Japan Atomic Energy Agency
Naka Fusion Institute

EX/8-5

Heat transport and pedestal structure of H-mode in the variation of current density profiles in JT-60U

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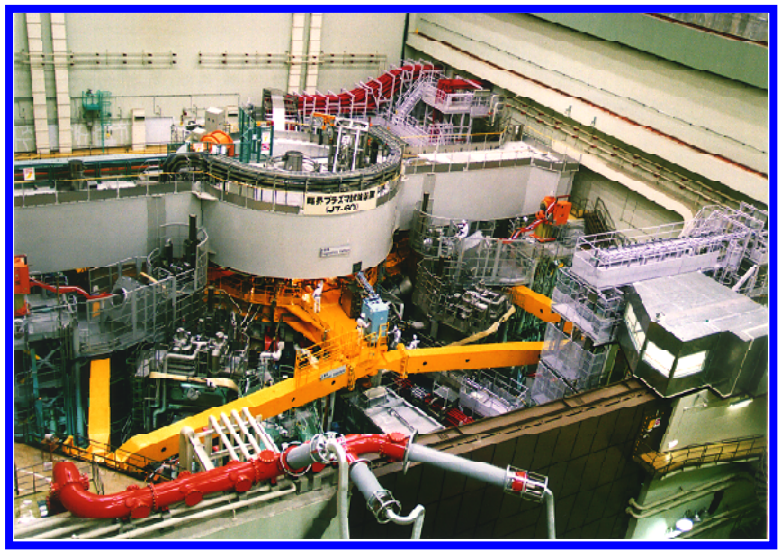
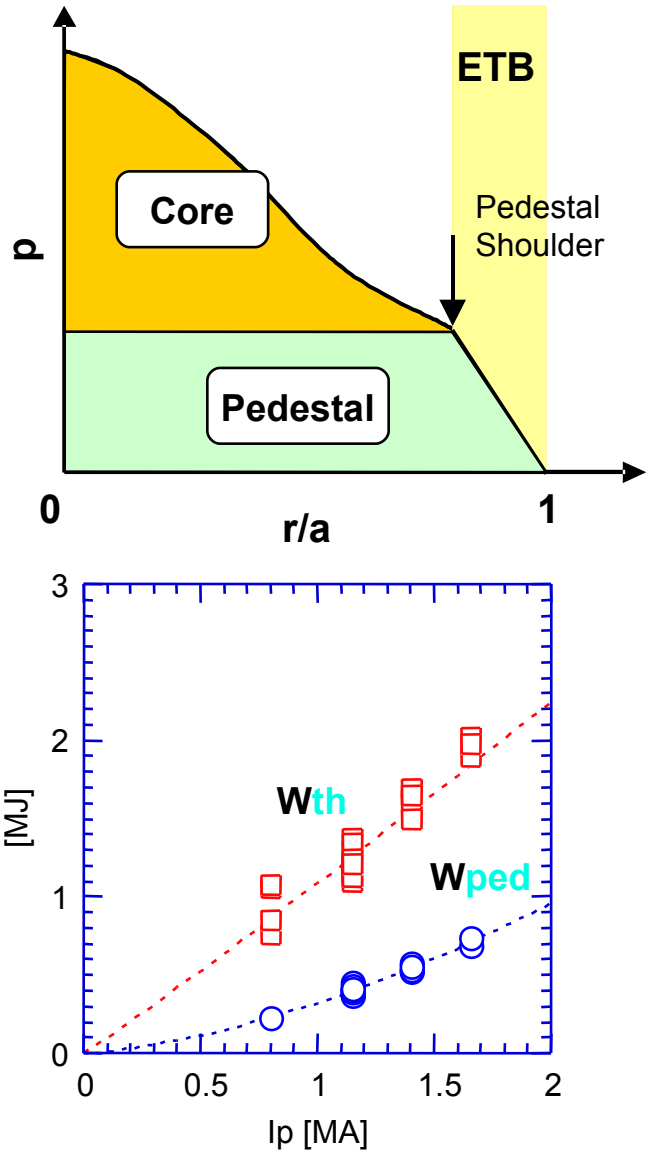


Introduction



Sufficiently high pedestal pressure is required for favorable energy confinement in ELMy H-mode plasmas.

