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XP 1016_ext: HHFW power coupling vs ELMs

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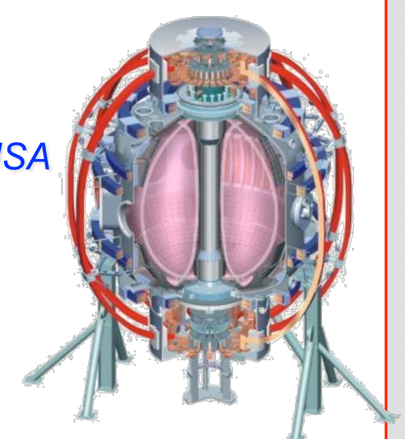

XP Review
March, 2011

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XP 1016: HHFW power coupling vs ELMs

Goals:

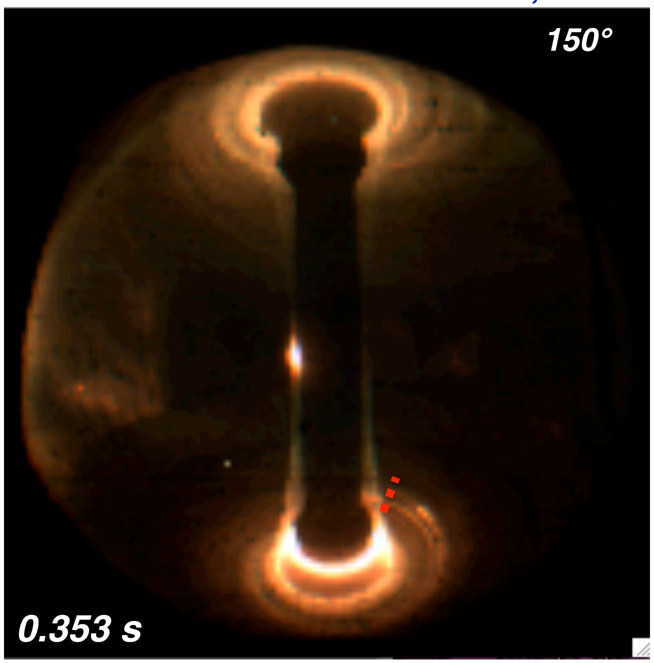
- Understand the effect of ELMs on HHFW heating efficiency and edge losses
- Determine if it is acceptable to power through the ELMs with the HHFW system without blanking or diverting the power during the ELM.

Objectives:

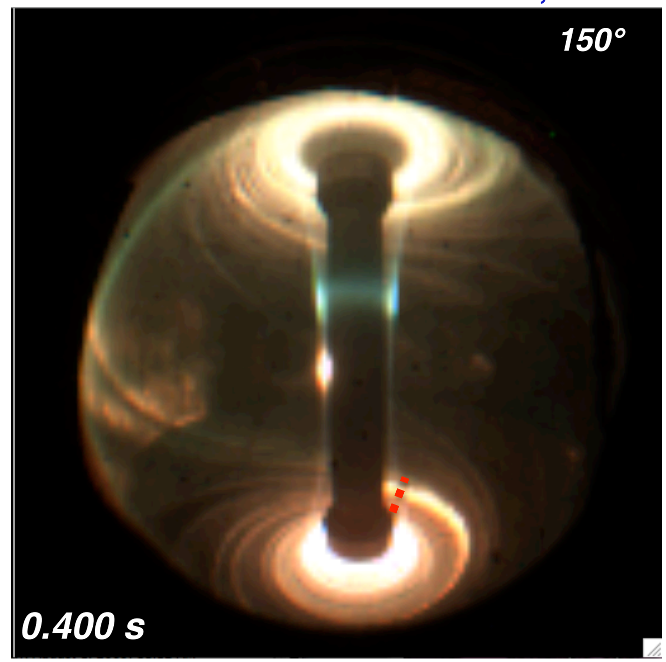
- Compare the ELMy H-mode case to the ELM-free H-mode case in deuterium
  - ➢ Quantify the effect of ELMs on the HHFW core energy confinement that is dominated by electron confinement
    - – Modulate P_{RF} to determine τ_E
  - ➢ Determine the effect of ELMs on edge power deposition
    - – For edge power deposited in the divertor and on the antenna and for the estimated power loss due to the PDI effect
    - – Characterize antenna hot zones with visible and IR cameras, as well as with probes, reflectometer, etc. as for XP 1017
      - ** Of particular importance will be the fast IR data

