Hydrogen and Helium Edge-Plasmas

Comparison of high and low recycling

T.D. Rognlien and M.E. Rensink
Lawrence Livermore National Lab

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Outline

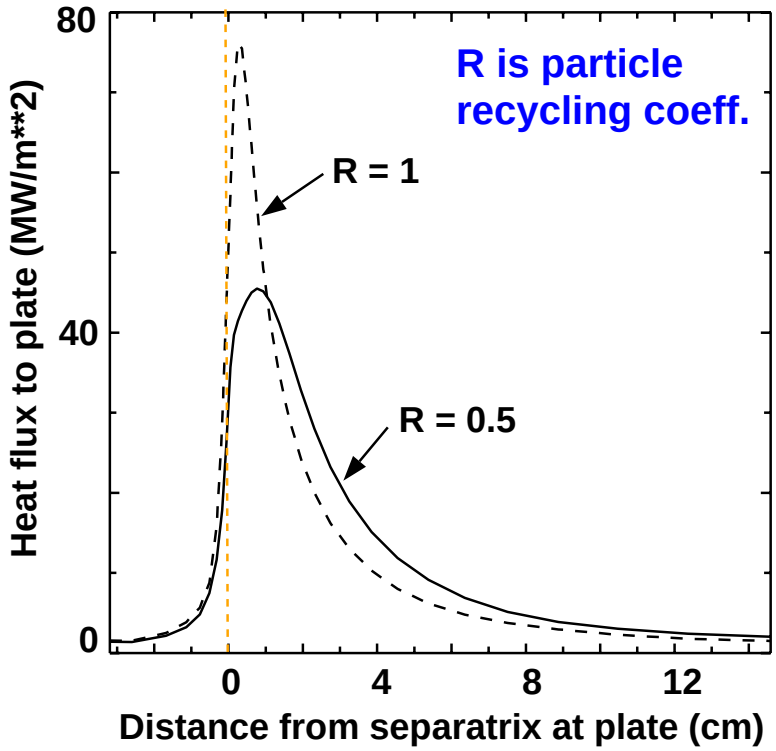
1. High- and low-recycling hydrogen plasmas

