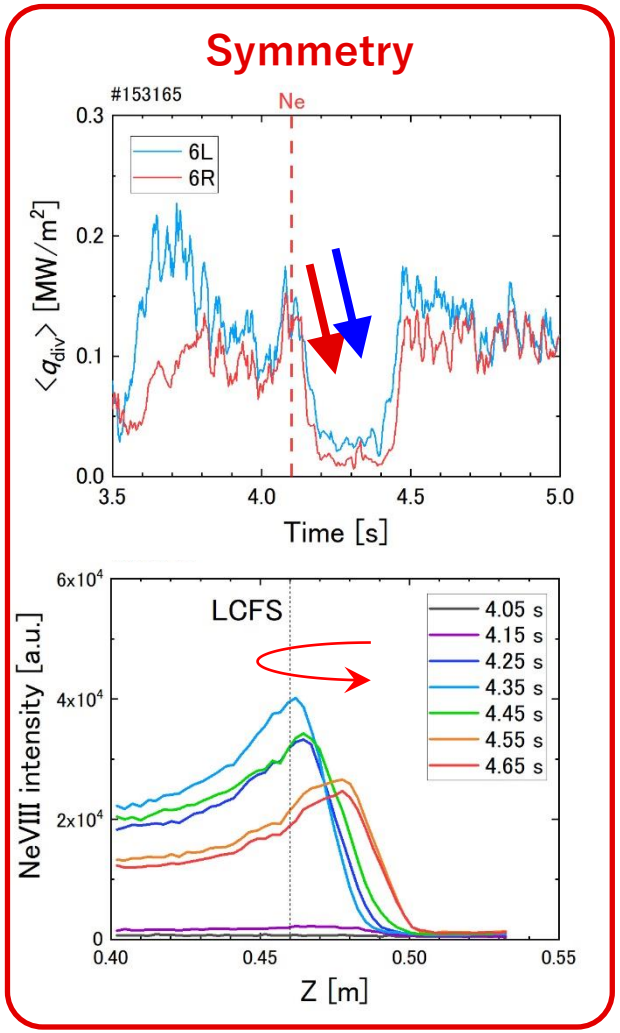
G. Kawamura et al, Plasma Phys. Control. Fusion 60 (2018) 084005

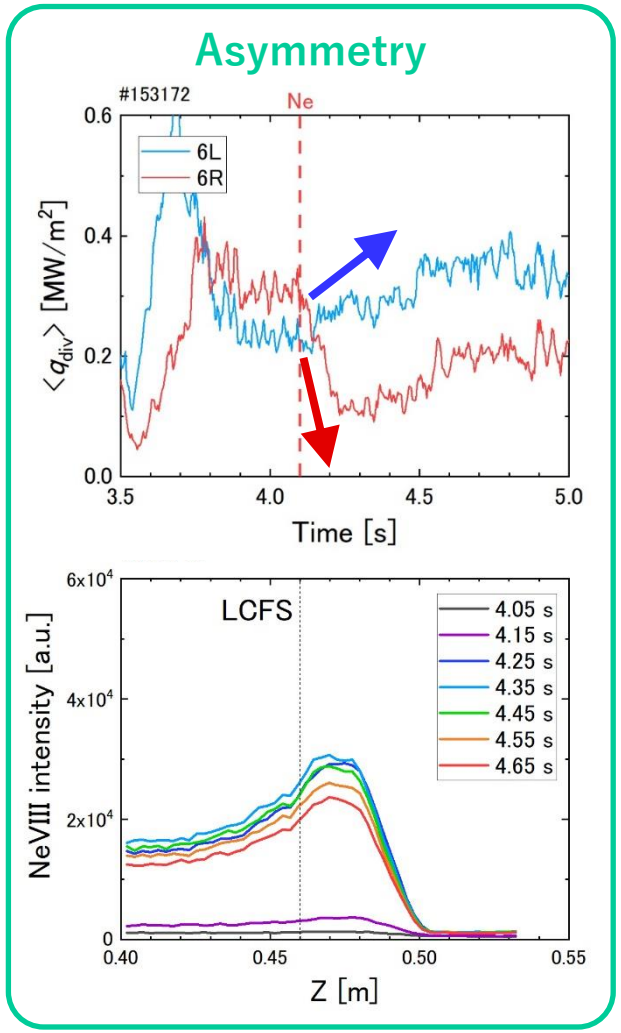
Toroidally asymmetric divertor plasma behaviors have been observed in LHD.