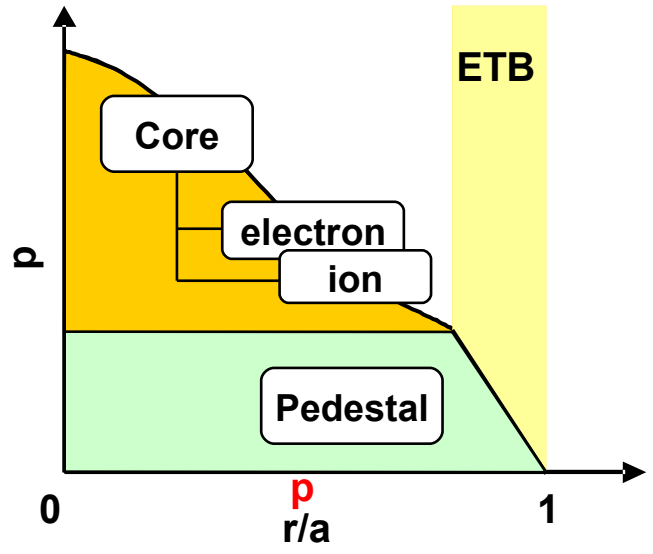
H-mode plasma can be treated by dividing into the core and pedestal components.

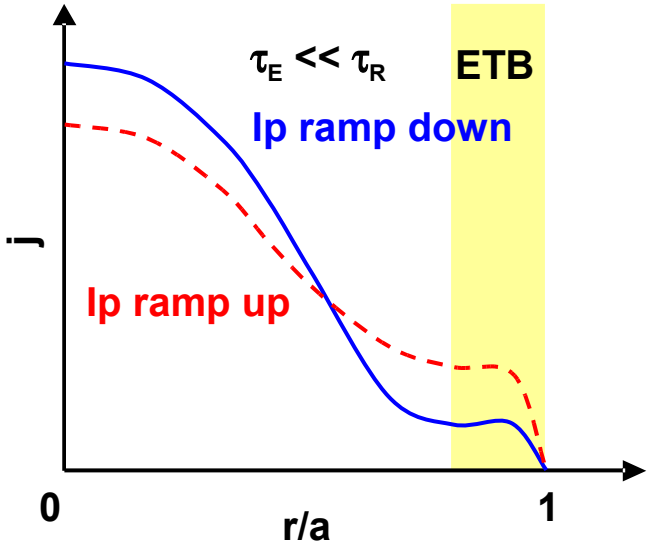
So far, H-mode properties have systematically been investigated for the influences of density, plasma shape, power, toroidal rotation and so on.

H-mode confinement and pedestal stored energy have a strong Ip dependence.

Little is known about the effect of current density profile on the H-mode properties.

Objectives





Dependence of the H-mode confinement and pedestal structure on the current density profile is investigated.

Conduct Ip ramp experiments to change the current density profile and compare the H-mode properties at a fixed Ip.

