Status of edge characterization in NSTX

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Analysis focused on

- Core fueling - efficiencies, sources, sinks - No dedicated XP
- Edge heat and particle transport - Joint XP-217 "Edge characterization experiment" by S. Paul and J. Boedo, data from other XP's
- Divertor performance - no dedicated XP

Experimental edge transport topics

- SOL width scaling and turbulent particle flux analysis (Jose Boedo, UCSD)
- Divertor heat flux scaling, in/out divertor heat flux split (R. Maingi (ORNL))
- Divertor power balance (S. Paul (PPPL))
- Core fueling, edge transport, divertor performance (V. Soukhanovskii (PPPL))
- Edge turbulence (S. Zweben (PPPL), R. Maqueda (LANL))

Edge relevant diagnostics available in 2002:

- 20-pt MPTS with higher edge resolution
- Filtered 1-D CCD cameras
- IRTV (heat profiles)
- Divertor bolometry
- Neutral pressure gauges
- Divertor / CS tile probes
- Passive spectroscopy (VIPS, SPRED, GRITS, HAIFA, Filterscopes)
- VIPS-2 took first edge poloidal rotation data
- UCSD fast reciprocating probe
- Gas Puff Imaging
- Edge reflectometry

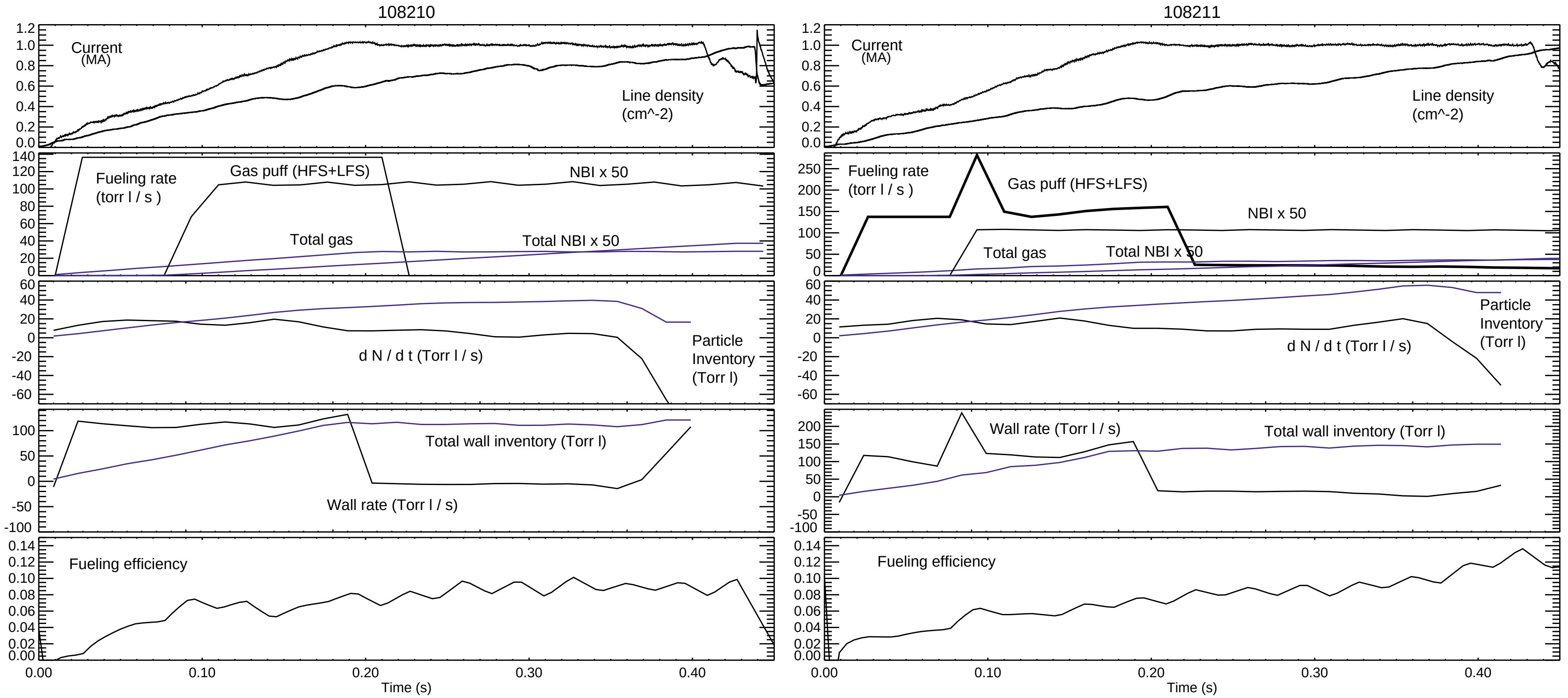
Core fueling and particle control

- Particle balance equation for D
- Average gas fueling efficiency FE = 0.05 - 0.20 (“low”)
- Fueling efficiency does not depend on gas inj. rate
- Fueling efficiency does not depend on density for LFS gas
- NBI fueling efficiency FE < 0.9 (“high”)
- Impurity fueling insignificant
- Fueling frequently dominated by recycling

- H-mode fueling efficiency analysis is in progress
- Particle balance in HHFW heated plasmas is being analyzed

