Proposed HHFW XPs For 2008

1. Low power (<200 kW) loading measurements during NBI-driven H-modes (piggyback experiment) to prepare for tuning/matching issues.

2. **RF power accountability in H-mode** - repeat last year's modulation experiments (edge density, k, perhaps B) during beam-driven H-mode. See how steeper edge profiles effect heating efficiency, PDI spectrum on reflectometer, edge ion heating.

3. **CD experiments in L-mode with time-advanced MSE beam blips** for conditions where Vloop differences have been seen (0.45 T) and for higher B-field conditions.

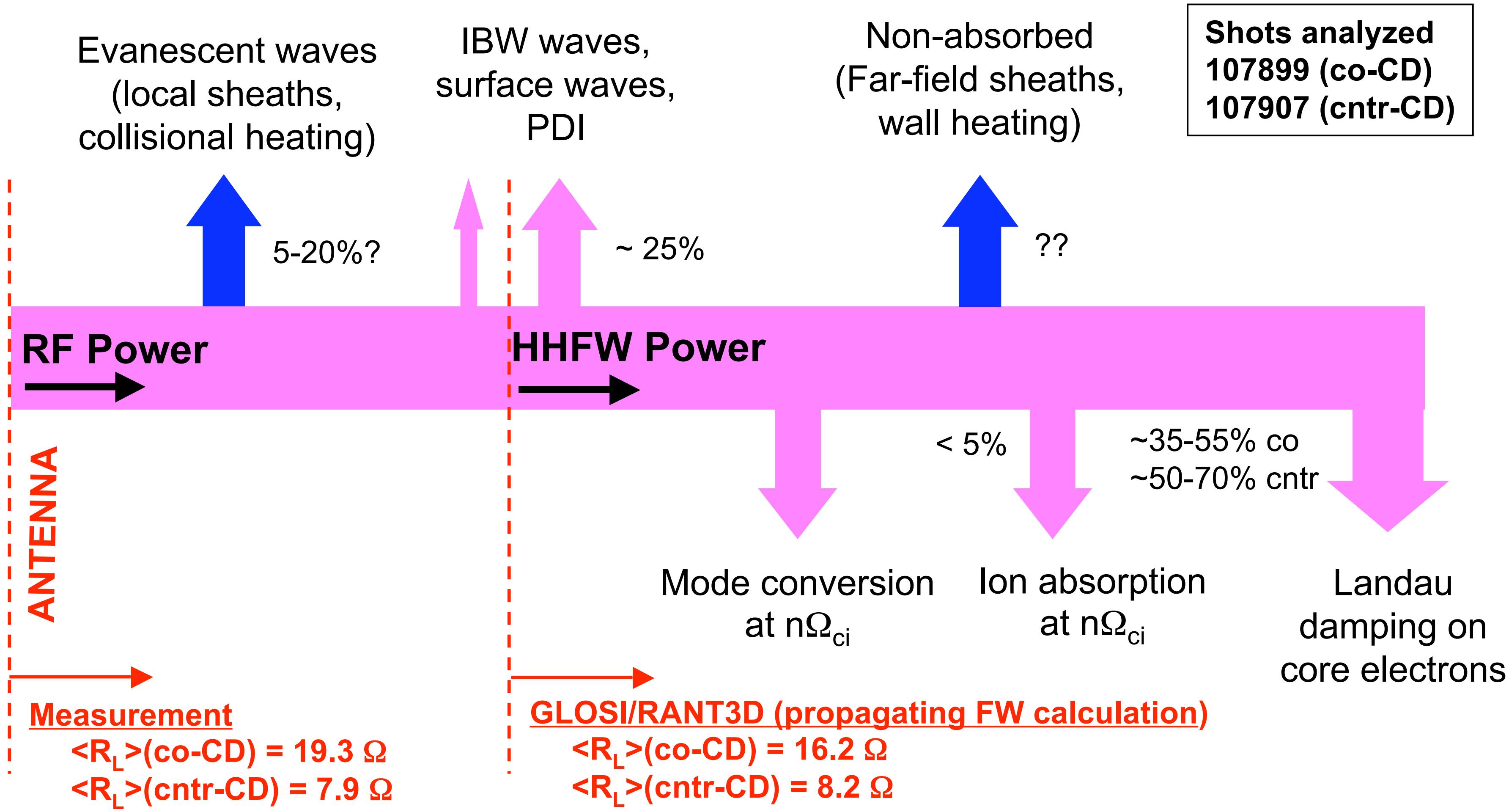
4. Low current, low Te heating/CD experiment to prepare for ECH/EBW target plasmas.