2. ARIES-RS results

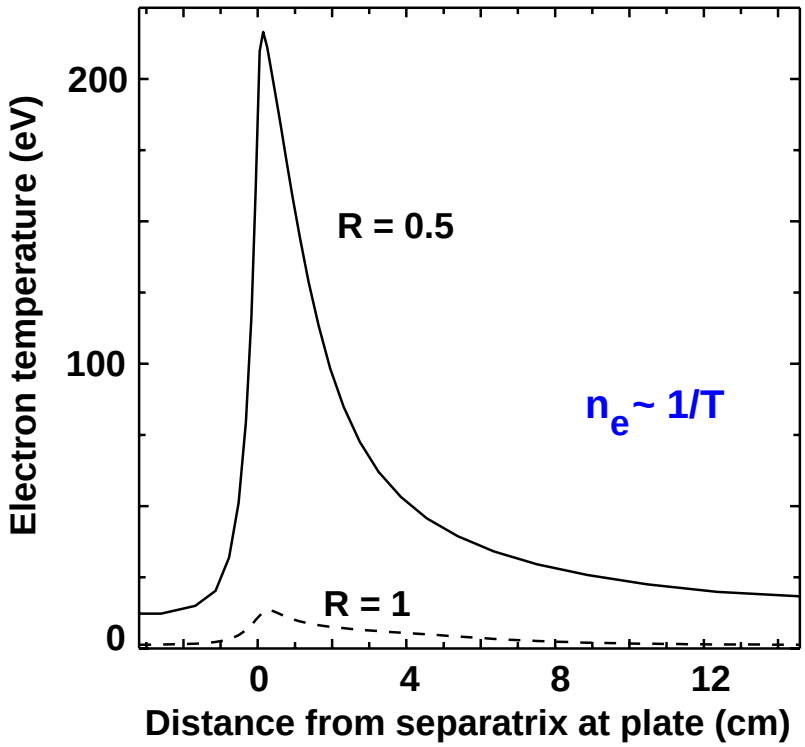
3. Helium spatial concentrations

High and low recycling have similar plate heat flux profiles

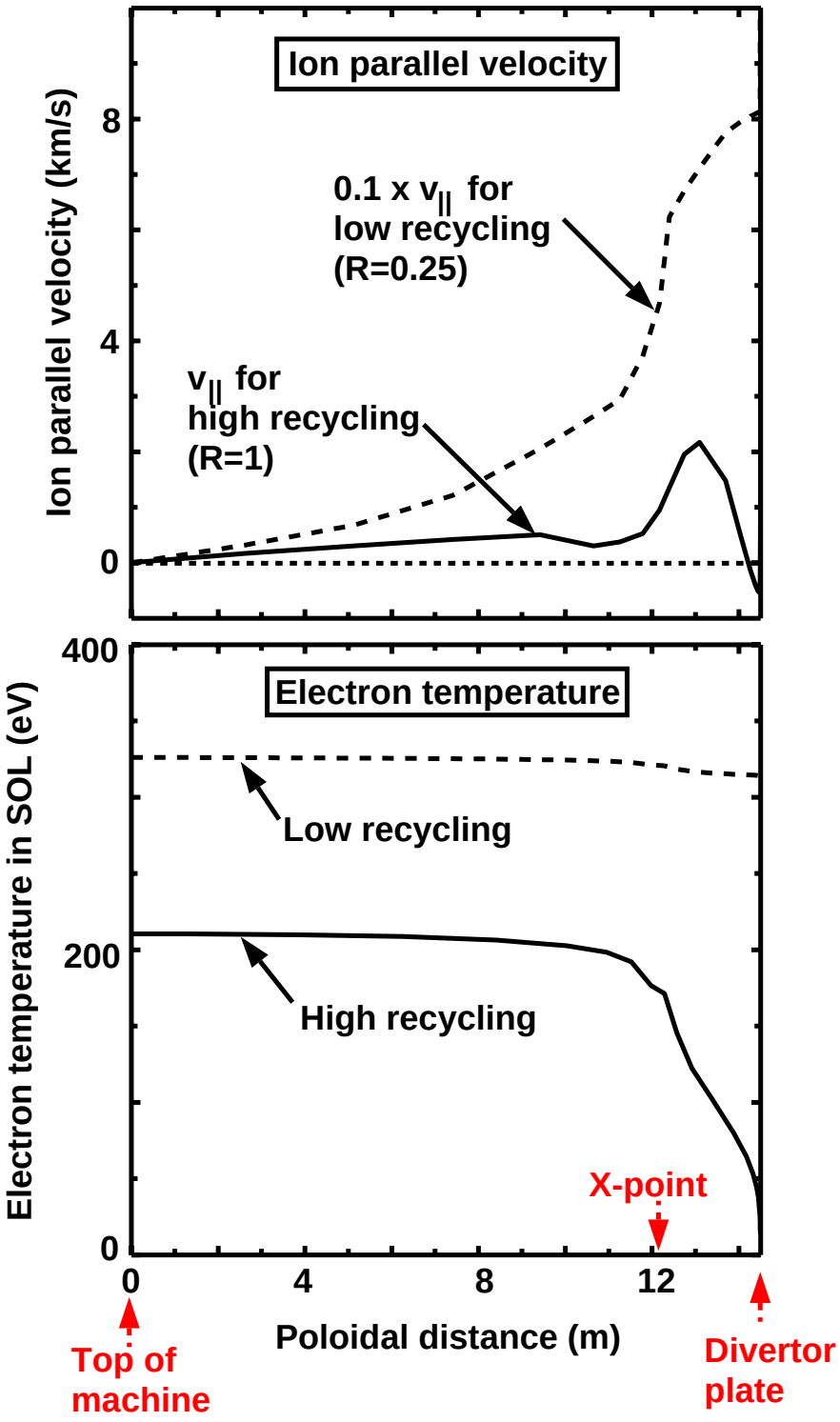
