Alcator C-Mod Plans for JRT-2016

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Disruption theory workshop
PPPL
2015/07/14

Impending C-Mod shutdown

DoE will be funding Alcator C-Mod for just 5 weeks of physics operation in FY2016, and then C-Mod will permanently cease operation

- Our JRT disruption experiments are being run now in FY2015, since there is no guarantee of run time in FY2016
- After C-Mod ceases operation, our JRT-16 contributions will be entirely through collaborations with DIII-D and NSTX-U

Disruption experiments in FY2015

C-Mod disruption experiments in this campaign primarily respond to specific ITER requests:

- Compare MGI mitigation of ‘sick’ plasmas to previous MGI data. We have chosen to concentrate on mitigation of plasmas with a pre-existing m=2/n=1 locked mode
- Study effect of impurity gas puffing on runaway electron growth/decay. Since C-Mod does not have RE’s during disruptions, we will do these experiments in very low density discharges during the quiescent flattop
- Study the visible synchrotron spectrum from relativistic electrons to extract information on energy and pitch angle distributions

MGI of plasmas with locked modes

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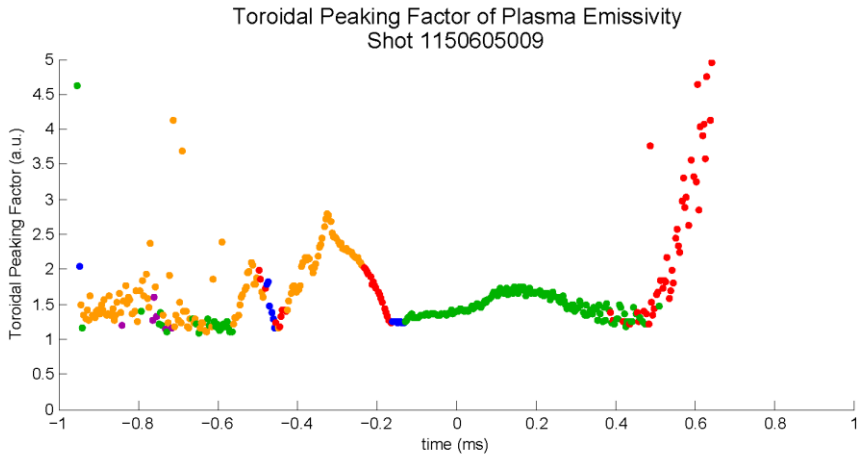
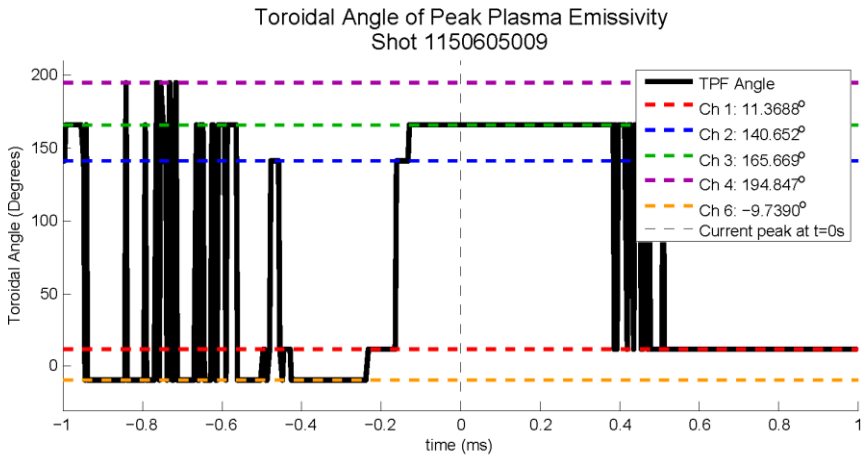
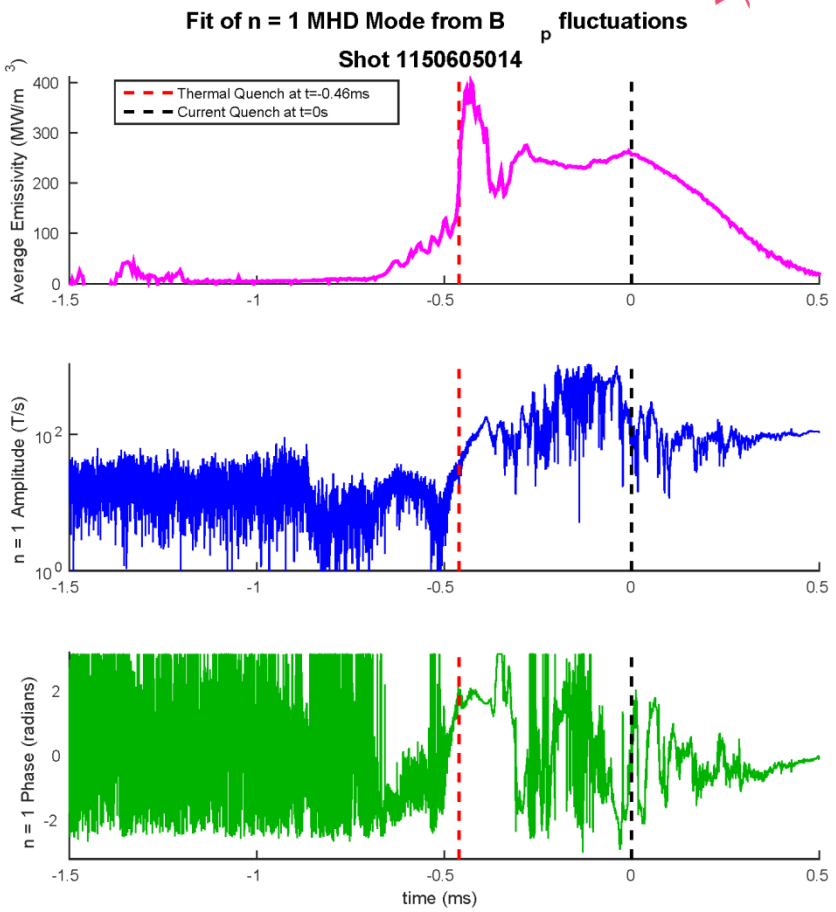
Very successful experiments over two run days have recently been completed (June). We are currently analyzing a large amount of data from these experiments.

