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Interferometric Observation of RF Induced Density Fluctuation Using FIReTIP

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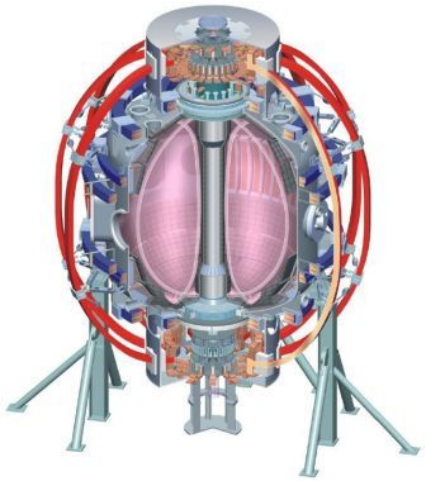

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Interferometric Observation of RF Induced Density Fluctuation

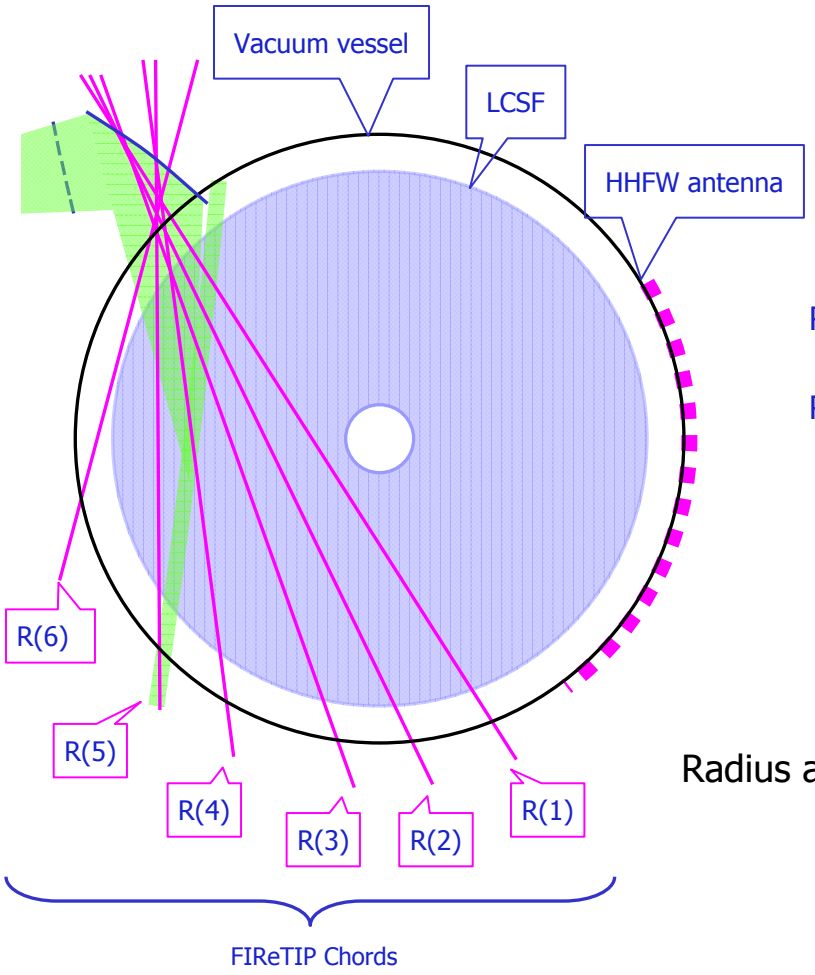
- Density fluctuation induced by 30 MHz HHFW
  → Macroscopic fluctuation in dielectric constant