ITER-like geometry with 150 MW into SOL



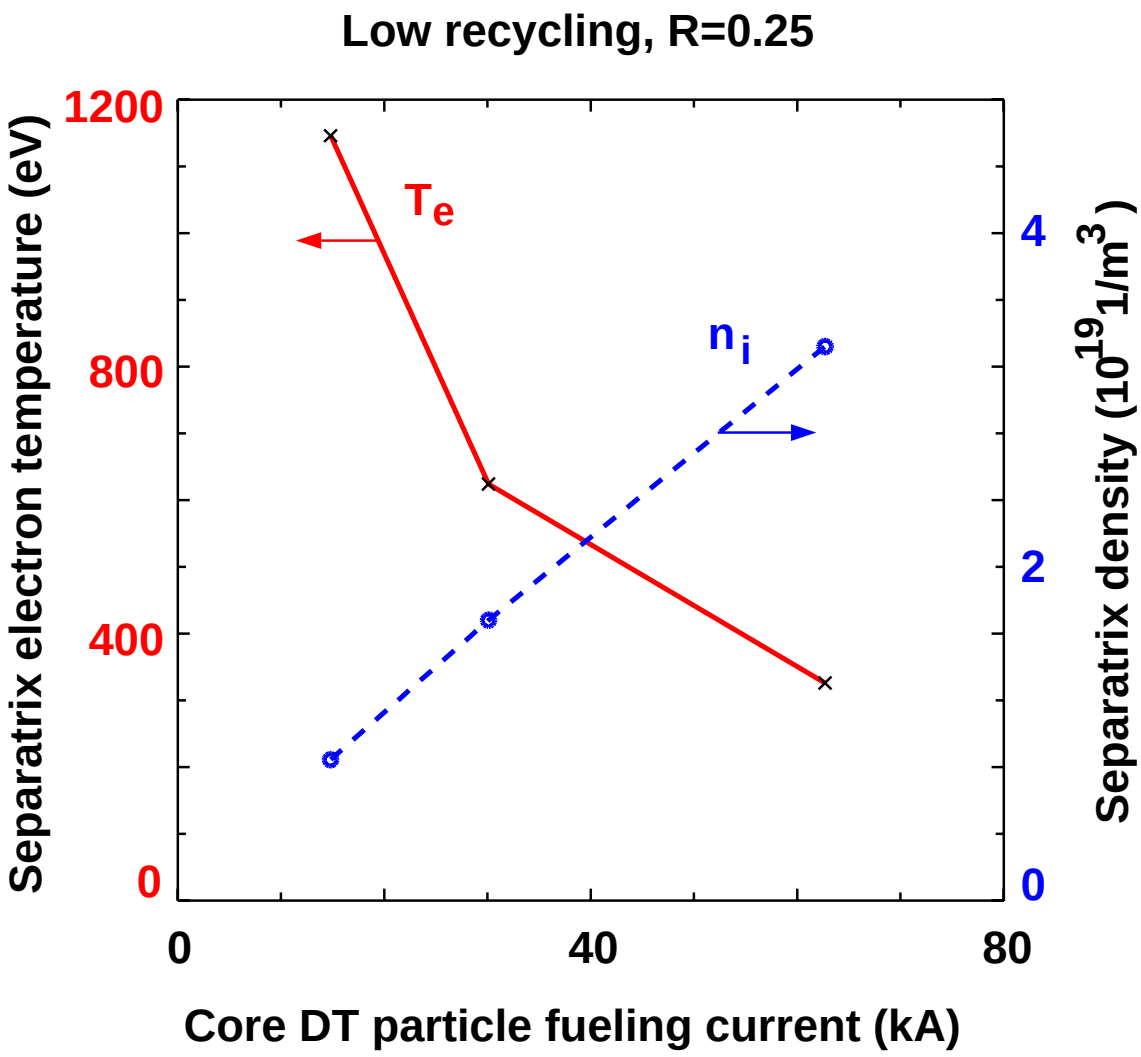
1-D plasma pressure balance is broken by radial transport for R=0.5 case