Heating on outer divertor plate is more intense with ELMs with same field pitch (P_{RF} = 1.9 MW)

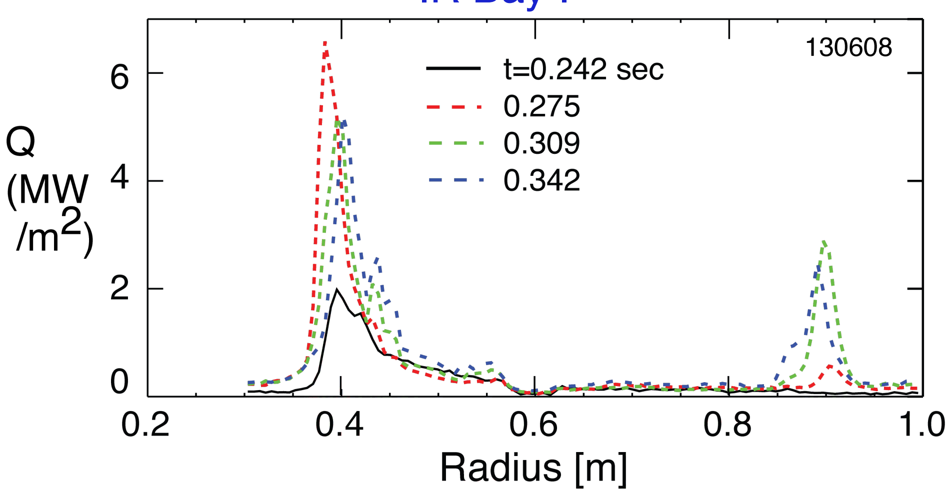
130608 ELM free – 5.5 kG, 1 MA



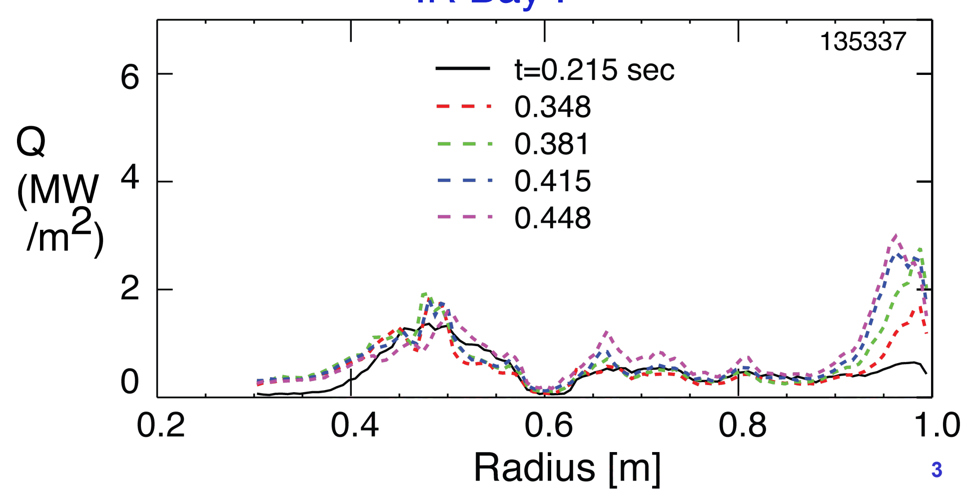