1. Core heat transport properties for electron and ion in the variation of current density profiles.

2. Change in pedestal characteristics.

Outline

1. Introduction

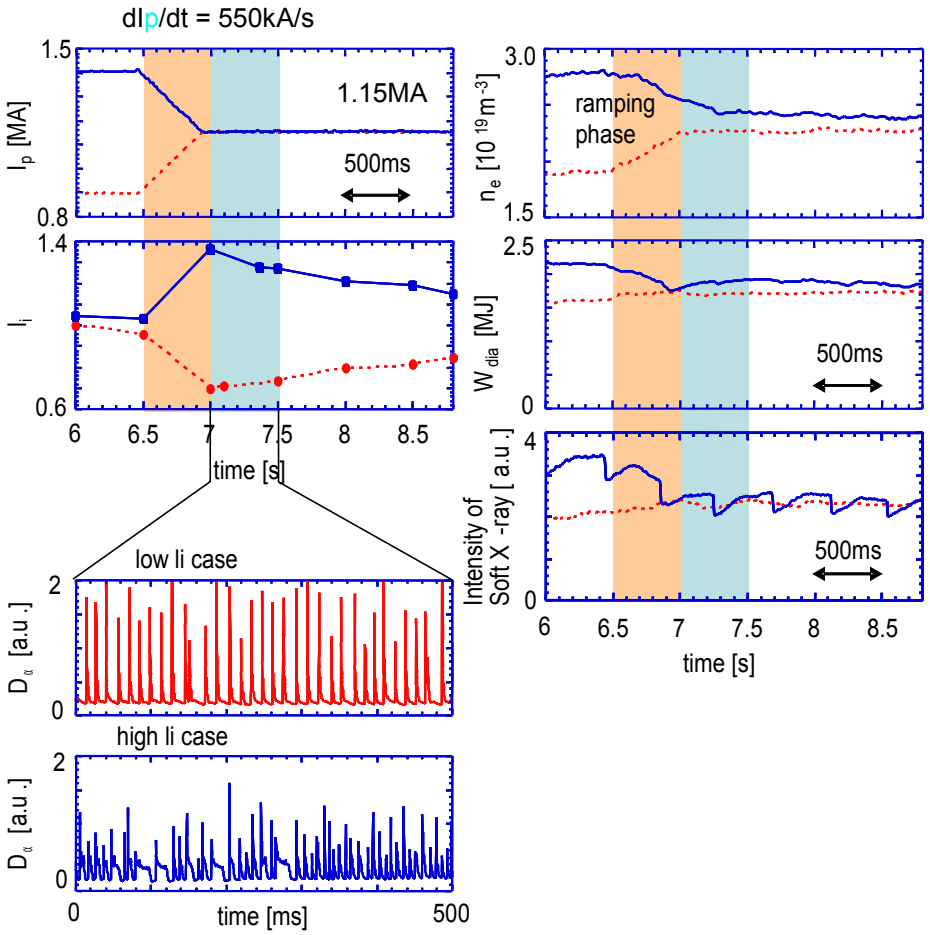
1. Objectives

1. H-mode confinement in the variation of current density profile

1. Pedestal structure in the variation of current density profile

1. Summary

Ip ramp experiment on ELMy H-mode plasmas



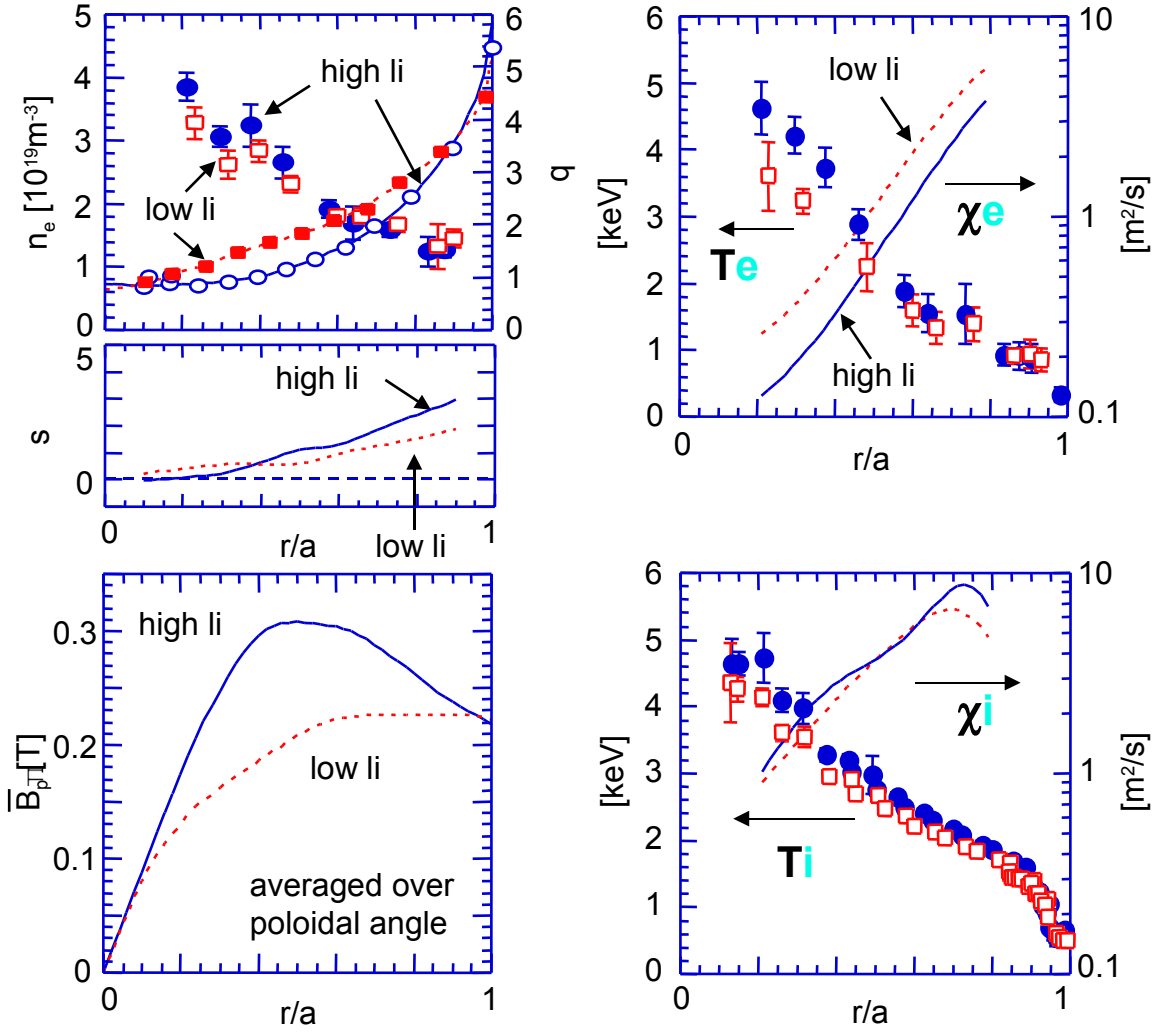
Compare the H-mode properties in the phases after Ip ramp up and down in a situation where current density profile is changed while keeping Ip fixed.