Isat,detach / Isat,attach



H. Tanaka et al., Nucl. Mater. Energy 12 (2017) 241.





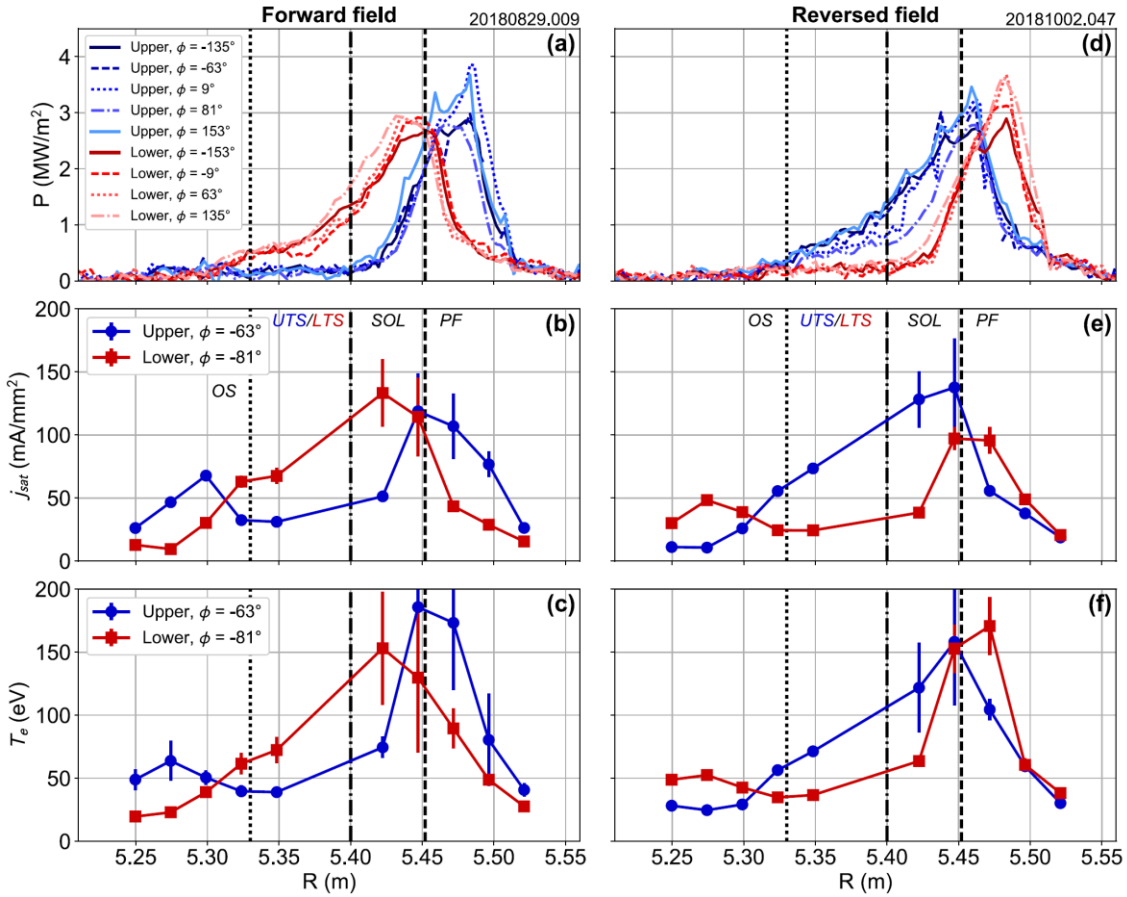
Ne seeding exp.

K. Mukai

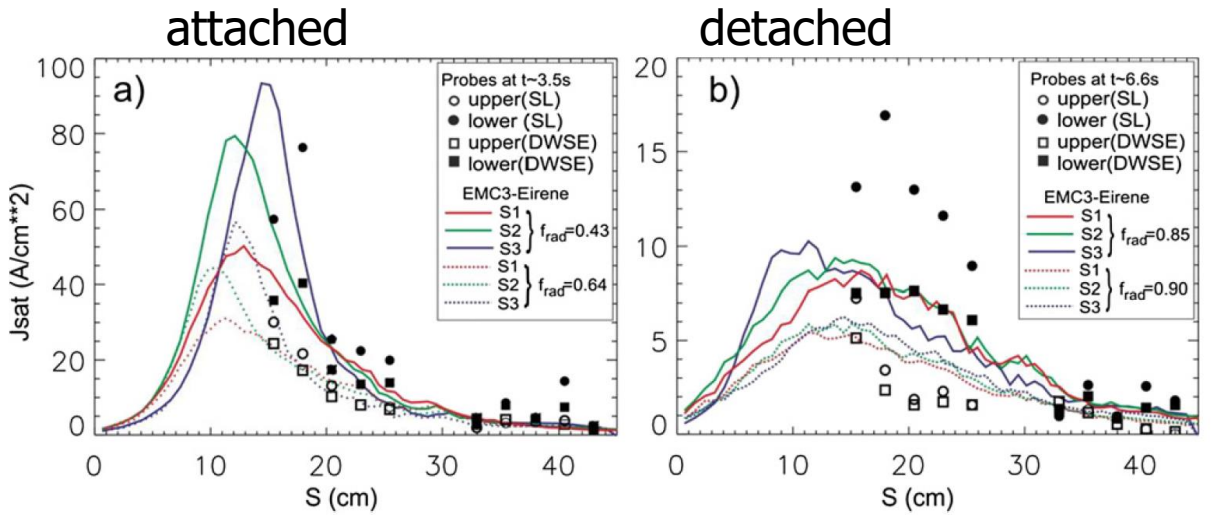
Up-down asymmetry of heat and particle loads on divertor tiles