5. Low power (10-200 kW) operation to determine local sheath losses.

HHFW Power Accountability in H-mode Plasmas

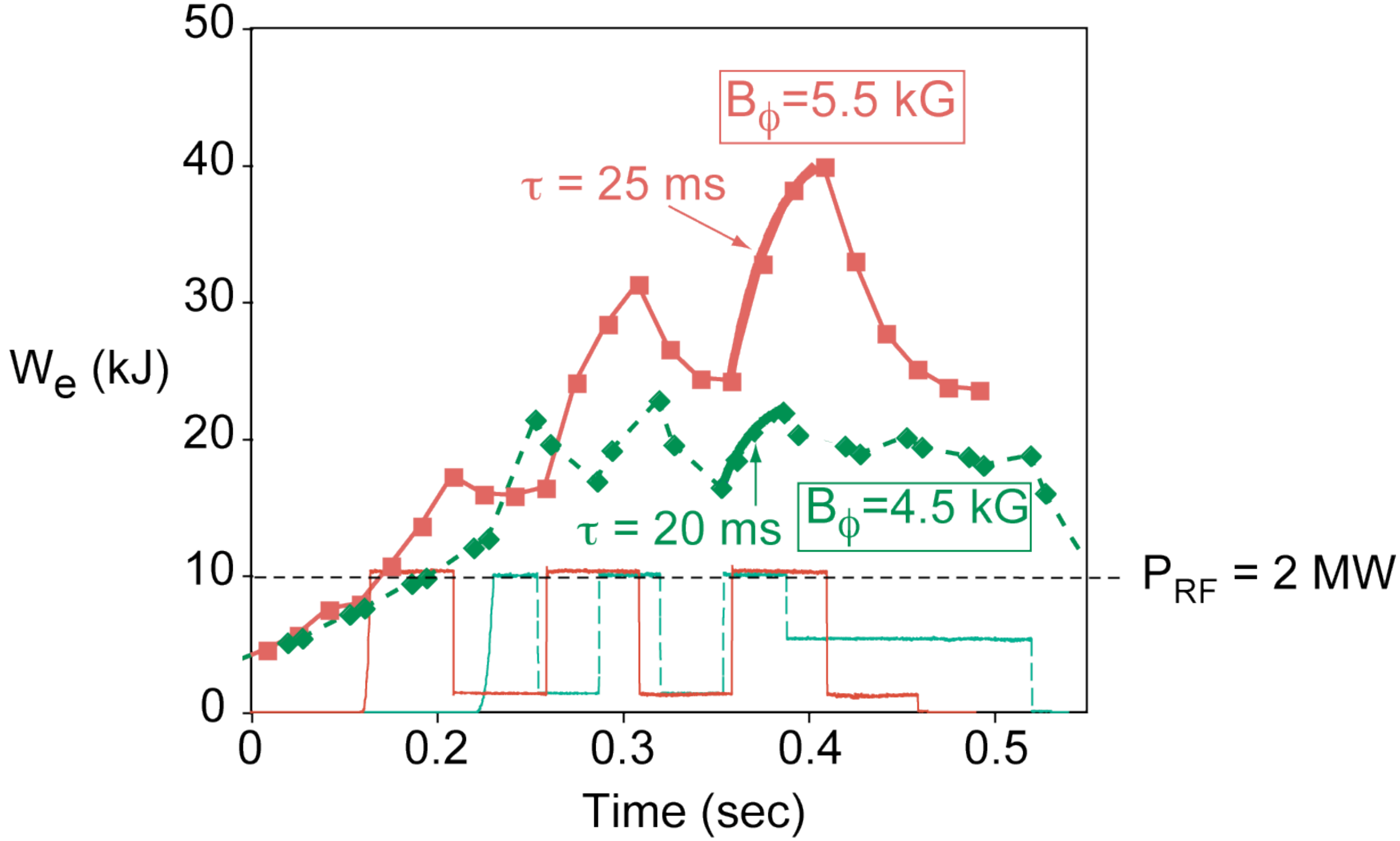
- Need to measure and understand RF power channels in H-mode plasmas (using techniques employed on L-mode plasmas)
- Power modulation experiments on L-mode plasmas:
  - **Power to ions (~15-25%)**
    - based on difference between $W_{electron}$ and W_{total}.
    - Assumed to be due to PDI damping on edge ions.
    - Relatively constant under L-mode plasma conditions.
    - may increase with NBI-heated H-mode plasmas.
  - **Power to electrons (20-70%)**
    - strongly dependent on B, k, edge density, etc.
  - **Anomalous power loss**
    - Can be very high for long wavelength, high edge density
    - seems to be due to near-field (antenna) and far-field sheaths; waves traveling along the plasma edge where there are no strong damping mechanisms eventually interact with wall.
- Additional considerations for H-mode:
  - Increased power loss to fast beam ions.
  - Steep density profile, large gap will alter (beneficially?) wave propagation along plasma periphery.

