Kinetic simulation plan for the NSTX edge

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on behalf of
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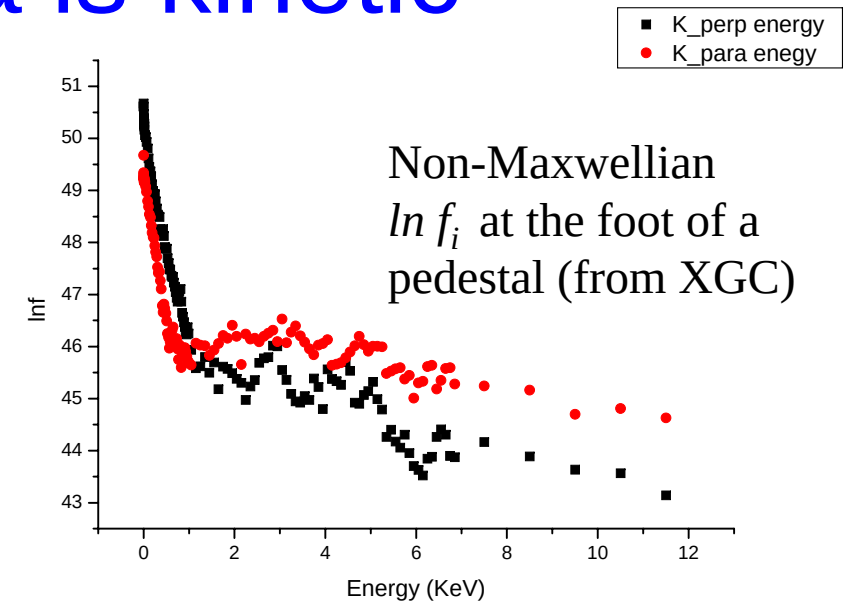
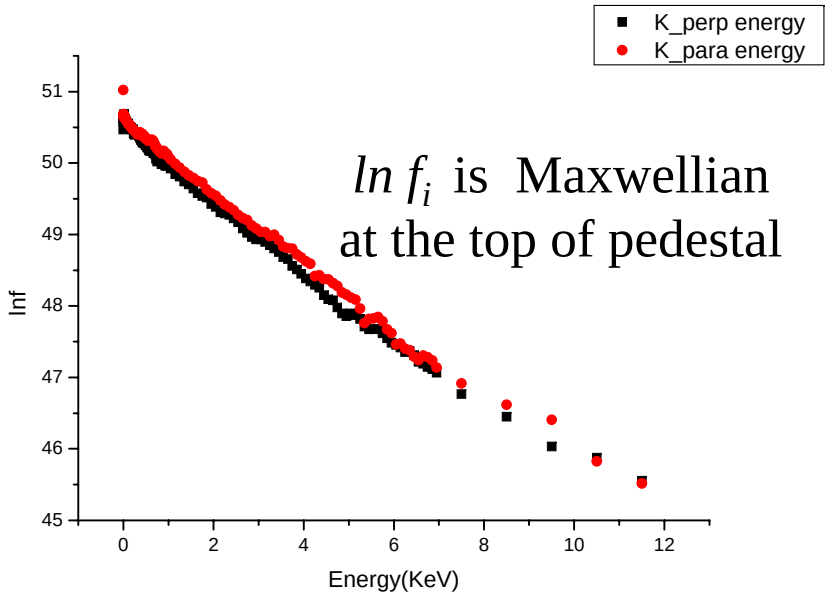
CPES can help understand kinetic edge physics in a spherical torus

- Analyze and predict
  1. L-H transition, pedestal growth, shape and height, SOL flow, turbulence & transport, ELM properties, ELM cycle, wall load, etc.
  2. Difference with higher aspect ratio tokamaks and scaling to ITER
- NSTX specific application requires emphasis of classical physics (large gyroradius at low-B side)
- The collaboration should start with code validation
  - Turbulence property (k & ω spectrum) at L-H transition
  - Density, temperature, rotation profile property in L and H
  - Pedestal scaling
  - Neutral density distribution (XGC-DEGAS2)
  - Wall load distribution change with $V_{\nabla B}$ direction change

Edge plasma is kinetic

- Edge ions are mostly non-Maxwellian
  $\Rightarrow$Kinetic
- Excellent scalability of a 5D PIC simulation to high performance computers
- Arbitrary wall shape with PIC





