

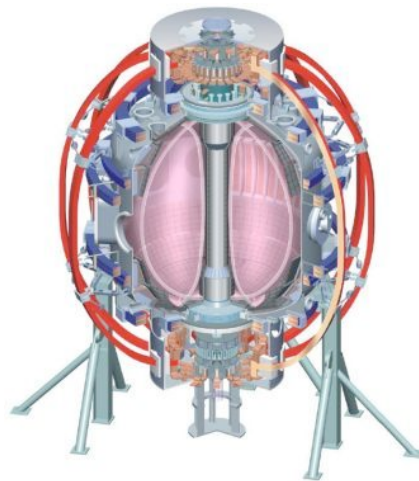
Measurements of Heat Flux Profiles for the FY2010 Joint Research Milestone

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NSTX Research Forum
Princeton, NJ
Dec. 1-3, 2009



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Additional data (and lots of analysis!) needed to fulfill FY2010 Joint Research Milestone on SOL thermal transport

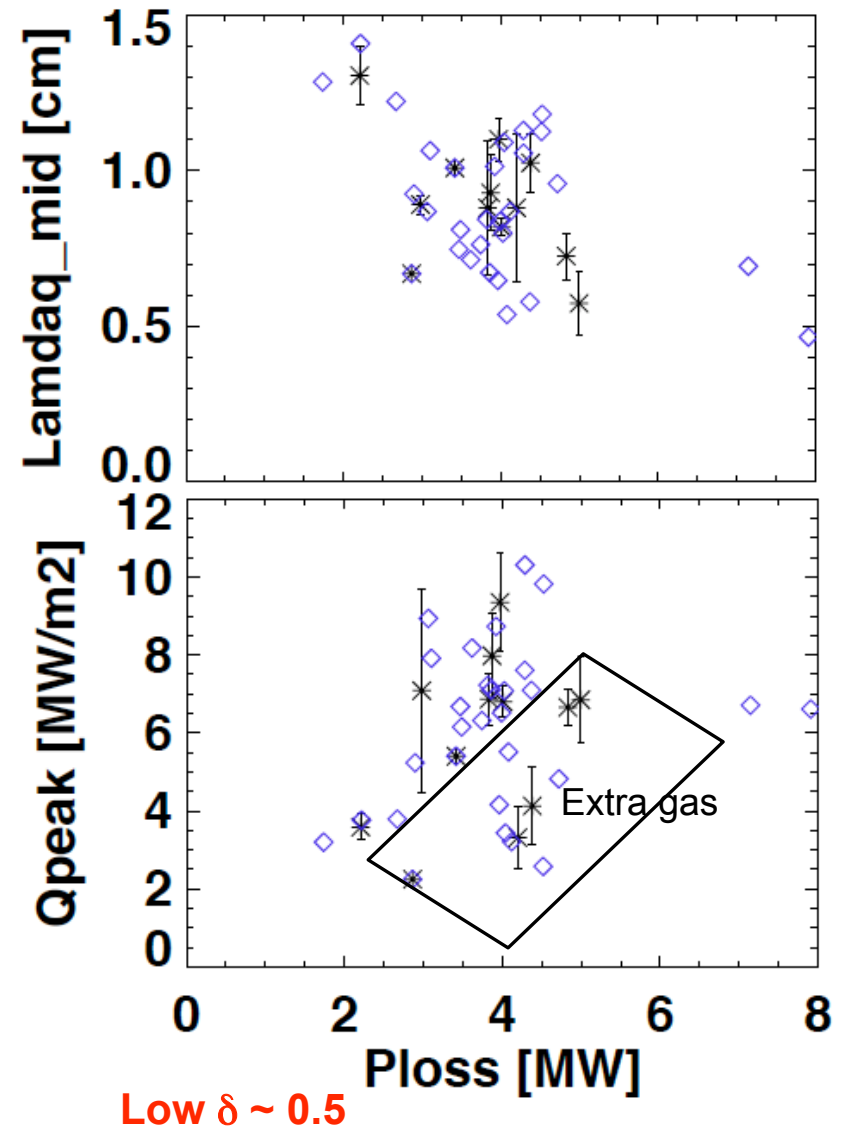
- ✓ Wide P_{NBI} and moderate I_p scans at low $\delta \sim 0.5$ (2004, 2009)
 - Slow IR camera data (Maingi JNM 2007, Maingi EPS 2007)
 - New fast IR camera data being analyzed (Ahn, RSI 2009 submitted)
- ✓ Nice I_p scan and flux expansion scans at $\delta \sim 0.7$, coarse NBI scan (2008)
 - *Piggyback on detachment study (Soukhanovskii NF 2009, EPS2009)*
- Desired: higher I_p range at high δ
 - *divertor bolometers not ready at time of 2009 XP; ok for 2010?*
- Desired: B_t scan at constant I_p , q_{95}
- Desired: power balance vs. magnetic balance (δ_r^{sep})
- Desired: data from scaled poloidal shape match to C-Mod
- Desired: Snowflake divertor shape effects (piggyback)
- If TMB disallowed, then 2color IR required!

