Modeling of Li Coating Experiments with UEDGE

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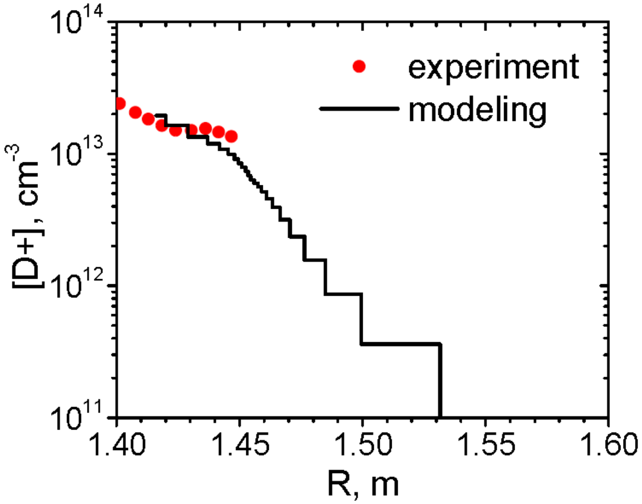
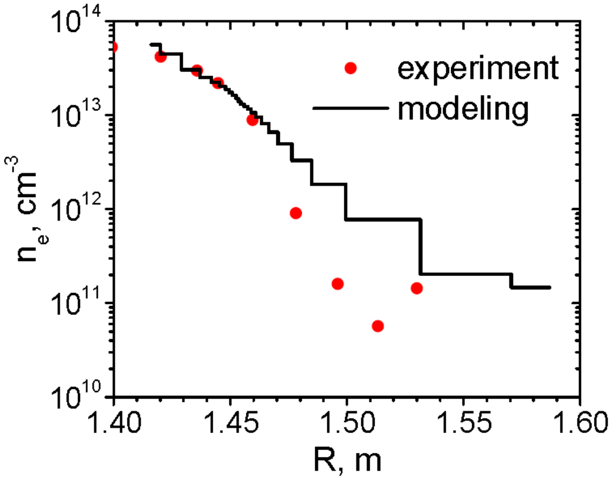
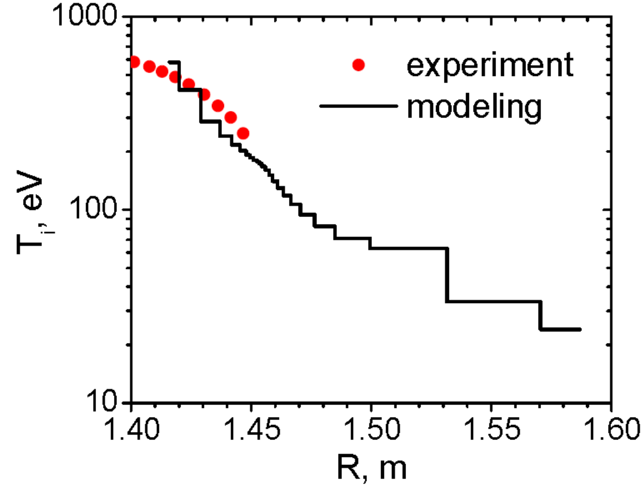
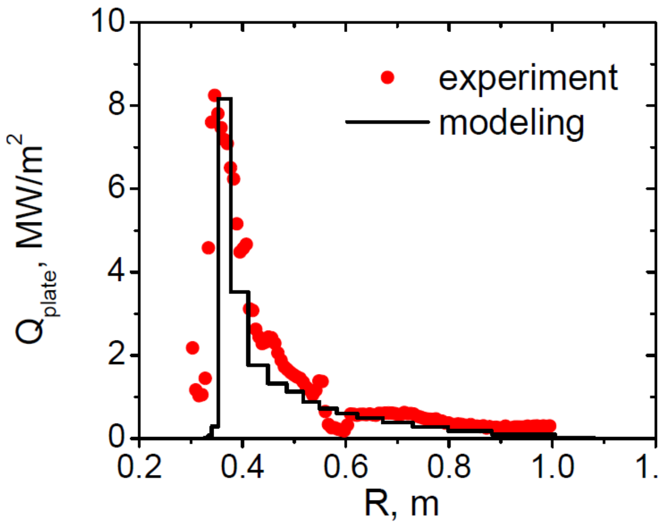
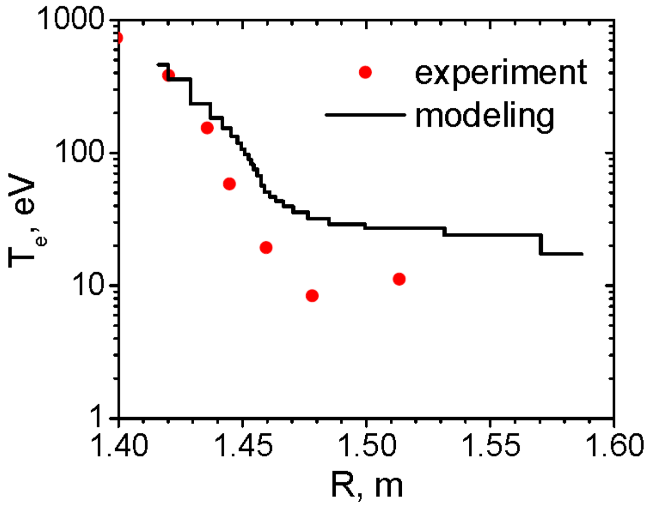
UEDGE gives fit to major diagnostic data