135337 with ELMs – 4.5 kG, 0.8 MA



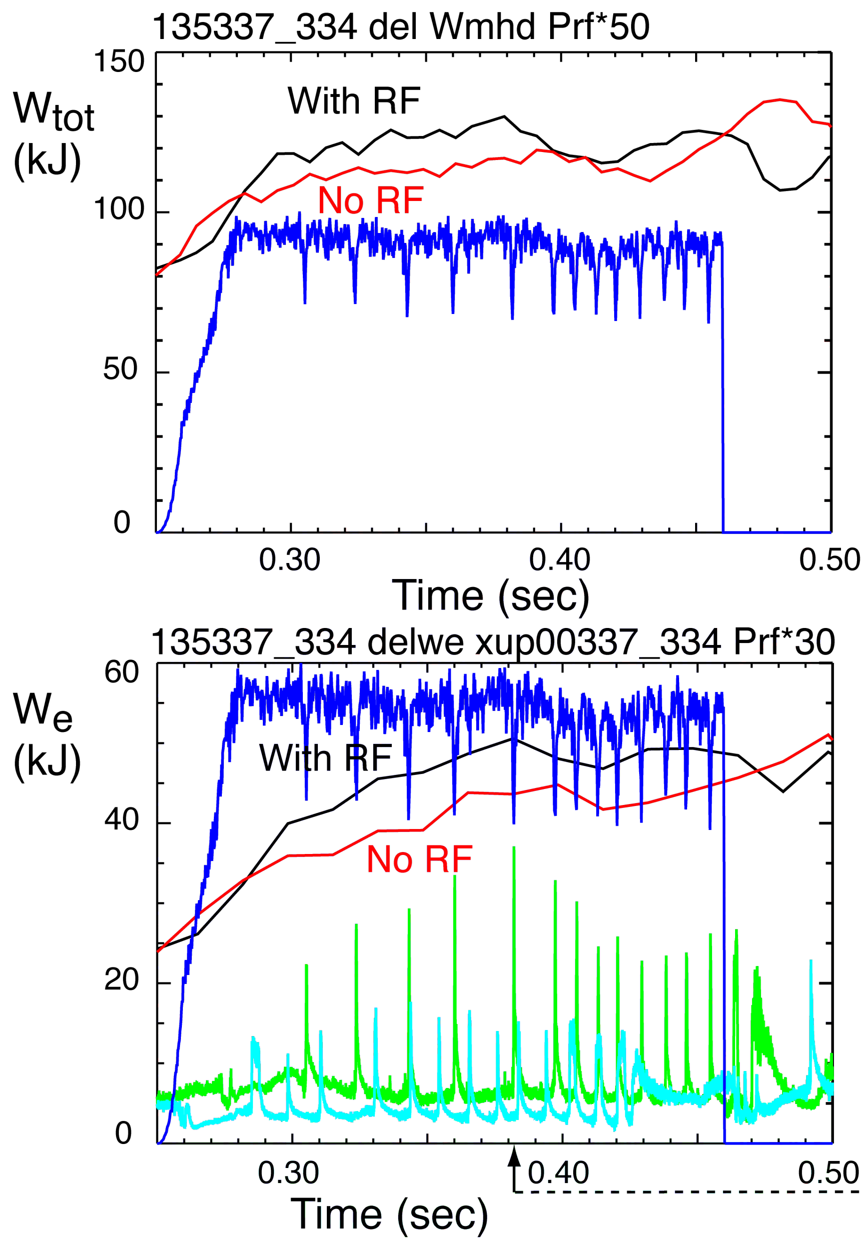
IR Bay I



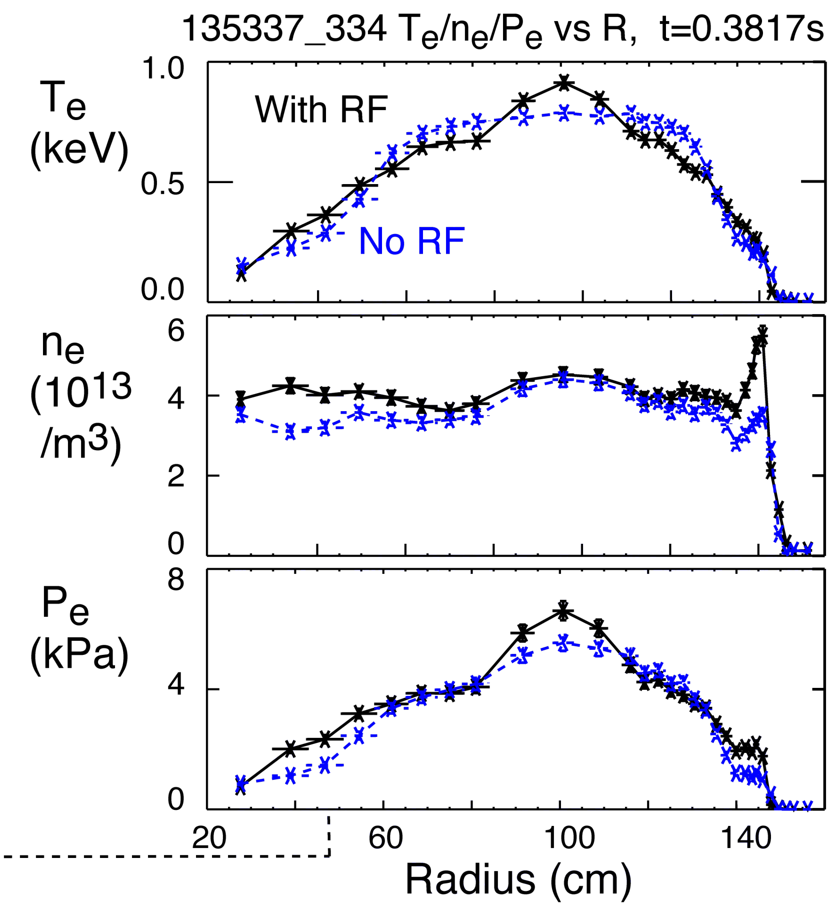
IR Bay I



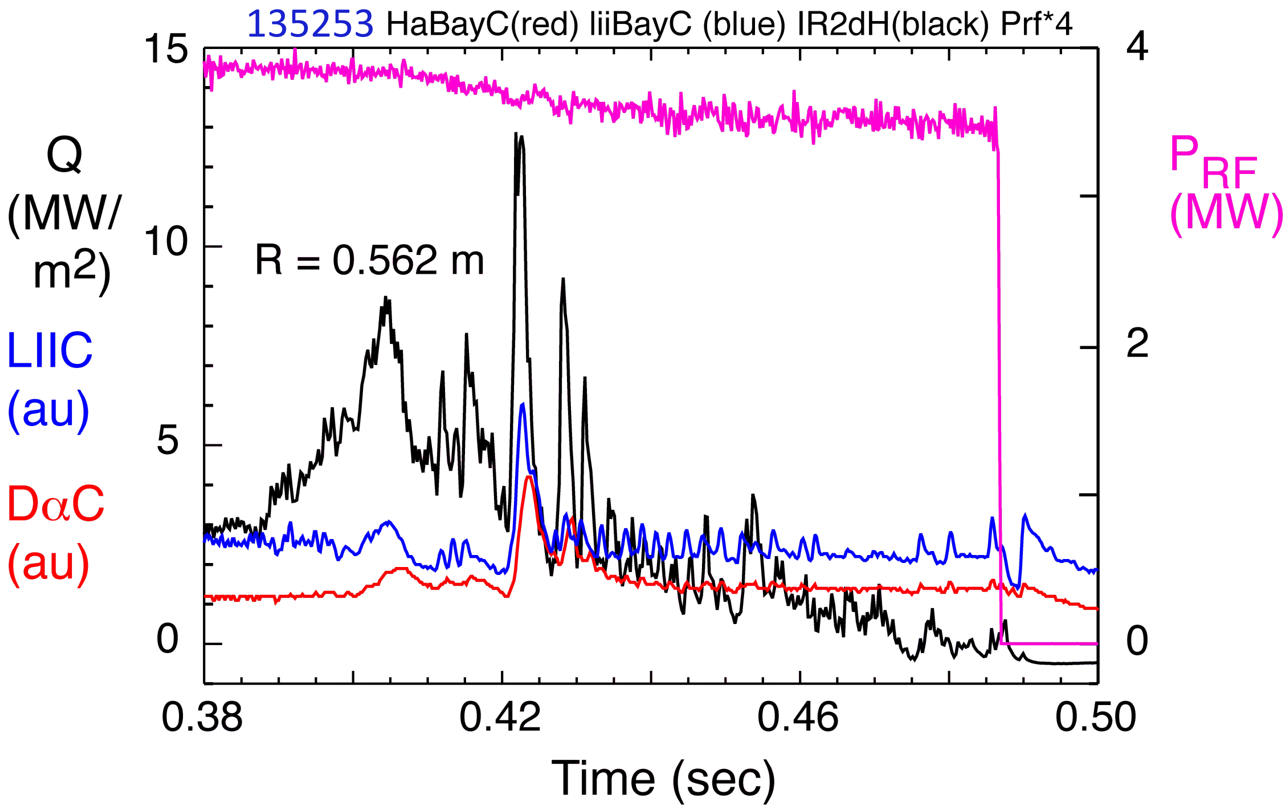
Power coupled to core is affected by ELMs and/or by higher edge density/steeper density gradient



ΔW_{tot} and ΔW_e for shot 135337 with ELMs are reduced by ~ 50% relative to shot 130608 ELM free case

