**GOALS**

- Optimum NB absorption and efficient CD
- Profiles (CD and fusion) controllability
- Steady-state beam-plasma operation
- Shine-through losses/power reduction
- High neutron yield from beam-plasma fusion

**MOTIVATION**

- Previous modelling has shown NB effects to be highly sensitive to NB and plasma shaping, plasma kinetic profiles and magnetic topology;
- High-performance and detailed methods are needed (e.g. real-time) simulation: analytical + 3D

**ASSUMPTION**

- Beam-plasma operation can be efficiently simulated by LNB approach (“Life model”) = combination of 3D statistics + analytics (BTR + BTOR workflow)

**LITE NEUTRAL BEAM**

- Beam response in plasma
  - Optimum NB absorption and efficient CD
  - Profiles (CD and fusion) controllability
  - Steady-state beam-plasma operation
  - High neutron yield from beam-plasma fusion

**BTOR plasma geometry**

- Detailed 3D injected beam geometry and statistics (~10^9 particles)

**FAST IONS SLOWING-DOWN and CURRENT DRIVE CALCULATION**

- Fast ion slowing-down time
- Spitzer time for electrons
- Critical energy

**NB CONTRIBUTION TO FUSION (DEMO-FNS)**

- Beam-plasma fusion rates and NB share in neutron yield for given plasma depend on NB energy ratio to plasma temperature (Eb/Te) and on thermal energy confinement time (nB). Fusion rates in DEMO-FNS and ITER are almost identical (for fixed Te), while NB share in ITER neutrons is low due to 7 times higher plasma volume.

**TAPERED CORRECTIONS**

- Ion parallel velocity fluctuations (a_p = 2)
- Mean parallel velocity

**NB FUSION & NEUTRON YIELD**

- Fusion rate dependence on T_e thermal, beam-plasma total

**DEMO-FNS VS ITER**

- n_e,B = 1 × 10^{20} m^{-3}
- Eb = 500 keV (D)
- η_e,B = 0.5/0.5
- n_e,B = 1.2 × 10^{20} m^{-3}
- Eb = 1 MeV (D)

**BEAM DEPOSITION PROFILE CONTROL**

- Toroidal (neo-classical) effects are incorporated through spatial variation of B-field along a magnetic line. They vanish with decrease of inverse aspect ratio ι (= R/δ). They get maximum at the plasma periphery and negligible near magnetic axis. The toroidal reduction of the ion current has a strong impact on the current profile and the overall CD due to ion parallel velocity bouncing along deceleration path.