NSTX

Supported by

U.S. DEPARTMENT OF ENERGY | Office of Science

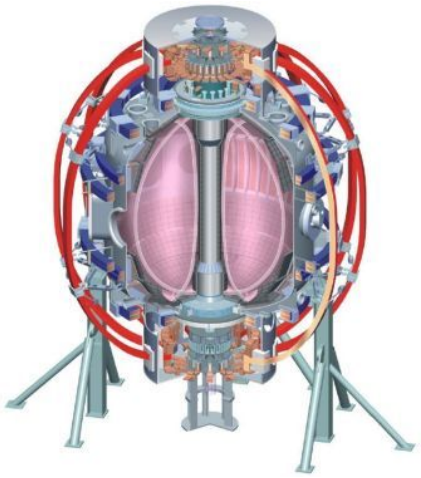
ASC XPs Related to Impurity Control and Reduction

College W&M
Colorado Sch Mines
Columbia U
CompX
General Atomics
INEL
Johns Hopkins U
LANL
LLNL
Lodestar
MIT
Nova Photonics
New York U
Old Dominion U
ORNL
PPPL
PSI
Princeton U
Purdue U
SNL
Think Tank, Inc.
UC Davis
UC Irvine
UCLA
UCSD
U Colorado
U Illinois
U Maryland
U Rochester
U Washington
U Wisconsin

Canik, Gerhardt, Menard

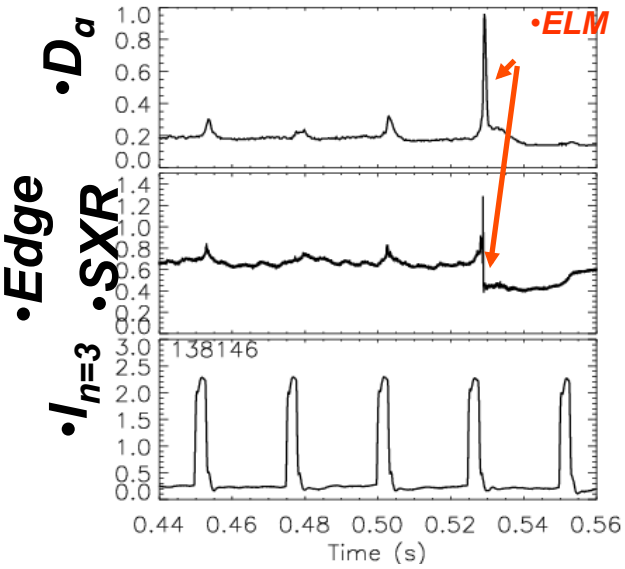
Culham Sci Ctr
U St. Andrews
York U
Chubu U
Fukui U
Hiroshima U
Hyogo U
Kyoto U
Kyushu U
Kyushu Tokai U
NIFS
Niigata U
U Tokyo
JAEA
Hebrew U
Ioffe Inst
RRC Kurchatov Inst
TRINITI
KBSI
KAIST
POSTECH
ASIPP
ENEA, Frascati
CEA, Cadarache
IPP, Jülich
IPP, Garching
ASCR, Czech Rep
U Quebec

