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Progress and plans of General Perturbed Equilibrium Code (GPEC)

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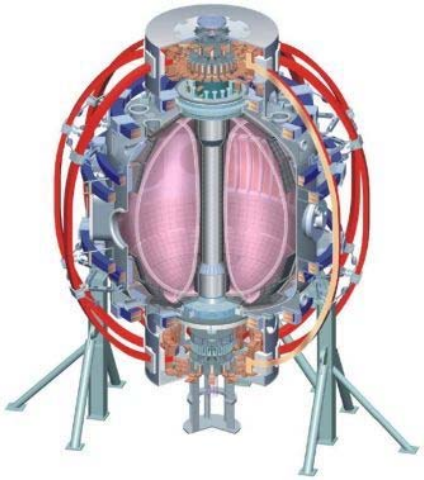
...

Macroscopic stability TSG Meeting
February 14, 2012



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GPEC is the extension of IPEC (2-3 more years to finish)

- General Perturbed Equilibrium Code (GPEC) is the extension of IPEC
  - **To solve 3D force balance with general jump conditions at the layer**
  - **To solve 3D force balance with tensor pressure or general force**
  - **To provide fast and linearly self-consistent answer for 3D equilibrium including islands, rotations, NTVs**

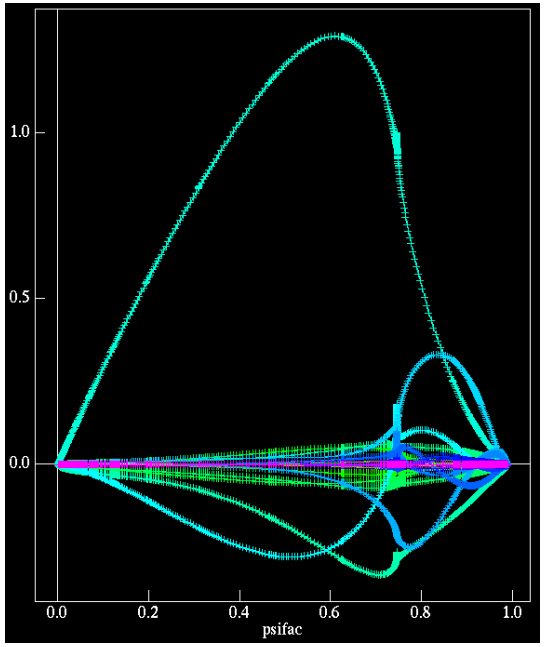
- Extension is made to retain large solutions as well as small solutions
  - **This first step has been successful by solving Euler-Lagrange equations in the δB frame rather than the ξ frame**
  - **Issue with finite pressure gradient remains at the resonant surfaces, but solution at the non-resonant layer is almost independent on the layer treatment**
  - **Immediate applications : Classical Δ' index in general geometry, effects by other islands, field penetration with islands**

- Tensor pressure solver is underway (POCA)
- Inner-layer solver development is planned with new manpower

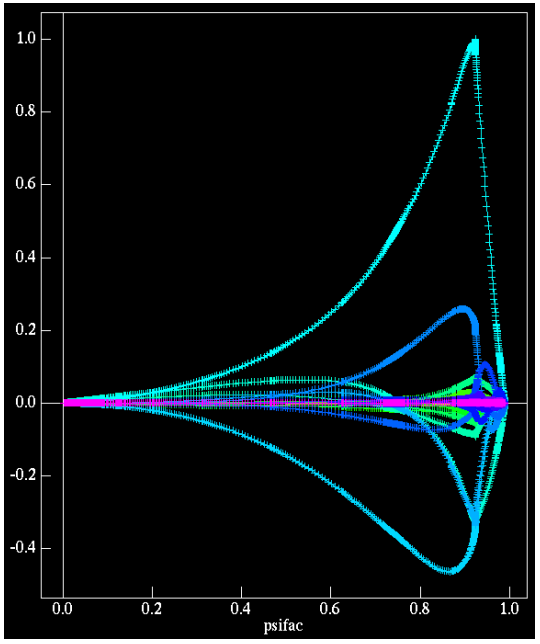
Update for perturbed equilibria with islands

