# Revisiting the HHFW-NBI Interaction in NSTX-U

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- **Significant experimental progress was made in heating NSTX plasmas with HHFW+NBI:**
  - Produced RF only H-mode plasmas with $T_e(0) \approx 3$ keV, $P_{RF} = 1.4$ MW, $I_P = 300$ kA, $I_{RFCD} \approx 85$ kA, $I_{BS} \approx 100$ kA and $f_{NI} = 60\%$.
  - Adding NBI power resulted in lower $f_{NI}$ (~50%) due to absorption of RF power on fast ions and from density increase (fast ions hitting antennas ?).
  - Used state of the art simulation capability to analyze this interaction:
    - AORSA+ORBIT RF used to assess role of FOW in interaction
    - Compared to GENRAY+ZOW-CQL3D
- **Problem for NSTX-U – higher $B_t$:**
  - ***Expect fast ion losses to be lower in NSTX-U because of higher $I_p$***
  - ***But the HHFW-fast ion interaction will be stronger at the lower harmonic resonance numbers (because of the higher $B_t$).***
  - Propose that we revisit the absorption and propagation physics of HHFW in NSTX-U in light of the fact that the magnetic field for the upgrade will be 1 T and the harmonic resonances will be lower, by about a factor two.
  - Assess the HHFW-NBI interaction with AORSA+ORBIT RF, AORSA+NUBEAM, AORSA+DC
  - Compare results to GENRAY+FOW-CQL3D and TORIC + ORBIT RF.

# Diagnostic Measurements that would help to understand the HHFW-NBI Interaction and Validate Simulation

- **Fast ion loss measurements:**
  - Magnitude and location of losses
- **FIDA and neutron data:**
  - Might be able to determine what fraction of HHFW power absorption on NB ions is consistent with measurements.
  - Use a synthetic diagnostic for FIDA and neutrons based on simulated fast ion distributions from AORSA/ORBIT-RF, GENRAY+FOW-CQL3D, and TORIC-ORBIT RF.