

# Study of detached plasma profile in the divertor simulation experimental module of GAMMA 10/PDX

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## ABSTRACT

- In order to study the detached plasma structure, a Thomson scattering (TS) system and a microwave interferometer system have been installed to measure the inside plasma parameters of the D-module of GAMMA 10/PDX, and a movable electrostatic probe has been placed at the inlet of the D-module to measure the inlet plasma density and temperature.
- The entire density and temperature structures from the core plasma to the divertor plate were obtained. During the formation of detachment, electron temperature decrease and density rollover behaviour along the magnetic field line are clearly observed.

## INTRODUCTION

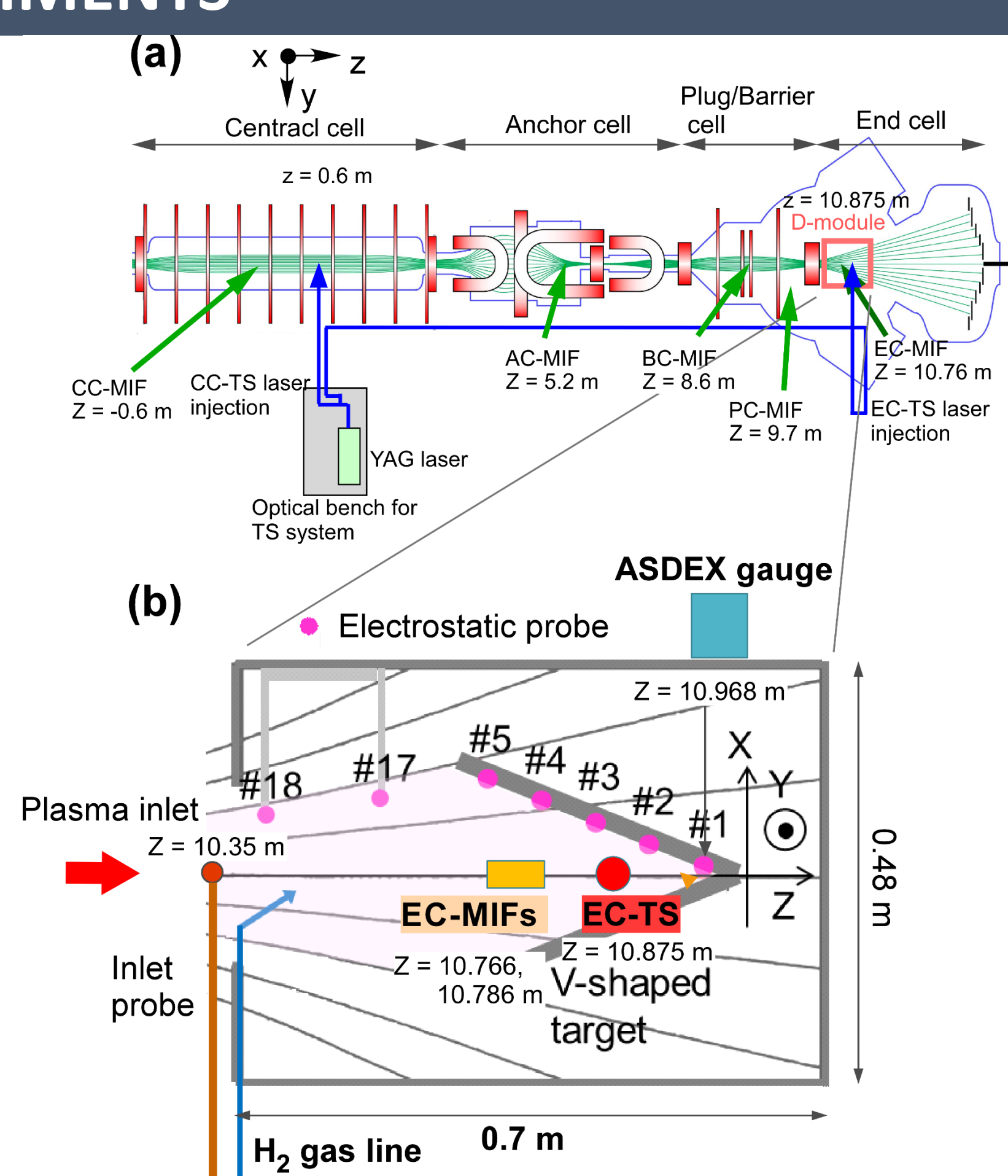
- Study of mechanisms of detached plasma in fusion plasma devices is one of the most important issues for handling heat and/or particle load to the plasma facing components.
- In GAMMA 10/PDX, using the divertor simulation experimental module (D-module), the mechanisms of detachment are investigated to reduce heat and particle fluxes to the divertor plate under conditions equivalent to ITER SOL and divertor plasma.
- We show the detached plasma structure and the entire density and temperature structure from the core plasma to the divertor plate by using all measuring systems. The ionization region location and its behaviour are investigated.