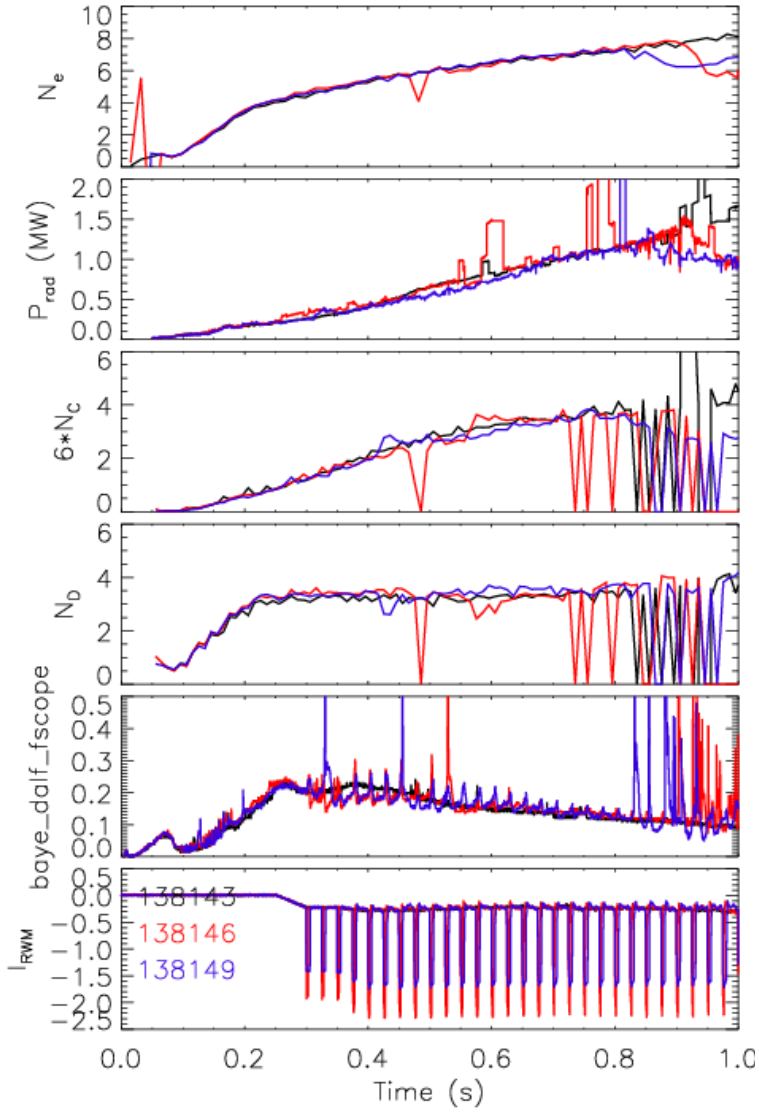
LRTSG Meeting
July 14, 2010



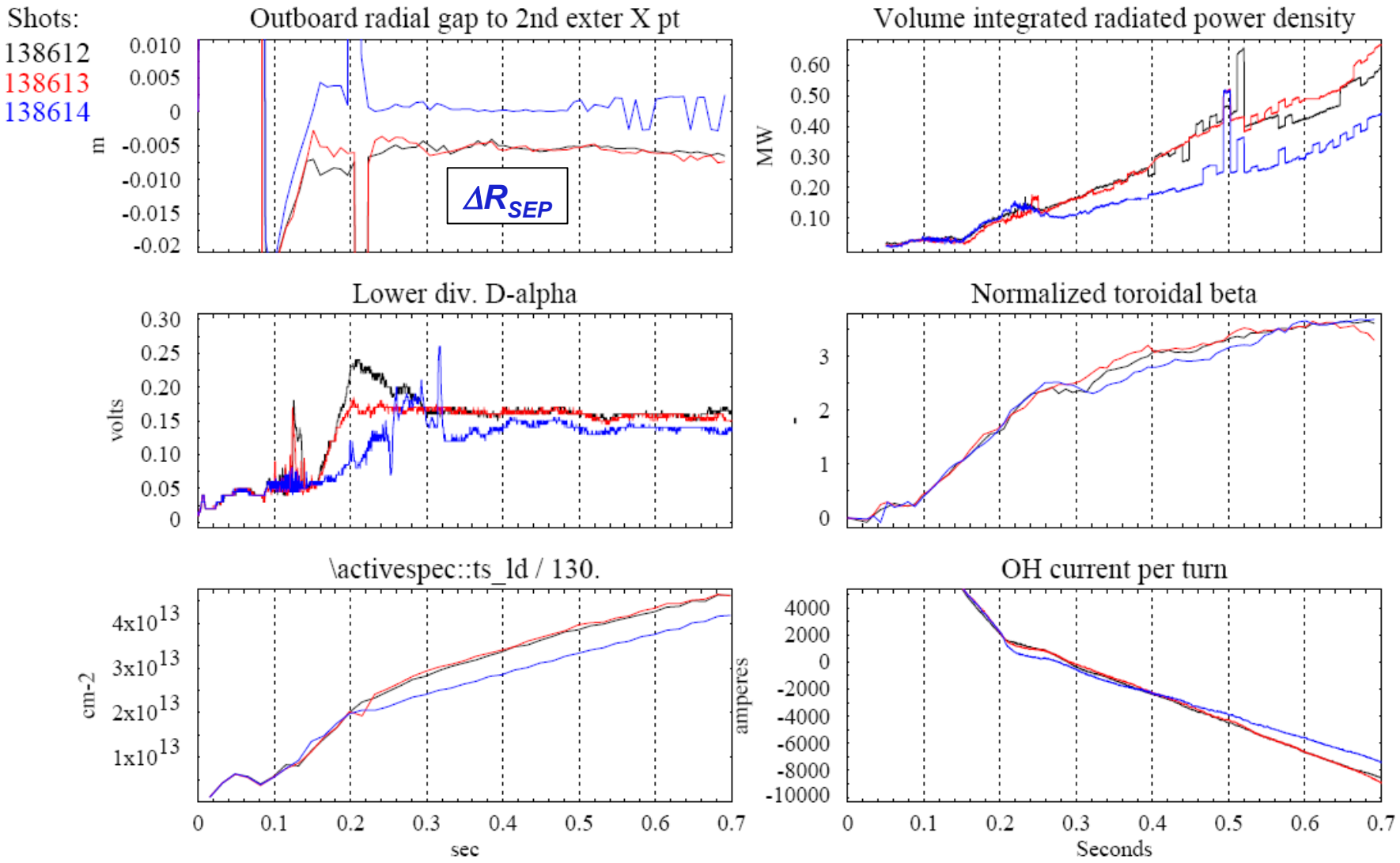
3D field pulses below threshold for ELM-triggering ineffective for impurity screening