- Rotation locking was achieved by application of externally generated m=2/n=1 error fields at three different toroidal phases
- Both natural and MGI disruptions, with and without locked modes, were obtained for direct comparisons.
- 0-D measurements include total energy radiated, thermal deposition on divertor, current decay time, vertical displacement, halo currents on outer divertor (at one toroidal location)
- Extensive toroidally-resolved measurements of $P_{rad}(t)$ and $\tilde{B}_{n=1}$ were obtained

MGI of locked plasmas seems to be very similar to MGI of healthy plasmas







Studying RE synchrotron spectrum

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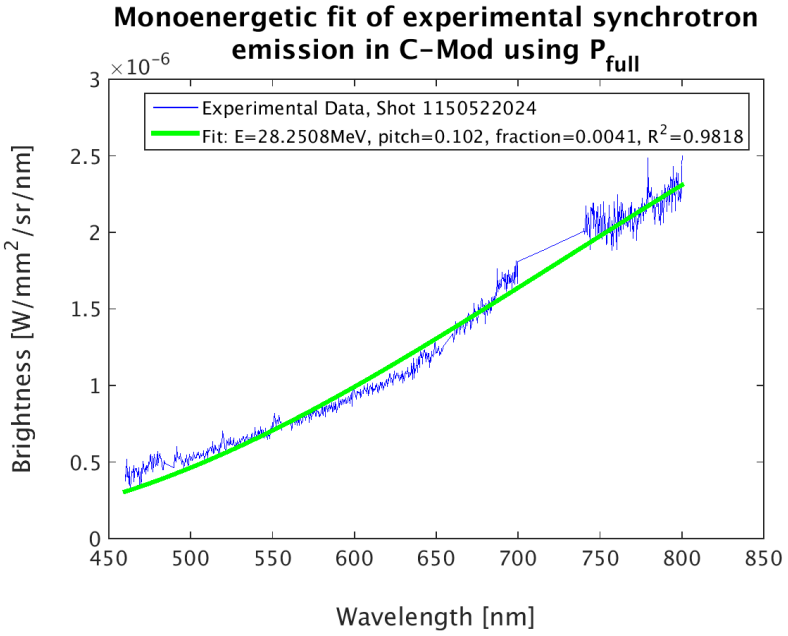
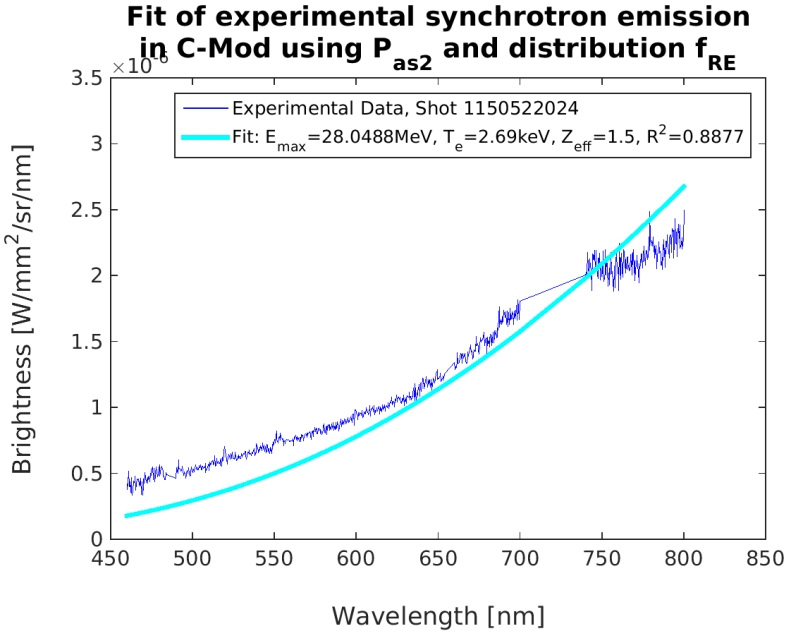
- Several recent PRL's predict that RE energy distribution should have a 'bump' in the tail due to synchrotron losses. The same physics should also affect the pitch angle distribution.
- During most recent manned access, we did an in-situ absolute calibration of two visible spectrometers (350-800 nm
- We have been working with Chalmers group (A. Stahl) and J. Decker to determine if we will be able to experimentally distinguish continuum distribution from bump distribution from our expected synchrotron measurements.
- We need to reverse our B_{tor} before we run our RE experiments (late in FY2015)

Studying RE synchrotron spectrum





Left plot: green curve shows calculated spectrum from mono-energetic distribution

Right plot: cyan curve shows calculated spectrum from continuous distribution (from A. Stahl)

Develop multi-machine disruption warning/avoidance algorithm(s)

- Endeavor to develop robust real-time disruption warning/avoidance algorithm(s) that are valid on NSTX-U, DIII-D, and C-Mod, using relevant data from these machines. Something along the lines of Gerhardt's NSTX warning algorithm is currently envisioned.
- Databases of disruptive (and perhaps non-disruptive) shots should prove quite useful in this effort. C-Mod already has such a database (13000 disruptions). A DIII-D disruption database has just recently been created (16000 disruptions). We will work with PPPL to create an NSTX-U disruption database.
- If a successful algorithm is developed, the intent is to incorporate it into the plasma control system on DIII-D and/or NSTX-U.