Need strong core fueling and active density control

LFS and HFS fueling of NBI-heated L-mode plasmas

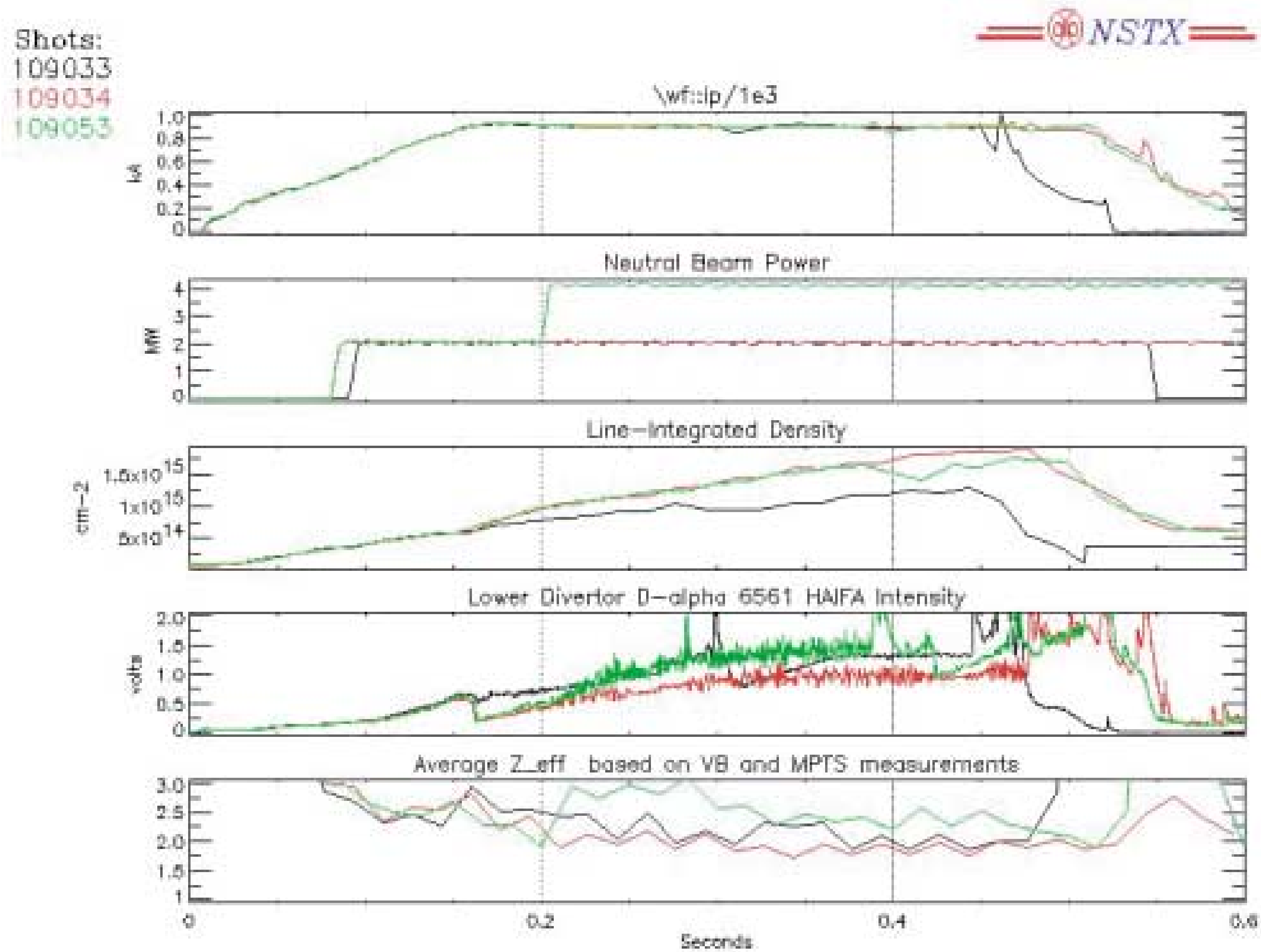


- dN/dt is < 20 Torr l / s, NBI is about 2 Torr l / s
- LFS only: wall pumping, LFS+HFS: wall degassing

Edge heat and particle transport

- Data from XP-217: L- and H-mode comparison, H-mode power and density scan
- Data from XP-223: field scan, correlation with core transport and confinement
- UEDGE modeling commenced -
  LLNL group (G. Porter, M. Rensink, N. Wolf) and
  UCSD group (A. Pigarov, S. Krasheninnikov)
- EFIT separatrix position is being questioned
- BOUT simulations of edge turbulence + GPI modeling
- UEDGE results will be used in TRANSP
- In/out asymmetries in divertor heat flux and recycling are being analysed

