NSTX-U

Supported by

U.S. DEPARTMENT OF ENERGY | Office of Science

NSTX-U 2015 Experimental Proposals:

1. RWM Stabilization Dependence on Neutral Beam Deposition Angle

2. RWM Stabilization Physics at Reduced Collisionality

J.W. Berkery, S.A. Sabbagh, J. Hanson

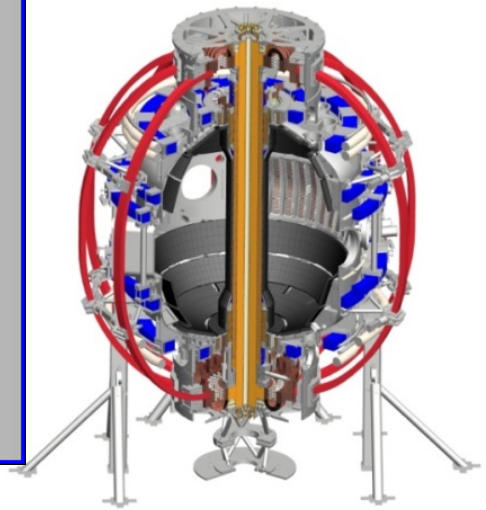
Department of Applied Physics, Columbia University, New York, NY

NSTX-U Research Forum

February 25, 2015

PPPL

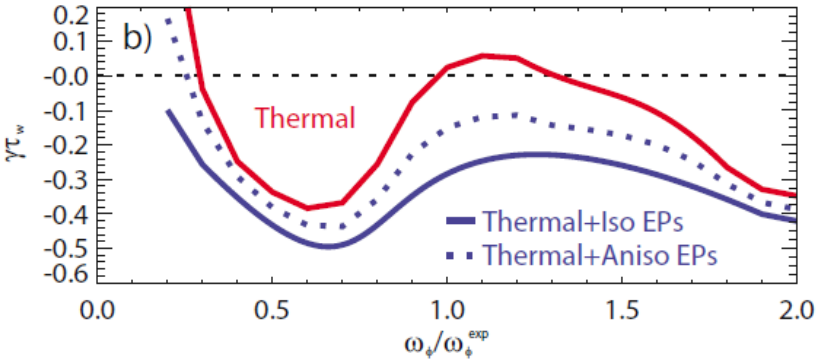
Coll of Wm & Mary
Columbia U
CompX
General Atomics
FIU
INL
Johns Hopkins U
LANL
LLNL
Lodestar
MIT
Lehigh U
Nova Photonics
ORNL
PPPL
Princeton U
Purdue U
SNL
Think Tank, Inc.
UC Davis
UC Irvine
UCLA
UCSD
U Colorado
U Illinois
U Maryland
U Rochester
U Tennessee
U Tulsa
U Washington
U Wisconsin
X Science LLC



Culham Sci Ctr
York U
Chubu U
Fukui U
Hiroshima U
Hyogo U
Kyoto U
Kyushu U
Kyushu Tokai U
NIFS
Niigata U
U Tokyo
JAEA
Inst for Nucl Res, Kiev
Ioffe Inst
TRINITI
Chonbuk Natl U
NFRI
KAIST
POSTECH
Seoul Natl U
ASIPP
CIEMAT
FOM Inst DIFFER
ENEA, Frascati
CEA, Cadarache
IPP, Jülich
IPP, Garching
ASCR, Czech Rep

RWM Stabilization Dependence on Neutral Beam Deposition Angle

- Motivation
  - EPs are known to play an important role in RWM stability
  - We need to assess the effect of the new NBI on stability



[J.W. Berkery *et al.*, Phys. Plasmas **17**, 082504 (2010)]

