Divertor Heat Flux Measurements and HINT2 Calculations at LHD

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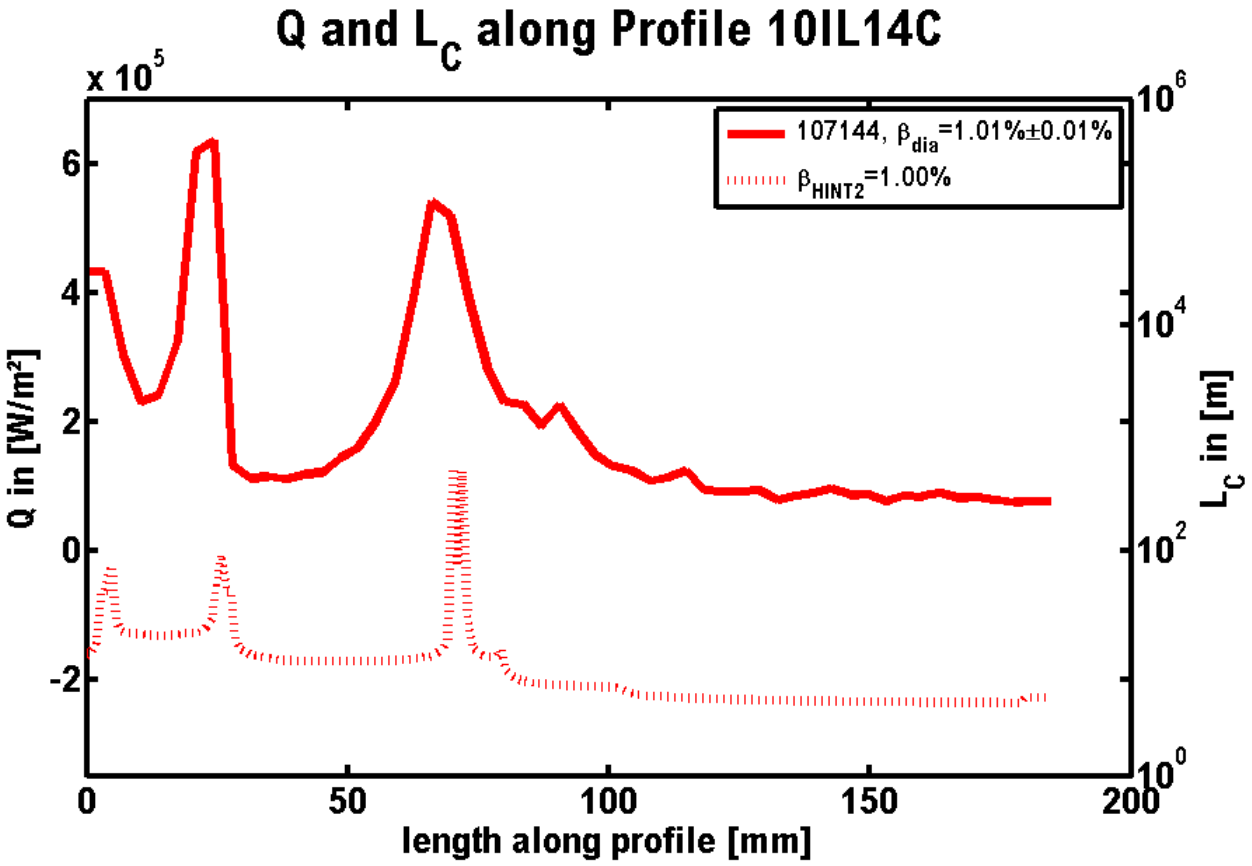
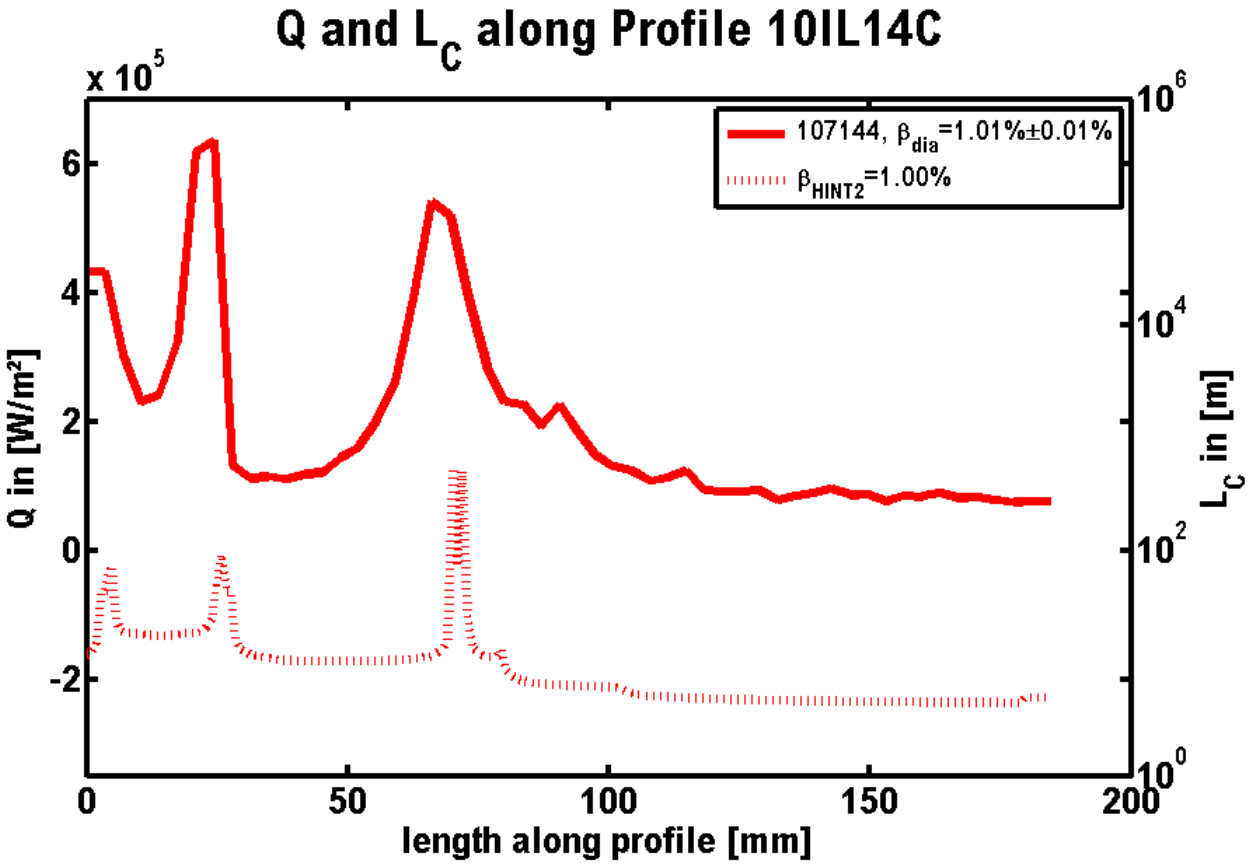
Heat Flux at Strike Line



