1. MAST 2D BES SYSTEM

- ZEMAX model of optical system
- CATIA model of ex-vessel periscope
- Intermediate optics
- Field lenses with filters
- Imaging lens
- Ex-vessel optical hardware

2. HOW DOES BES WORK?

- BES detects photons released from excited neutrals.
- Neutrals collide with electrons, ions and impurities
- Excited neutrals are populated
- Radiative decay (Emission of fluorescence)
- Detect and count emitted photons (typically D<sub>α</sub>)

3. FACTORS INCLUDED IN SYNTHETIC BES DATA

- Emission (interaction of beam with plasmas)
  - Beam flux attenuation as the beam penetrates plasma (collisions between beam and plasmas)
  - Beam cross-section profile (divergence of beam)
  - Beam excitation rate
  - Atomic transition time (finite half-life of the D<sub>α</sub>)

- Collection
  - B-field topology along LoS
  - Optical light cone size along LoS
  - Optical magnification factors along LoS
  - LoS integration of the Doppler shifted D<sub>α</sub> emission

4. GENERATING SYNTHETIC BES DATA

- Beam Profile
  - Beam attenuation along beam path
    \[ \rho(0)-\rho(L) = \int_0^L n_0(x)dx \] where \( \rho \) is the beam stopping rate
  - Beam cross-section profile
    \[ \rho(x) = \rho_0 \left( \frac{x}{x_0} \right) \] where \( x_0 \) is the beam width
  - Beam excitation rate: Emissivity
    \[ \lambda(x) = \lambda_0 \left( \frac{x}{x_0} \right) \] where \( \lambda_0 \) is the emission rate

5. SYNTHTIC BES DATA DOMAIN AND CUTIE DATA

- Photon flux along LoS
- Total photon flux along LoS
- View planes along LoS
- B-field effects on one channel

6. RESULTS AND DISCUSSIONS

- Synthetic BES data are generated based on CUTIE data.

- 1) Kinetic energy traces for CUTIE and BES without photon noise
- 2) Radial/Poloidal FWHM Profiles at two different radii
- 3) PSF and STF at two different radii
- 4) RMS diff and poloidal group velocity profile