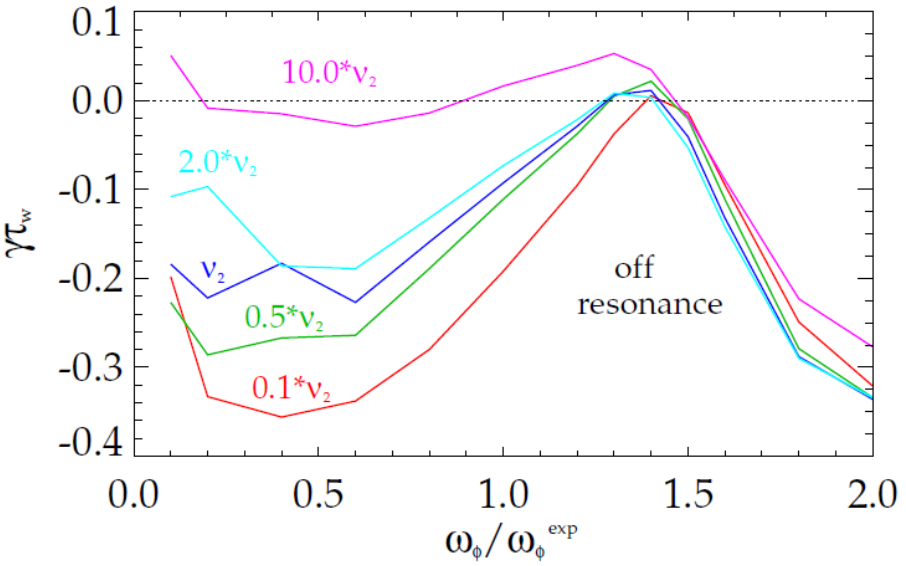
- Addresses:
  - Multi-TSG XP with EP group: extends to higher β "Characterization of the 2nd Neutral Beam Injection Line"
  - R(15-2): Assess the effects of NBI parameters on the fast ion distribution function and neutral beam driven current profile
  - R(15-3): Develop physics tools for high-performance discharges
  - JRT: Quantify impact of broadened J and p on tokamak confinement and stability
  - ITPA: MDC-21: Joint experiments on resistive wall mode physics

RWM Stabilization Dependence on Neutral Beam Deposition Angle

- Approach
  - NSTX-U plasmas with various on- and off-axis neutral beam injection will be used to produce a variety of rotation profiles and energetic particle distribution functions
    - Changes of the beam voltages can also be used to change the energy dependence of the EP distribution function, and the total number of energetic particles (or the ratio β_{EP}/β_{total}) as well
  - Add n=1, 30 Hz., 1kA peak to peak traveling wave for active MHD spectroscopy
  - Use n=2 and/or n=3 non-resonant magnetic braking to decrease plasma rotation, find marginal point or peak in RFA
  - Change plasma conditions, such as changing beam mix while maintaining same β_N. Repeat for comparison to theory at multiple conditions.

RWM Stabilization Physics at Reduced Collisionality

- Motivation
  - Reducing collisions has two competing effects:
    - Reduces collisional dissipation that is important when plasma rotational resonances are not present
    - Reduces damping of resonant kinetic stabilizing effects, making them more powerful
  - In future devices with lower ν, plasmas in resonance will gain stability, but the stability gradient with rotation will increase



[J.W. Berkery *et al.*, Phys. Rev. Lett. **106** 075004 (2011)]

[J.W. Berkery *et al.*, Phys. Plasmas **106** 075004 (2011)]

- Addresses:
  - R(15-3): Develop physics tools for high-performance discharges
  - ITPA: MDC-21: Joint experiments on resistive wall mode physics

RWM Stabilization Physics at Reduced Collisionality

- Approach
  - Establish target low collisionality plasmas
    - This XP will leverage the successful development of a reliably operating low collisionality target
  - Add n=1, 30 Hz., 1kA peak to peak traveling wave for active MHD spectroscopy
  - Use n=3 non-resonant magnetic braking to decrease ω_ϕ
  - Go to both higher and lower collisionality. Repeat for comparison to theory at multiple conditions
  - Lower density plasmas are expected to be subject to more EPMs. It is possible that we could find EPM-triggered RWMs in this XP
  - Techniques to diagnose the eigenfunction, with edge ME-SXR, reflectometer, or BES, can also be tried