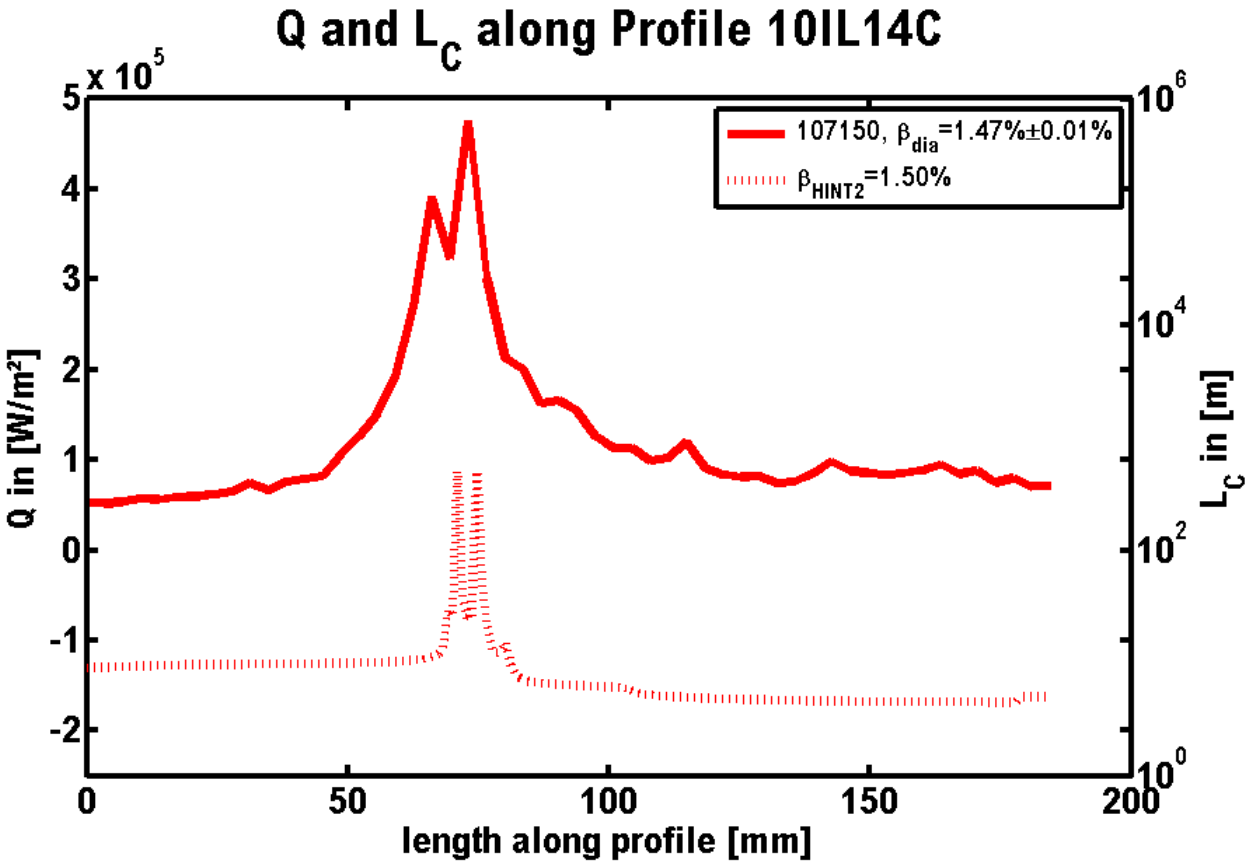
- L_C peaks position (HINT CoSy) fits to Q peak positon (measure in LHD CoSy)

