1. Introduction

1.1 Tokamak and Ion Cyclotron Range of Frequency (ICRF) heating

- A tokamak is a device using magnetic fields to confine plasma in the shape of a torus. The aim is to realize nuclear fusion.
- ASDEX Upgrade (AUG) is one of the middle sized tokamak.

1.2 EMC3-Eirene

- The EMC3-EIRENE code is a coupled 3D Monte Carlo plasma fluid transport (EMC3) and kinetic neutral recycling and transport (EIRENE) package.
- The code includes transport of particles, electron and ion energy, and parallel momentum in stochastic fields with 3D plasma-facing component geometries.

2. Computation grid construction

- 3D computation grid construction using a new reversible field line mapping (RFLM) technique in EMC3.
- ICRF antennas and limiters construction.

3. Simulation of gas puff effects on edge density

3.1 Simulation validation with experiments

- Parallel electric field generated by ICRF antennas will rectify the Direct Current (DC) potential and lead to edge density modification through convective cells.
- Ideas
  a. Using SSWiCH to generate 2D DC potential map.
  b. Implement field line tracing way to construct 3D potential.
  c. Calculate ExB drifts using 3D potential.

- Thermalisation

3.2 Gas puff system in ASDEX Upgrade

- To maintain the plasma temperature additional heatings are needed.
- Ion Cyclotron Range of Frequency (ICRF) heating is one of the most important additional heatings with ion/collisional heating frequency 50-60MHz.

3.3 Top gas puff simulation results

- Initial generation of top gas puff.
- Four gas inlets used, gas rate for each: (2.6e22)/4 e/l/s.
- Gas puff position (toroidal): -168.75°, -78.75°; 33.75°, 101.25°
- In front of ICRF antennas (1-4): -78.75°, -33.75°, 101.25°, 146.25°

3.4 Middle plane gas puff simulation results

- Initial generation of mid-plane gas puff.
- Two gas inlets used, gas rate for each: (2.6e22)/2 e/l/s.
- Gas puff position (toroidal): -56.25°, 168.75°
- In front of ICRF antennas (1-4): -78.75°, -33.75°, 101.25°, 146.25°

4 Further work

4.1 Gas puff effects on edge density

- Adding gas pump in the simulations to make the complete simulation.
- Developing 3D plots to see the more details of the density profiles.
- A L-mode simulation with both gas puff and pump.

4.2 ICRF effects on edge density and potential

- A parallel electric field generated by ICRF antennas will rectify the Direct Current (DC) potential and lead to edge density modification through convective cells.

- Ideas
  a. Using SSWiCH to generate 2D DC potential map.
  b. Implement field line tracing way to construct 3D potential.
  c. Calculate ExB drifts using 3D potential.
  d. Treat drifts as convective filed in EMC3-Eirene.