- To systematically investigate the up-down asymmetry of heat and particle loads on divertor tiles.
  - ✓ Density and heating power will be scanned, respectively.
  - ✓ Discharges under high and low magnetic field strength, and forward and reversed fields will be conducted.
  - ✓ The up-down asymmetry in detached plasma is also investigated.
  - ✓ Comparison of H and He discharges is interesting.

Observed up-down asymmetries of plasma parameters in W7-X



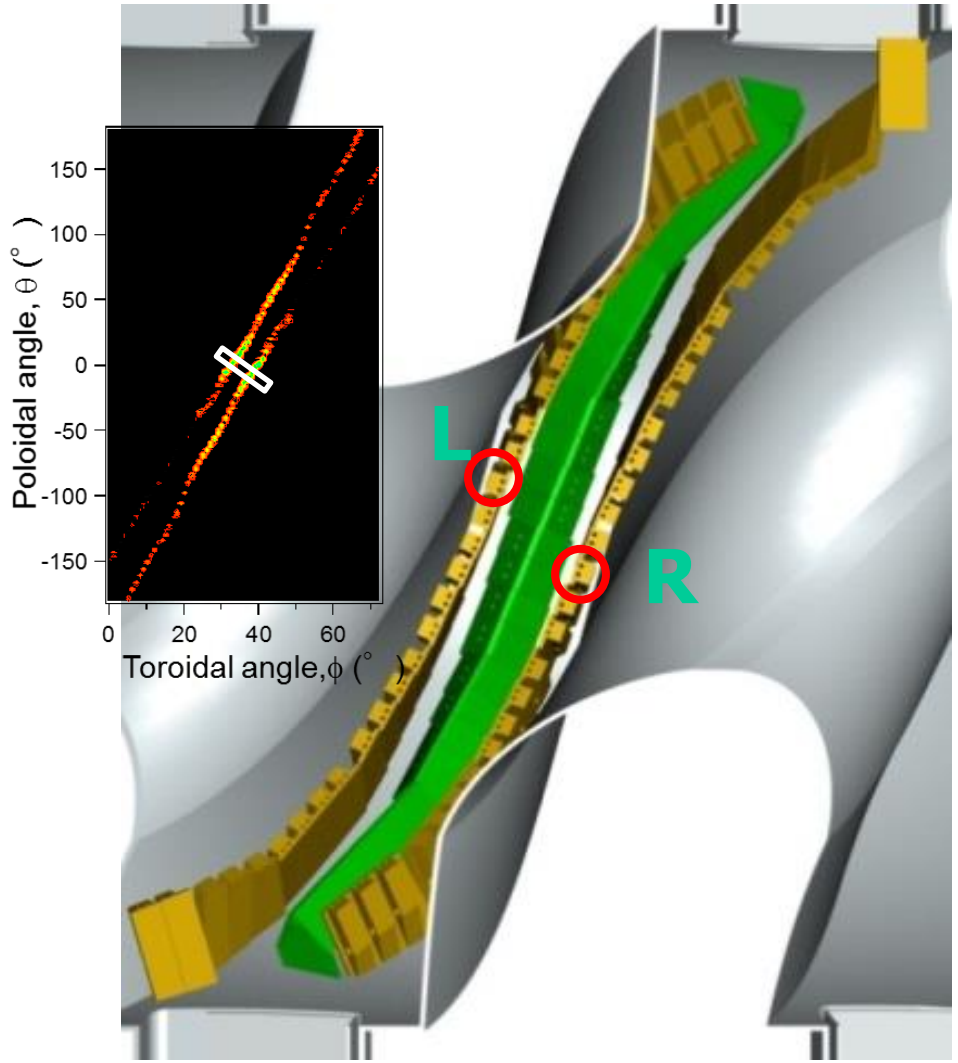
K. Hammond et al, Plasma Phys. Control. Fusion 61 (2019) 125001.