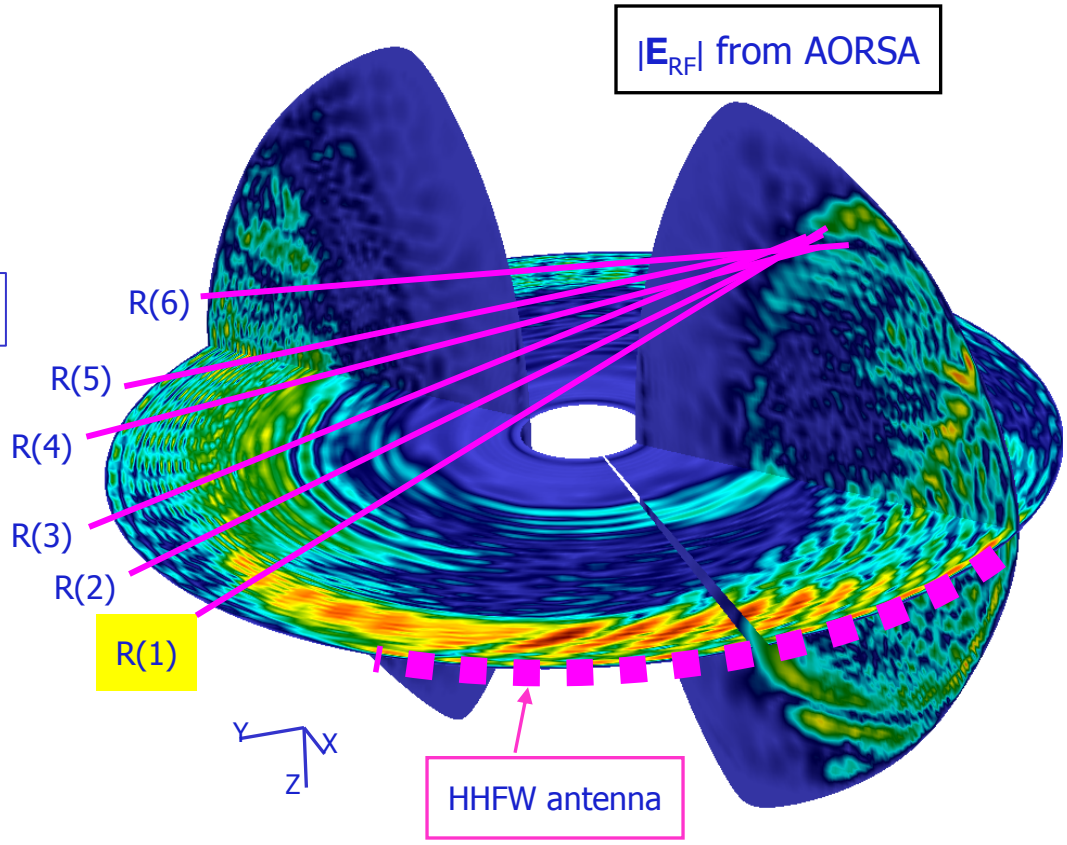
$$n_e = \bar{n}_e + \tilde{n}_e \Rightarrow \Delta\phi_e = \bar{\phi}_e + \tilde{\phi}_e$$
$$\tilde{n}_e \sim \tilde{n}_{eo}\cos\omega_{RF}t \Rightarrow \tilde{\phi}_e = \tilde{\phi}_{eo}\cos\omega_{RF}t \ll 1$$

$\bar{n}_e$: Unperturbed density
$\tilde{n}_e$: RF induced density fluctuation

- FIReTIP
  - Separate outputs with additional mixers at RF frequency
  - FIReTIP has six chords each with different radius at tangential point.
    - RF mixing circuit can be installed on any of these chords.
- Measured fluctuation at various radial chords and antenna phase angles will be compared to the predictions from TORIC Code