β Induced Strike Line Changes



- 1% → 2 %: strong changes in magnetic topology

β Induced Strike Line Changes



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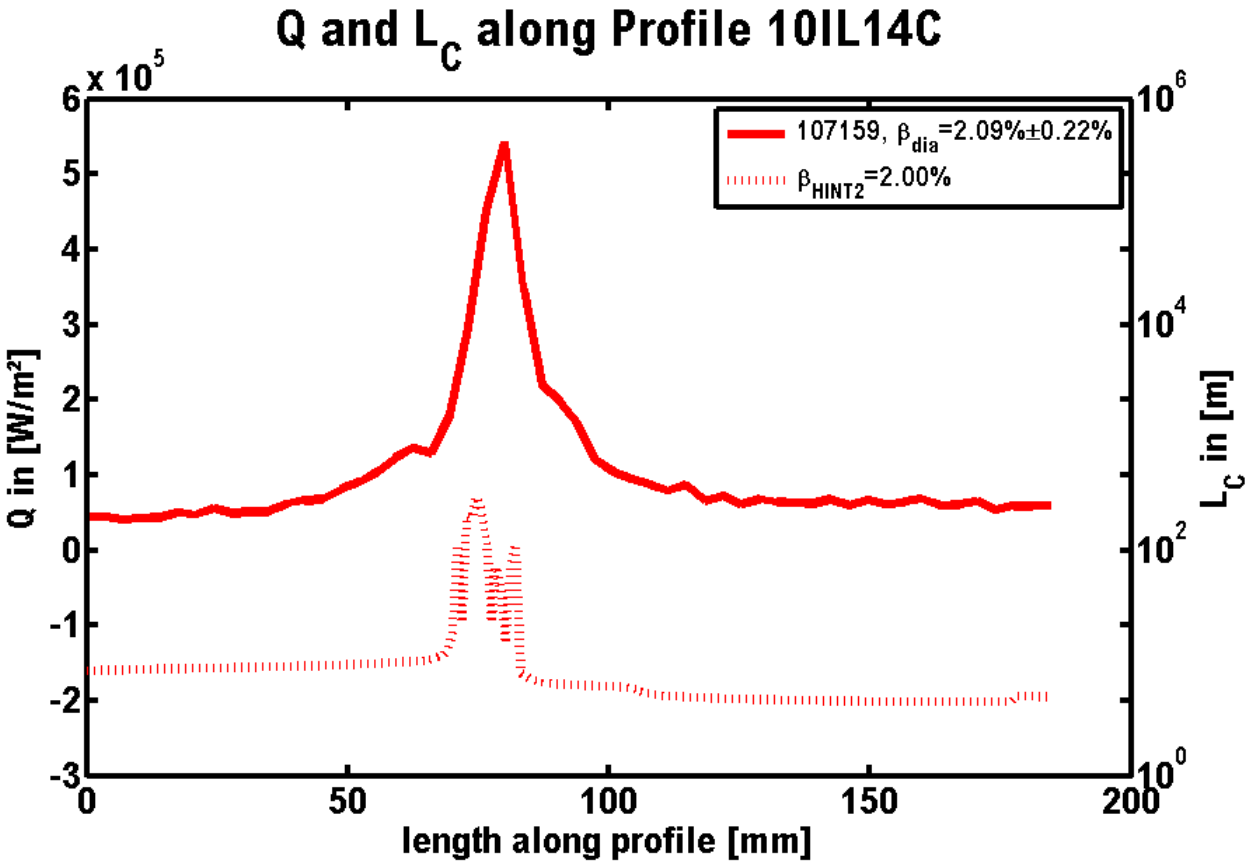