Higher ELM frequency f_{ELM} is observed in high li case.

Electron density and stored energy become higher in high li case.

Sawtooth activity is seen in the central region in case of higher li plasma.

Core n_e and T_e profiles tend to be peaked at higher l_i

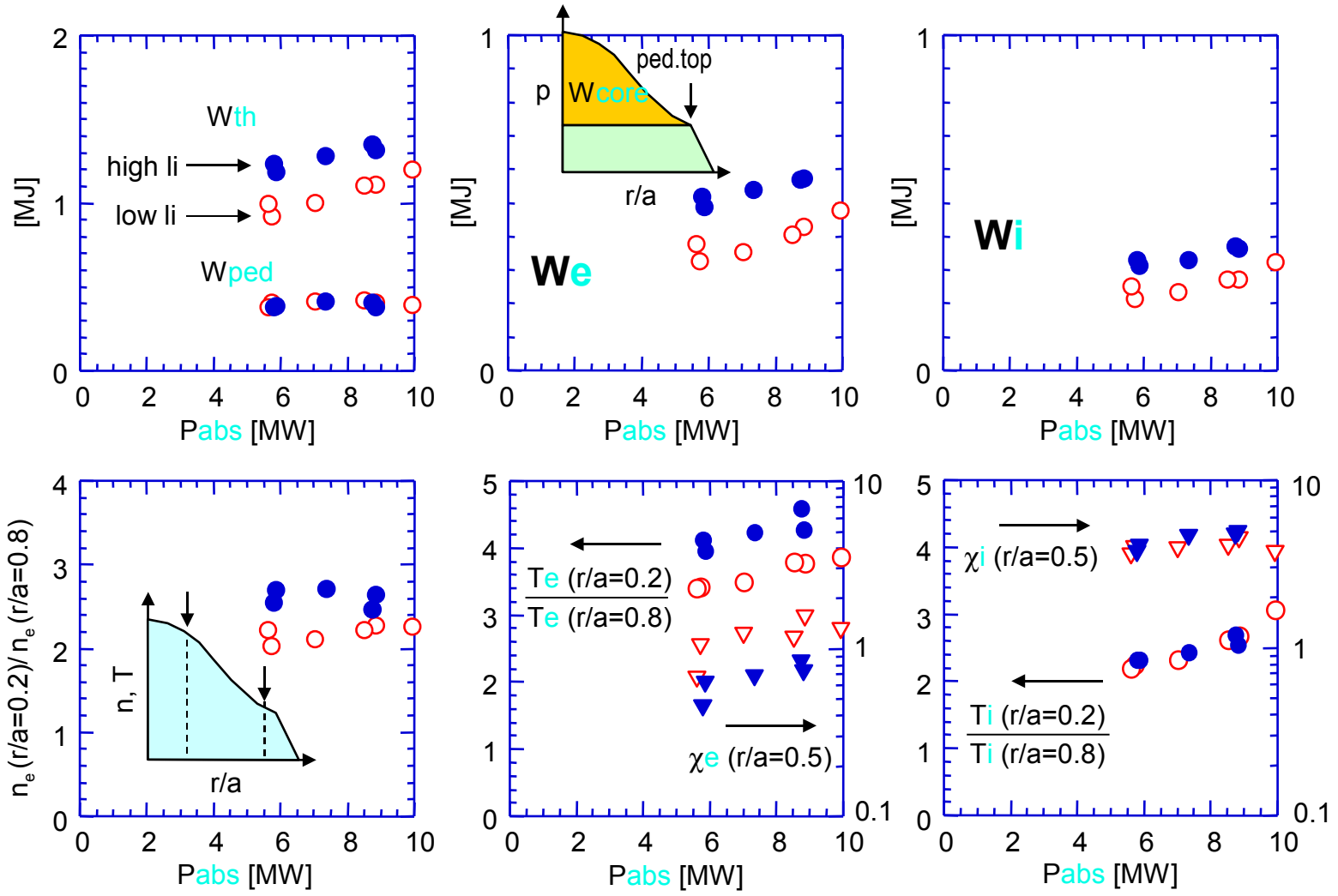


Different q profiles are obtained by Ip ramp experiment. Core B_p profile differs largely while the edge B_p values are the same.

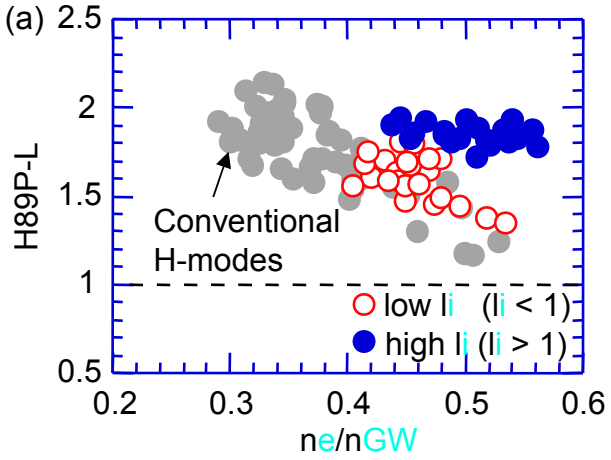