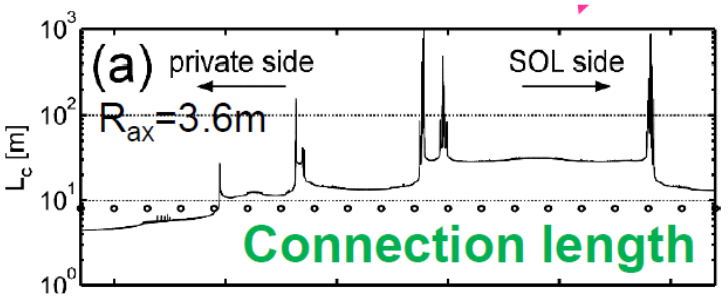


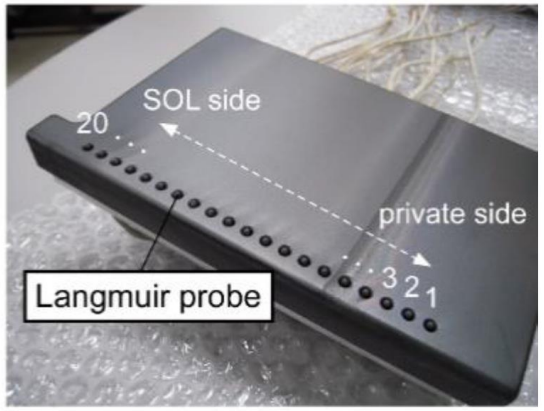
Y. Feng et al, Nucl. Fusion 61 (2021) 086012.

Is the asymmetry enhanced during detachment?

