

Kinetic simulation plan for the NSTX edge



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on behalf of



Center for Plasma Edge Simulation

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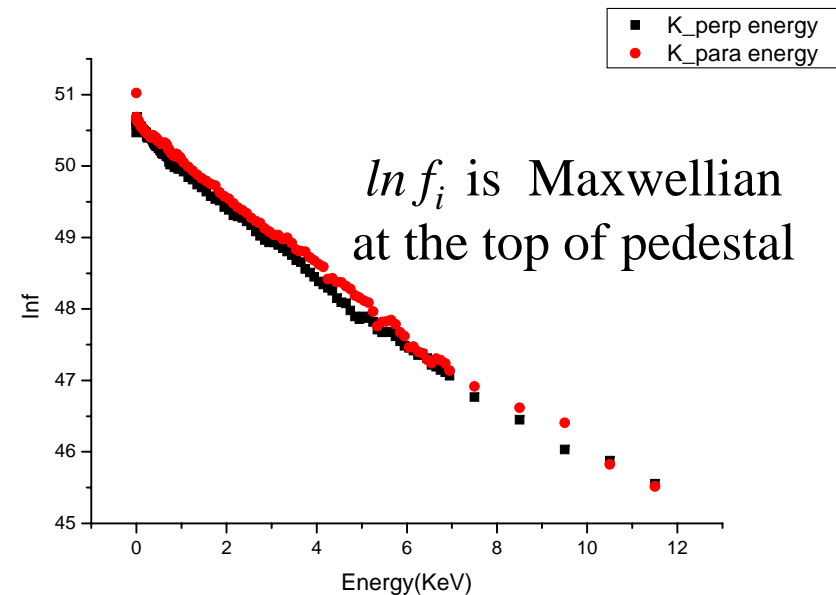
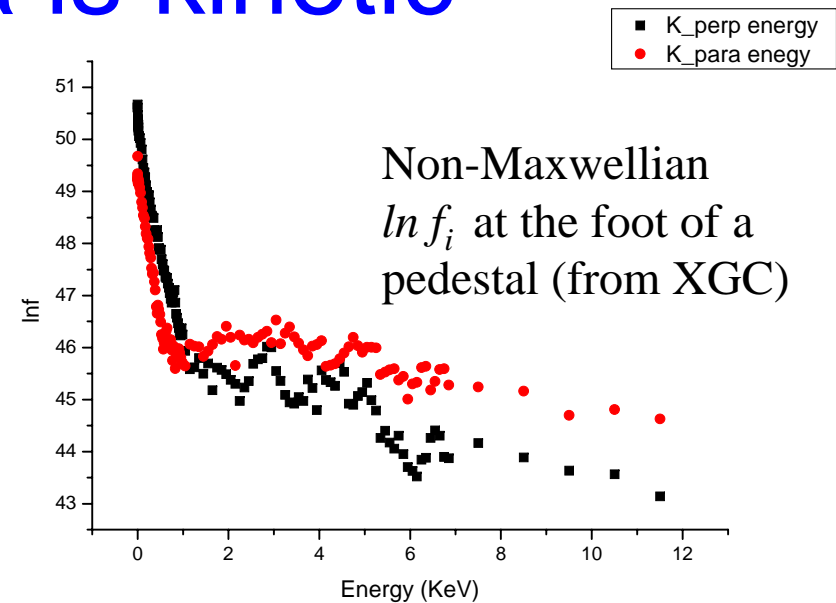
CPES can help understand kinetic edge physics in a spherical torus



