NSTX-U

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NSTX-U Collaboration Status and Plans for: University of California at Davis

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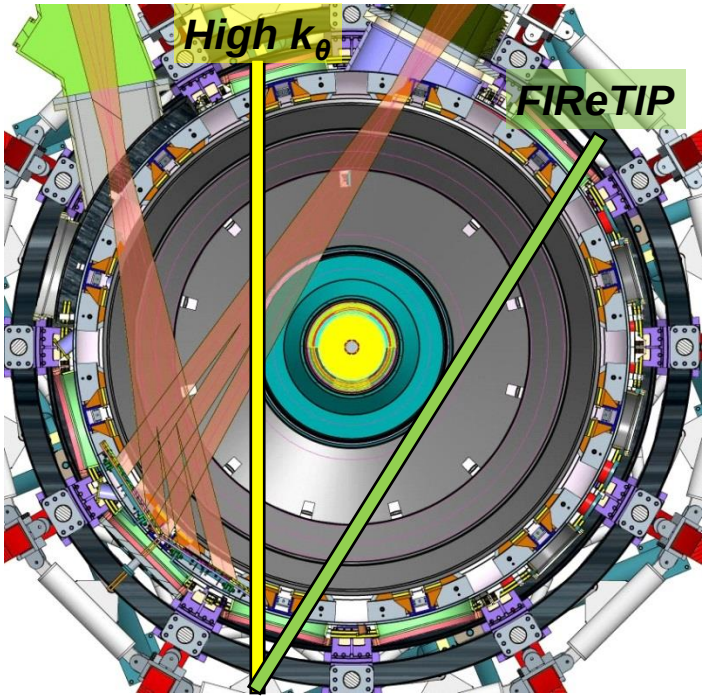
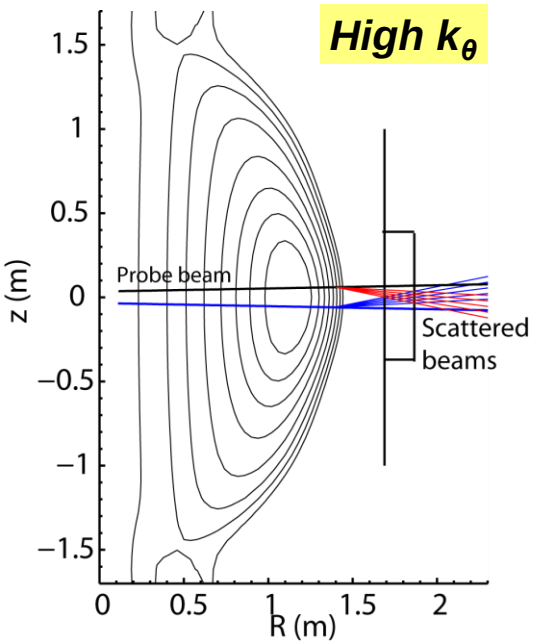
NSTX-U Collaborator Research Plan Meetings
April 25, 2014

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





Research plans and needs for this year (FY2014) in preparation for NSTX-U operations in FY2015

- Reconfigure FIReTIP system
  - FIReTIP chord #1 (with two additional chords planned) to employ entrance window on Bay G, with internal retroreflector on Bay B
    - Will provide core plasma density monitoring, and density calibration of Thomson scattering system
    - Design new optics layout; needs to coexist with other diagnostics on Bay G
  - CO_2 and FIR lasers to be relocated to "cage" area outside test cell
    - Dielectric-coated waveguides (2) plumbed through radiation wall to couple FIR beams to Bay G launch optics
- Develop high power, high k_θ source
  - Optimize CO_2-pumped FIR laser performance at 693 GHz, to be launched into Bay G as high k_θ probe source
    - Will coexist with the reconfigured FIReTIP system on a 3-level optical table in NSTX cage outside test cell
    - Corrugated waveguides remachined at UC Davis for low loss at 693 GHz, and plumbed through radiation wall to couple FIR beam to Bay G launch optics

Research Plans for FY2015

- Commission and operate FIReTIP system
  - Collect first data with redesigned system and verify data integrity of FIReTIP chord #1
  - Install heterodyne HeNe laser interferometer for real-time vibration compensation
  - Develop and test prototype real-time feedback control electronics
- Fabricate and characterize high k_θ optics and receivers
  - Fabricate 4x1 pixel array receivers
    - FIR subharmonic mixer arrays fabricated jointly by UC Davis in collaboration with researchers at Hübner GmbH
  - Design and fabricate launch and imaging optics
    - Translatable optics and multi-element receiver provides access to both k_θ and k_r wavenumbers in the NSTX core
  - Characterize and optimize system performance at UC Davis