The n_e and T_e profiles tend to be peaked at the center at higher l_i. The χ_e is reduced in the plasma core. However, the T_i profile is not clearly changed.

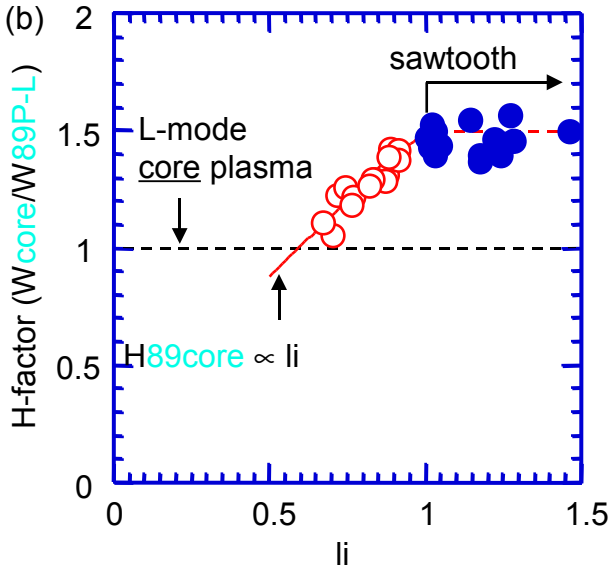
The n_e, T_e and T_i values at the pedestal are similar. (The p_{ped} remains constant).

High energy confinement obtained at high li is due to core improvement (pedestal confinement does not change)



Core energy confinement is improved with li





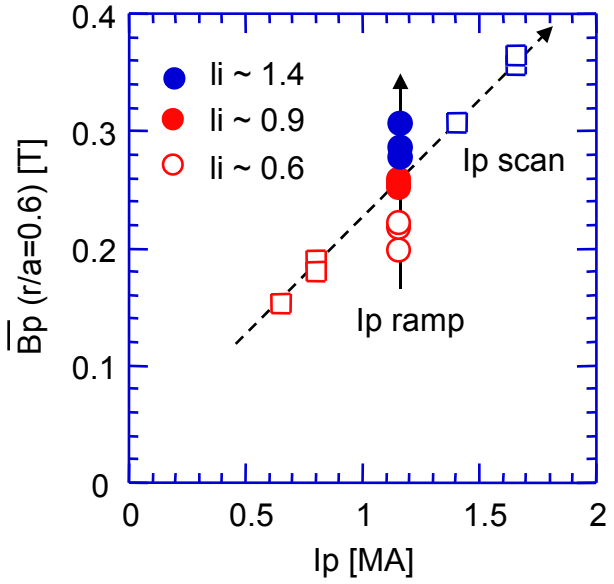
Higher H-factor can be sustained without