FIReTIP Chords in NSTX Midplane





Radius at tangential point

R(1) = 32 cm
R(2) = 57 cm
R(3) = 85 cm
R(4) = 118 cm
R(5) = 132 cm
R(6) = 150 cm

Interferometric Observation of RF Induced Density Fluctuation

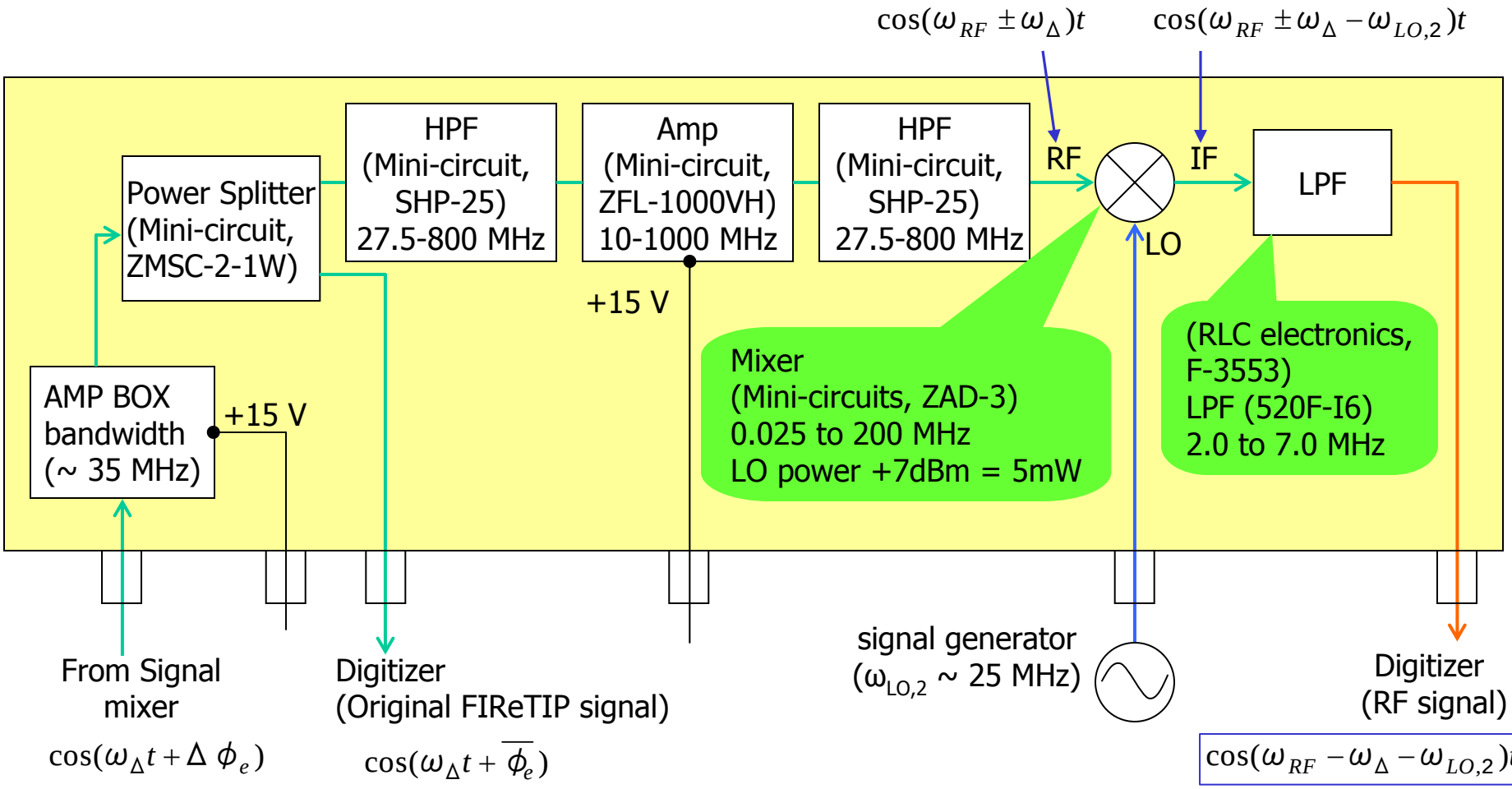
- Measured fluctuation at various radial chords and antenna phase angles will be compared to the predictions from TORIC Code
  - TORIC output → *Electric field* in Stix Frame
  - FIReTIP → *Line integrated density*.
  - Perturbed density vs. Electric field
    - Perform approximate calculations from TORIC results with cold plasma approximation.
    - Improved model: Modify the TORIC to extract the high frequency electron current density information and calculate the density fluctuation.

