Intrinsic impurities in MST are Aluminum, Boron, Carbon and Oxygen

- MST has a 5 cm thick aluminum vacuum vessel
- Inside the vessel, there are poloidal and toroidal carbon limiters, carbon and ceramic tiles
- Boronization has been attempted recently

Measurements are done for high-temperature high-current improved confined plasmas

- Plasma current ~ 500 kA
- Electron density ~ 10^{19} m^{-3}
- Electron temperature ~1.5-2 keV
- "Pulsed Poloidal Current Drive" used to mitigate field line stochasticity

High resolution measurements of aluminum are obtained in fusion grade plasma

- Aluminum charge exchange cross-section is orders of magnitude higher than its electron impact excitation (background) cross-section. Measurements are possible with modest concentrations.
- Data-fitting takes into account fine-structure transitions
- $T(\text{Al}^{+13}) = T(\text{Al}^{+11})$ ~ 1.2 keV
- A collisional radiative model (ADAS) used to estimate densities of other charge states.

Equation: $n_{\text{imp}}(r) = n_{\text{D}}(r) \frac{T_D(r)}{T_D(0)} Z_{\text{eff}}^2$

- As bulk ion (D) density profile is flat, "temperature screening" (thermal force due to temperature gradient) expels impurities from the core resulting in a hollow $Z_{\text{eff}}$ profile.
- Experimental radial profile of carbon (points) in good agreement with classical transport prediction (solid line).

Impurities are expelled from the core and radial profile evolves to a hollow shape.

- One radial position per discharge
- Spatial accuracy ~ 1 cm
- Viewing chord separation $\Delta r/a = 0.17$
- Capable of measuring various impurities
  - C VI (343.4 nm)
  - B V (298.1 nm)
  - O VIII (297.5 nm)
  - Al XI (321.1 nm)
  - Al XIII (310.7 nm)

Estimated $Z_{\text{eff}}$ profile is hollow, less than previous estimates

- Calculated using measured impurities in conjunction with a collisional radiative model.
- Previous estimate from X-ray measurements and modeling range from $Z_{\text{eff}}$ ~ 4 – 6.
- Reason for this discrepancy is not clear at present.

Equilibrium radial profile from classical flux:

- $n_{\text{imp}}(r) = n_{\text{D}}(r) \frac{T_D(r)}{T_D(0)} Z_{\text{eff}}^2$

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