L- and H-mode 2-4 MW NBI heated plasmas



$T_e \cong 0.8 keV$

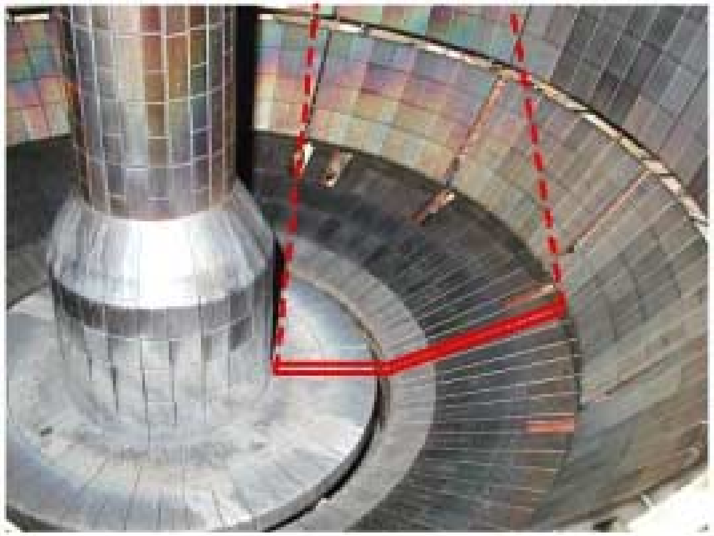
$\tau_E \cong 45 ms$

