Fast Particle Issues and Action Items

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Single Particle Orbit and Loss in AT Regimes

- **Summary of recent work (White)**
  - Analysis of alpha loss using guiding center (ORBIT) code with collisions
  - FIRE with q(0)≈3 has 6% prompt loss, 12 % loss at 50 ms(≈τ_s)
  - Loss concentrated at midplane
- **Action Items**
  - Calculate power density of prompt loss alphas on first wall using ORBIT and/or LORENTZ code
  - Need to benchmark loss predictions to experiment
    - Ripple experiments on JET (δ16 -> δ32), JFT-2M

Collective Instabilities

- **Non-perturbative Instabilities in FIRE for positive and reverse magnetic shear (Gorelenkov)**
  - Non-perturbative Alfvén eigenmodes relevant to FIRE
  - HIgh-N STability analysis applied to q(0)<1 and q(0)>1 reference plasmas
  - q(0)<1 plasmas are unstable to low-n RTAEs
    - internal redistribution possible
  - q(0)>1 plasmas are always unstable to low-n RTAEs
    - modes strongest near q-min (as seen on TFTR)
    - internal redistribution possible

R&D Needs

- **Key issue is whether modes will be strong enough to significantly enhance loss**
- **Action Items**
  - Alpha simulation experiments needed on present devices
    - High field side minority RF heating in AT regimes
  - Develop global low-n code for RTAE stability: NOVA-2
    - benchmark to NSTX, TFTR, DIII-D, …
  - Develop non-linear simulation capability
    - M3D (G. Fu)
    - reproduce bursting, chirping modes seen in experiment
    - benchmark against saturation level observed on TFTR, DIII-D, …
  - Update projections for Burning Plasma

Non-linear TAE Physics and Resonance Overlap

- For high-n modes, need to assess role of resonance overlap in burning plasma
- Action Items
  - Determine if TFTR experiments are a good example of resonance overlap
    - ORBIT analysis needed with multiple modes (White)
    - compare to Fokker-Planck-MHD simulations (Todo)
    - extrapolate to burning plasma

AT regimes with Alpha self-heating

- **Production and sustainment of AT regimes with dominant electron heating**
- **R&D Needs**
  - Characterize formation condition of ITB in present devices
    - ECH plasmas on DIII-D with ITB in the electron channel
    - IBW physics and ITB formation in FTU
    - ITB formation in C-MOD with RF heated H-minority
      - Will enhancement persist if sawtooth is stabilized?
  - Fluctuation diagnostics needed to assess role of turbulence and shear flow in the formation and evolution of these ITBs