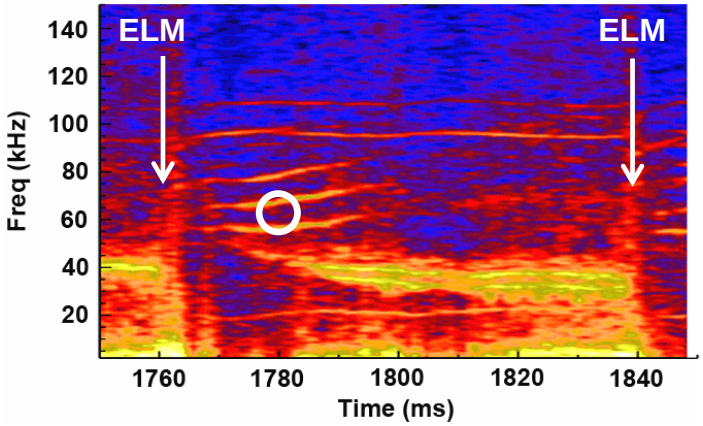
Research Plans for FY2016 Forward

- Install real-time feedback control electronics on FIReTIP
  - Feedback control software to be developed by PPPL
- Install and commission high k_θ system
  - Install high power FIR laser source in NSTX cage area
  - Install source optics and steering mirrors on Bay G
  - Install imaging optics and receiver electronics on Bay L
  - Collect first data with redesigned system and commission system
- Develop Microwave Imaging Reflectometer (MIR) system
  - Design and modeling carried out under Diagnostics program
  - Current contract funding ends on Feb. 28, 2016; fabrication of imaging hardware and electronics to take place in FY2016 (assuming successful renewal by DoE), with installation in FY2017

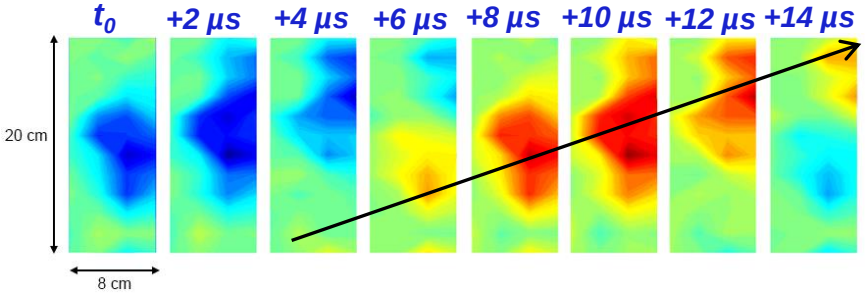
Microwave imaging reflectometry (MIR) to provide 2D images of density fluctuations in NSTX-U

- Envisage 12 (poloidal) x 8 (radial) system to make **localized** measurements of low-k density fluctuations over a wide extent of the NSTX-U plasma
- MIR optics to share the same large aperture (34 cm x 13 cm) window employed by the high k_θ scattering system
- Preliminary optics design underway and operating frequency range under discussion
- 12x4 system implemented on DIII-D (to be upgraded to 12x8 and eventually to 12x16)
- Example from DIII-D: type-I ELM precursor

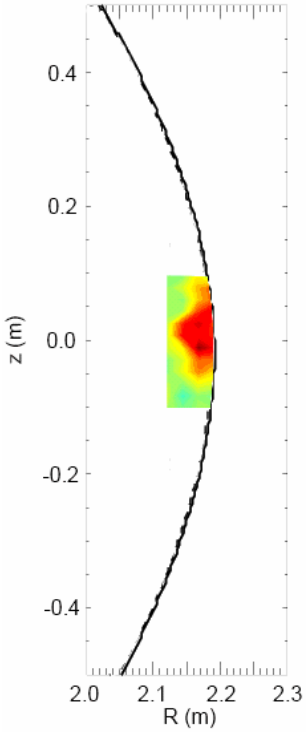
Rich spectrum of inter-ELM modes



Time-lapse images show vertical rotation of encircled 58 kHz mode through viewing window



Mapping to DIII-D cross-section



Ideas to enhance participation in NSTX-U research/program by U.S. Universities, early-career researchers, and students

- Offer low cost housing options for graduate students working on NSTX-U
  - Possibility to allow graduate students outside of Princeton University to have access to Princeton University graduate housing?
- Offer introductory seminar(s) on NSTX-U
  - Would improve the learning curve for inexperienced graduate students and assimilate them into the facility quicker

Highest-priority incremental measurement capability
(For diagnostic solicitation grantees funded for 2012-2015)

- New FIReTIP Mixers
  - FIReTIP was designed and operated with the 2.54 THz corner-cube mixers from the TFTR MIRI system because of funding constraints
  - Additional funds would allow these whisker-contacted mixers to be replaced with modern waveguide mixers
    - Will increase signal levels by 10-20 dB, yielding significantly increased S/N ratios and enhanced density fluctuation sensitivity and provide increased reliability due to their robustness
- Additional high k_θ receiver array
  - Initial high-k_θ system (to be installed and commissioned in FY2016) to consist of one 4-element poloidal array
  - Additional funds would permit fabrication of a second 4-element array, permitting simultaneous 2-D imaging (2 radial x 4 poloidal channels)
    - Second array to be installed together with the first array in FY2016