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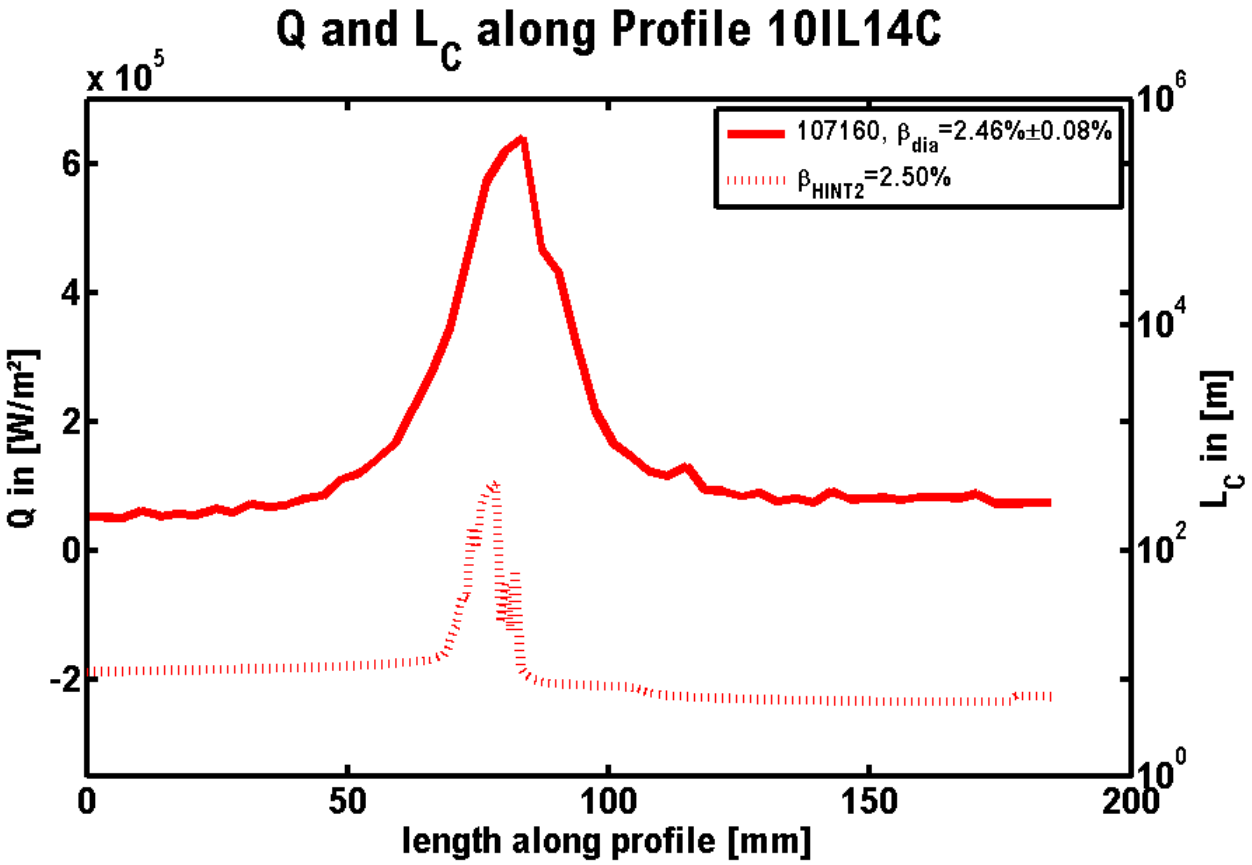