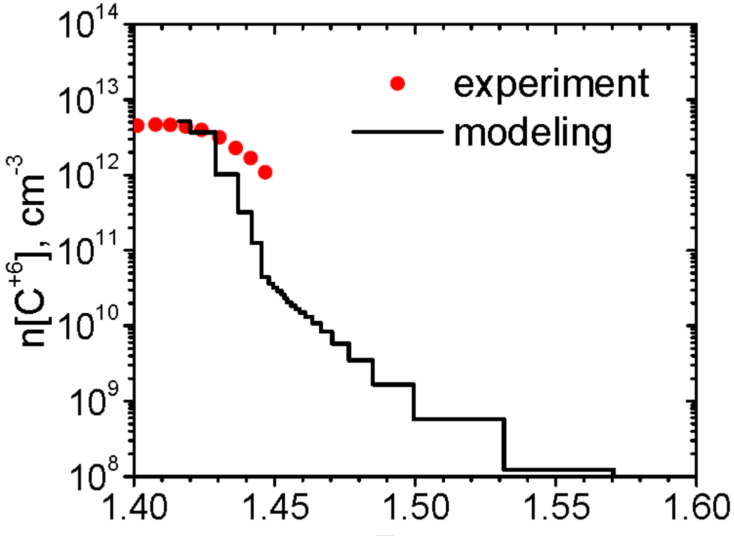


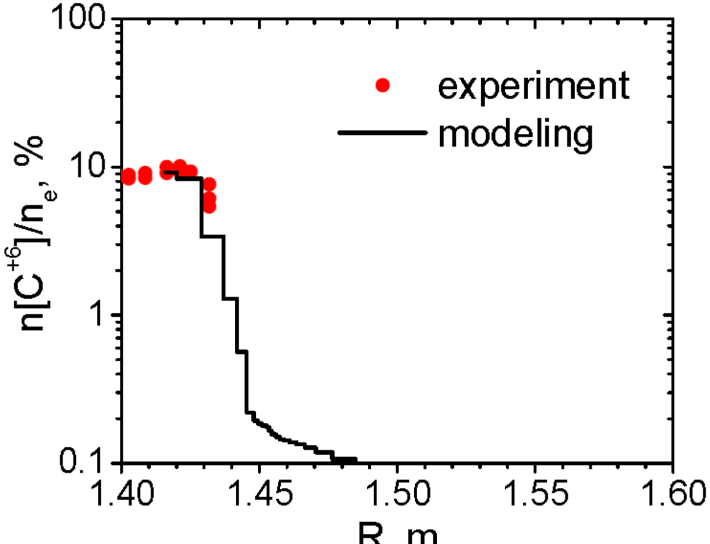




Shot 129061
UDN
With Li
Low recycling conditions
R=0.87

Density "ears" via carbon impurities are modeled





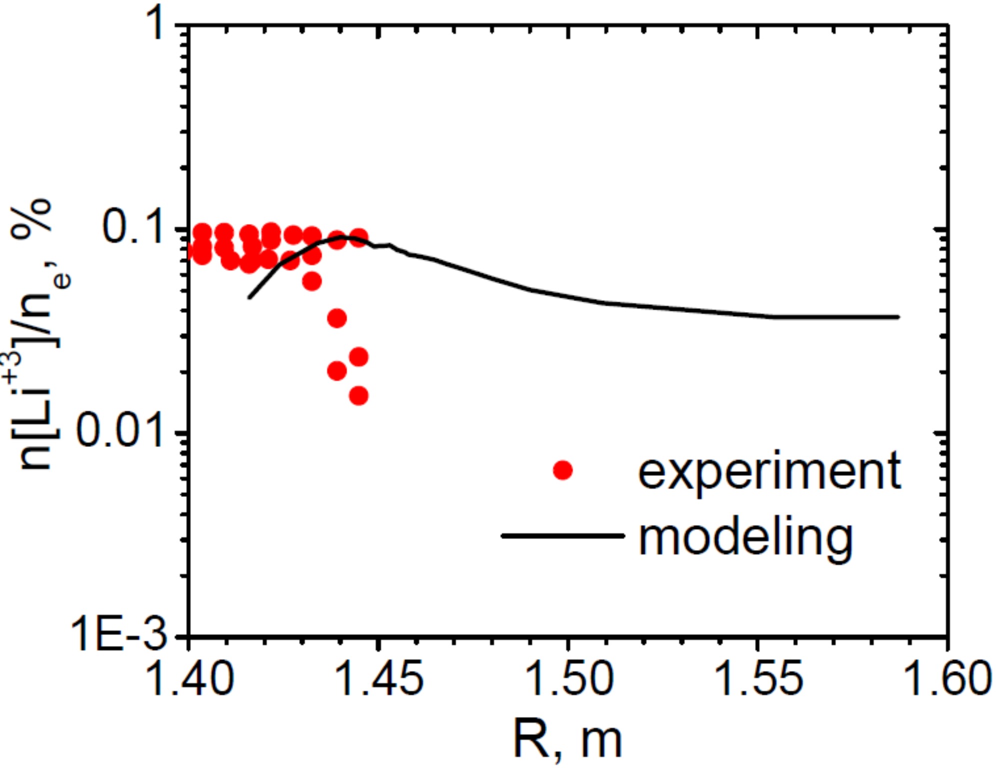
We assume a combination of inward pinch velocity (radially and poloidally dependent) and reduced diffusivity in the ear region in core.

Creates a convective cell (influx on inboard, outflux outboard)

