Toroidal divertor flux deposition asymmetries due to localized gas injection

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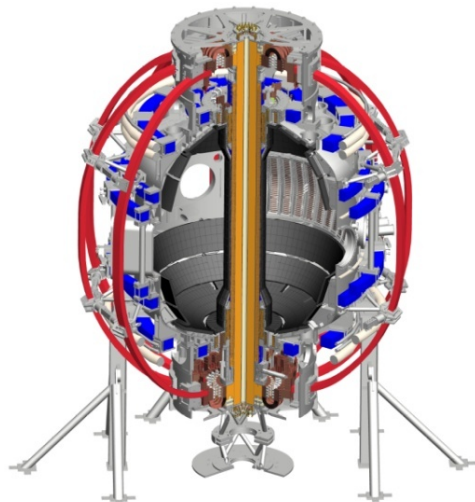
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# Localized divertor gas puff can cause toroidal asymmetries in SOL radiation, divertor electron pressure

- Alcator C-Mod has 5 divertor gas injectors with layout similar to ITER design

- Gas injectors sequentially activated in separate shots in L- and H-mode experiments at request of IO

  - Compare diagnostic data shot-to-shot to look for asymmetries

- L-Mode: Repeatable toroidal variation observed on many divertor diagnostics

- H-Mode: Asymmetry greatly reduced

Div. Probes

Div. Bolo.

Puff Locations

Div. Probe

Div. Spec.
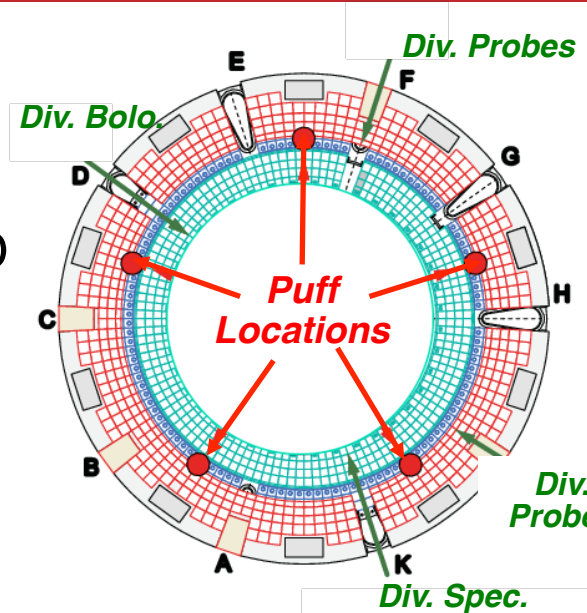
Divertor Electron Pressure
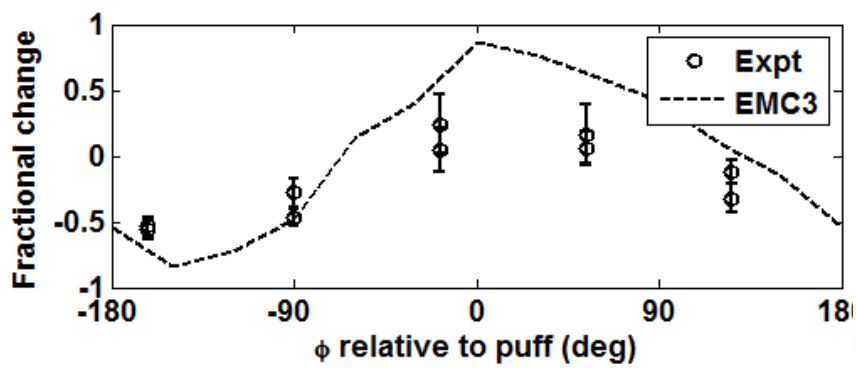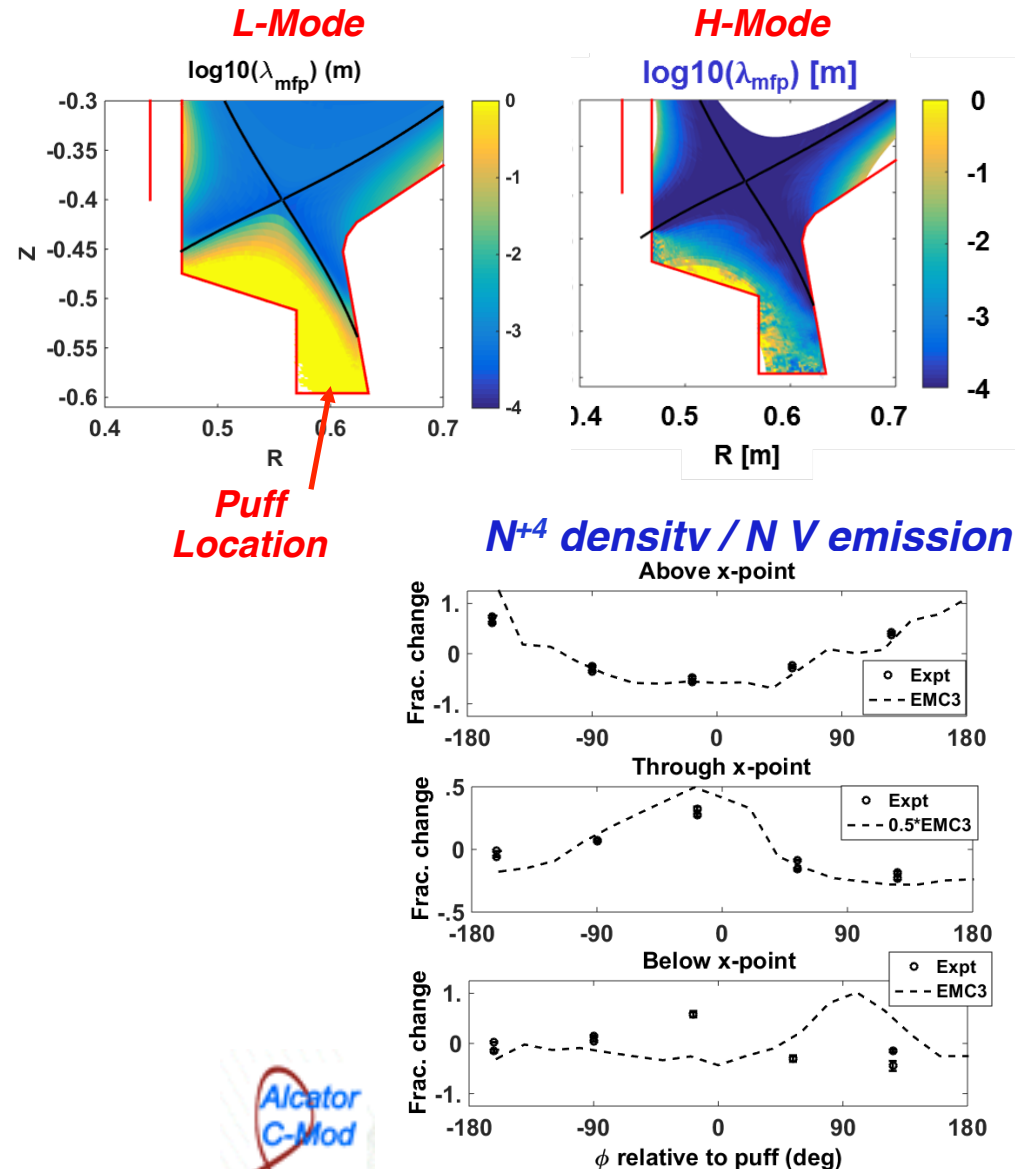

