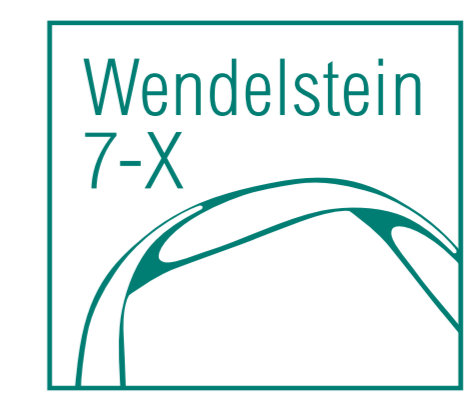


# Radial localization of electron temperature edge pedestal and ELMs using ECE measurements at Wendelstein 7-X



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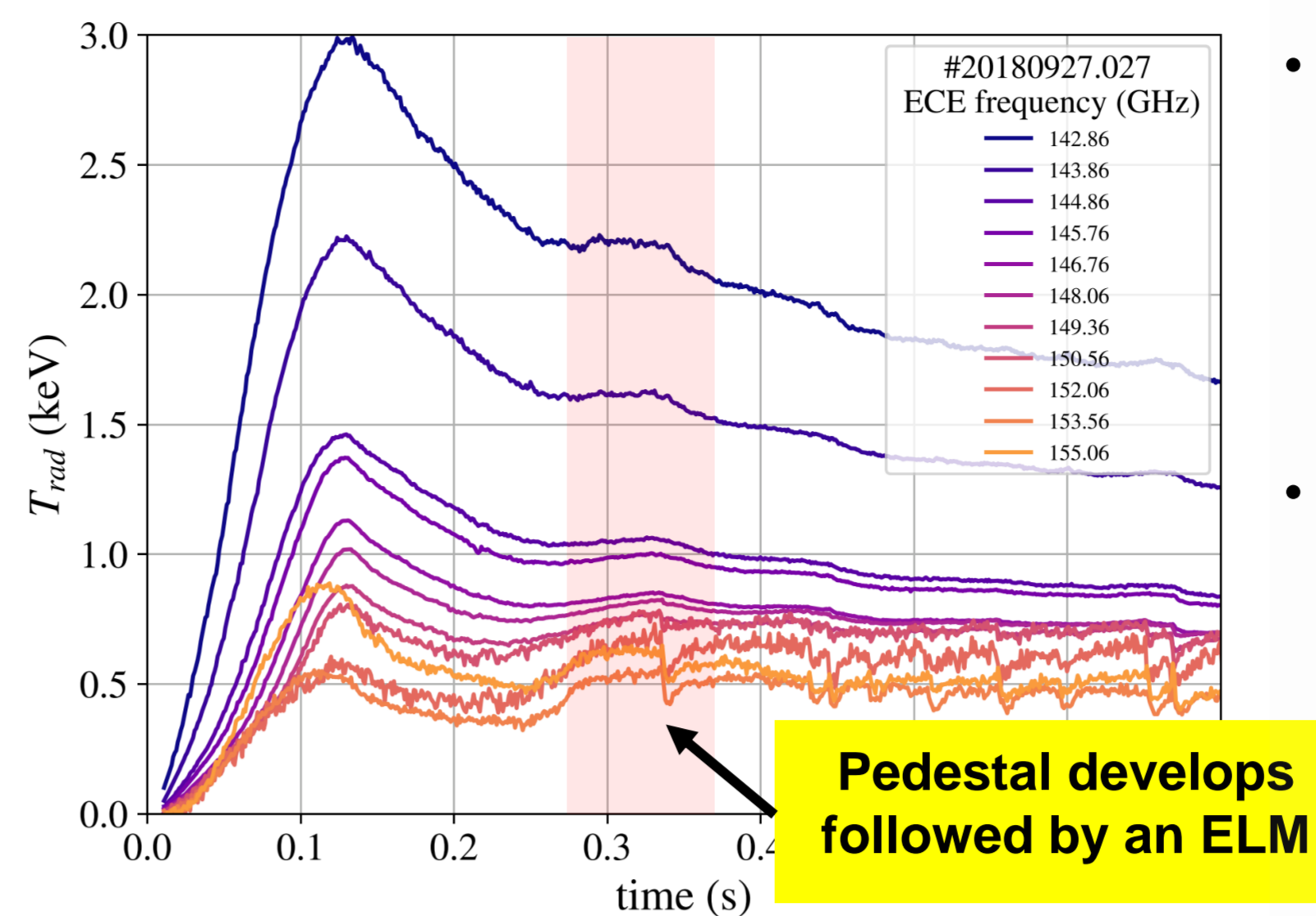
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## Abstract

