NSTX-U

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XP1522: Beam Ion Confinement of 2nd NBI Line

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EP Group Review
NSTX-U Control Room Annex
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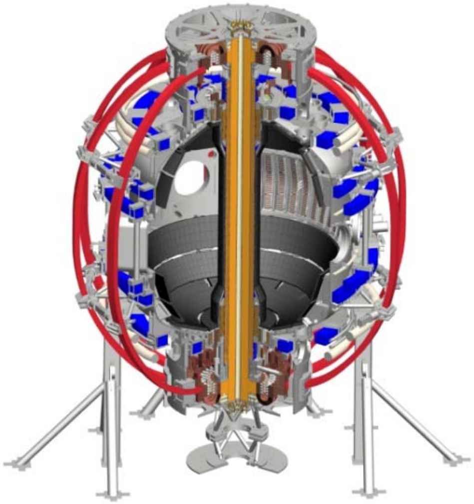

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XP1522 Goals: 2nd NBI Checkout and NUBEAM Sanity Check

Motivation

- The 2nd NBI is a major upgrade component with the purpose of improving NBCD efficiency and providing more flexibility in current/q profile control.
- Good fast ion confinement is essential to achieve these anticipated improvements.

→ Need to check the beam ion confinement on NSTX-U and gain confidence in utilizing the 2nd NBI.

Objective

- Characterize the confinement of beam ions produced by NBI line #1 & #2
- Investigate the dependence of beam ion confinement on beam source, injection energy, plasma current, and toroidal magnetic field.
  - utilize all neutral beam sources
  - E_{inj}=65keV vs. 90keV; I_p=1.0MA vs. 0.7MA; B_t=0.65T vs. **0.5T(from XMP)**
- Compare with the classical predictions (NUBEAM, FIDAsim)

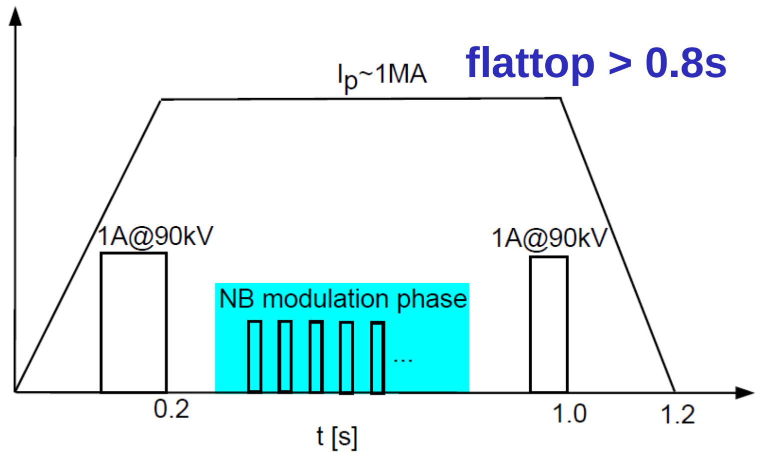
Overall Run Plan (1.5 Days)

Baseline conditions (similar to "FIDA/ssNPA/sFLIP checkout" XMP)

- **quiescent L-mode discharge**, reference shot from the FIDA XMP
- **B_t=0.65T,** I_p~1MA, relatively low density (3-4x10^{13} cm^{-3})

Template discharge

- Source 1A @90kV to provide MSE and CHERS measurements.
- Three main injection patterns in "NB modulation phase"
  - -short blips(20ms on/off)
  - -isolated blips (20ms on, 50ms off)
  - -relatively long pulses(90ms on)