FY2010 Joint Research Milestone: Thermal Transport in the Scrape-off Layer

- Conduct experiments on major fusion facilities to improve understanding of the heat transport in the tokamak scrape-off layer (SOL) plasma, strengthening the basis for projecting divertor conditions in ITER.
- **Divertor heat flux profiles and plasma characteristics** in the tokamak scrape-off layer will be measured in multiple devices **to investigate the underlying thermal transport processes**. The unique characteristics of C-Mod, DIII-D, and NSTX will enable collection of **data over a broad range of SOL and divertor parameters (e.g., collisionality, beta, parallel heat flux, and divertor geometry)**. **Coordinated experiments using common analysis methods** will generate a data set that will be compared with theory and simulation.

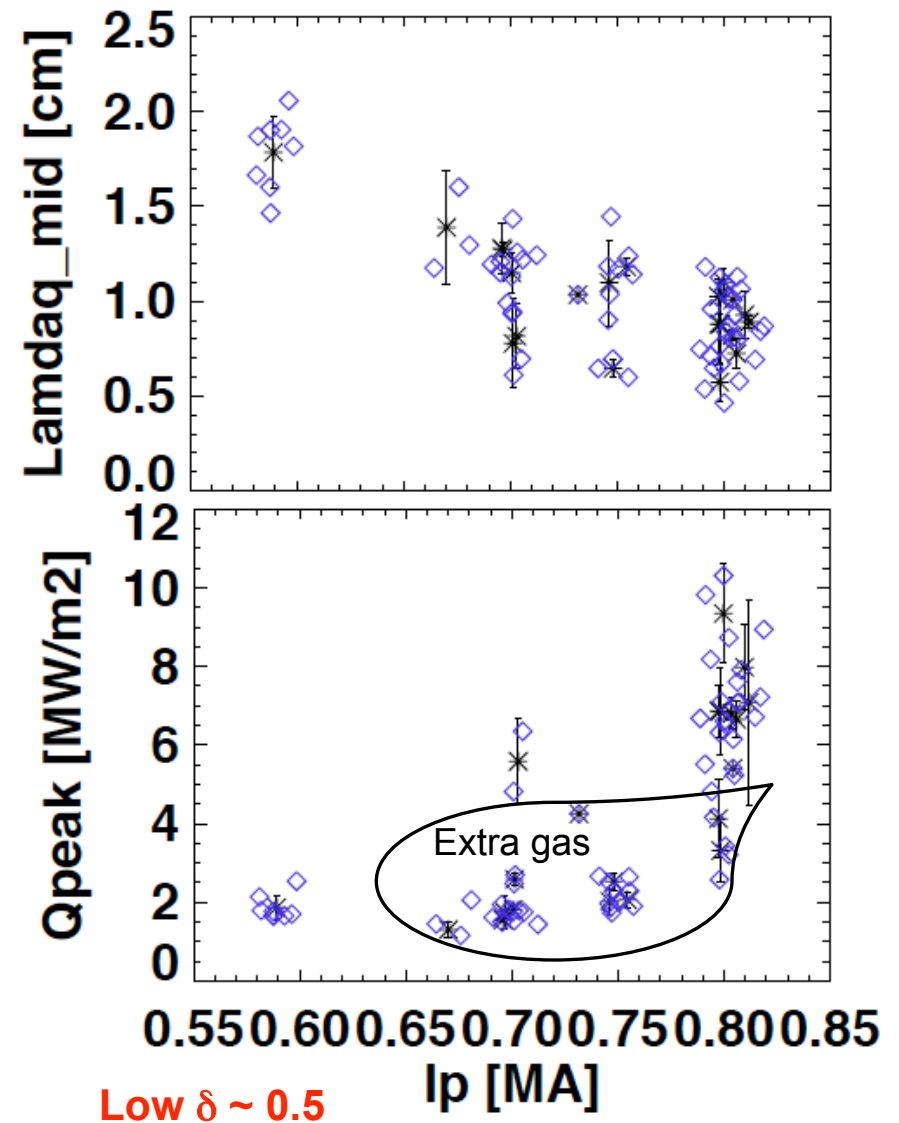
XP923: SOL width contracts with P_{NBI}

- Run early in year pre-Li
 - Obtained slow IR, fast IR (low δ), D_α cameras, GPI
 - New divertor bolometer channels unavailable
- Obtained a nice P_{NBI} scan at low $\delta_{\text{bot}} \sim 0.5$
 - ELMs change
 - SOL heat flux width contracts with P_{NBI}
- To do: analyze fast IR, turbulence, D_α data



XP923: SOL width contracts with I_p

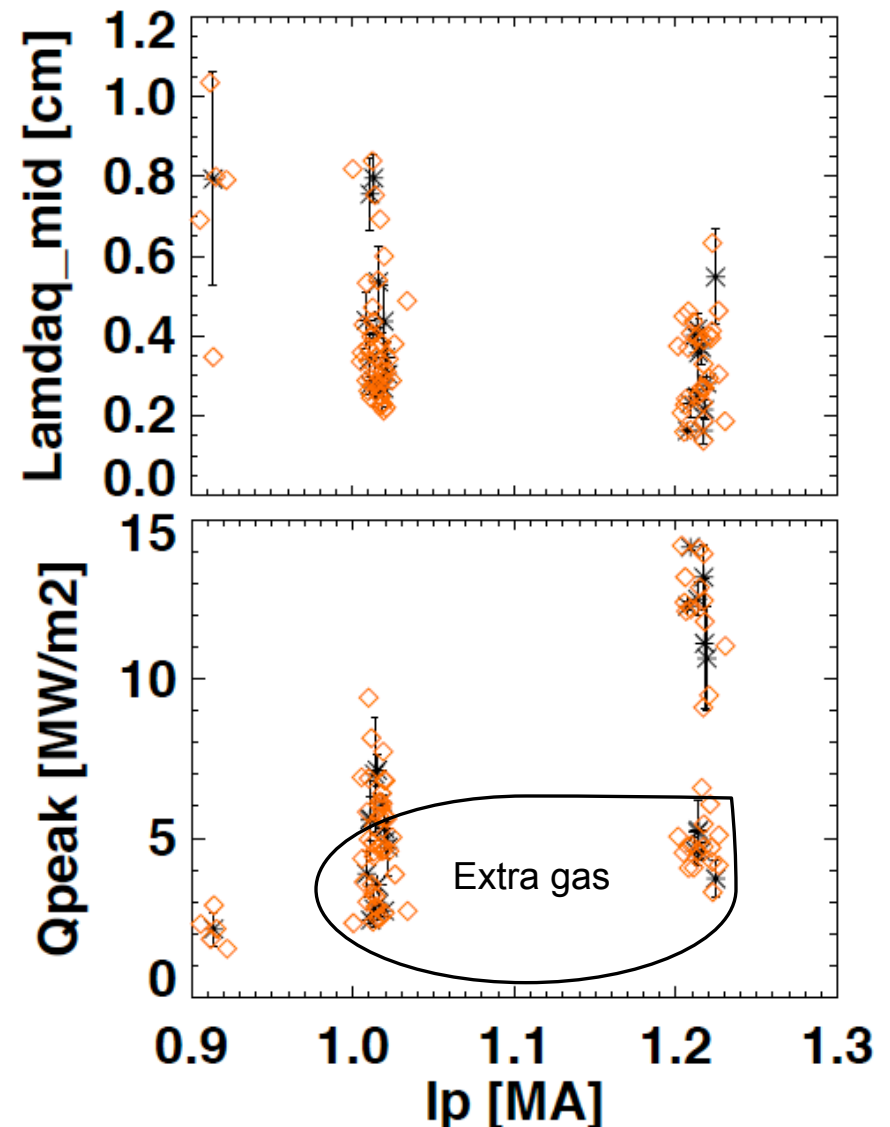
- Obtained a nice I_p scan at low $\delta_{\text{bot}} \sim 0.5$
 - ELMs change
 - SOL heat flux width clearly contracts with I_p