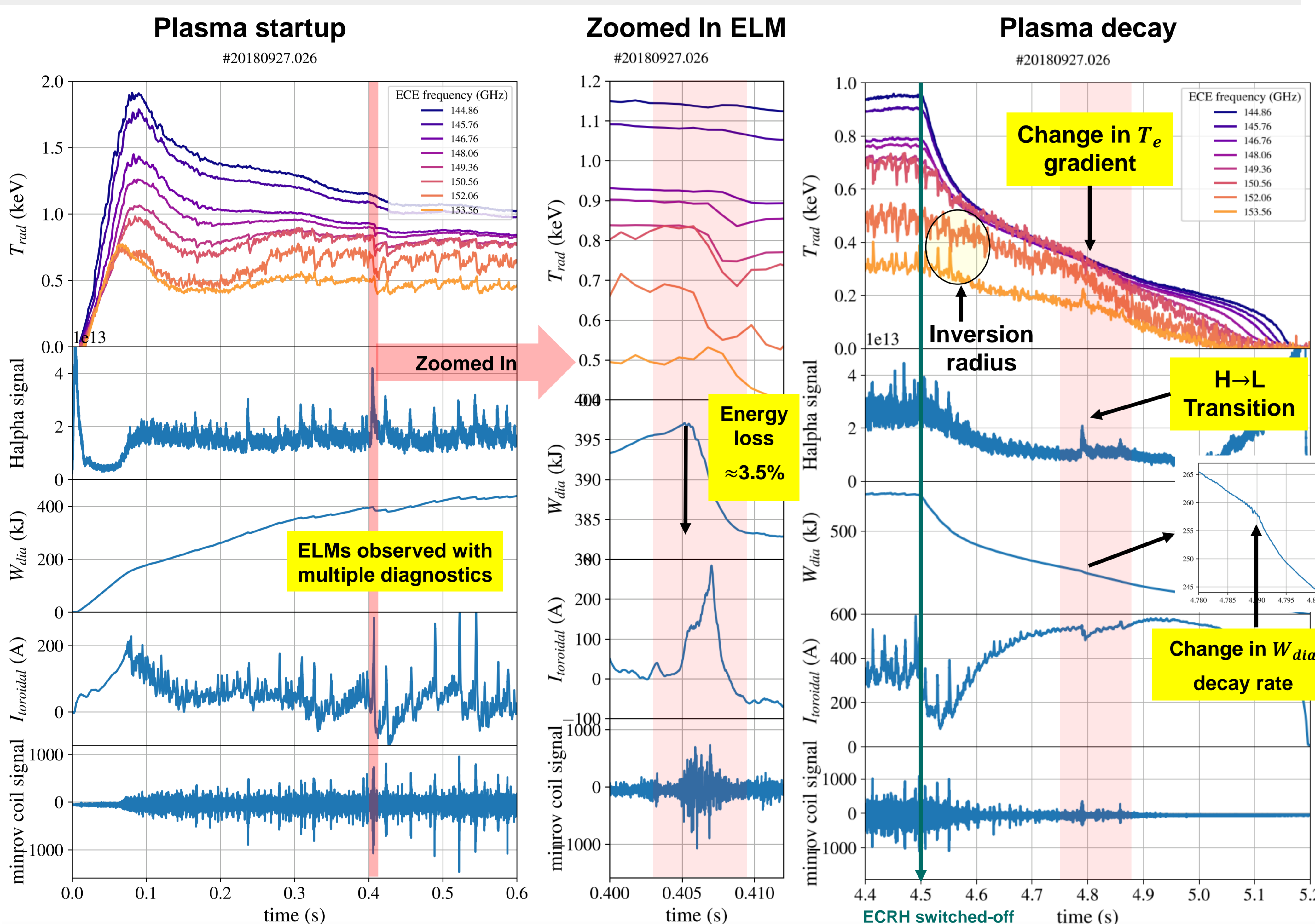
- A magnetic configuration scan was performed at W7-X by varying the rotational transform to analyze the plasma confinement for magnetic configurations with different edge island sizes and locations (1,2).
- For a few of the magnetic configurations, it was observed with the 32 channel electron cyclotron emission (ECE) radiometer (X2 spectral range, 120-160 GHz) (3) that an edge pedestal develops at the start of the plasma discharge followed by edge localized modes (ELMs) in electron temperature,  $T_e$ .
- This work presents the investigation of the changes in the  $T_e$  edge gradients for different magnetic configurations with a focus on the identification of the spatial location of the  $T_e$  edge pedestal and the ELM events with respect to the radial location of rational islands.