## DETACHED PLASMA EXPERIMENTS

### GAMMA 10/PDX

#### EXPERIMENTAL SETUP

GAMMA 10/PDX is the largest tandem mirror machine. The dual-path Thomson scattering system, which contains CC-TS and EC-TS, for measuring the electron temperature and density both at the central and end cells, simultaneously. The microwave interferometers (MIFs) for measuring average electron densities at each cell. In D-module, the electrostatic probes (IP and #1) are installed and mounted on the V-shaped tungsten target plate.



Schematics of the experimental setup of GAMMA 10/PDX (a), and the divertor simulation experimental module (b).

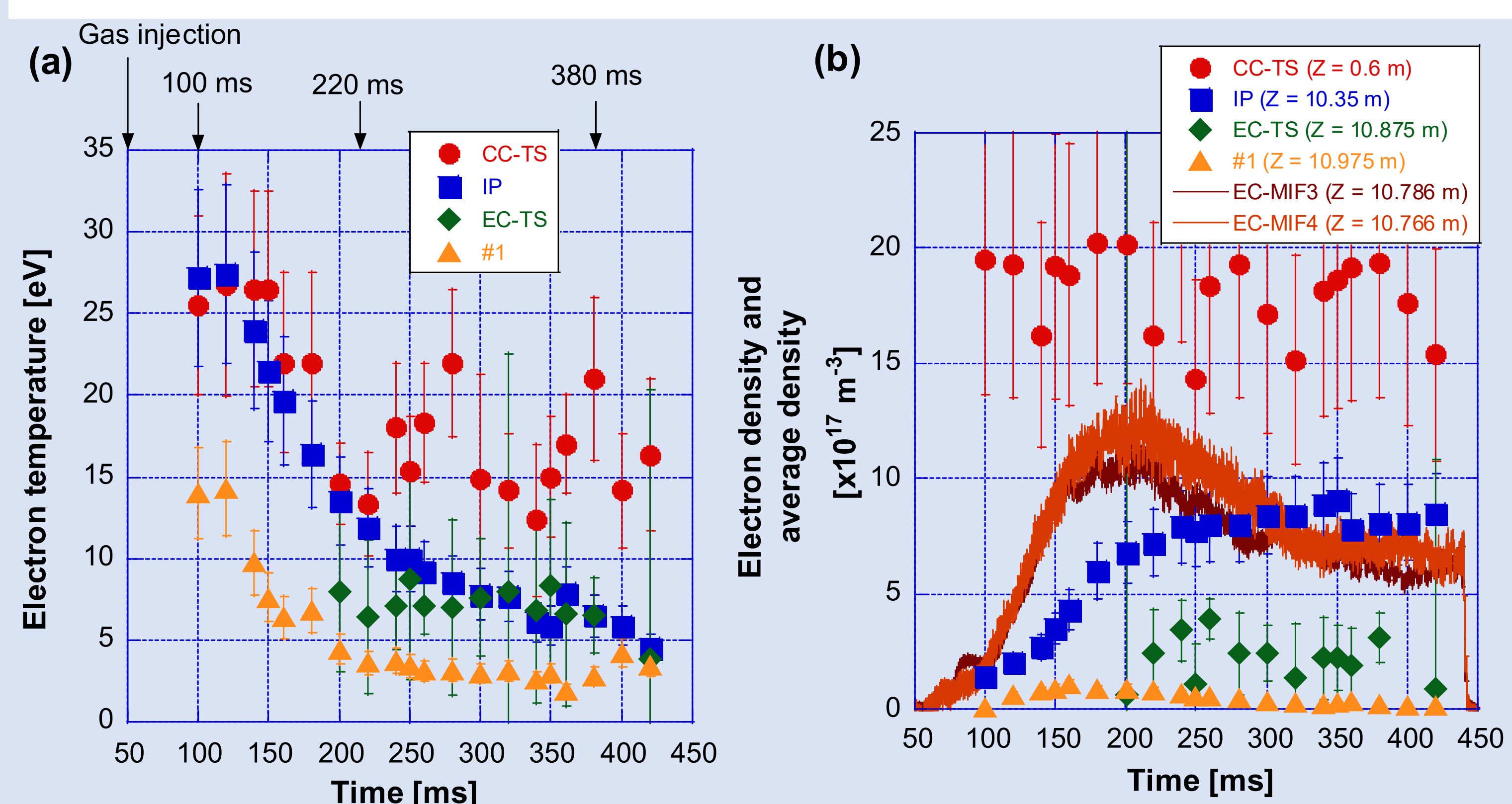
### GAMMA 10/PDX EXPERIMENT

The plasma is heated and maintained while applying ICRF waves from  $t = 51$  to 440 ms. The additional hydrogen gas puffing began at  $t = 50$  ms, and the pulse duration was 400 ms for 750 mbar of plenum pressure in the D-module to produce a detached plasma condition from  $t > 200$  ms.