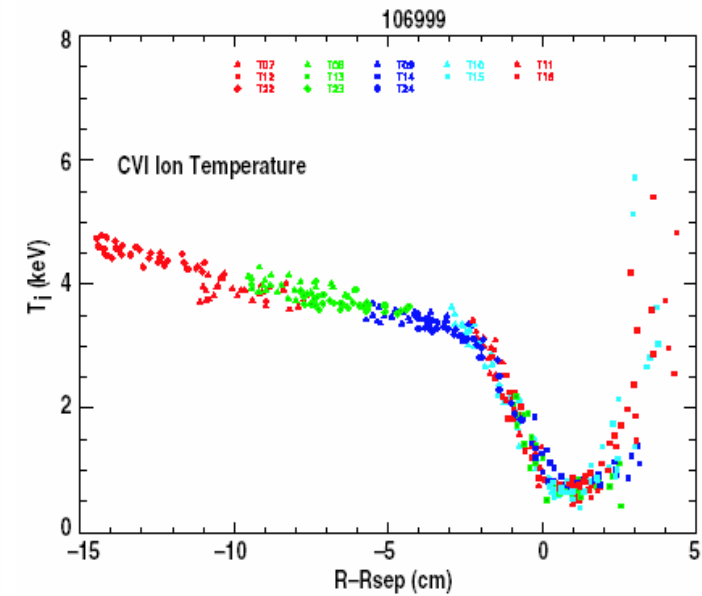
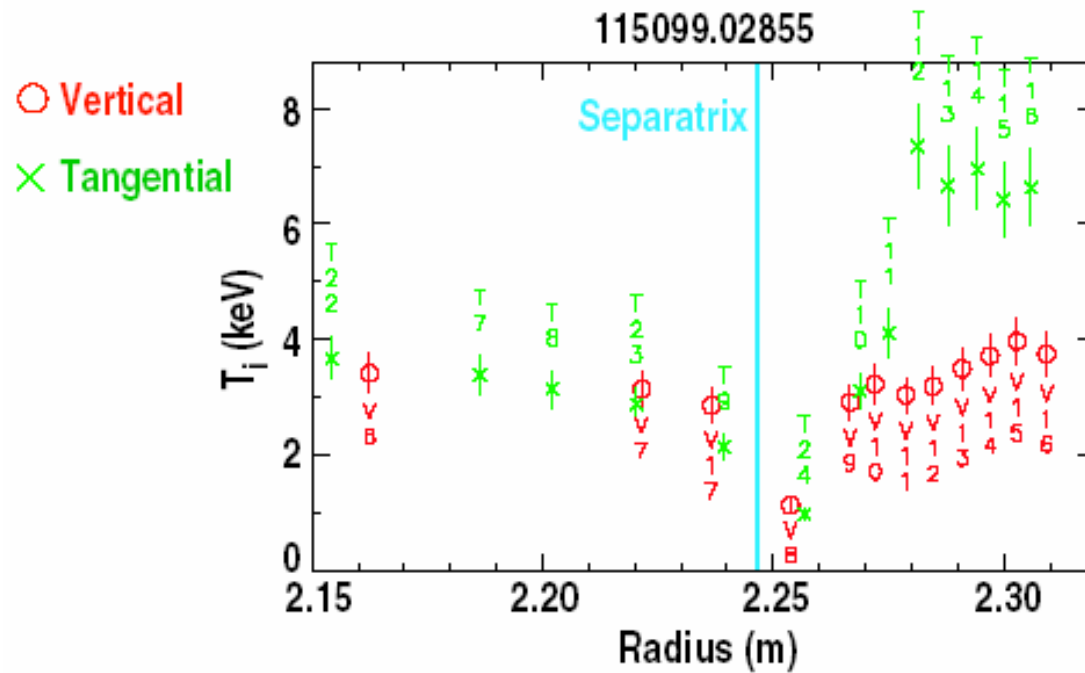
- Analyze and predict
 1. L-H transition, pedestal growth, shape and height, SOL flow, turbulence & transport, ELM properties, ELM cycle, wall load, etc.
 2. Difference with higher aspect ratio tokamaks and scaling to ITER
- NSTX specific application requires emphasis of classical physics (large gyroradius 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
⇒ Kinetic
- Excellent scalability of a 5D PIC simulation to high performance computers
- Arbitrary wall shape with PIC