RF Power Flow and Possible Loss Channels



Loading calculations agree with measurements to within 20% for co-CD, 5% for cntr-CD

Heating Efficiency for $k_{||}$ = - 8 m^{-1} Increased Substantially as B_ϕ Increased from 4.5 kG to 5.5 kG



- ΔW_e for B_ϕ = 5.5 kG is ~ 2 times the value for 4.5 kG over same time interval
- RF power deposition to electrons increases from ~ 22% to ~ 40% at higher B_ϕ, total efficiency increases from ~ 44% to ~ 65%

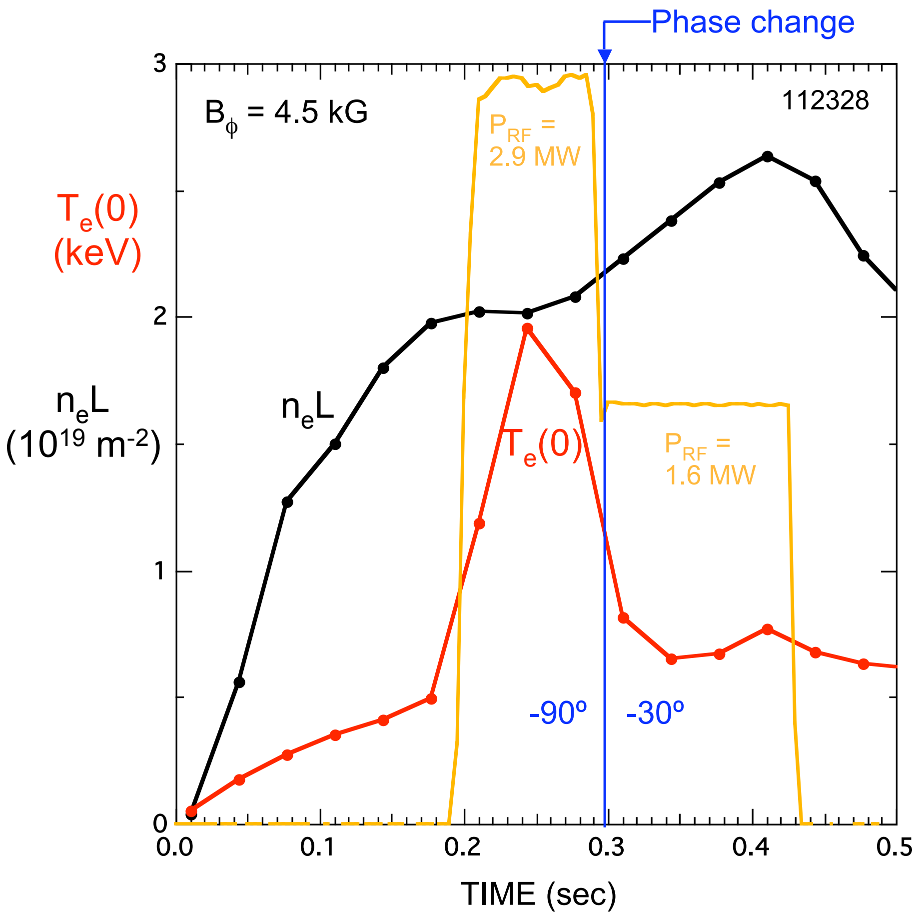
Need to solve anticipated H-mode issues

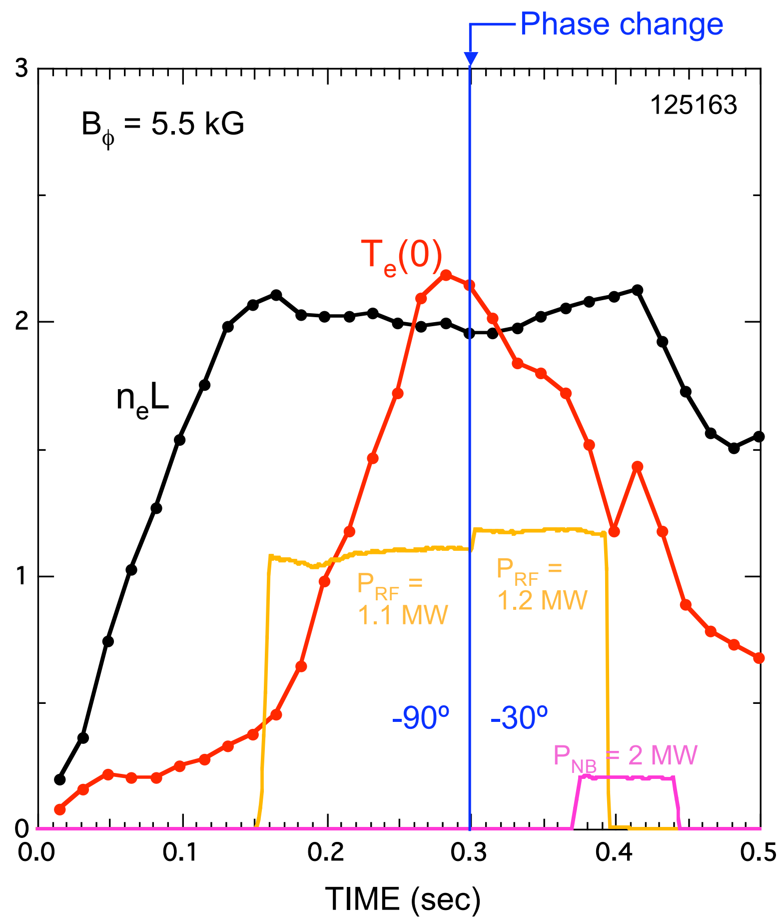
- Need to control density with D plasmas (Li may help). Develop during conditioning time.
- Lower antenna loading will limit power; will need to operate at higher antenna voltages (conditioning time is essential).
- L-H transition:
  - matching across transition, particularly with RF-only driven H-modes, may take development time.
  - Voltage feedback available?
- NBI-driven H-modes:
  - large gap may be needed to protect antennas, will decrease loading.
  - How to measure damping on fast beam ions (NPA noise pickup)?

Phase scan for HHFW CD with time-resolved MSE