N V emission
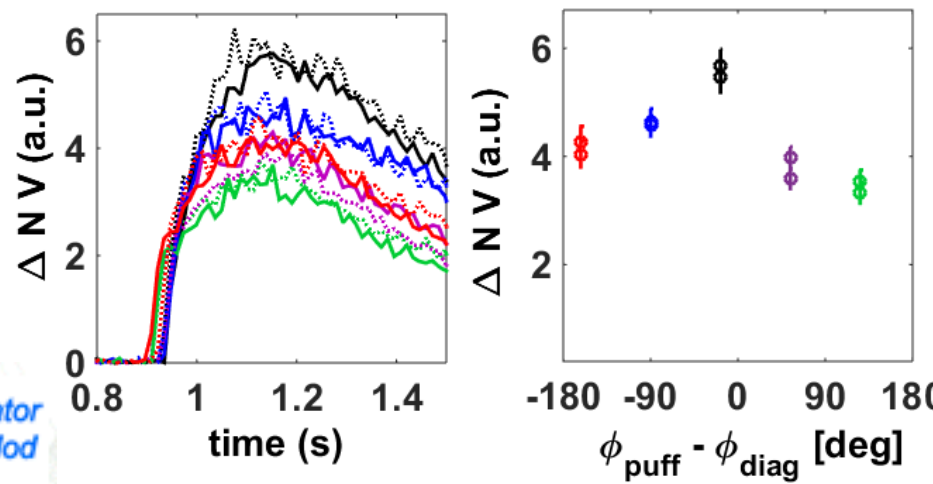
3D modeling indicates asymmetry depends on injection and ionization location of impurities

- Experiments were modeled using EMC3-EIRENE code

- Qualitative agreement found in level of asymmetry in L- and H- mode.

  – Difference attributed to impurity ionization

- Asymmetry in divertor heat flux predicted in L-mode, however no IR camera data available

L-Mode $\log_{10}(\lambda_{mfp})$ (m)

H-Mode $\log_{10}(\lambda_{mfp})$ [m]

Puff Location

N^{+4} density / N V emission

Above x-point

Through x-point

Below x-point

ϕ relative to puff (deg)

Experimental plan

- For most ITER relevance, use high-power discharges detached with both valves

  - Once baseline established, use single valve and change active valve over two shots to achieve the broadest coverage

- Also take L-mode (or possibly low power H-mode) to investigate relationship between impurity ionization and asymmetry

- Ideally use multiple gasses with different recycling characteristics (N2 and Ne? → or choose based on camera filters, CH4?)

- Modeling suggests puff position relative to strike point very important, try impurity injection in SOL vs PFR if enough time