XP814: Peak heat flux (width) varies directly (inversely) with plasma current at high δ

- λ_q^{mid} dependence on I_p seems to connect to the low δ data from XP 923 smoothly(!)
 - λ_q^{mid} down to 2mm observed in these conditions, with q_{\parallel} up to 300 MW/m²

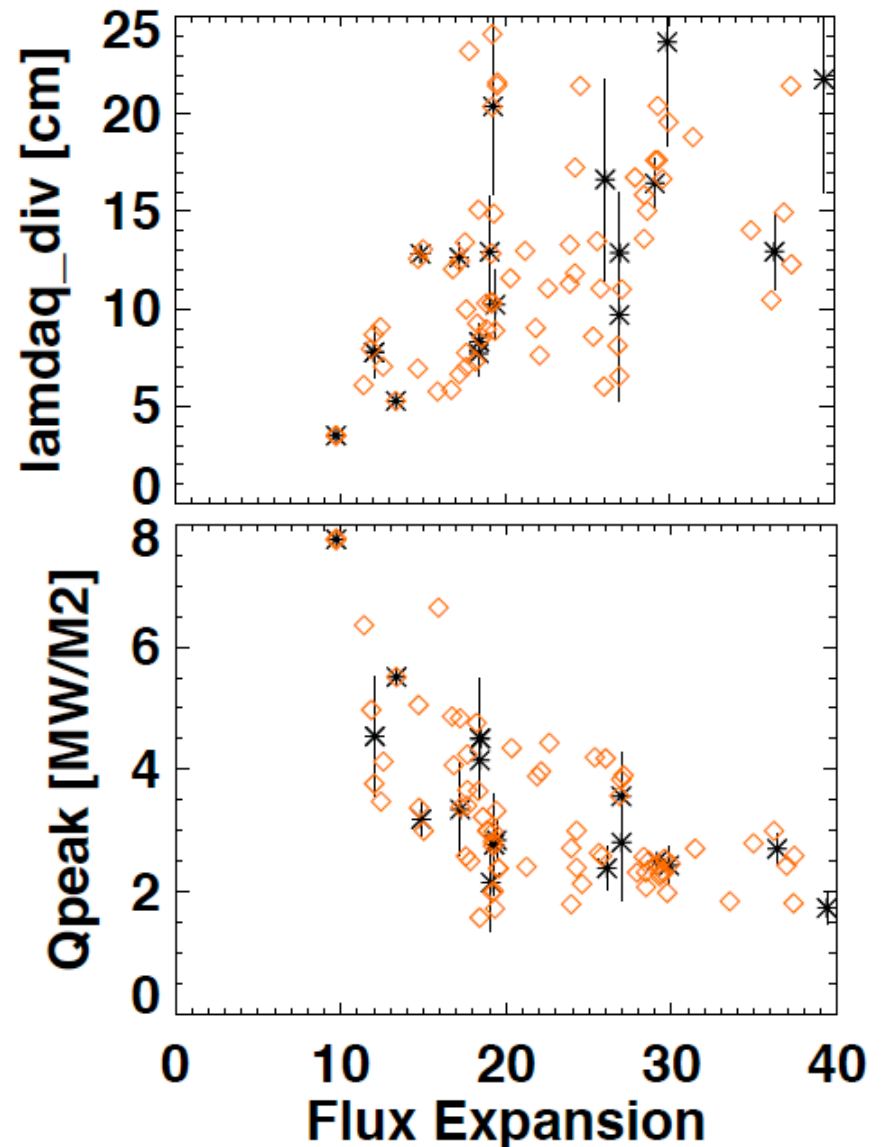
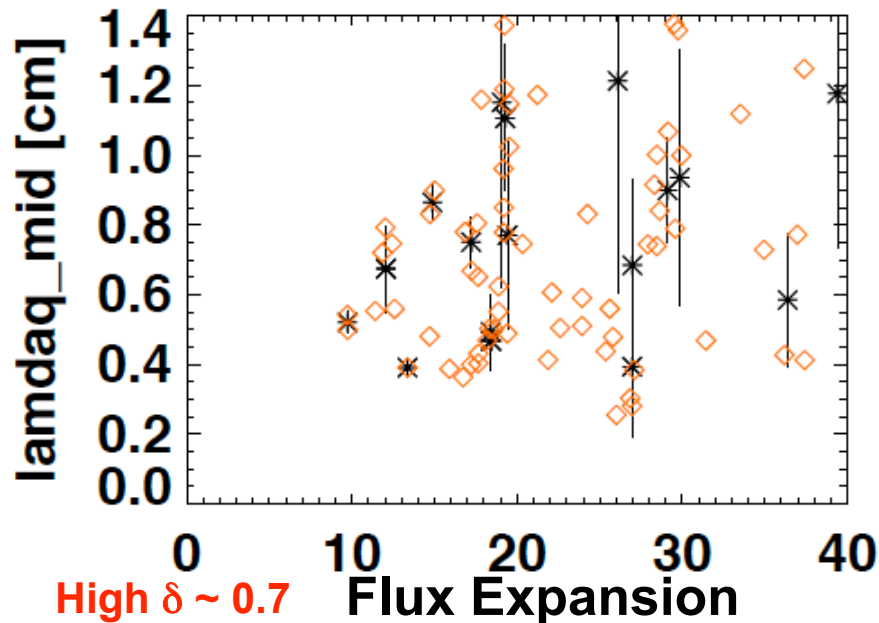
✓ Peak heat flux and detachment reported at IAEA 2008 in Soukhanovskii's paper (NF 2009)



High $\delta \sim 0.7$

XP816: Peak heat flux (width) varies inversely (directly) with flux expansion at high δ

- λ_q^{mid} stays approximately constant during the scan
- Large variability – need to refine analysis to see if error bars can be reduced
- ✓ Partly reported at EPS 2009 in Vlad's paper



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 - Slow IR camera data (Maingi JNM 2007, Maingi EPS 2007)
 - New fast IR camera data being analyzed (Ahn, RSI 2009 submitted)
- ✓ Nice I_p scan and flux expansion scans at $\delta \sim 0.7$, coarse NBI scan (2008)
 - *Piggyback on detachment study (Soukhanovskii NF 2009, EPS2009)*
- Desired: higher I_p range up to 1.4-1.5 MA at high δ
 - *divertor bolometers ok for 2010?*
- Desired: B_t scan (0.4-0.55 T) at constant I_p , q_{95}
- Desired: power balance vs. δ_r^{sep} (esp. near $\delta_r^{\text{sep}} = 0$)
- Desired: data from scaled poloidal shape match to C-Mod (e.g. from XP721: $\delta \sim 0.5$, $\kappa=1.8$, large δ_r^{sep})
- Desired: Snowflake divertor shape effects (piggyback on new data from Vlad's 2010 XP – extend flux expansion scan)