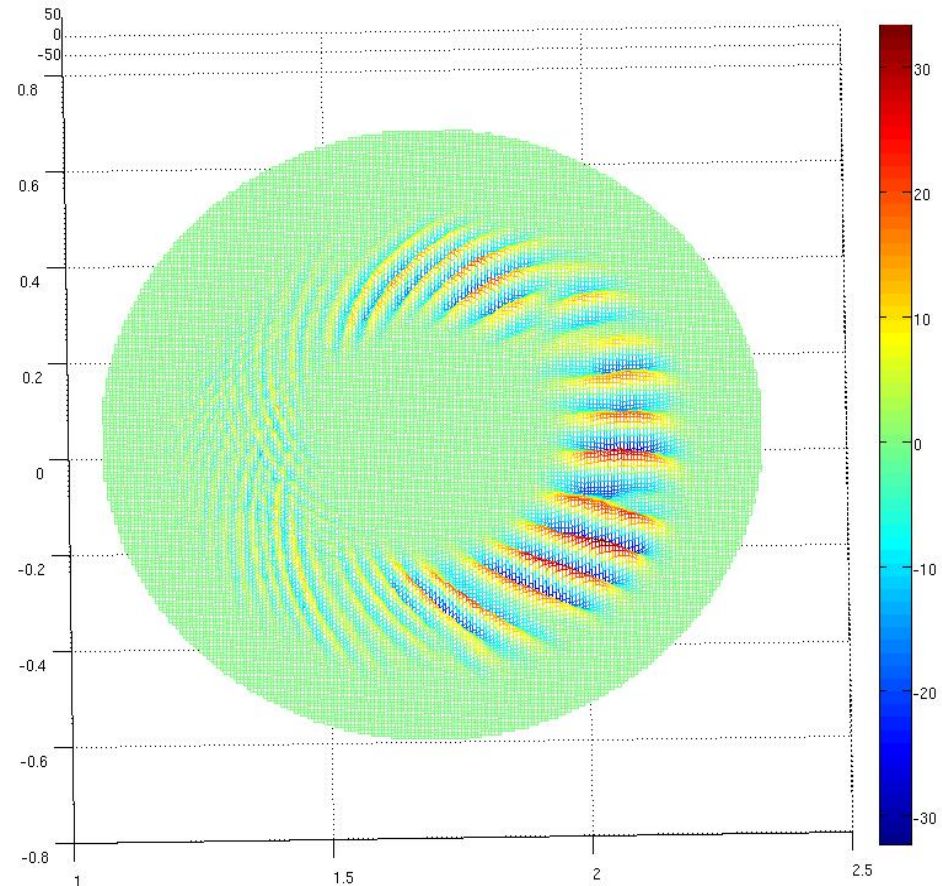
Experimental evidences of anisotropic non-Maxwellian edge ions (K. Burrell, APS 2003)