## RESULTS AND DISCUSSION

### ELECTRON TEMPERATURE AND DENSITY

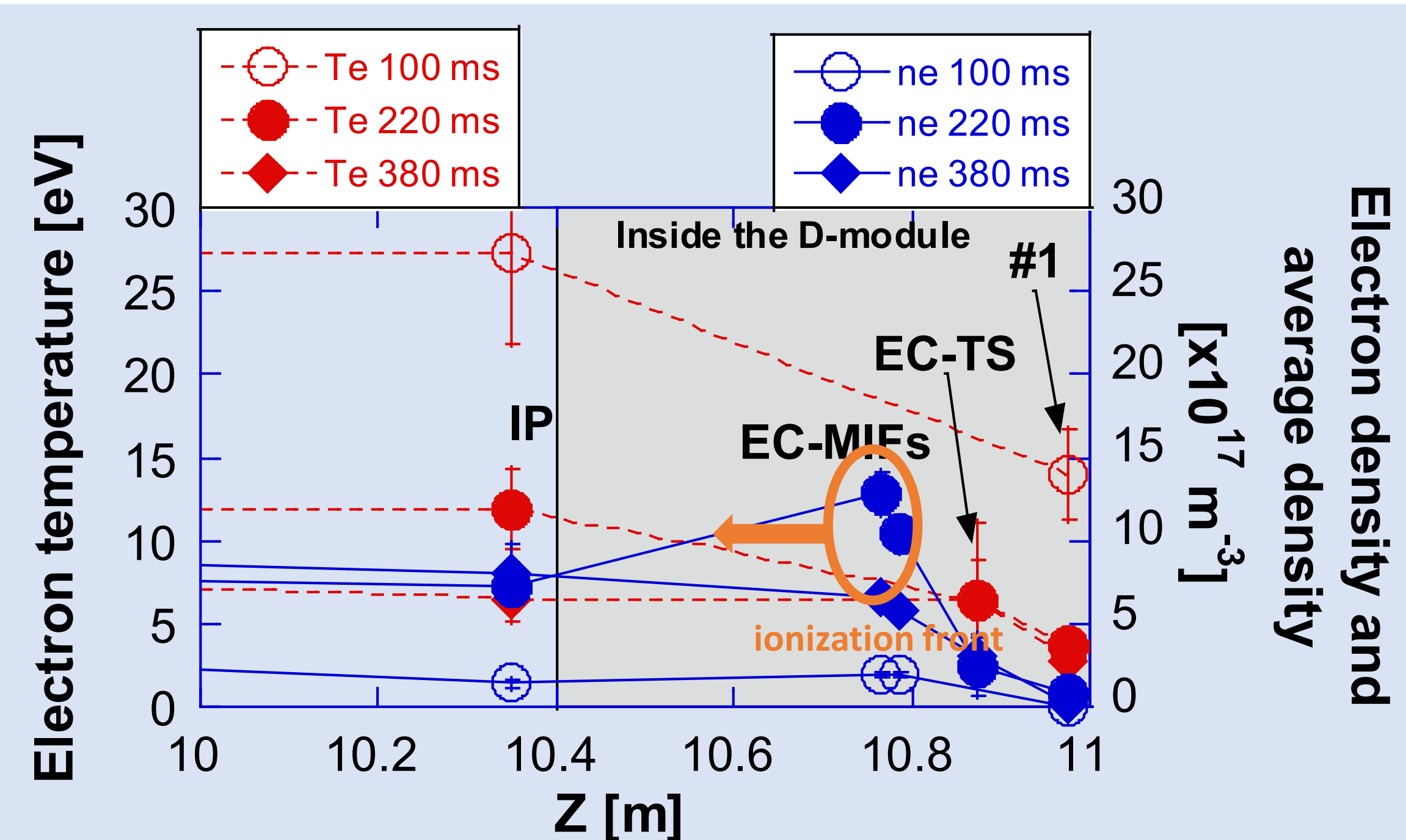
The electron temperatures measured by IP and EC-TS are higher than that measured by #1 probe. Electron densities measured by IP increased and saturated by the effect of additional gas puffing. The electron density measured by IP increased and became saturated, while the electron densities measured by EC-MIFs and #1 probe displayed rollover behaviour.



Time evolutions of electron temperature (a) and density (b) measured by using the CC-TS, IP, EC-TS, and #1 probe, respectively.

### PLASMA PROFILE

The ionization front region in the detached plasma experiments are clearly observed for the first time in GAMMA 10/PDX. It is considered that the ionization front region moves upstream because there is no higher density region in the downstream area.



Electron temperatures and densities axial profiles at  $t = 100$  ms, 220 ms, and 380 ms. The inside size of D-module was shown as hatched region.

## CONCLUSION

- We successfully measured the core and edge plasma electron temperature and density, simultaneously, and obtained the axial density and temperature profiles in the detached plasma experiments.
- We clearly observed the ionization region along the central axis in the detached plasma for the first time in GAMMA 10/PDX. It is useful to study more detail of the ionization region behaviour in the detached

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