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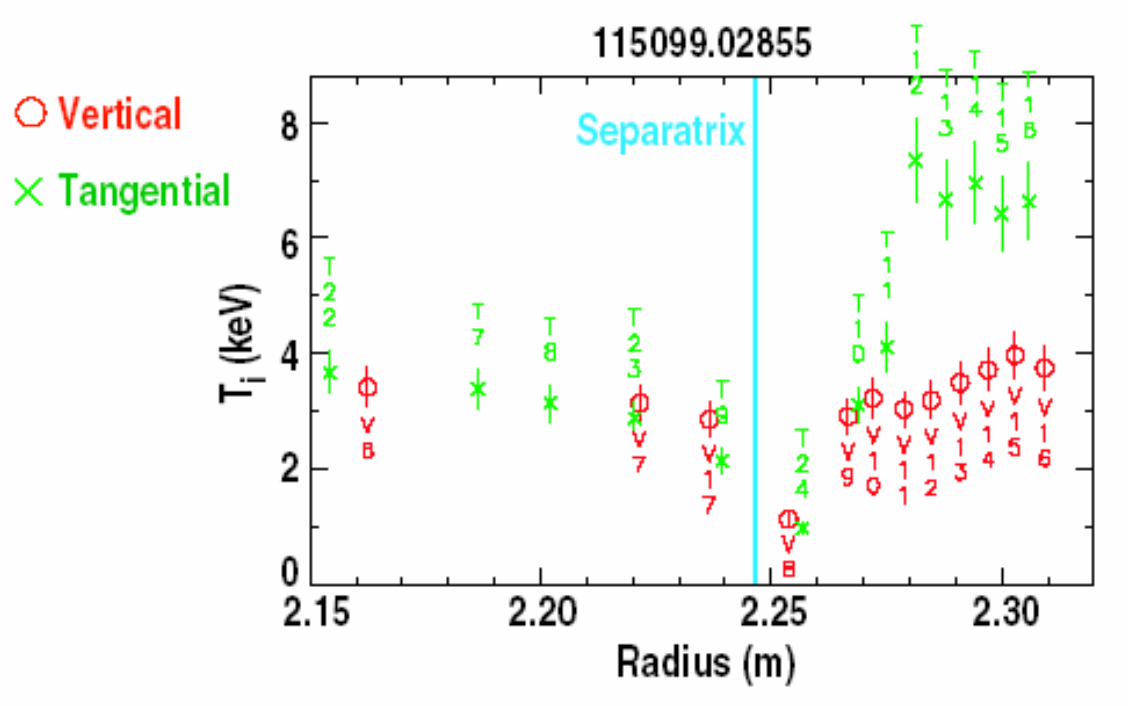
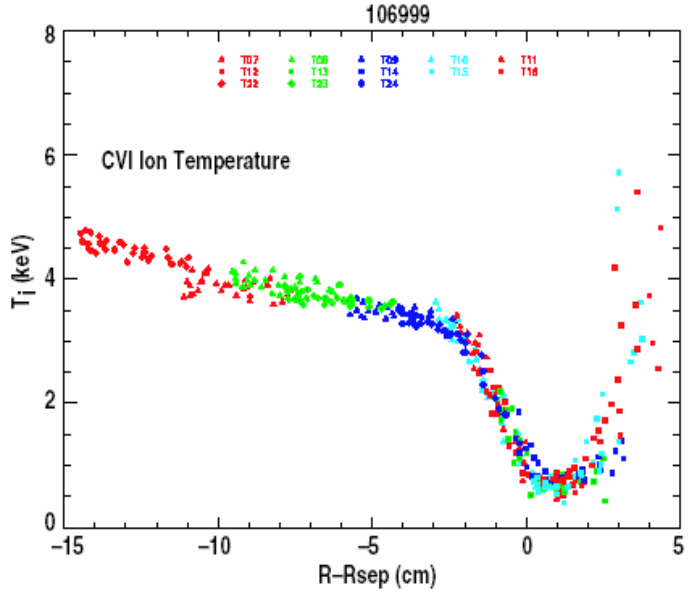
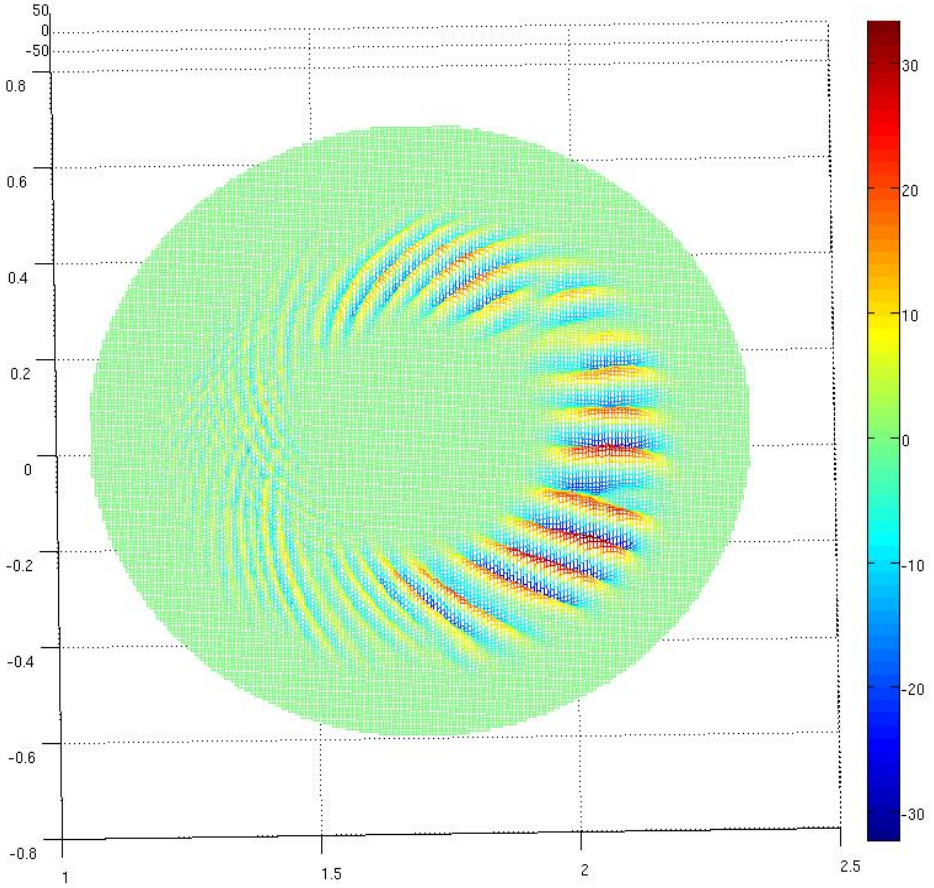
Experimental evidences of anisotropic non-Maxwellian edge ions (K. Burrell, APS 2003)





