**PROPOSAL FOR BES-CPO**

*Authors: Ö. Asztalos1, G.I. Pokol1, M. Aradi1 and B. Szondy1*

*1BME NTI, Budapest, Hungary*

**Purpose of the proposal:**

The RENATE synthetic diangnostic, designed for fluctuation BES diagnostic system modelling is to be integrated into EU-IM. Communication of various actors responsable for executing code is only possible through **C**oherent **P**hysical **O**bjects (CPO). The current proposal outlines the design of the BES – CPO, responsable for handling all data relevant for a BES sysnthetic diagnostic within the EU-IM.

**Detailed layout and design of BES – CPO tags:**

1. **time** [s] [integer]: Contains the number of the time slice in question.
2. **beams (:) [nbeams]** The tag will contain relevant data for beam modelling. The CPO will be set-up such as to handle a time dependent beam geometry or simultaneous beam modelling of 2 or more beams. Array of structures containing any number of beams. It is based on the NBI CPO beamlet handling structures. <http://www.efda-itm.eu/ITM/html/itmtypes__4.10b.html#4.10b:beamletgroup>
3. **width** [m] [float]: width of the modelled beam.
4. **height** [m] [float]: height of the modelled beam.
5. **divergence** [rad] [float]: divergence of the beam.
6. **energy** [eV] [int]: beam energy.
7. **species** [-] [string]: the type of atoms composing the beam (H,D,Li,Na).
8. **direction** [-] [int]: Gives the direction of the beam, co and counter clockwise
9. **beamlets** Contains the data for the modelling of the 3D beams.
   1. **position** [rzphi] [nbeamlets]: Startpoint of the beamlets
   2. **angle** [rad] [nbeamlets]: Inclination angle
   3. **tang\_rad** [m] [nbeamlets]: Tangency radius
   4. **current** [A] [nbeamlets]: Beamlet current values
10. **modelled\_plasma\_species** [-] [string list]: Contains all the plasma species to be accounted for in beam evolution calculations (e, H, D, T, Li, etc) [coreprof, coreimpur, turbulence CPO]
11. **observation (:)[n\_observations]** Tag that stores all relevant data regarding the construction of the observation module
12. **lens\_diameter** [m] [float]: Contains the diameter of the last optical element of the observation system.
13. **pixel\_number** [-] [integer]: Gives the number of detector pixels the optical system is modelled with.
14. **collimator** (:) Contains information with regard to the observation volumes used for the pinhole optics modelling. It is take from fusiondiag CPO.

<http://www.efda-itm.eu/ITM/html/itmtypes__4.10b.html#4.10b:fusiondiag_collimator>

1. **optical\_performance** (:)[ndetectors] Contains the various forms of transmission rates that are applicable for each detector.
   1. **neutral\_tranmission** [-] [float]: Contains the wavelength independent transmission rates for each detector that arises from the optical system in case of the pin hole optical model.
   2. **filter\_transmission** [-] [float]: Contains the transmission values that arise from optical filtering processes.
   3. **light\_coll\_eff**  Contains the transmission matrix for each detector pixel. Input from detailed optical modelling.
      1. matrix [-] [1D array]: Contains the light collection weights for a 3D ROI.
      2. position [rzphi 1D]: Array Contains the corresponding coordinates of the points within the light collection matrix.
2. **observation\_point** [m] [rzphi]: Contains the coordinates of the entrance pupil of the observation system.
3. **focus\_point** [m] [rzphi]: Contains the coordinates of the focal point of the observation system.
4. **output(:)[n\_detectors]**:Contains output data, is an array of structures for all detectors
5. **simulated\_signal** Contains the modelled BES signal for one detector.
   1. **clean** [1/s] [1D array] [timestep]: Contains the detected photon count without any noise.
   2. **noisy**[1/s] [1D array] [timestep]: Contains the detected photon count with any noise.
6. **fluctuation\_sensitive\_area** Contains values for various calculations
   1. **estimated** Contains the total spatial resolution as a convolution of the atomic smearing, magnetic and beam geometry smearing and detector projection components for each detector pixel.
      1. r\_extent [m] [float]: Radial component of the total spatial resolution.
      2. z\_extent [m] [float]: Vertical component of the total spatial resolution.
      3. r\_center [m] [r]: Center of radial extent for sensitive area.
      4. z\_center [m] [z]: Center of vertical extent for sensitive area
   2. **fluctuation\_response** Contains the spatial resolution calculated from fluctuation response calculation for all detector pixels.
      1. r\_extent [m] [float]: Radial component of the total spatial resolution.
      2. z\_extent [m] [float]: Vertical component of the total spatial resolution.
      3. r\_center [m] [r]: Center of radial extent for sensitive area.
      4. z\_center [m] [z]: Center of vertical extent for sensitive area
7. **measurement** (:)
8. **data** [-] [2D array] [n\_detectors, data\_point]: Contains experimental BES measurements for the shot data in question.
9. **beam\_on** [s] [1D array]: Contains the time intervals where the beam was on, used for beam chopping.