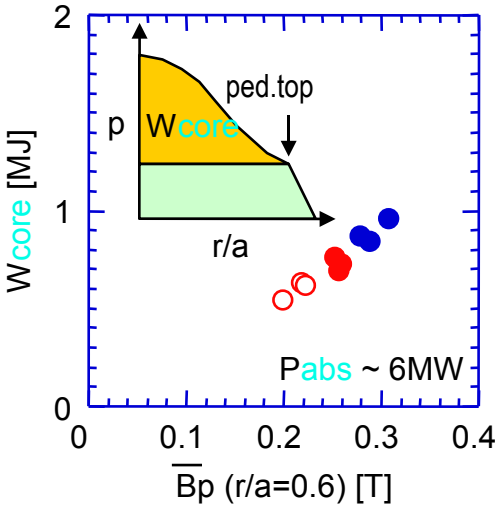
deterioration of energy confinement in high li case.

H-factor for the core plasma depends strongly on li.

When li is increased further, the existence of strong sawtooth prevents from the increase of the core H-factor.

Core stored energy is increased with Bp



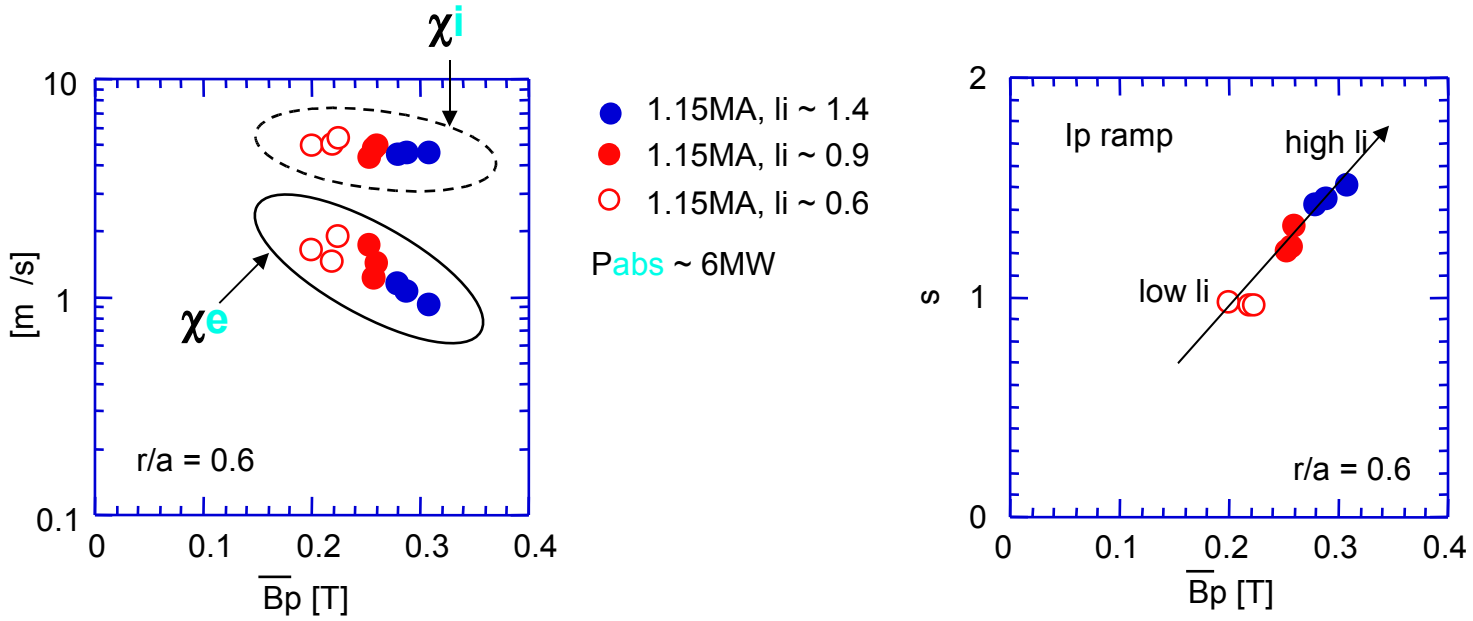


Confinement improvement obtained in higher li plasma is accompanied by the large Bp in the plasma core.