- Presently the code can obtain an internal solution with an island at a rational surface, but without islands at other rational surfaces
- These are fundamental solutions for each rational surface and can be linearly combined with ideal eigenmodes in IPEC and can allow any jump condition at each rational surfaces

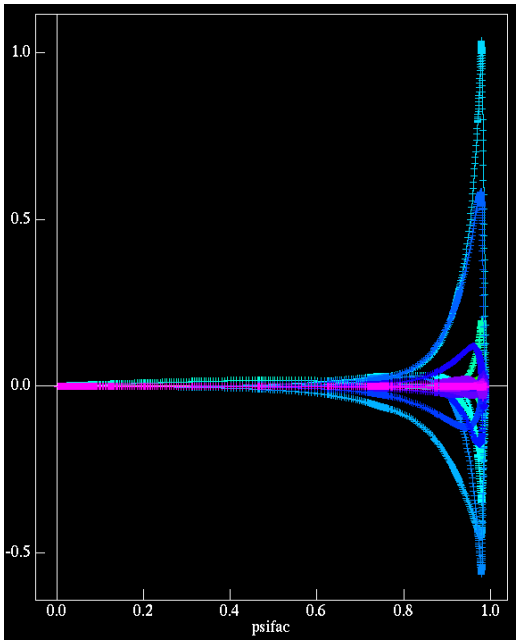
2/1 fundamental solution



3/1 fundamental solution



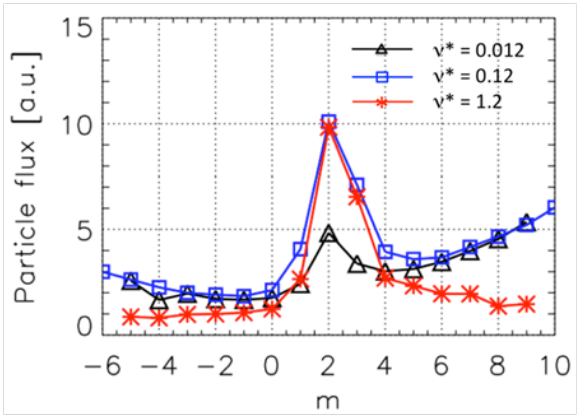
4/1 fundamental solution

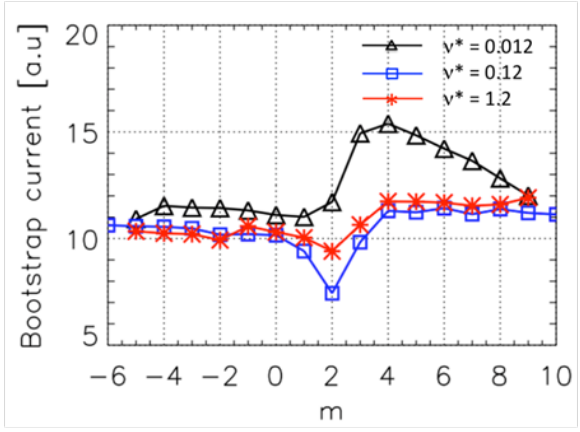


POCA is drift-kinetic δf particle code, optimized to obtain accurate 3D force and to IPEC coupling

- POCA (Particle Orbit Code for Anisotropic pressures, by Kim) follows drift-kinetic particles with (presently) pitch-angle scattering collisions, but with conserved momentum, and directly calculates tensor pressure forces
  - Uses IPEC type routines, ready for 2D or 3D equilibrium coupling, and parallelized
  - Finishes 2D benchmark with ORBIT, for diffusion and bootstrap currents
  - Finishes basic tests with 3D fields, for diffusion and bootstrap currents
  - NTV and tensor pressure calculations are underway, rechecking verification work between general NTV theory and FORTEC-3D or validation in DIII-D

Resonant and non-resonant 3D field effects (POCA)





A future validation target