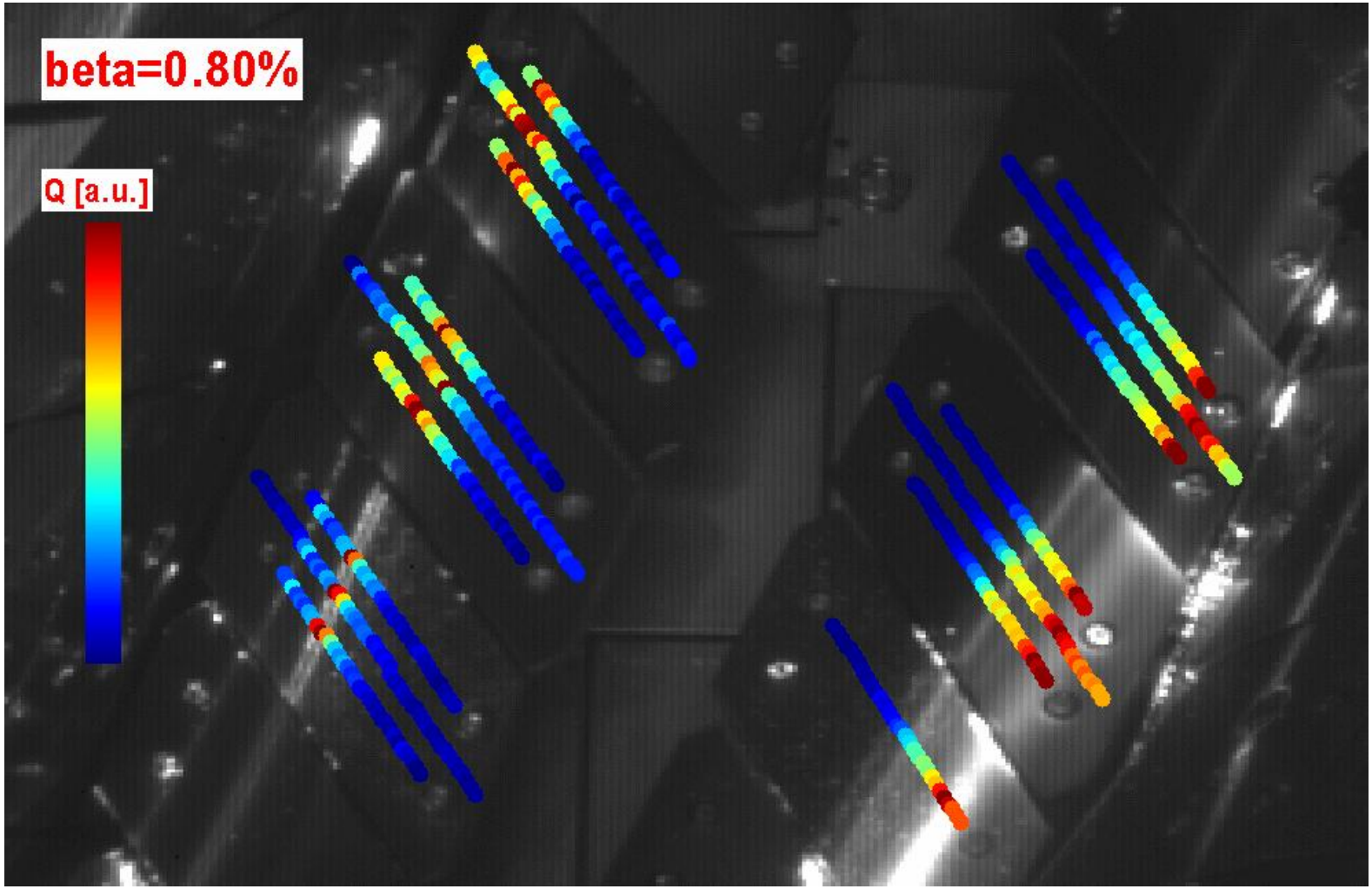
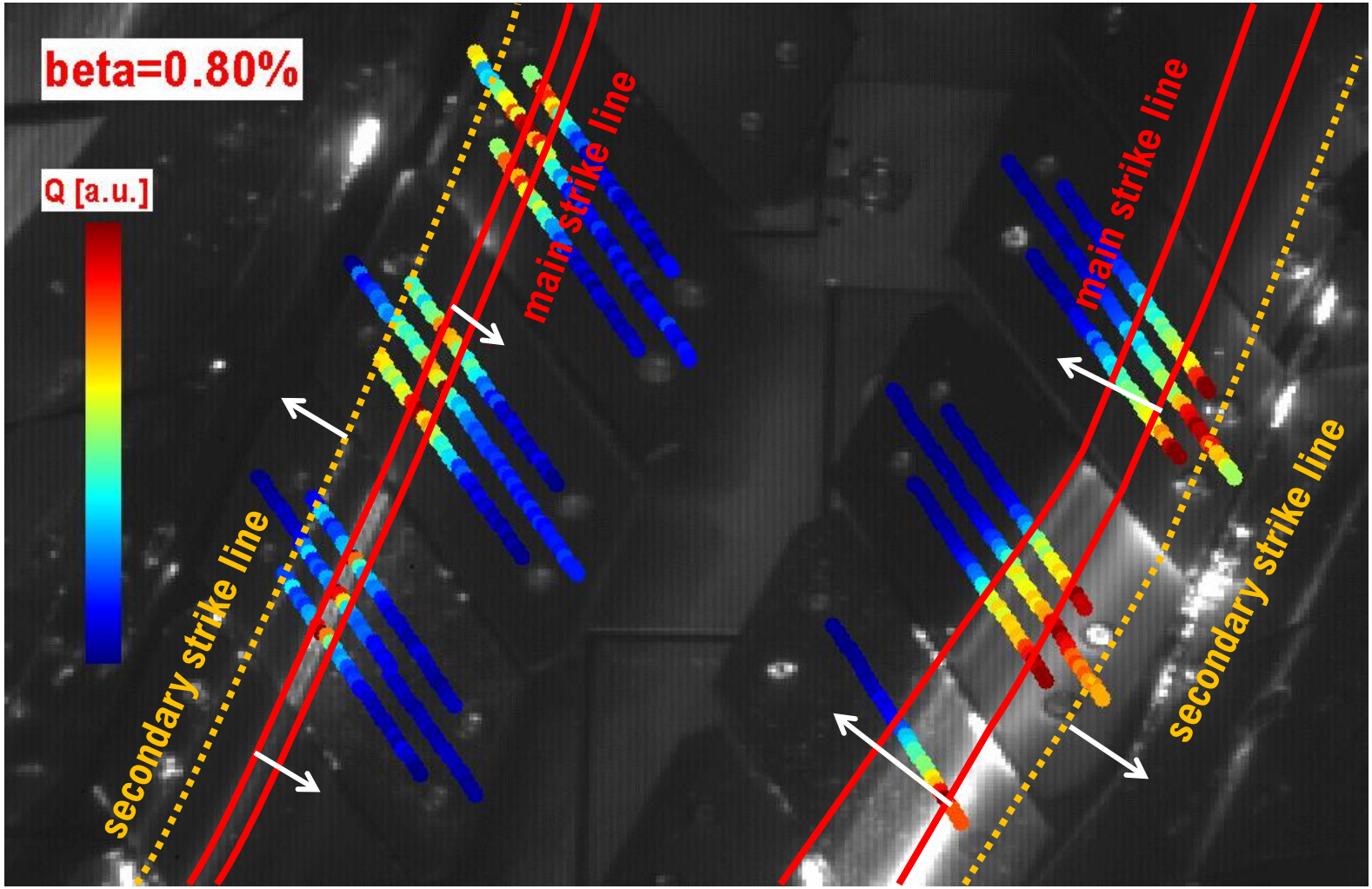