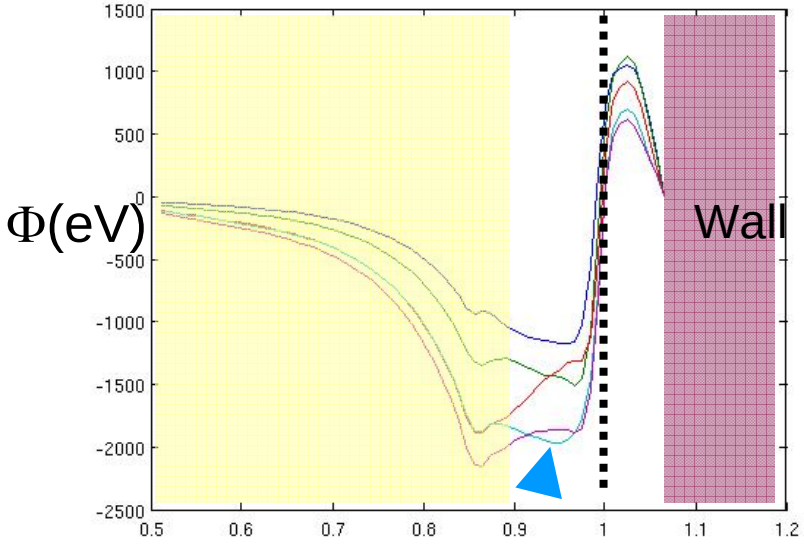
XGC will have edge electrostatic turbulence capability this year for L-H transition study

1. Verify the ITG capability in the cyclone plasma
2. Move the simulation to realistic NSTX edge
3. Both neoclassical and turbulence effect will be simulated together
4. Collisional particle noise reduction

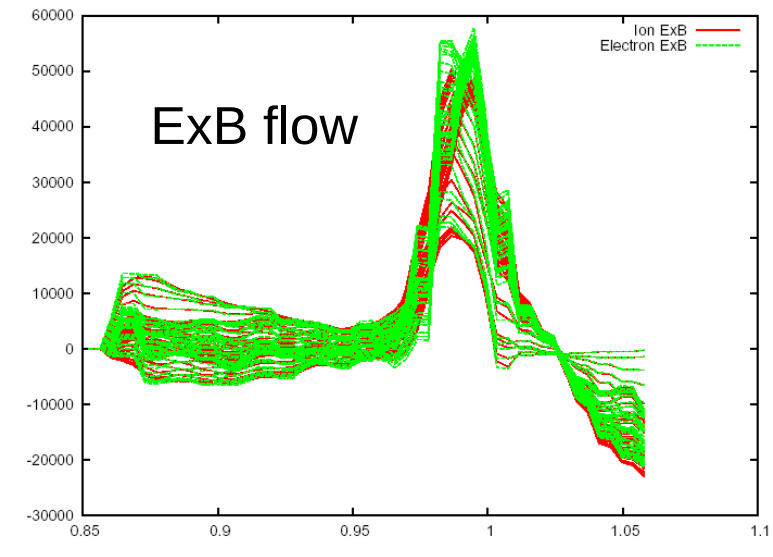


Liner ITG mode growth in cyclone geometry from XGC1

Strongly sheared ExB flow with a strong edge pedestal ⇒ Suppression of turbulence in H-mode

