

# Disruptions caused by ideal MHD

Year 1	Develop criteria for when locally exceeding $\beta$ -limit leads to a disruption
Year 2	Develop validated model that reproduces thermal quench in an ideal MHD disruption
Year 3	Develop validated model for current quench that reproduces current spike and decay times
Ys 4-5	Interface M3D-C1 and NIMROD with runaway electron model as developed by SCREAM

# Vertical Displacement Events

<b>Year 1</b>	<b>Benchmark NIMROD and M3D-C1 for axisymmetric VDE in toroidal geometry</b>
	Parametric studies of influence of halo-region properties and compare with analysis
<b>Year 2</b>	<b>Benchmark NIMROD and M3D-C1 for non-axisymmetric VDE in toroidal geometry</b>
	Incorporate sheath effects in VDE computations
<b>Year 3</b>	<b>Study effect of non-axisymmetric walls on VDE</b>
<b>Ys 4-5</b>	<b>Validation studies with DIII-D, NSTX, JET</b>
	Study of wall forces in mitigated and unmitigated VDE

# Resistive Wall Modes

Year 1	Benchmark NIMROD and M3D-C1 for linear RWM in toroidal geometry
Year 2	Explore effect of rotation and two-fluid effects on RWM stability
Year 3	Nonlinear studies of RWM --- How does RWM precipitate thermal quench?
Ys 4-5	Explore kinetic effects on stability with NIMROD, M3D-C1/DK4D: Compare with MARS-K
	Explore disruptions caused by energetic particles (fishbone modes) interacting with RWM

# Neoclassical Tearing Modes

<b>Year 1</b>	Implement DKE closures in M3D-C1 and NIMROD and verify
<b>Year 2</b>	Model NTM growth and saturation using DKE closures
<b>Year 3</b>	Understand the locking of NTMs from field errors, resistive wall. Compare with theory
<b>Ys 4-5</b>	Investigate how locked modes grow and cause disruptions

# Disruption Mitigation by Shattered Pellets

<b>Year 1</b>	<b>Construct SPI plume model and develop tracking algorithms</b>
	Develop 3D local pellet ablation model for FrontTier-MHD and perform single-pellet tests
	Perform SPI scoping and sensitivity studies using NIMROD with an existing analytic SPI model
	Implement full ionization/recombination/radiation model in M3D-C1
<b>Year 2</b>	Implement pellet debris plumes into FrontTier-MHD and test tracking algorithms.
	Perform SPI simulations and validation tests using FrontTier-MHD and DIII-D experimental data
	Develop analytic kinetic heat flow models for use with NIMROD and M3D-C1
	Complete SPI scoping studies using NIMROD and M3D-C1 with an existing analytic SPI model.
<b>Year3</b>	Develop algorithms for coupling of FrontTier-MHD pellet ablation with NIMROD and M3D-C1
	Test multiscale coupling algorithms using 1D FrontTier pellet code and 1D PRL MHD code
	Start multiscale integration of Frontier-MHD with NIMROD and M3D-C1
<b>Ys 4-5</b>	Perform test of multiscale coupling of FrontTier-MHD pellet ablation w. NIMROD and M3D-C1.
	Studies of accuracy, convergence, and stability, conservative properties of coupling algorithms
	Validation tests using FrontTier-MHD/NIMROD and M3D-C1 and DIII-D experimental data.
	Perform extensive simulations of DIII-Data within UQ program.
	Perform validation simulations using JET data as available
	Perform simulations of SPI applied to ITER

# Upcoming Meeting(s)

Theory and Simulation of Disruptions

PPPL

July 16-18, 2018