Measurement of divertor plasma asymmetry in LHD



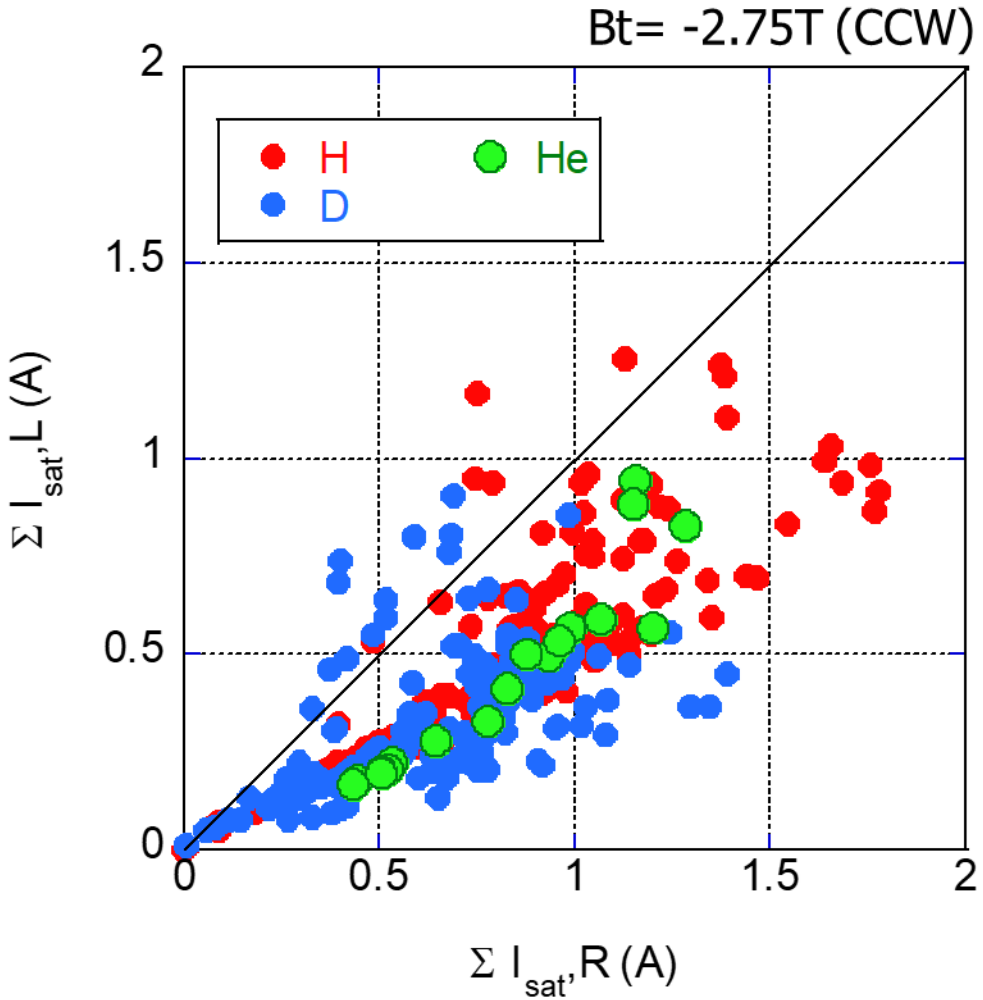


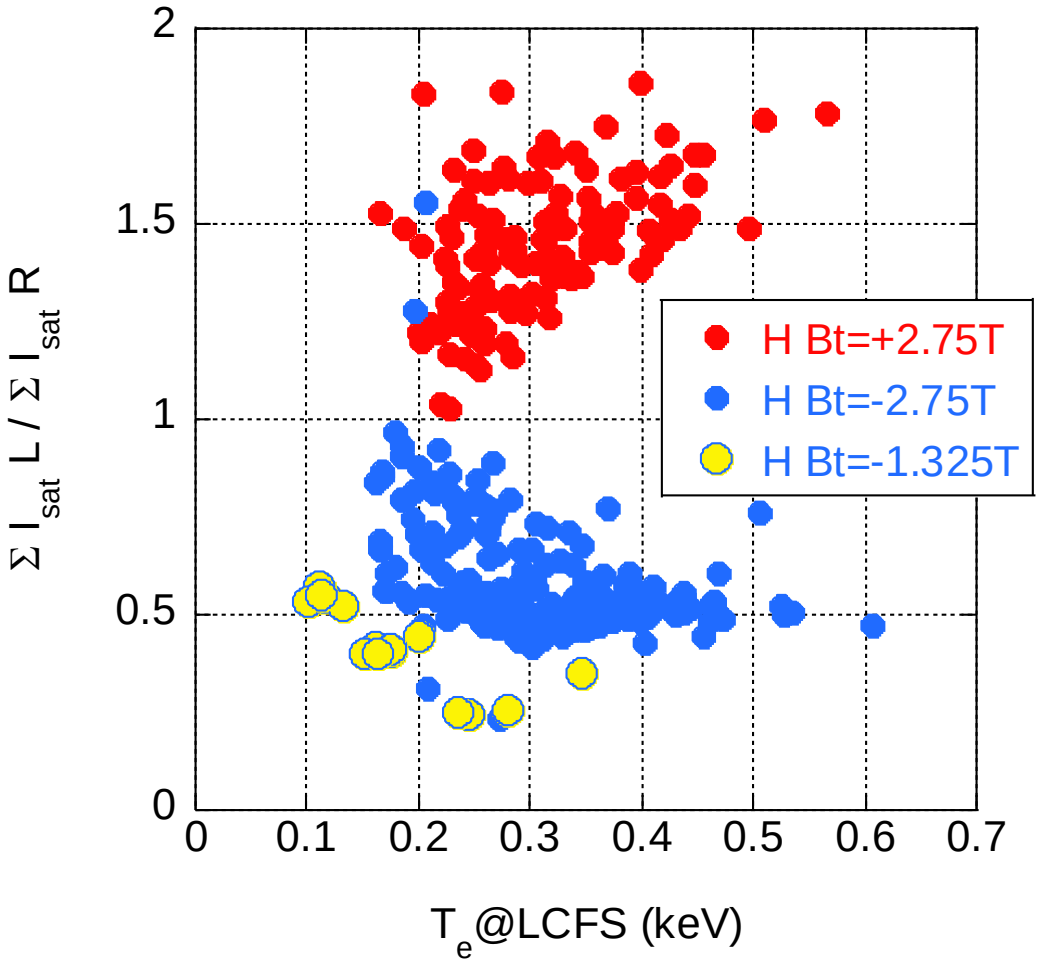


In this study, total ion saturation current to the Langmuir probe arrays are presented as ΣI_{sat} **L**, and ΣI_{sat} **R**, respectively.

The analyzed data were obtained during NBI heated plasmas.

Observed asymmetry in particle load on divertor tiles in LHD





S. Masuzaki et al, Nucl. Mater. Energy 18 (2019) 281.

Experimental conditions

- Density: 1E19 – 10E19 /m3
- Heating power: 2 – 6 MW
  - ✓Comparison btw NBI and ECH is interesting
- Magnetic configuration: low-iota, standard
- Magnetic field strength: low and high
- Magnetic direction: forward and reversed