In Ip ramp experiment, the core Bp value is increased with li at a given Ip.
(In Ip scan experiment, the core Bp value is increased with increasing Ip.)

Core stored energy is increased almost linearly with increasing the core Bp value at a fixed Ip.

Electron heat diffusivity is strongly reduced at high li

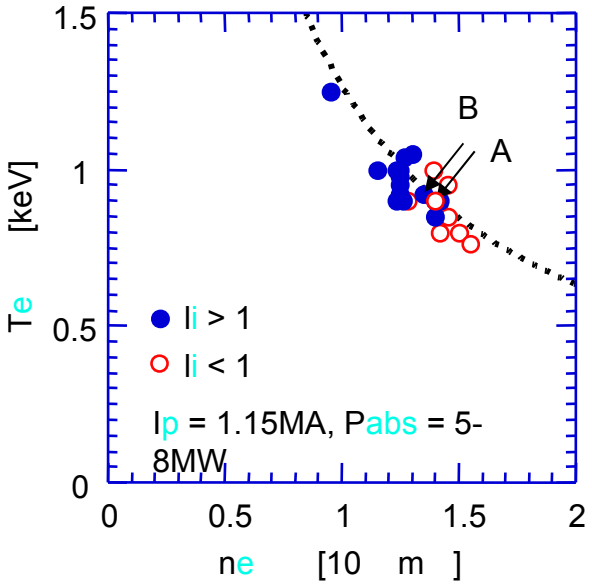


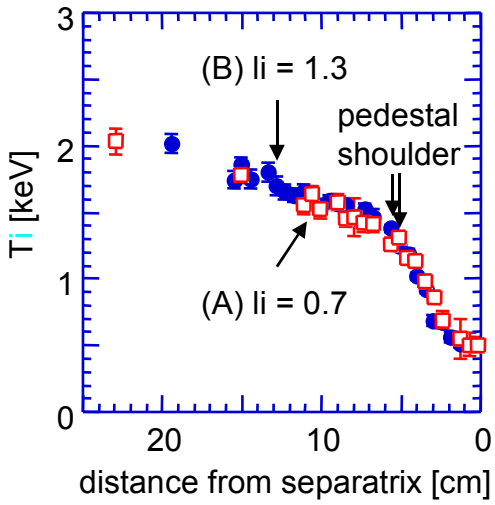
When the core Bp value is increased, the electron heat diffusivity is strongly reduced. On the other hand, reduction in the ion heat diffusivity is smaller than that in the electron.

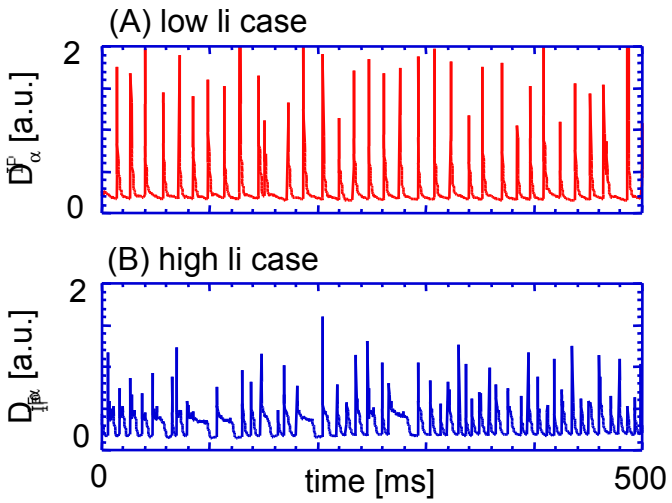
High energy confinement obtained by high li discharge is mainly attributed to the reduction in the electron heat diffusivity in the plasma core.

However, in Ip ramp experiment, core Bp value and magnetic shear vary monotonically together. The decisive factor determining the reduction of heat transport is still unknown.