- 1% → 2 %: strong changes in magnetic topology
- 2% → 2.5%: strike line stable, but n = 2.5 → 3.5 10^{19} m^{-3}

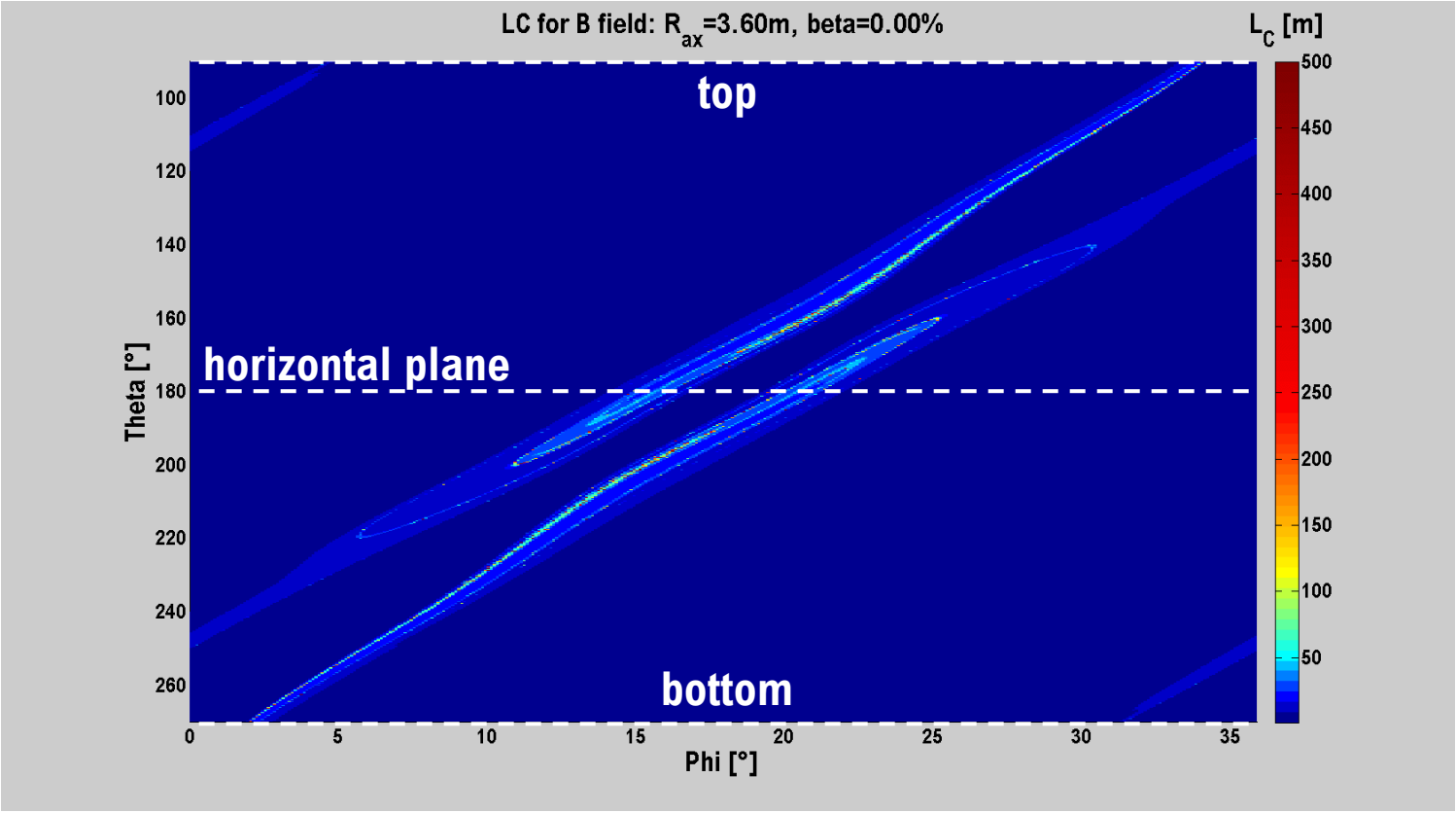
Q changes Along Divertor



Q changes Along Divertor



L_C Changes on Inboard Side



- ‘whiskers’ move helically from midplane to top and bottom
- heat flux measurement around midplane

Summary

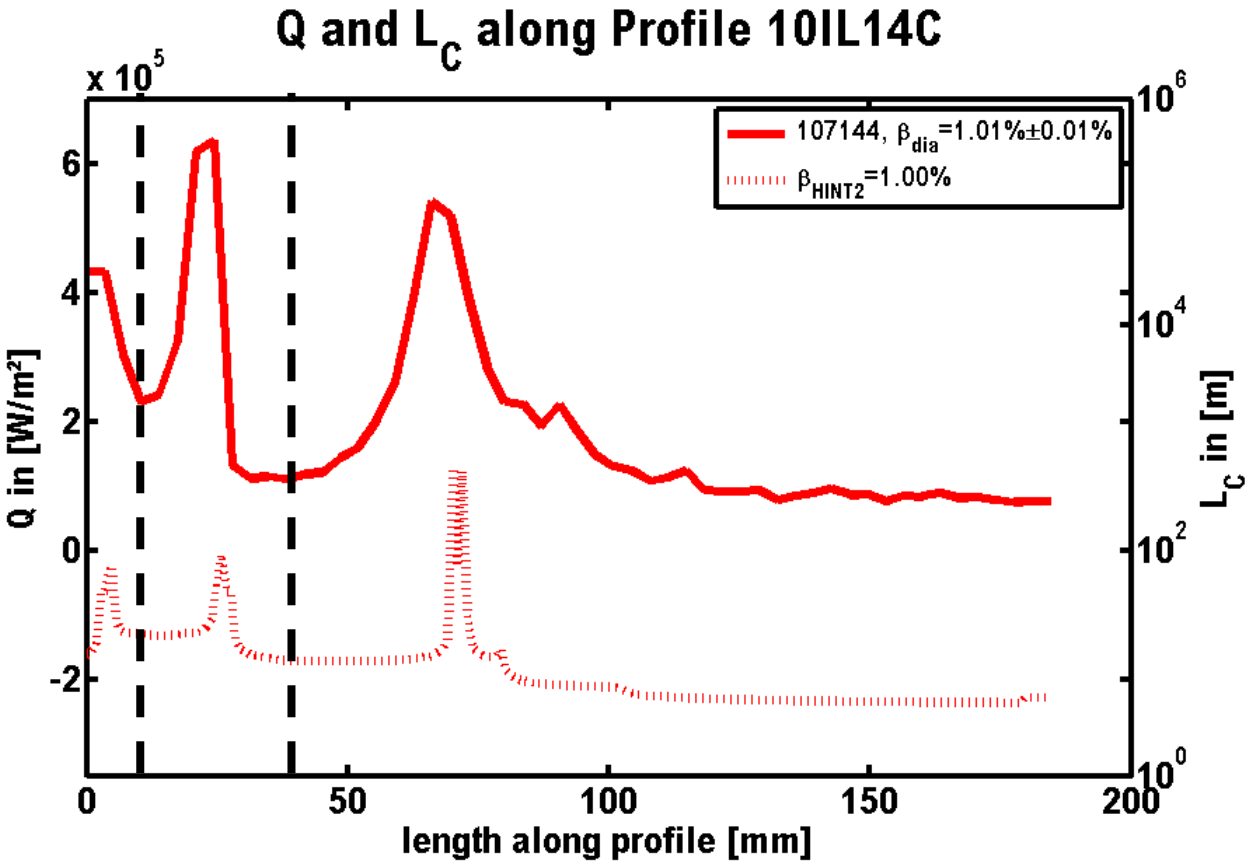
- measured heat flux peaks fit to HINT 2 results
- heat flux pattern strongly dependent on plasma β
- not only L_C determines heat flux value, but also d_{LCFS} along open field line