Concentration of C ions is at 10% level

C originates from upper plates and wall

UEDGE shows relatively low concentrations of Li in core



[Li+3]/ne~0.1% is modeled

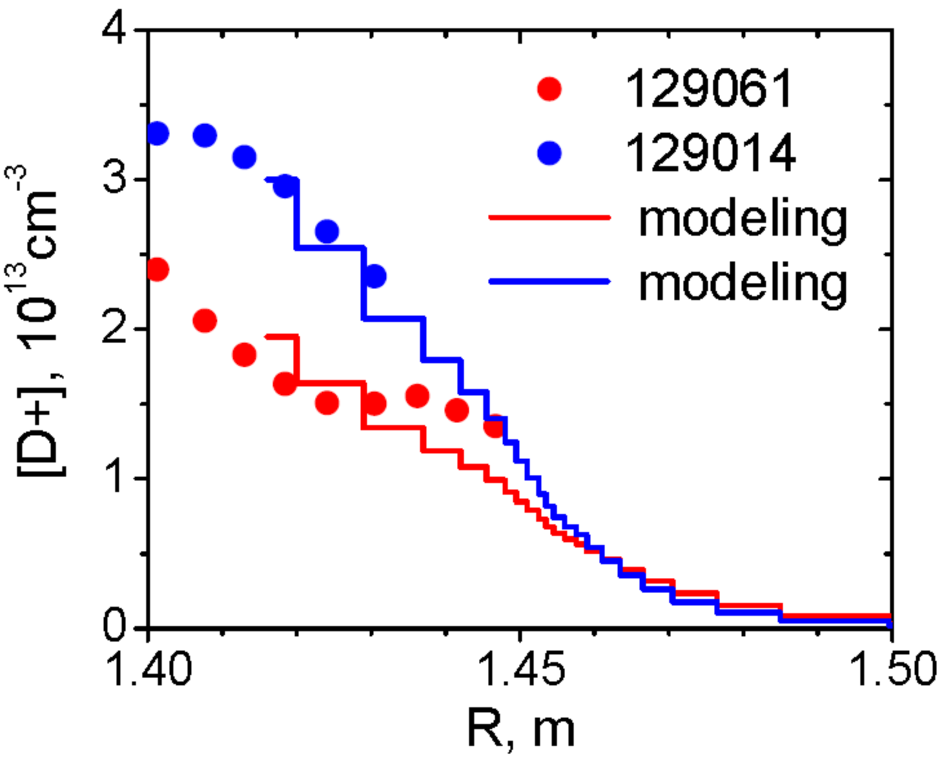
Lithium impurities originated from divertor plate via evaporation/ sputtering

Li is very well retained in the divertor volume (upper plates and wall are sinks).

However, with inward pinch assumption
[Li+3] can be ~1%.

Li coating tends to enhance the edge transport

W/O LITHIUM Igas=750A R=0.97



WITH LITHIUM Igas=250A R=0.85

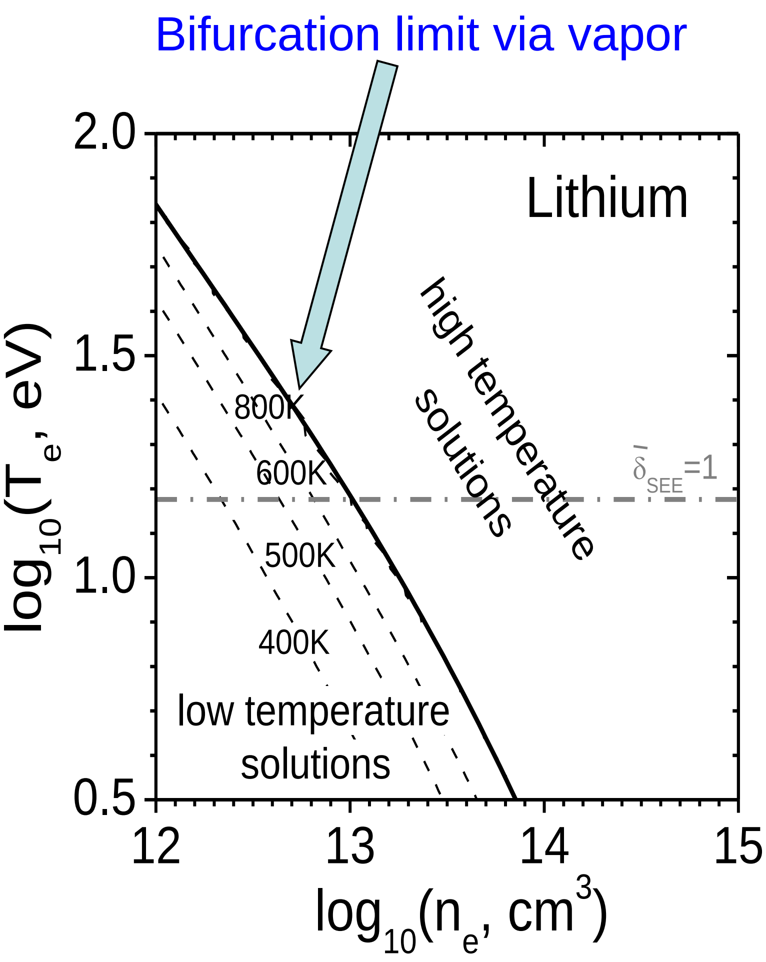
Compare similar discharges in NSTX: 129061 with Li and 129014 without Li.

