

Synthetic diagnostic of INPA passive signal in EAST

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The imaging neutral particle analyzer (INPA) diagnosis can be used to infer fast ion (FI) distribution, which is crucial for understanding neoclassical transport and anomalous transport induced by MHD events or turbulence.^[1,2] The experimental validation of the INPA has been successfully conducted in the Experimental Advanced Superconducting Tokamak (EAST).^[3]

The INPA passive signal, caused by cold edge neutrals, are measured and simulated. The synthetic images are in good agreements with the experimental images, as shown in figure 1. The simulation results indicate that the two observed pitch peaks predominantly originate from fast ions (FIs) with distinct initial deposition locations: the high pitch peak arises from particles initially deposited on the low-field side (LFS), while the low pitch peak corresponds to those initially deposited on the high-field side (HFS). Furthermore, experimental observations demonstrate that the change of the electron density, which directly affects the initial deposition distribution of FIs, leads to variations in the ratio between these two pitch peaks. During supersonic molecular beam injection (SMBI), the passive signal intensity exhibits an order of magnitude amplification

while preserving the two pitch peaks. Within similar electron density ranges, the proportion of low pitch peak increases with elevated β_N .

In conventional INPA diagnostics, passive signals are typically treated as noise when resolving the FI distribution. However, the analysis presented in this work reveals that the passive signal contains valuable information about the FI phase space distribution. At higher electron densities, the active signal from the diagnostic beam is no longer dominant, and the passive signal plays an increasingly important role. This work demonstrates the potential of INPA passive signals for inferring FI transport.

References

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- [2] D.J. Lin *et al*, Nucl. Fusion. **60**, 112008 (2020)
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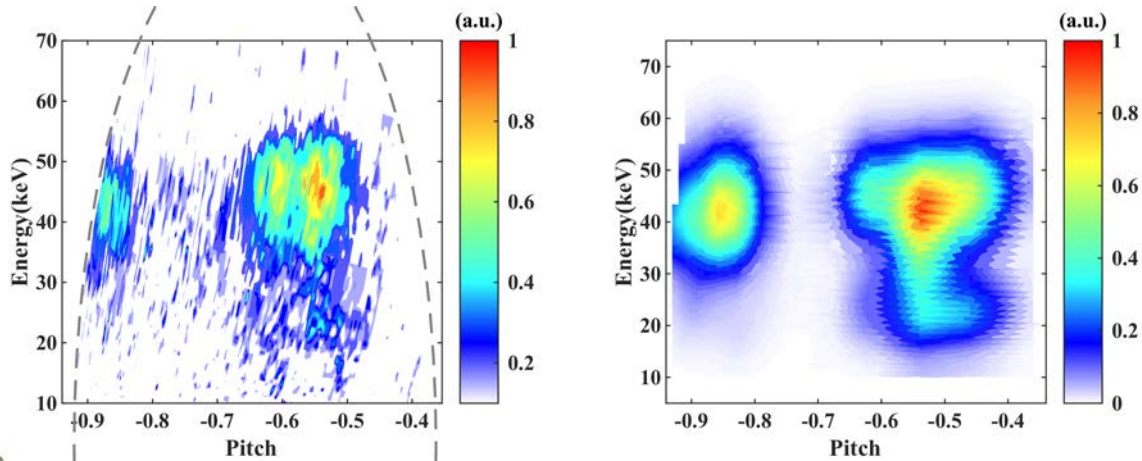


Figure 1. The experimental image of passive signal (left) and synthetic image of passive signal (right) of EAST shot #142319 5500ms.