- Response to n=3 field observed in divertor D_α even when pulse is too brief or low amplitude to trigger ELM
- 3D field optimized for sub-threshold pulses
  - Maximize n=3 amplitude, duration while avoiding large ELMs
- Without ELMs, particle expulsion insufficient for impurity control
  - No dramatic impact on P_{rad} or carbon inventory evolution



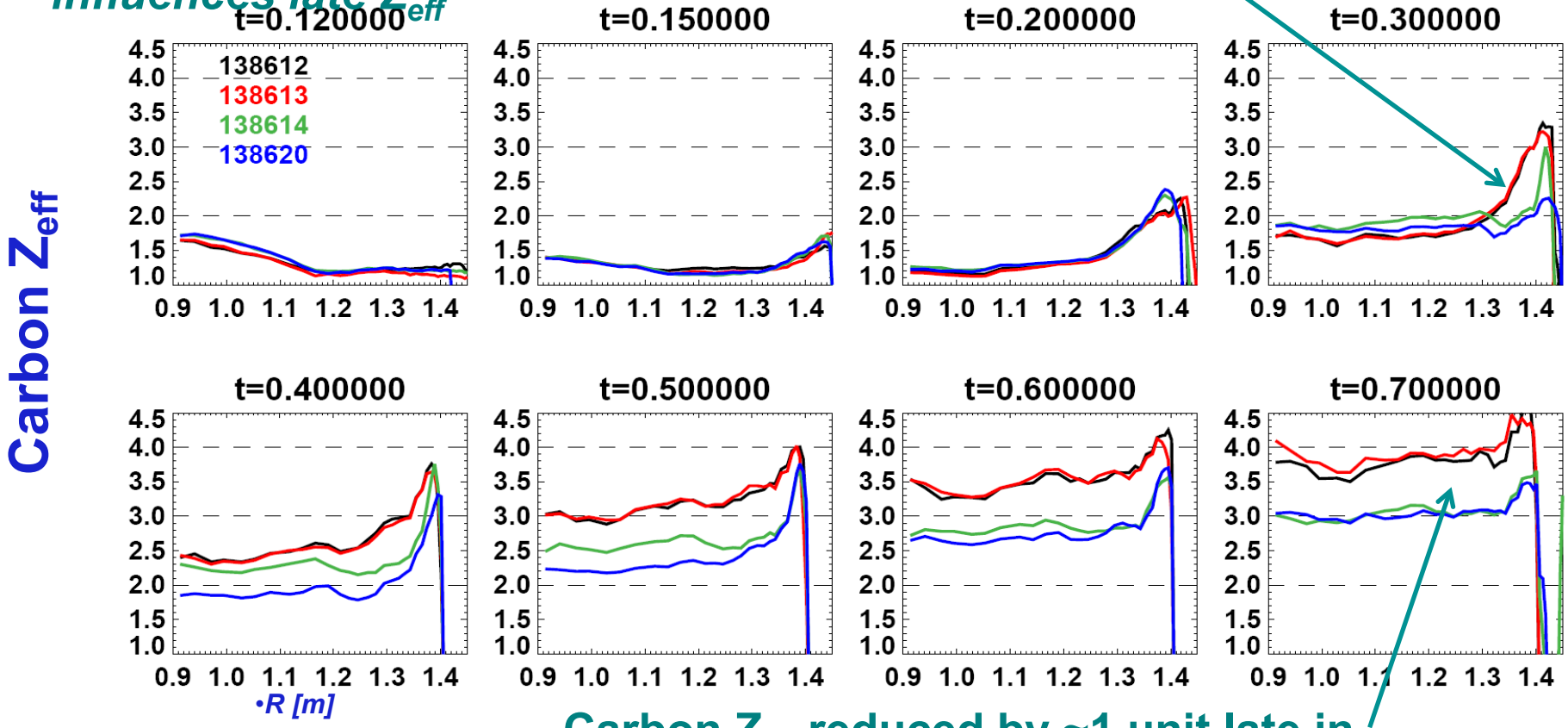


XP1005: modified bias of fiducial plasma after early H-mode reduces plasma density, radiated power, flux consumption



Bias change from -7mm to 0 reduces impurity confinement and/or generation and reduces C Z_{eff} by -1

- *Like 2009 result, size of H-mode C impurity "ear" near t=0.3s influences late Z_{eff}*



Carbon Z_{eff} reduced by ~1 unit late in

Motivates testing combinations of this + divertor D puff + SGI + snowflake + …

Remaining ASC Tasks With Respect to Impurities

- XP-1005 (Menard, et al.): Combine dr_{sep} optimization + divertor gas puffing.
  - Use "fiducial" shot, 800-900 kA, 0.45 T, κ~2.3
  - Attempt to demonstrate significant carbon reduction through both the source term and the magnetic configuration.

- XP-1006 (Gerhardt, et al.): Apply impurity control and fuelling optimization to high-κ scenarios with maximum non-inductive faction.
  - Use high-κ, β, q_{95} discharge scenario, had lowest ever flat-top average V_{loop}.
  - Use optimized early fuelling to achieve target density.
  - Use previously developed impurity reduction techniques to arrest carbon accumulation and density rise (divertor gas, ELM Pacing, dr_{sep}).
  - Additional non-impurity/fuelling related steps.

- XP-1007 (Bell, Canik, et al): Develop scenarios to heat H-mode NB plasmas with HHFWs, use RF to decrease the collisionality and drive out impurities, add ELM pacing as necessary to avoid impurity accumulation.
  - Begin at high-B_T, reduce to lengthen pulse.
  - Serious risk that this experiment will not run if the HHFW system is not brought into use.

Backup

Divertor Gas Puffing Effective in Reducing Z_{eff} and Carbon Inventory

- From Vlad's XP-1002:
  - Separate discussion at this meeting.
- Color Legend:
  - 138752, 138757, 138767: Reference.
  - 138768: 2500 Torr, @ 150 msec, for 100 msec
  - 138769: 3000 Torr, @ 300 msec, for 100 msec
- Clear improvement in impurity situation
  - reduction in Z_{eff} from VB
  - Reduction in total carbon inventory.
  - Increase in Deuterium inventory.