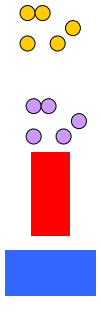


Ψ_N



Ψ_N

Particle motions in poloidal plane in a quiescent H-mode profile edge

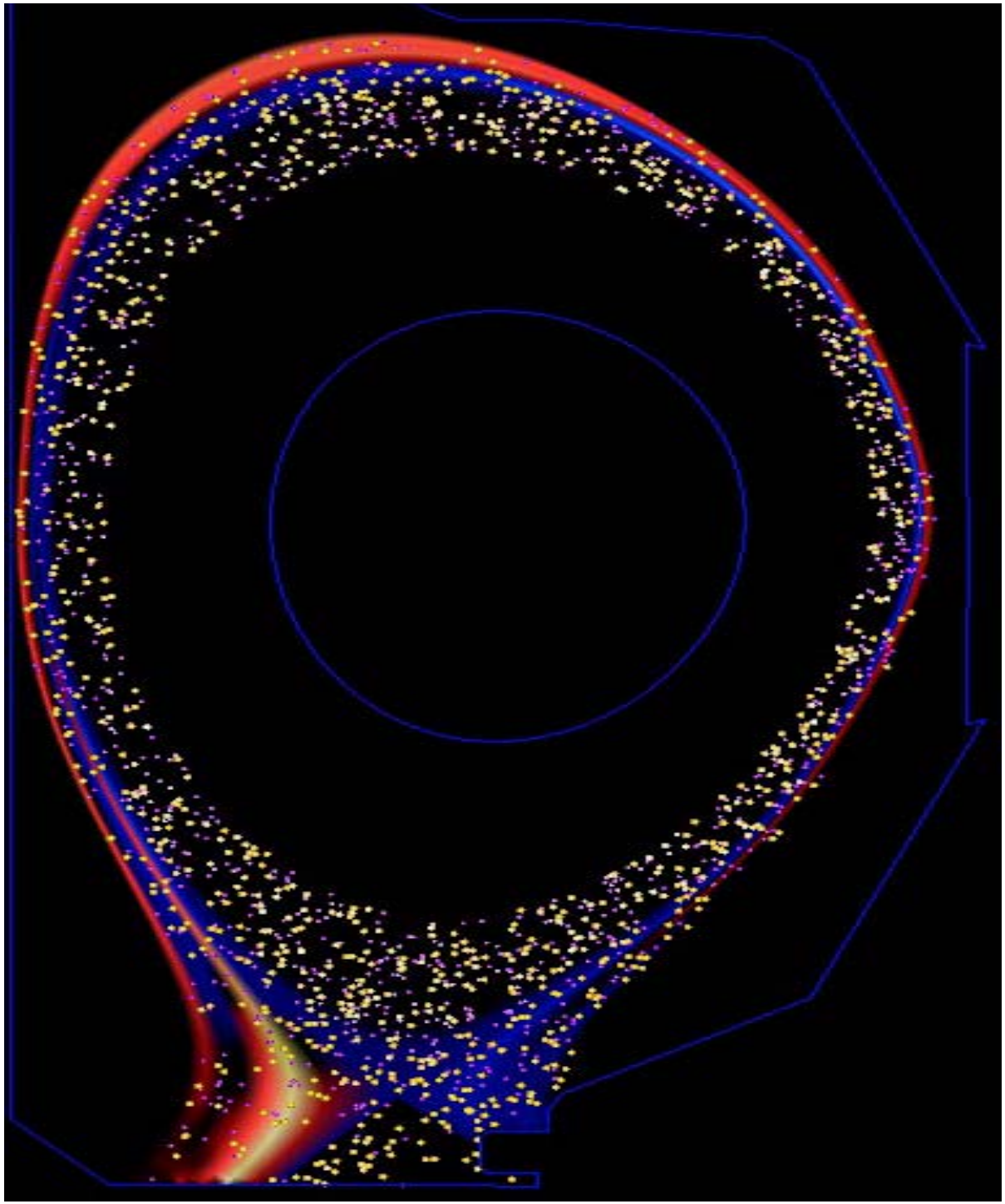


ions

electrons

$V_{||} > 0$

$V_{||} < 0$



CPES Physics Research Roadmap