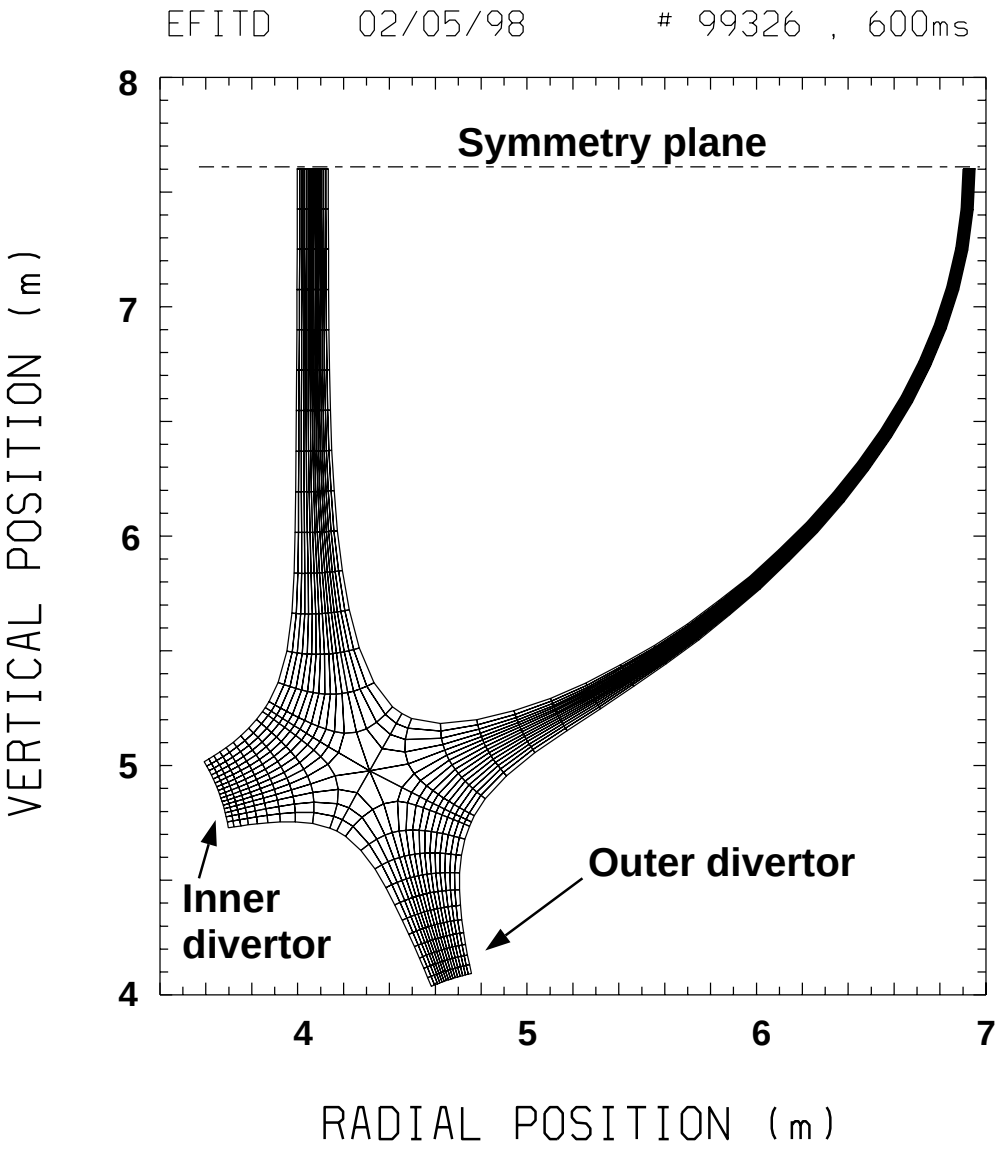
Edge plasma changes from low to high recycling



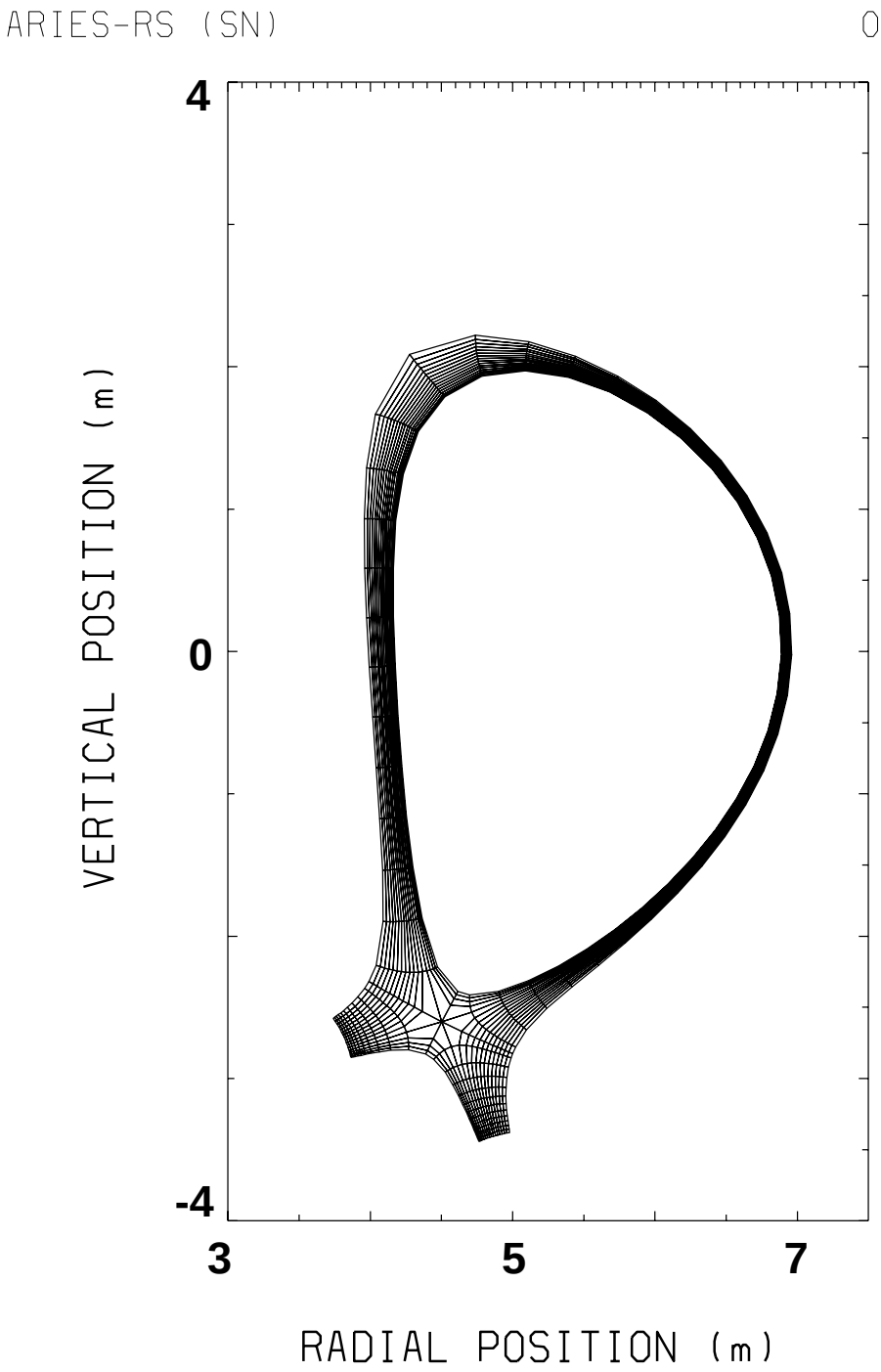
Low recycling yields hot edge plasma unless there is very large DT particle fueling