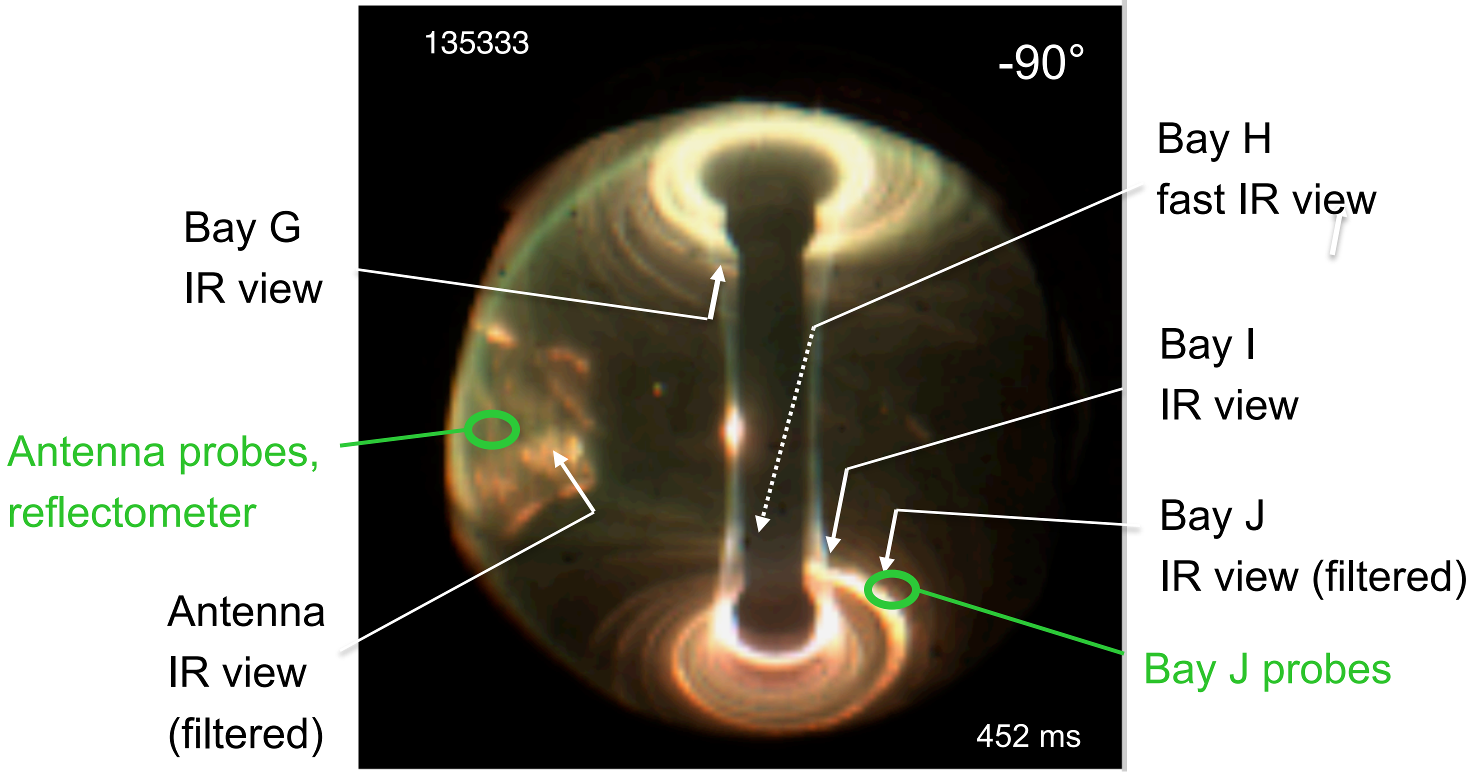


ELM heat deposition at the outer strike radius is very large but effect on density in plasma edge is small



- The Bay H fast IR heat deposition measurement, Q, clearly shows the ELM heat deposition on the lower divertor plate at R = 0.562 m (divertor strike radius)
- Small effect of largest ELM is barely evident on the net RF power
  - ELMs are located away from the antenna
  - Gives opportunity to evaluate ELM effect on confinement without edge density increase during ELMs causing a change in RF power coupled to core

IR cameras and probes are critical for documenting effect of ELMs on RF edge heating



B_ϕ = 4.5 kG, I_P = 0.8 MA

- Higher field pitch and mirror positioning will permit view of ELM effect on hot zone by fast IR at Bay H
- Expect edge heating to be unaffected by ELMs in RF H-mode case but increase by density increase in the NBI + RF case