$$n_{e,HF} = \frac{i}{\omega e_e} \nabla \cdot \mathbf{J}_{e,HF}$$

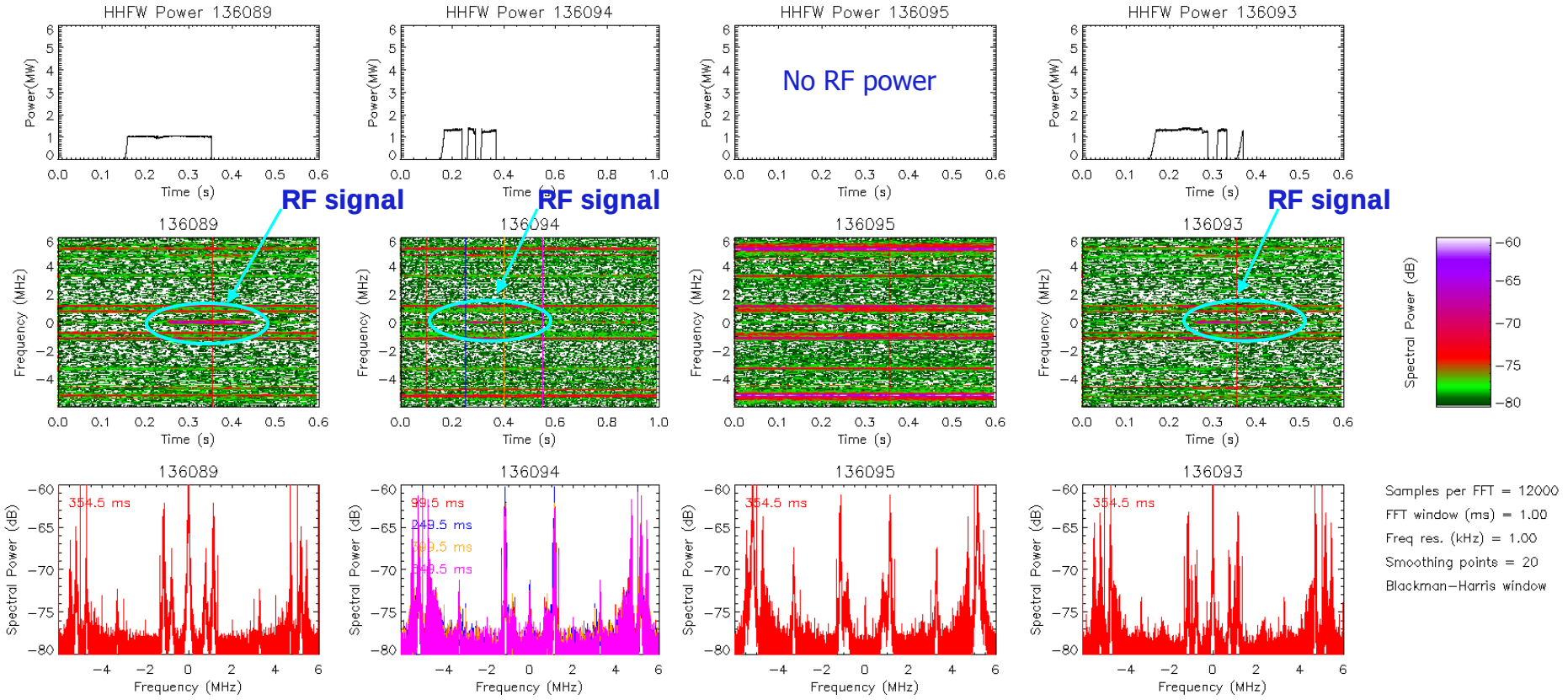
$$\mathbf{J}_{e,HF} = \overline{\overline{\boldsymbol{\sigma}}} \cdot \mathbf{E}_{e,HF}$$

- Back-up slide

RF Amp and Mixing Circuit



Preliminary Results of RF Measurement - FFT Spectrum



- FIReTIP signal was delayed 0.1 sec due to DAQ board.
- RF signals exactly coincided with the HHFW power and was detected even without laser.

No FIReTIP laser
(Laser was blocked)