## Edge pedestal development and ELMs



- Radiation temperature of ECE at different frequencies show development of a temperature pedestal at the start of the plasma which is eventually followed by an ELM (crash in radiation temperature of ECE channels at the location of the pedestal).
- As a consequence of ELM/pedestal breakage a heat/cold wave propagates outwards from the location of crash, which is seen in the radiation temperature of the neighboring ECE channels to the pedestal location.

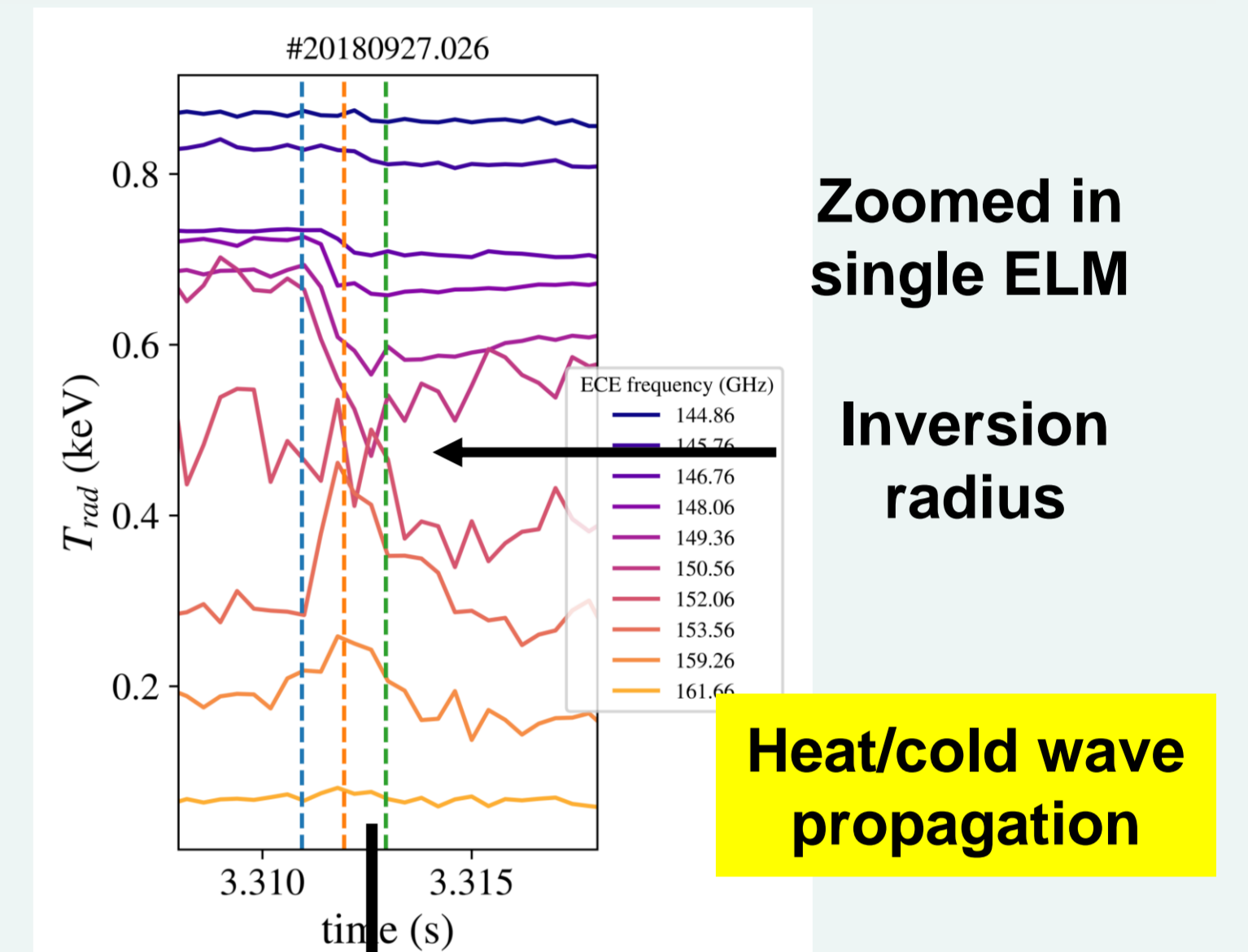
## FINGERPRINT OF H→L MODE TRANSITION



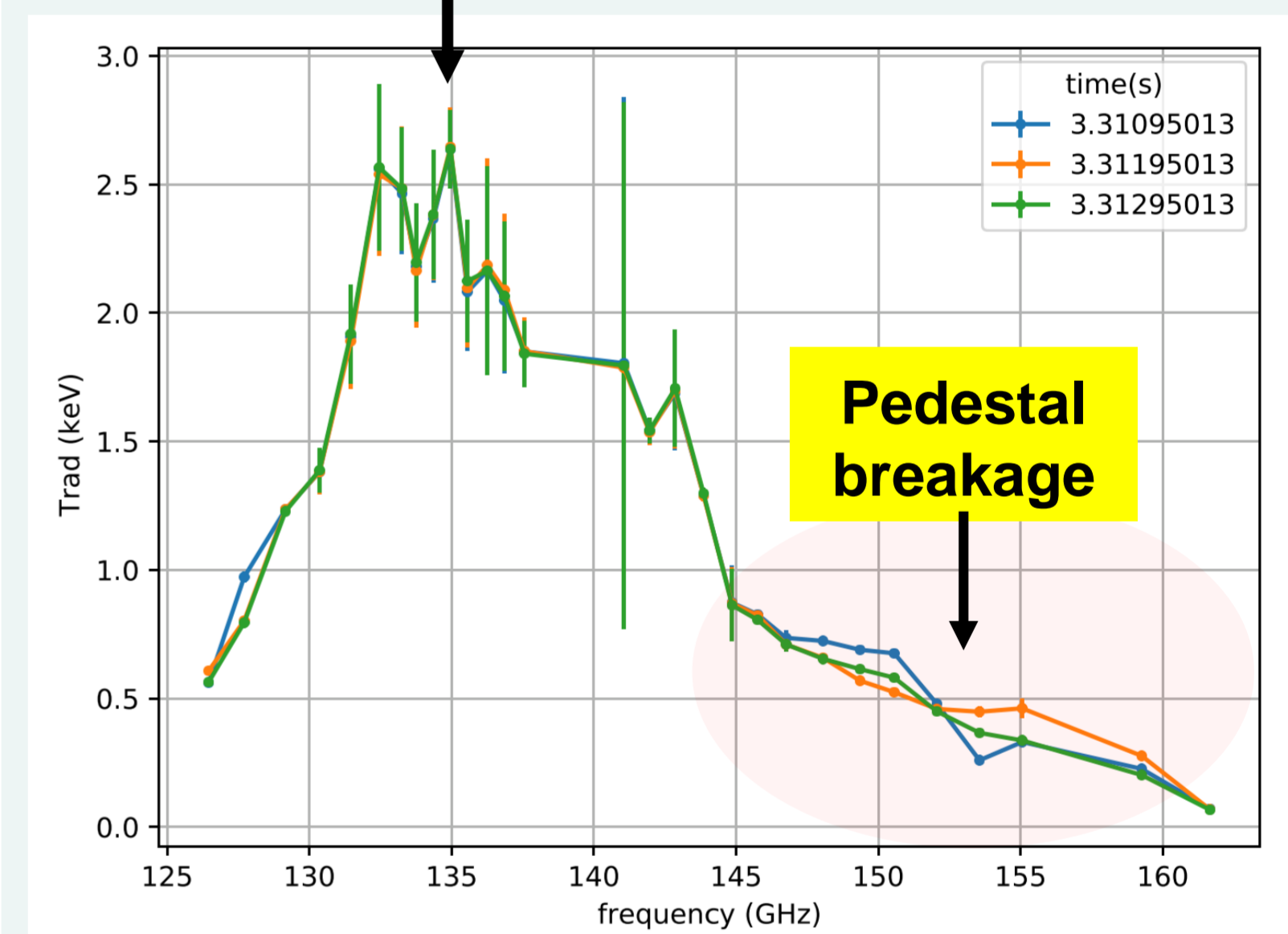
- A pedestal in electron temperature is observed with ECE diagnostic, and the ELMs (which are also referred to as island localized modes (ILMs), (4)) are observed with multiple diagnostic measurements such as electron temperature, total radiation levels, toroidal current, and magnetic fluctuations at W7-X.
- Pedestal develops in the plasma buildup phase, and a clear transition from L to H mode is not present. However, a possible back transition from H to L mode is observed during plasma decay when the plasma heating is switched off.

## ELM evolution

A crash in radiation temperature is observed in multiple channels with decaying amplitude moving away from the location of crash.