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

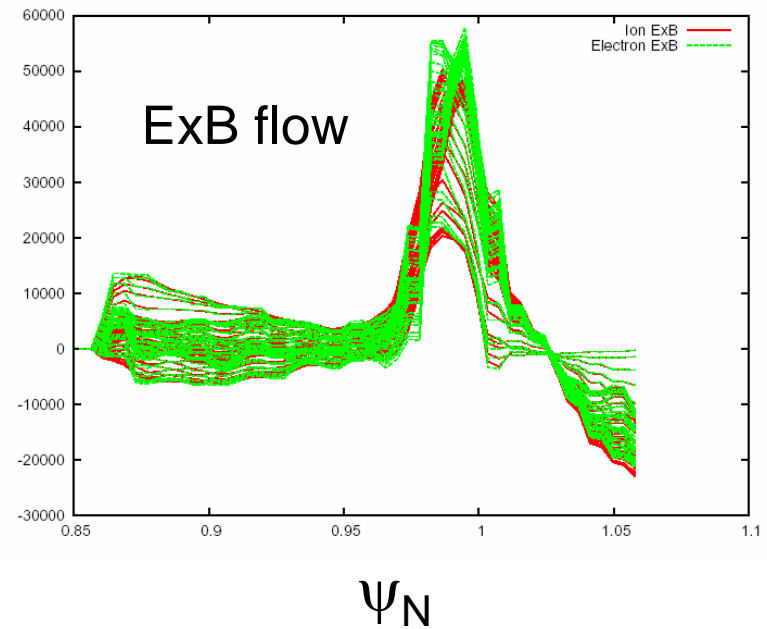
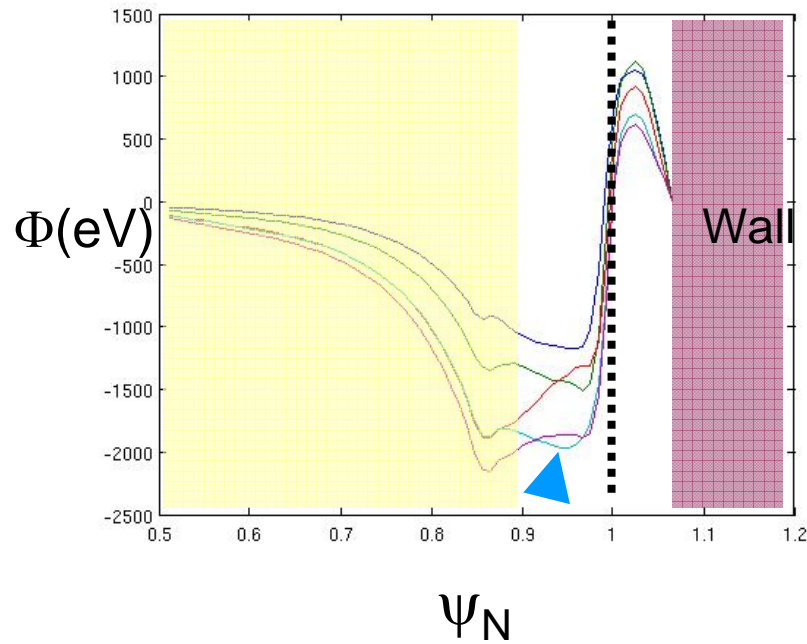


1. Verify the ITG capability in the cyclone plasma
2. Move the simulation to realistic NSTX edge
3. Both neoclassical and turbulence effect will be simulated together
4. Collisional particle noise reduction