Mesh obtained for standard ARIES-RS with symmetric double-null divertor

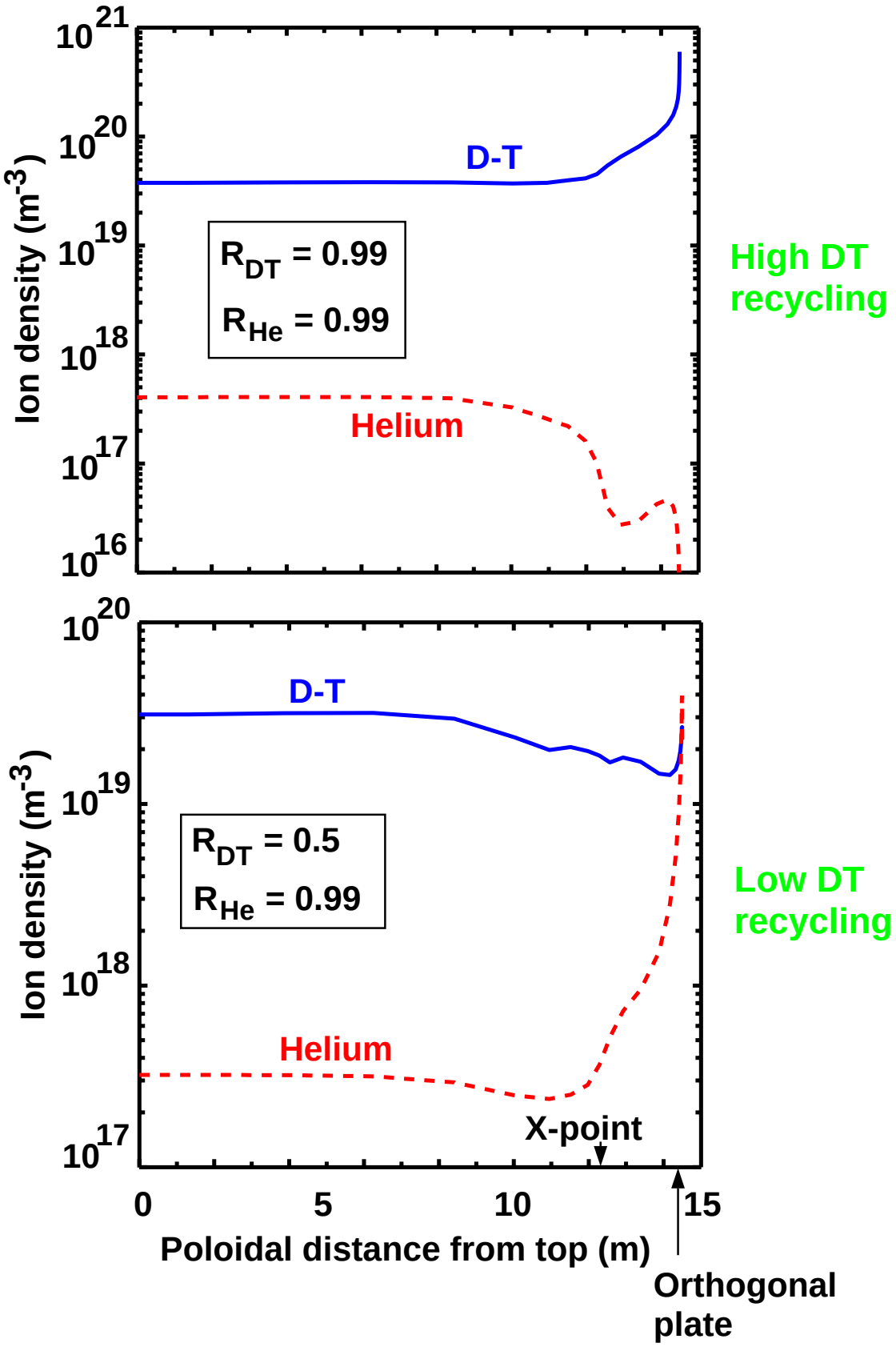


Small modification to poloidal B-field coils used to produce single-null configuration