Outlook:

- shape of heat flux peaks correlated to transport in edge
  - → fit model of magnetic diffusion and heat transport (T. Eich)
  - → compare $\chi_{||}$ and $\chi_{\perp}$ from fit to EMC3-EIRENE calculations

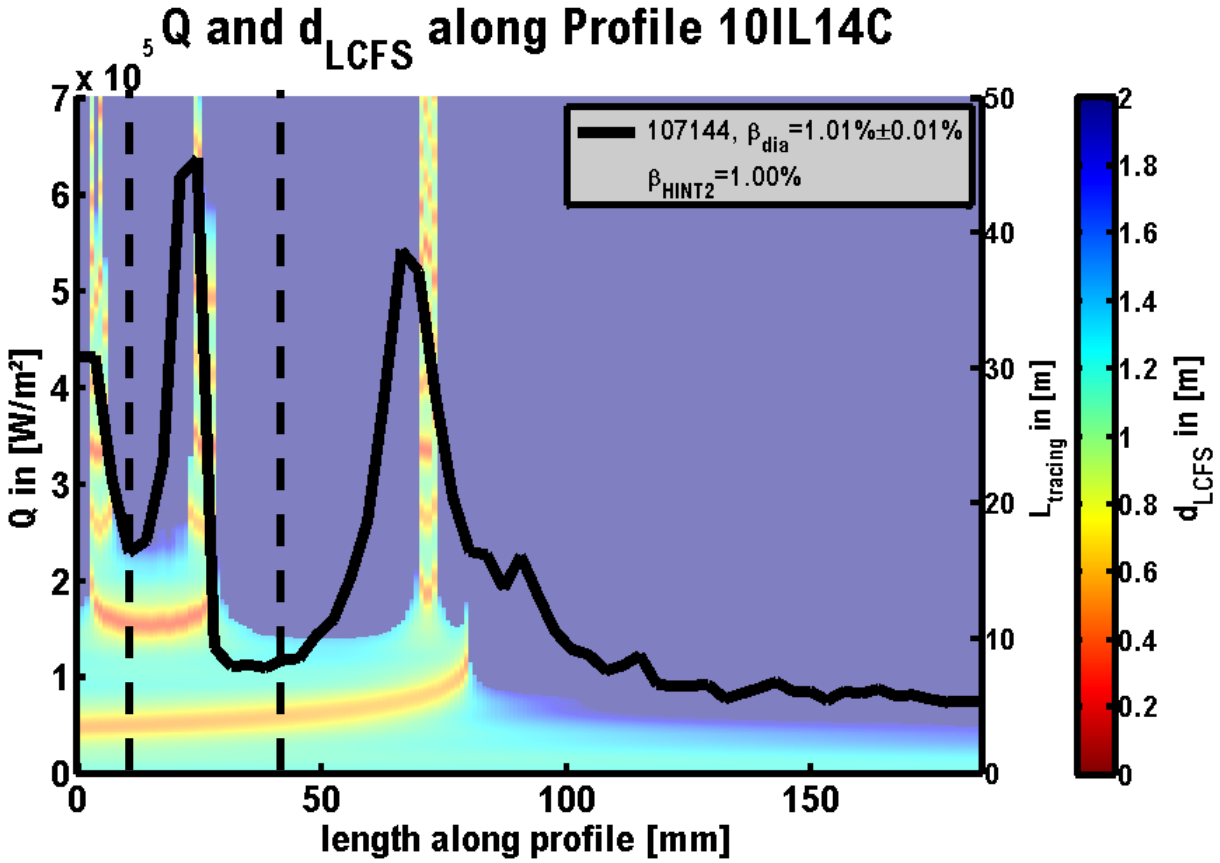
Bonus Slides

Field Lines Collect Energy



- different Q level even for similar L_C
- open field lines approach LCFS once/twice

Field Lines Collect Energy



- different Q level even for similar L_c
- open field lines approach LCFS once/twice