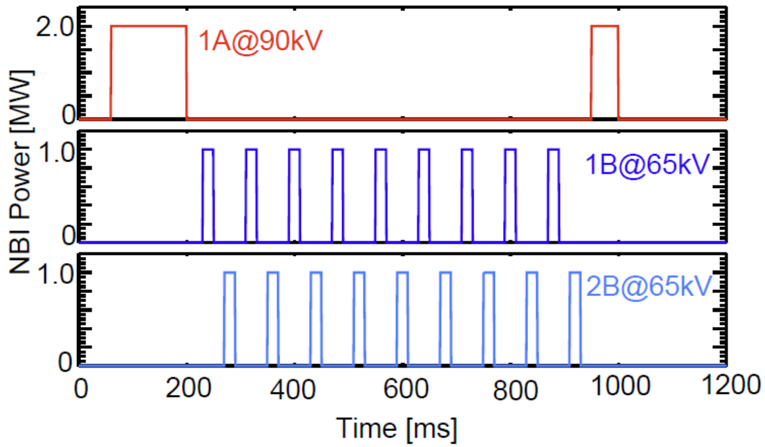


Part A: **1A@90kV, all the others @65kV** [14+2 development +1 optional shots]

Part B: **all** the sources **@90kV** [15 shots]

Shot Plan of Part A [2 development +14+1 optional shots]

- Step 1: **target plasma** (quiescent L-mode, B_t=0.65T, I_p~1MA) [2 development shots]
- Step 2: **short blips (20ms)** to check **neutron build-up and decay rates** [3 shots]



equivalent to 20ms on, 20ms off

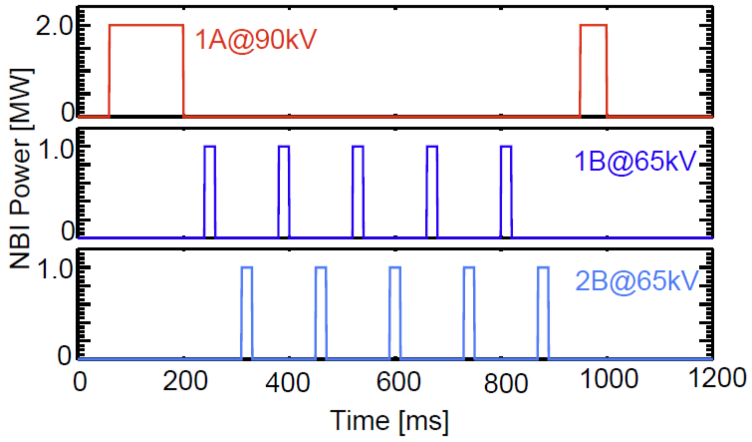
1B, 2B@65kV

1C, 2A@65kV

1A@90kV, 2C@65kV

One source from NBI #1→CHERS & FIDA data

- Step 3: **isolate blips** in quiescent plasmas (**50ms between blips**) [3 shots]