Change in pedestal pressure is small in the variation of current density profiles at a given Ip





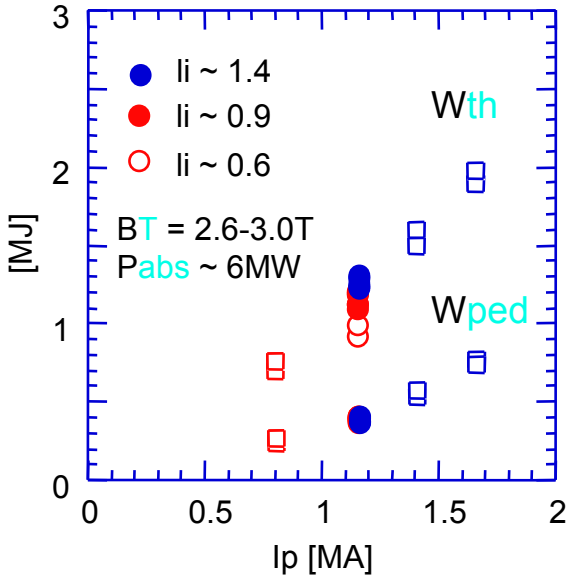


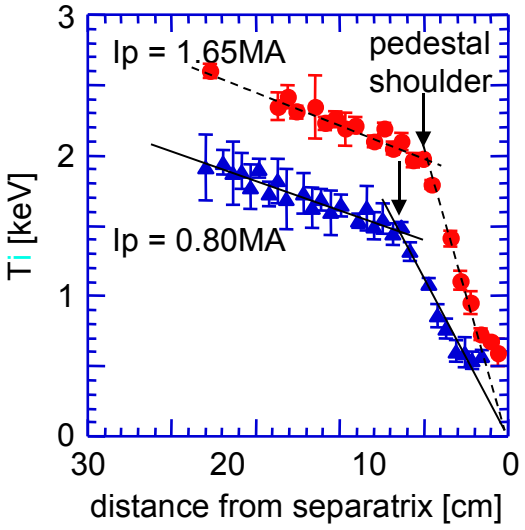
In the variation of the current density profiles, the range of the pedestal density is somewhat scattered. However, the achievable pedestal pressure is almost constant.

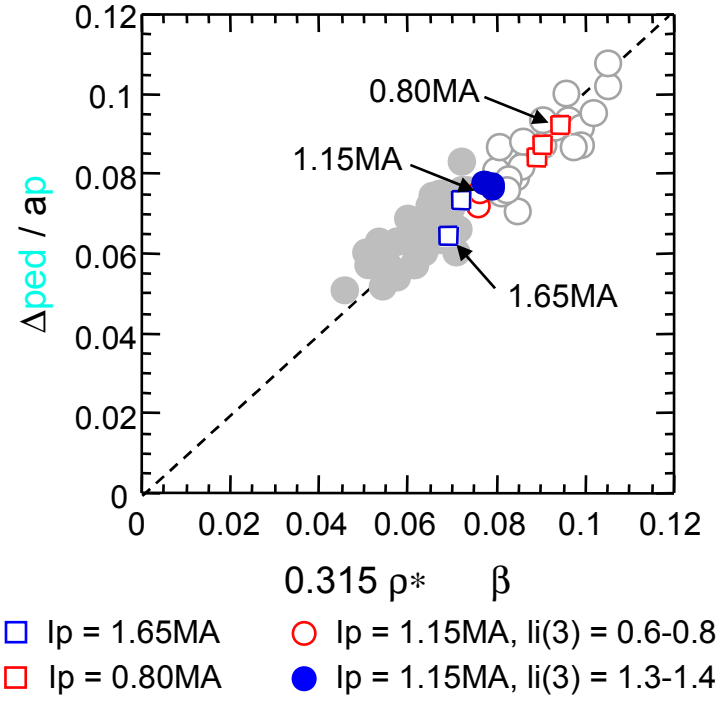
No clear difference is seen in the edge Ti profiles.

However, higher ELM frequency f ELM is observed in higher li H-modes.

Pedestal width







When Ip is increased, the pedestal temperature is raised while the pedestal width tends to shrink.

This change of the pedestal width is also predicted from the scaling obtained by the dimensionless parameter scan. No clear difference in the pedestal width is seen in the variation of the current density profiles.

Summary

Dependence of the H-mode confinement and pedestal structure on the plasma current density profile is investigated.

Higher energy confinement is obtained in higher li H-mode. The profiles of the core n_e and T_e tends to be peaked. The H-factor for the core plasma depends strongly on li ($H_{89core} \sim li^{0.8}$).

Higher energy confinement obtained at higher li is attributed to the core confinement improvement. The electron heat diffusivity is reduced in the plasma core.

Change in the edge pedestal pressure is small in the variation of the current density profiles.