Divertor Calibration Technique

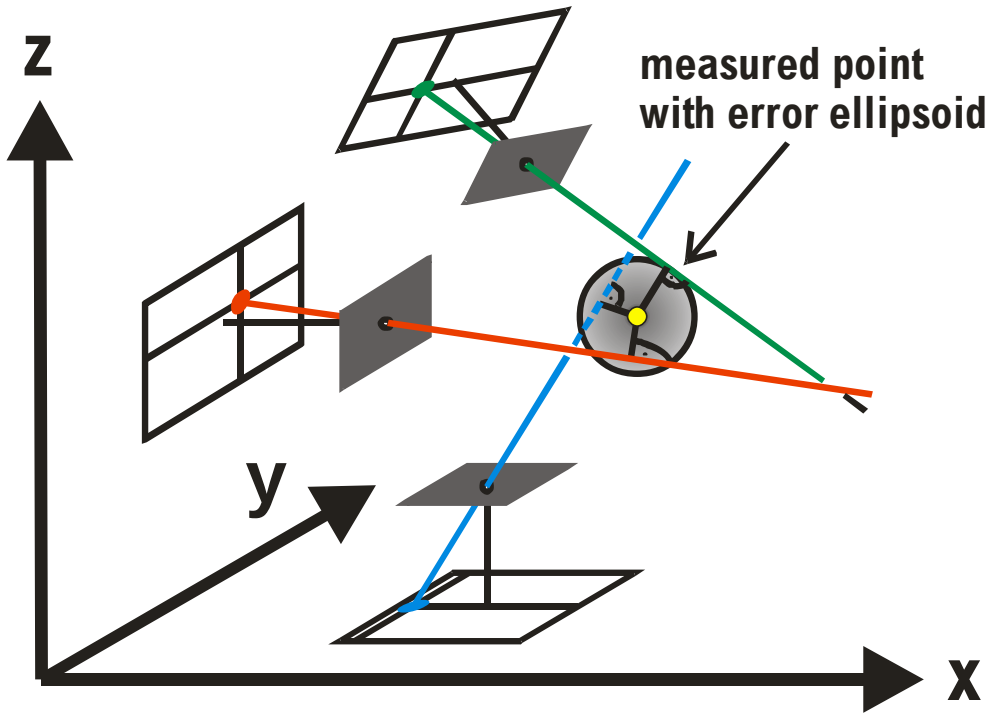
- take images from multiple views
- known camera position

→ calculate view line

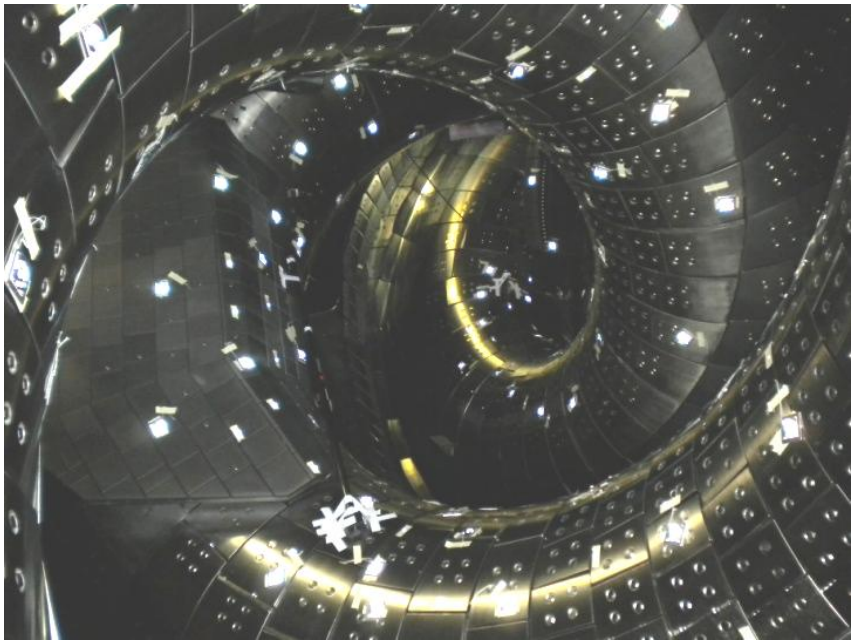
→ intersection point represents measured location

- known reference points

→ calibrate camera position



Measurement in Half Torus of LHD



- span grid of marker from divertor sections 10I and 4I
  → measurement volume: ca. 3mx11mx6m
- use reference points
  with known LHD coordinates

uncertainty	dx [mm]	dy [mm]	dz [mm]
maximal	4.6	4.4	1.9

Eich Fit of Heat Flux Profiles

- T. Eich assumes exponential power decay at mid plane
- flux expansion to divertor widens strike line by f_x

$$q(\bar{s}) = q_0 \cdot \exp\left(-\frac{\bar{s}}{\lambda_q f_x}\right)$$

- heat flux diffuses perp. along the divertor leg

→ convolution with Gaussian of width S

$$q(\bar{s}) = \frac{q_0}{2}\exp\left(\left(\frac{S}{2\lambda_q f_x}\right)^2 - \frac{\bar{s}}{\lambda_q f_x}\right) \cdot \mathrm{erfc}\left(\frac{S}{2\lambda_q f_x} - \frac{\bar{s}}{S}\right) + q_{BG}$$