equivalent to 20ms on, 50ms off

1B, 2B@65kV

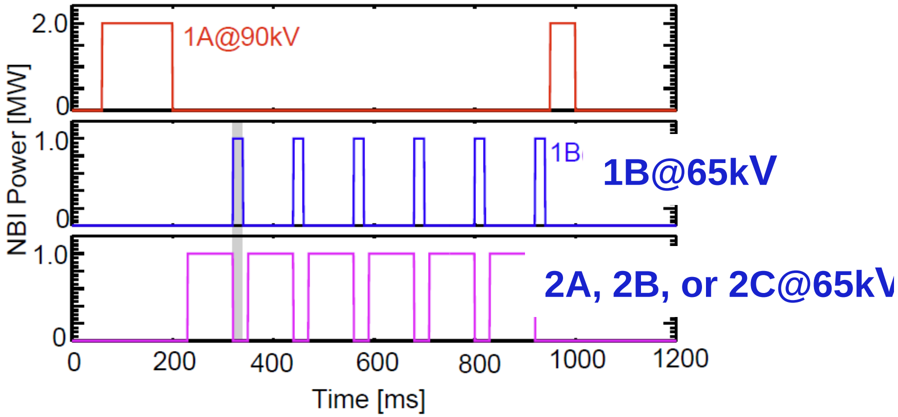
1C, 2A@65kV

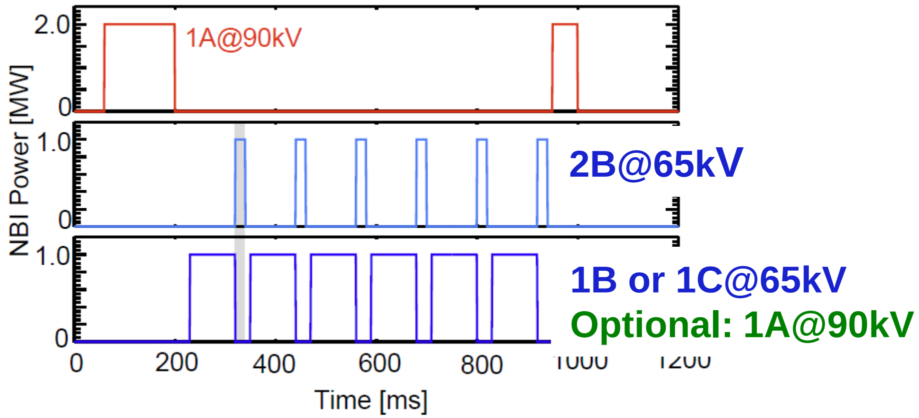
1A@90kV, 2C@65kV

One source from NBI #1→CHERS & FIDA data

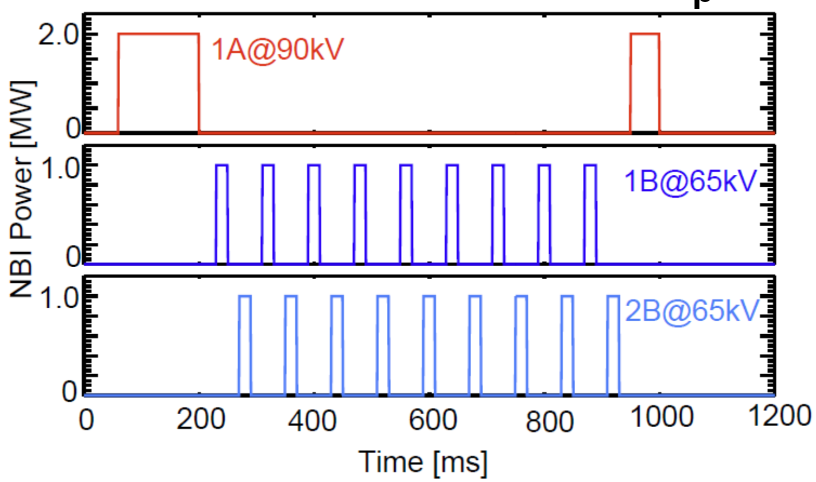
Shot Plan of Part A (Cont'd)

- Step 4: **relatively long NB pulses (~90ms)** to get **stationary slowing-down distribution**. [5 shots +1 optional]





- Step 5: repeat step 2, but set **I_p=0.7MA** instead of 1.0MA [3 shots]



equivalent to 20ms on, 20ms off

1B, 2B@65kV

1C, 2A@65kV

1A@90kV, 2C@65kV

Shot Plan of Part B [15 shots]

- Change beam injection energy to 90kV for all neutral beam sources
- Repeat all steps in part A
- The optional shot in step (4) of part A is changed to priority 1 in part B

Machine, Beam and Diagnostic Requirements

- Require **reproducible L mode** plasmas with no or minimal MHDs.
- **Need all six beams** operational at 65kV/90kV except 1A always @90kV.
- **The machine needs relatively clean** to avoid impurity contamination on FIDA spectra.
- Diagnostic needs: Mirnov coils, plasma profile diagnostics (MPTS, CHERS, MSE) and fast ion diagnostics (FIDA, SSNPA, sFLIP, neutron).
- XP at least a week later than the “FIDA / SSNPA / sFLIP checkout” XMP

  at least a week earlier than the M. Podesta’s XP1523.

In case not all beam sources are available, a backup plan is provided in the written XP form. The minimum requirement is three NB sources, i.e. 1A, 1C (or 1B), and 2A (or 2B).