- Increase HHFW power to 3-4 MW range, 300-400 ms pulses (may be tough, be prepared to back off).
- Run similar conditions to where loop voltage differences have been seen in the past upon phase change (107899, 107907) but also at higher B (.55 T).
- Start MSE beam blip at end of HHFW pulse and progressively move it forward in time upon succeeding shots to determine the current relaxation time (3 steps)
- Do for $k_{||}$ = -8, +8, -3, +3 m^{-1} (if time).
- Do one last shot at each antenna phase with the diagnostic beam on for the full RF pulse.
- 4 x 2 at .45 T, 4 x 4 at .55 T = 24 shots (1 day)
- If time, phase transition from -8 to -3; two beam blips before transition, two after (4 additional shots).

Heating at k_ϕ = -3 m^{-1} is Improved with Preheat of Electrons at k_ϕ = -8 m^{-1} and with higher B-field, but $T_e(0)$ Cannot be Sustained Against Surface Damping





- Phase change from -90º to -30º during an RF pulse provides a $T_e(0)$ = 2 keV single pass damping target for the -30º ($k_{||}$ ~ - 3 m^{-1}) wave
- Surface wave loss still dominates core damping and $T_e(0)$ falls off toward normal -30º level
- Heating at both -90º and -30º is improved at higher B_ϕ.