Although there is no data points at separatrix (i.e. if extrapolation is valid), experimental data shows different [D+] gradients with and w/o Li.

UEDGE shows that with Li all transport coefficient should be increased by factor of 2.5 with respect to without Li discharge

Low sensitivity of separatrix density to transport coefficient variation.

Liquid Li PFC overheating study



R. Smirnov et al., submitted to PoP 2009

Thermally unstable heating can occur when a positive feed-back exists between the plasma heat flux to PFC and Twall.

We found new mechanism of liquid surface overheating via positive loop caused by evaporating flux.

Bifurcation is near Twall=800K for Li. For Be bifurcation is at 1500K (near melting point).

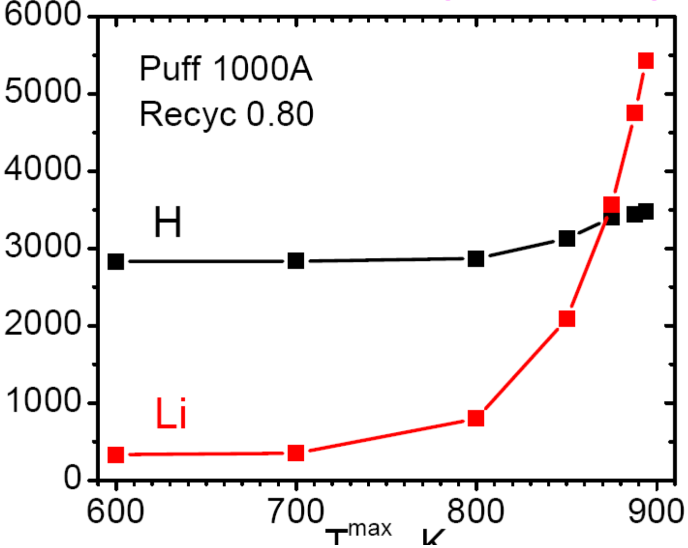
This mechanism drives overheating at much lower Twall than the well-known mechanism via thermionic emission.

SEE enhances heating and can shift bifurcation limit towards lower Twall

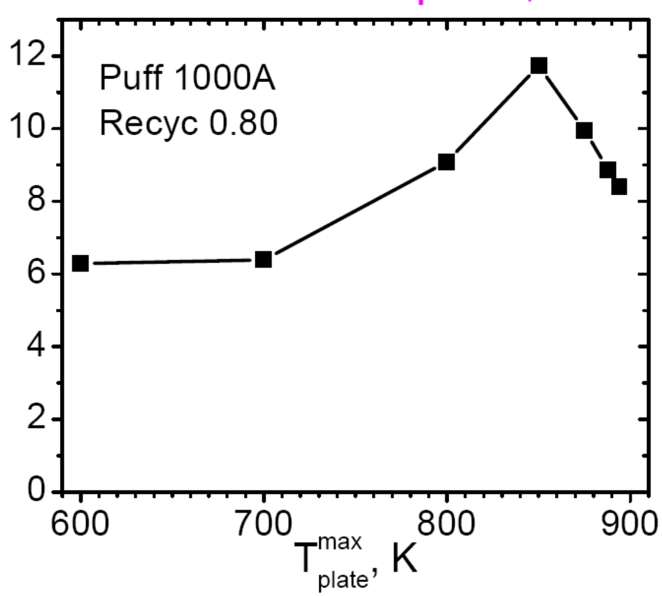
May be related to Li BLOOMs observed in disruptions on T-11

Vapor positive loop confirmed by UEDGE

Ion flux to outer plate, Amp



Peak heat load to plate, MW/m^2



Increase in Twall enhances the evaporation and the heat flux to wall, that increases further Twall.

Possibly, the instability can be stabilized by impurity radiation upstream reducing the heat flux.

Self-consistent UEDGE modeling of plasma/vapor transport and Twall is in progress.

Instability may be a potential threat to NHTX and LLD