Resulting divertor plasma parameters given in a memo

Low recycling hydrogen can give much better helium compression in divertor

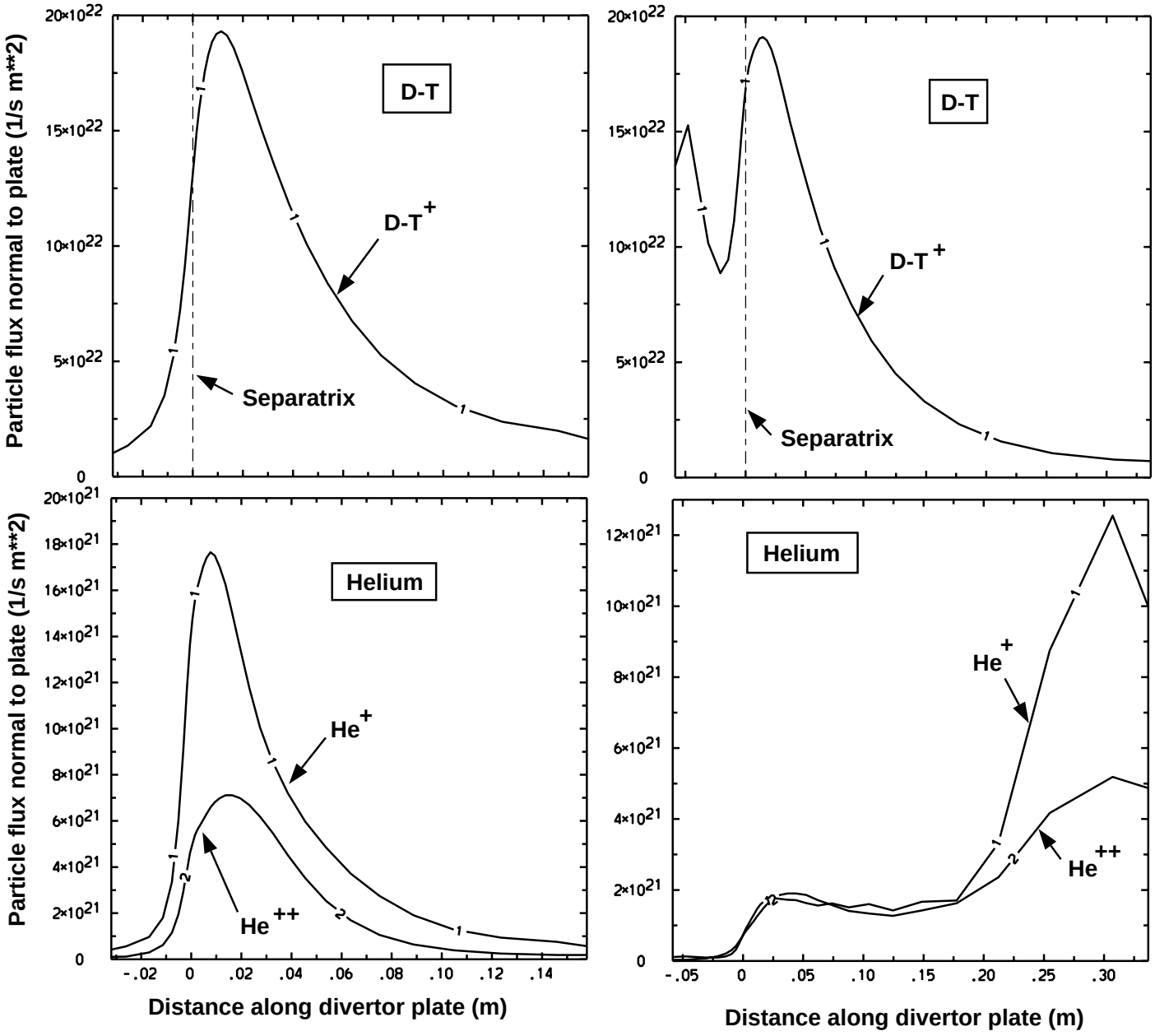


Helium flux displaced toward outer wall for vertical divertor plate

1% helium at the core-edge boundary
R_hydrogen = 0.5, R_helium = 0.95

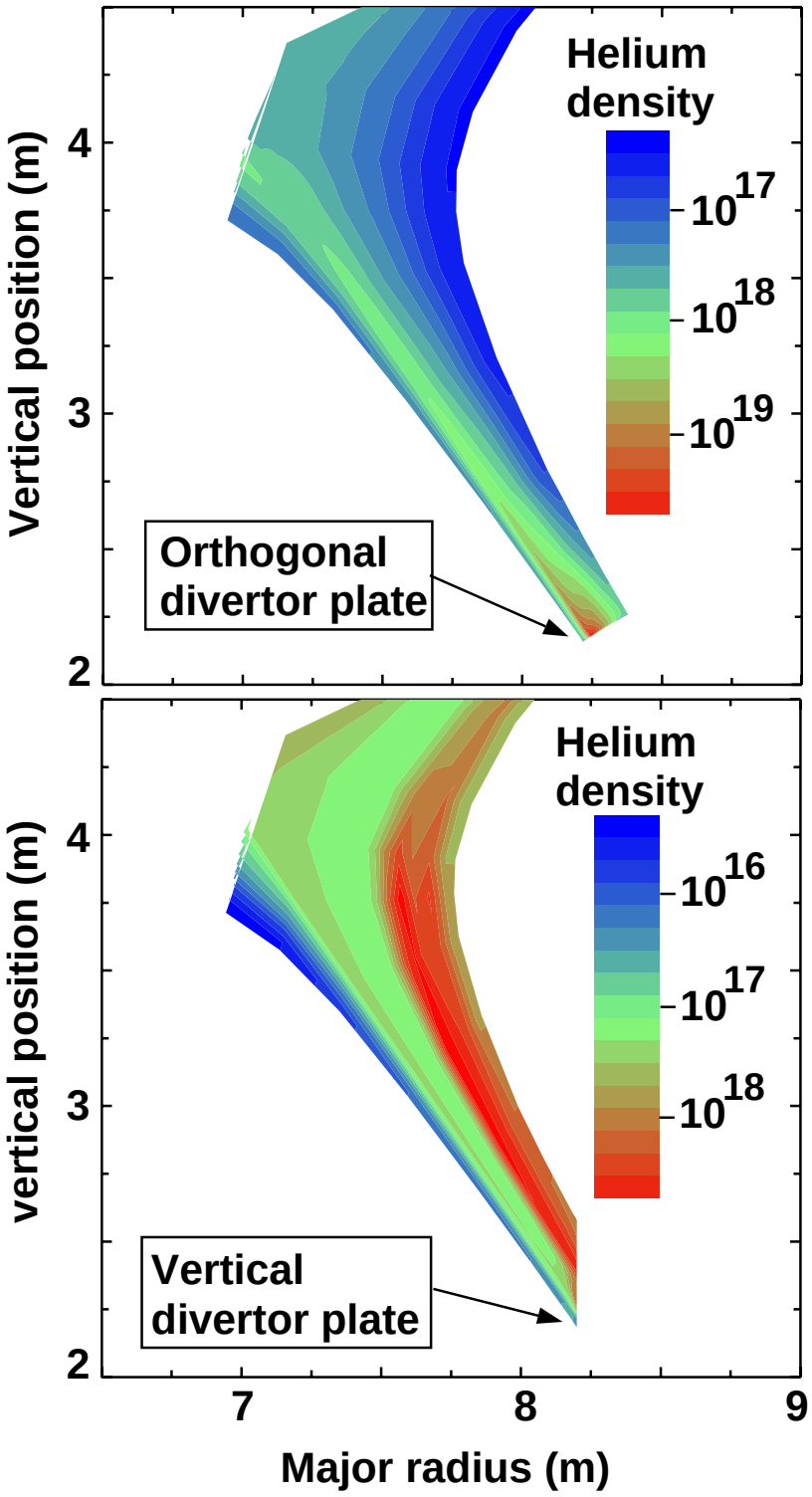
Orthogonal divertor plate

Vertical divertor plate

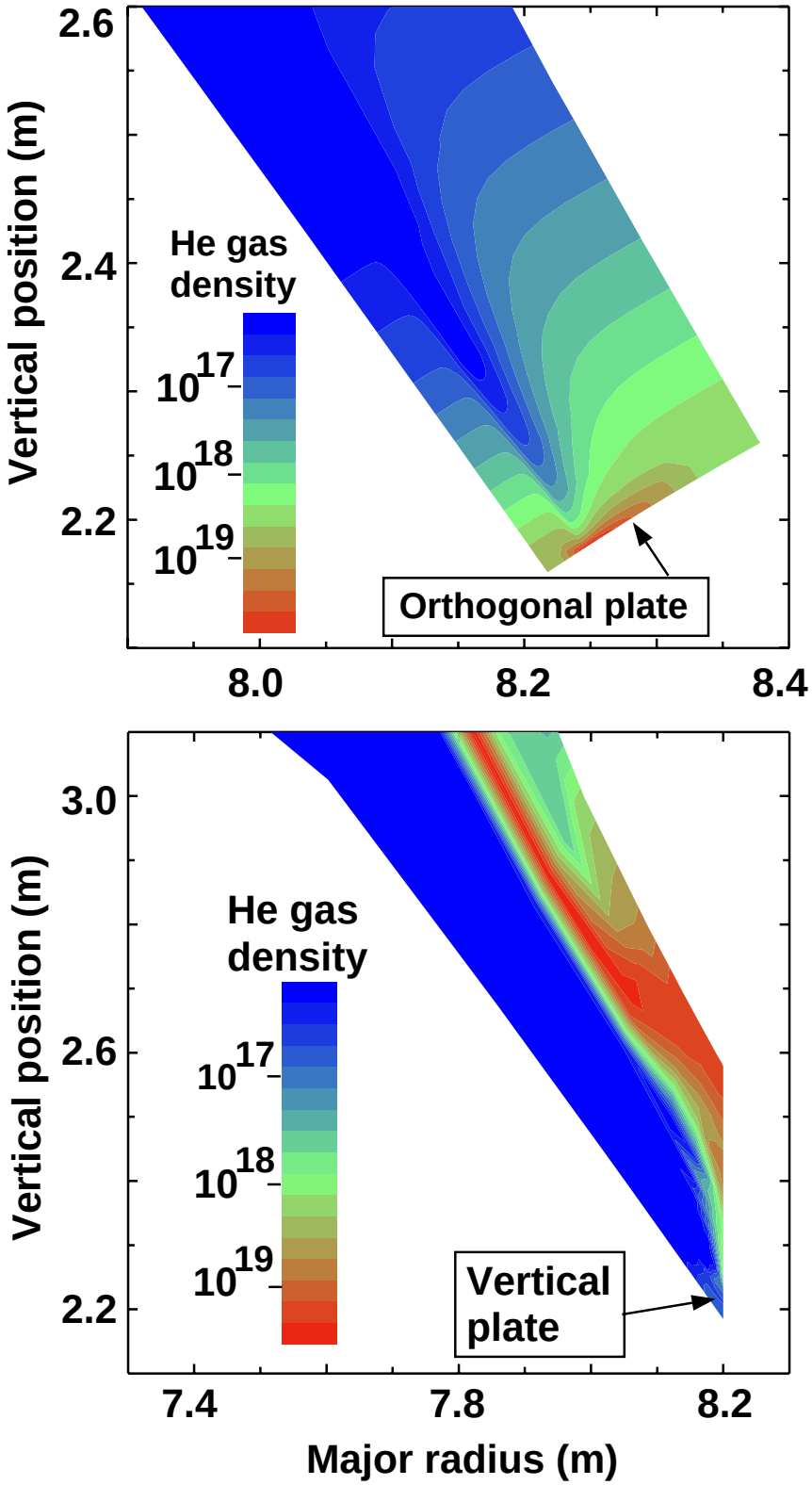


Helium ion density concentrates near wall for vertical divertor plate

R_{DT} = 0.5, R_{He}= 0.99, n_{He} at core boundary = 4 x 10^{17} m^{-3}



Helium gas density also concentrates near wall for vertical plate



Summary

1. High- and low-recycling hydrogen plasmas

- poloidal flow toward divertor much reduced for high recycling plamas - major impact on impurities

- edge density for low recycling is controlled by fueling; more analysis of cases with low edge density needed

2. ARIES-RS results

- an MHD equilibrium for single null now available

- divertor plasma weakly attached assuming 90% of core power radiated; strongly attached otherwise

3. Helium spatial concentrations

- low recycling with large fueling causes large helium densities near the plate - enhances duct pumping

- tilted divertor plate forces helium toward outer wall