Density fluctuations increase with off-axis heating (QHS plasma, B=1T in CCW).

### Interferometry System

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacuum pressure</td>
<td>3.0 mtorr</td>
</tr>
<tr>
<td>Electron density</td>
<td>~1x10^14 cm^-3</td>
</tr>
<tr>
<td>Electron temperature</td>
<td>3 eV</td>
</tr>
<tr>
<td>Magnetic field</td>
<td>4.5 T</td>
</tr>
<tr>
<td>Plasma current</td>
<td>2.5 MA</td>
</tr>
</tbody>
</table>

### Density Fluctuations Increase with Off-Axis Heating (QHS Plasma, B=1T in CCW)

#### Plasma Parameters

- **Parameters:**
  - Electron density
  - Electron temperature
  - Magnetic field
  - Plasma current

#### Change in Density Fluctuations with Heating Locations

- **3 Different Electron Heating Scenarios**
  - Off-axis (n=2) interferometer
  - On-axis interferometer
  - Background interferometer

#### Density Fluctuations Increase with ECRH Power

- **Scenarios:**
  - 0% ECRH
  - 10% ECRH
  - 30% ECRH

#### Flows Approximately Follow the Helical Direction of Symmetry

- **Direction:**
  - ECRH power increases
  - Core localized density gradient is reduced
  - Density fluctuations are suppressed

#### Bias Excited Mode Located at the Edge, 15kHz Mode Located in Plasma Core

- **Differential interferometer measurement at the core**
  - Bias reduced mode is not observed by core differential interferometer measurement
  - Coherent mode at 15kHz is observed and frequency does not change with Biasing (not localized)

#### Broadband Density Fluctuations Suppressed During ECRH Heating

- **Energy and Core Density Fluctuations are consistent with driven gradient mode**
  - ECRH power increases
  - Core and edge density fluctuations are suppressed

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**Summary and Future Plans**

1. **Interferometry and Differential Interferometry are used to measure density fluctuations in HSX:**
   - Two interferometer measurements: spatial information available by comparing data
   - Differential interferometry is used to obtain core localized measurements

2. **Both coherent modes and broadband fluctuations are observed:**
   - For Off-Mode:
     - Significant changes (amplitude and frequency) of fluctuations are observed with changes in heating location and power
     - Density and temperature fluctuations are consistent with density gradient drive (not T gradient)

3. **Broadband density fluctuations are accompanied in plasma core:**
   - Positive biasing can excite coherent oscillations in the plasma edge
     - Changes in density fluctuation amplitude (edge and core) consistent with driven gradient mode

4. **Mirror plasmas:**
   - Core and edge density fluctuations signal only broadband fluctuations and plasma flow similar to those in QHS plasmas

**Future work will focus on identification of fluctuations and relation to transport**