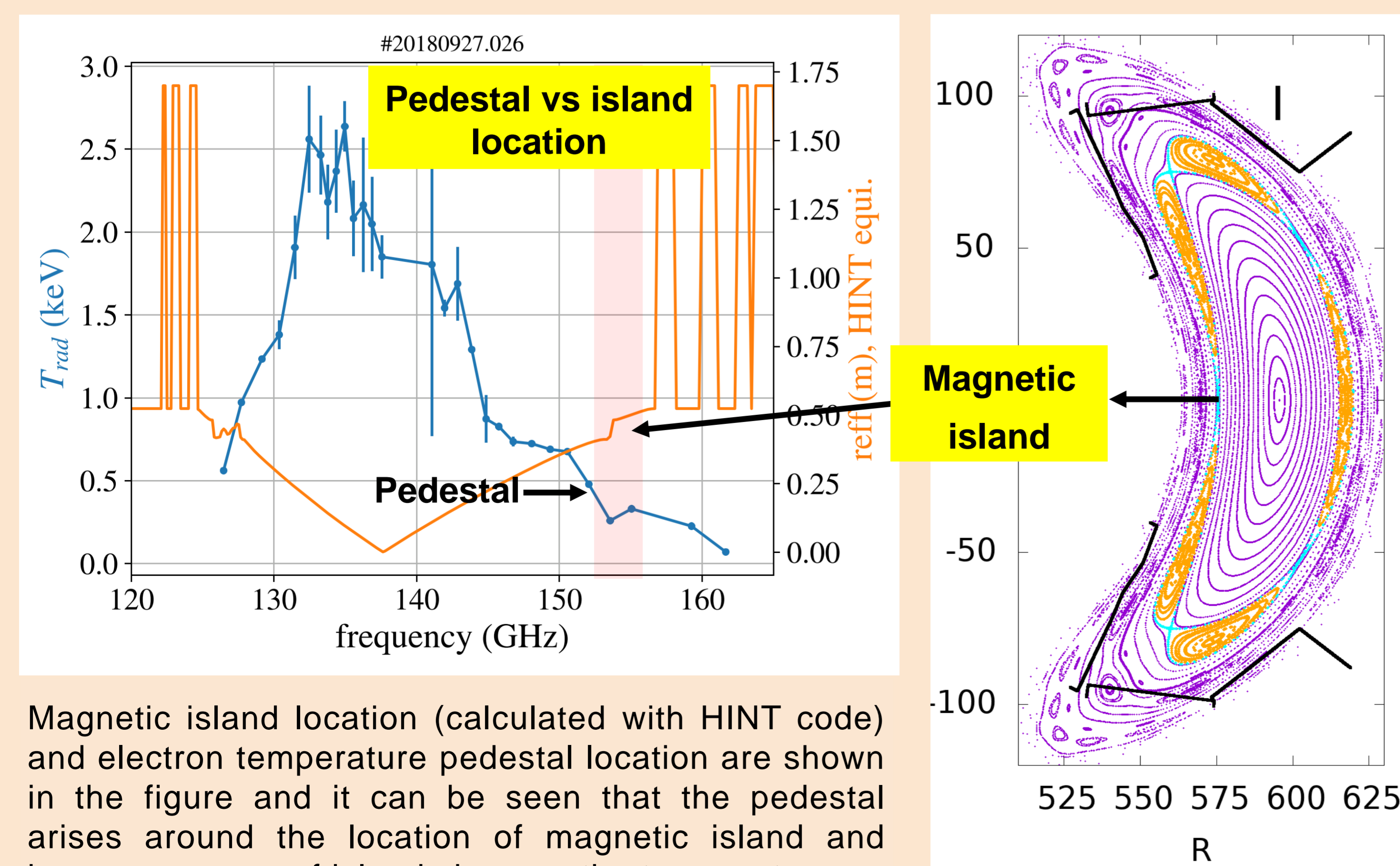


Three time stamps are selected during an ELM to investigate the effect on the pedestal, which is shown in the spectra given below.



Pedestal is present before the ELM occurrence (blue) covering channels 150-155 GHz, and during the ELM, a clear pedestal breakage (green) can be observed in the ECE radiation temperature spectra.

## Pedestal location with respect to magnetic island



Magnetic island location (calculated with HINT code) and electron temperature pedestal location are shown in the figure and it can be seen that the pedestal arises around the location of magnetic island and hence presence of island changes the transport.

## Conclusion

- The pedestal and ELM locations are at the rational island location, suggesting that islands affect the transport in that regime.
- The ELM characteristics changes with varying iota profile, plasma density and electron temperature, since the plasma pressure changes. A typical ELM results in 3-5% of energy loss.
- The pedestal builds up in the plasma startup phase in W7-X stellarator and hence no clear forward L→H mode transition is seen for all the available configurations with different iota profiles.
- However, a possible backward H→L mode transition is seen, during the plasma decay phase after the heating is switched off, from different diagnostic measurements and the plasma parameters that lead to back transition varies with different iota profiles.

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