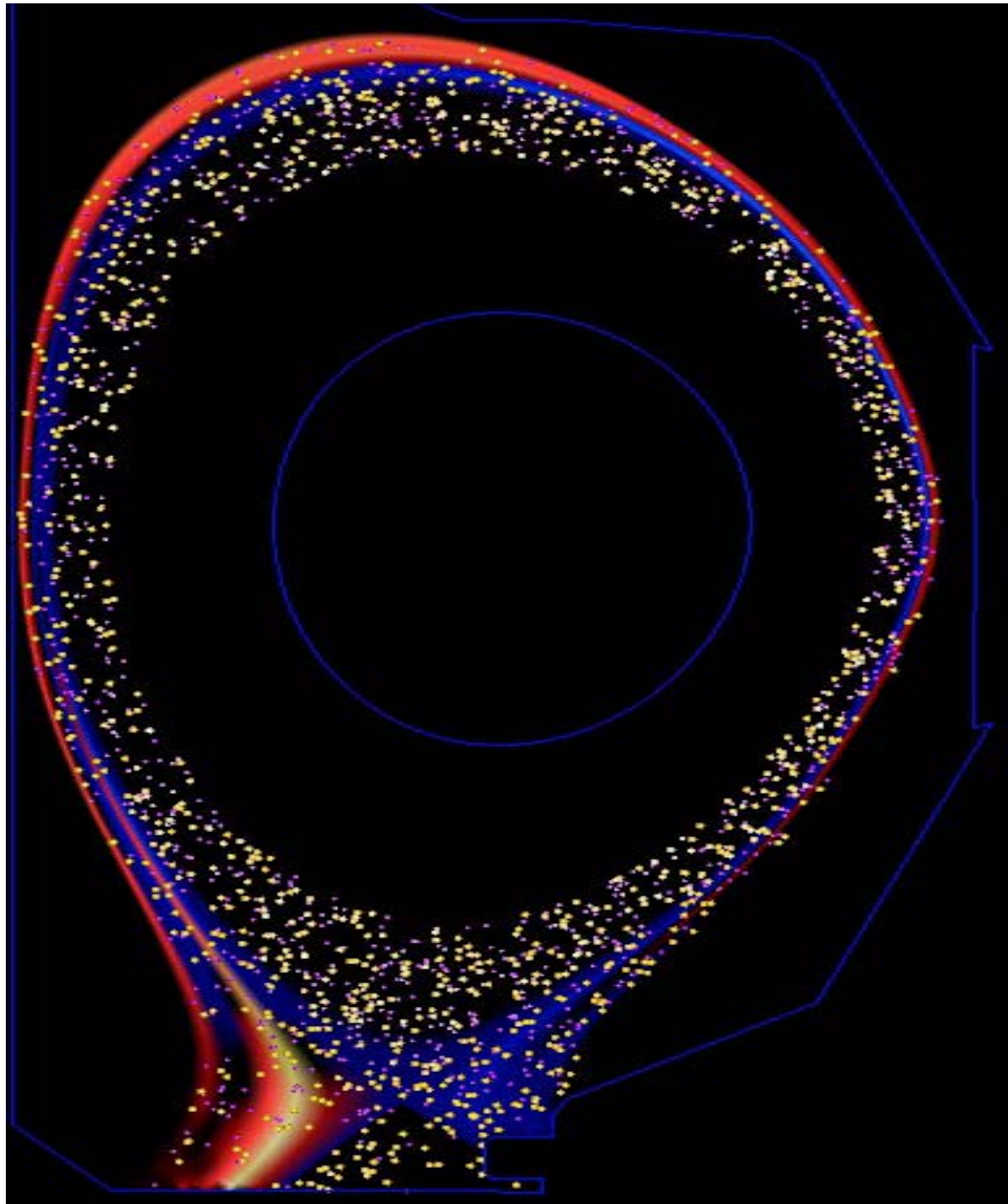
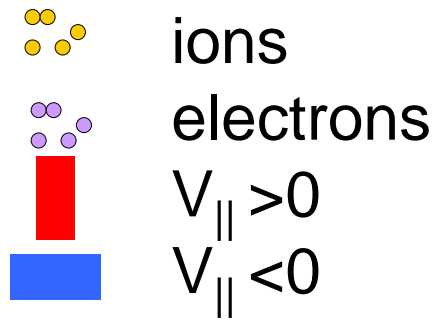


Liner ITG mode growth in cyclone geometry from XGC1

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



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



CPES Physics Research Roadmap

	Pre-CPES	2006	2007	2008	2009	2010
Edge Kinetic code	XGC0, Full-f ions with 1D E_r solver	XGC1, Full-f ions & electrons, Axi-symmetric 2D solver (E_r, E_θ)	XGC1, Full-f, electrostatic turbulence in the entire edge		XGC2, full-f E&M edge Turbulence code	Develop coupling to core code
			Enhance XGC0 with Electrons & DEGAS2	Multiscale XGC0-XGC1 coupling	Develop XGK: Multiscale XGC0-XGC2 Integration framework	
Physics Research	First 1D neoclassical ion edge solution, with pedestal buildup by neutrals	First 2D neoclassical kinetic solution in the entire edge	Edge rotation physics. Ripple and error field effects on pedestal, rotation & ELM	Study L-H transition	Study pedestal-ELM cycle with concurrent turbulence capability (in integration with an MHD/ELM code)	Study core-edge coupled physics