Impurity Transport Studies in LHD

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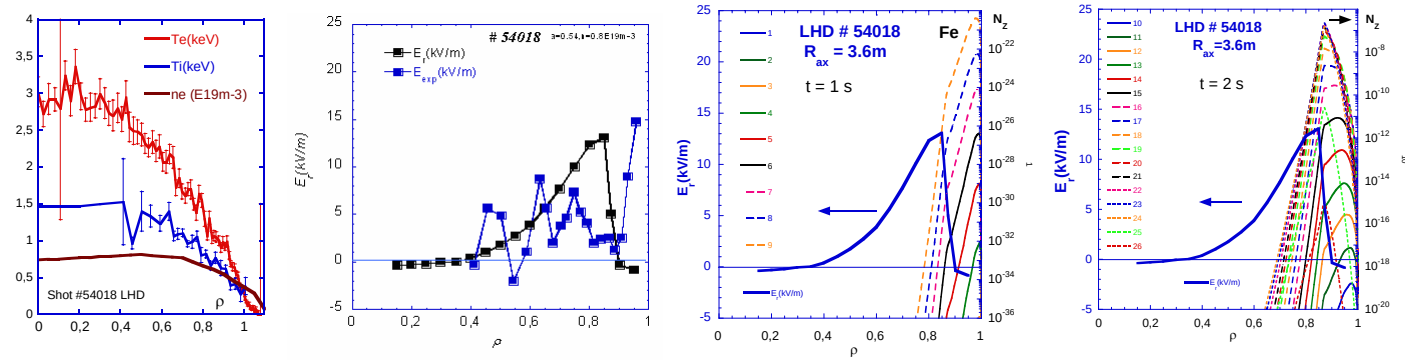
Large Helical Device

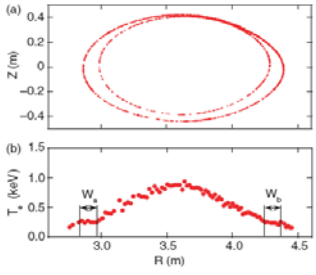
Screening effect of the positive electric field

LHD Shot # 54018 Rax=3.60m low density case



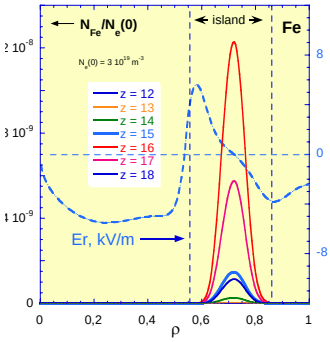
Fe distribution at t=1s and t=2s. The source at the separatrix (r=1) was turned off at t=0.1s. Fe ions are completely screened by positive electric field.

Impurity control by external island



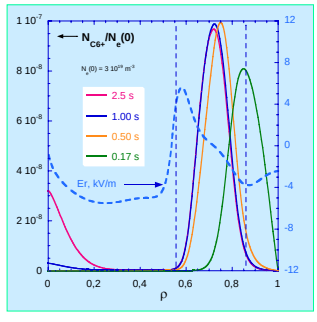
(*a*) The structure of the *n/m* = 1/1 magnetic island in vacuum.
(*b*) the Te profile at the midplane
The width of the island (*Wa* , *Wb*) is about 15 cm.

Y. Nakamura *et al Nucl. Fusion 43, (2003), p.219*

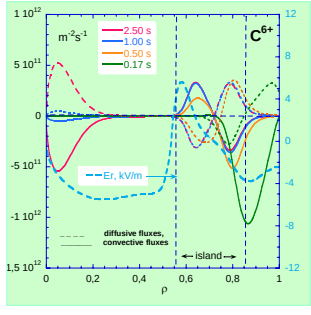


Distribution of Fe ions in an LHD discharge with island

Cconductive and diffusive (dashed) fluxes of C ions at the edge in an LHD discharge with externally induced island



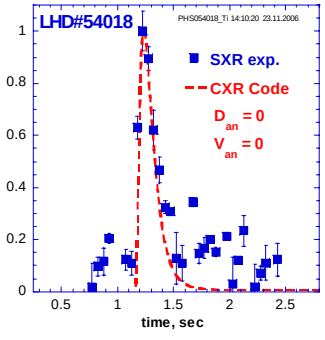
Carbon distribution at different t



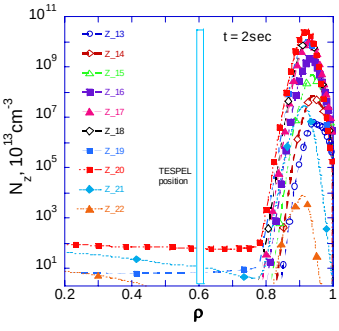
Impurity control by external island

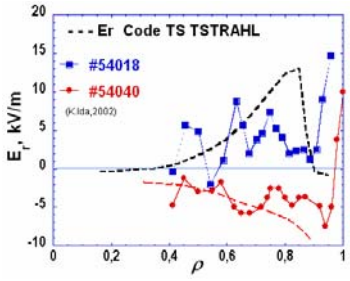
SIT STRAHL Code: Analysis of the TESPEL SXR Signal

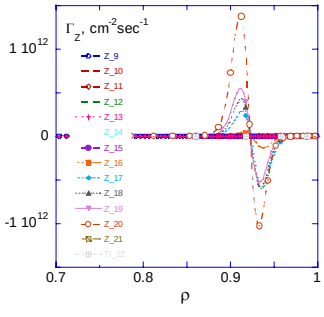
TESPEL Ti Kα emission (a.u.)



Ti ion density radial distribution







Objectives

using SIT STRAHL Code to investigate

- **screening effect of positive Er**
- **screening effect of magnetic island**
- **to analyze of the TESPEL signal**

CONCLUSIONS

- A new **Stellarator Impurity Transport Code (SIT)** has been developed aiming to describe impurity behaviour in the frame of stellarator-relevant neoclassical transport theory.
- Modeling with the SIT STRAHL code of SXR signal of TESPEL and assessments of the impurity transport coefficients have been started.
- At low plasma density the neoclassical transport dominate the impurity Ti ions transport, whereas at high density it seems to be anomalous.
- Calculation show that in contrast to tokamak plasmas the temperature screening effect does not appear in stellarator configurations. The radial electric field plays a dominant role in pulling the impurities into the plasma core. Only in the case of low density and high temperatures (positive radial electric field) one can expect the impurity retention at the plasma edge.
- It is shown that impurity ions can be retained within an externally induced magnetic island (m=1, n=1) near the plasma edge. This happens due to a positive electric field in the innermost part of the island, which prevents the impurities from penetrating.