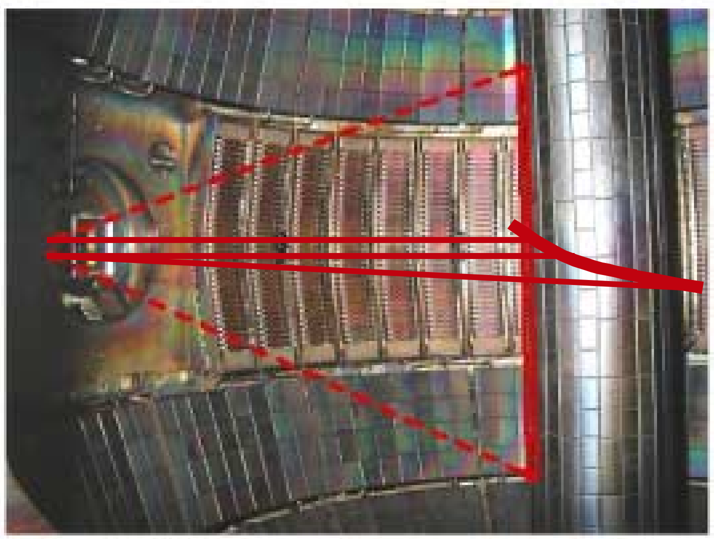
$P_{OH} \cong 0.7 MW$

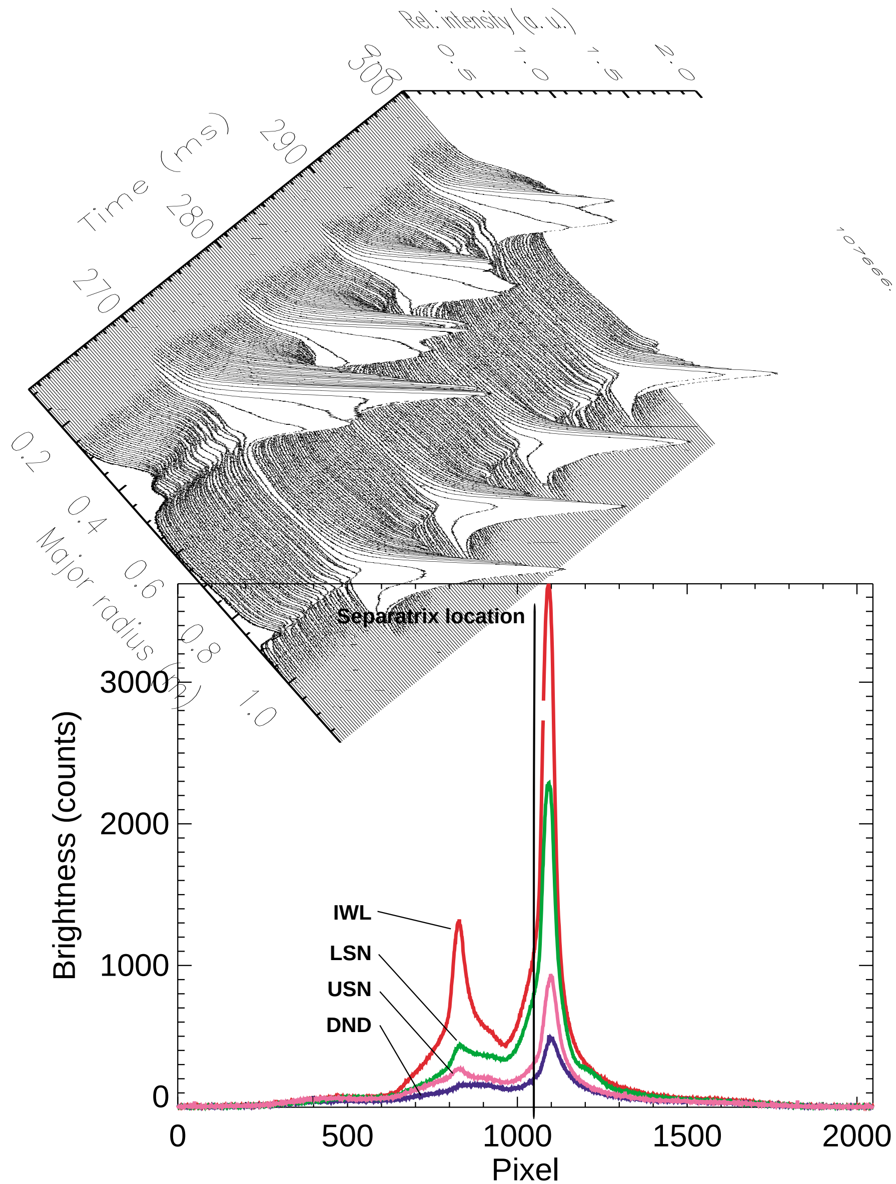
$E < 200 J$

$B_t \cong 0.4 T$

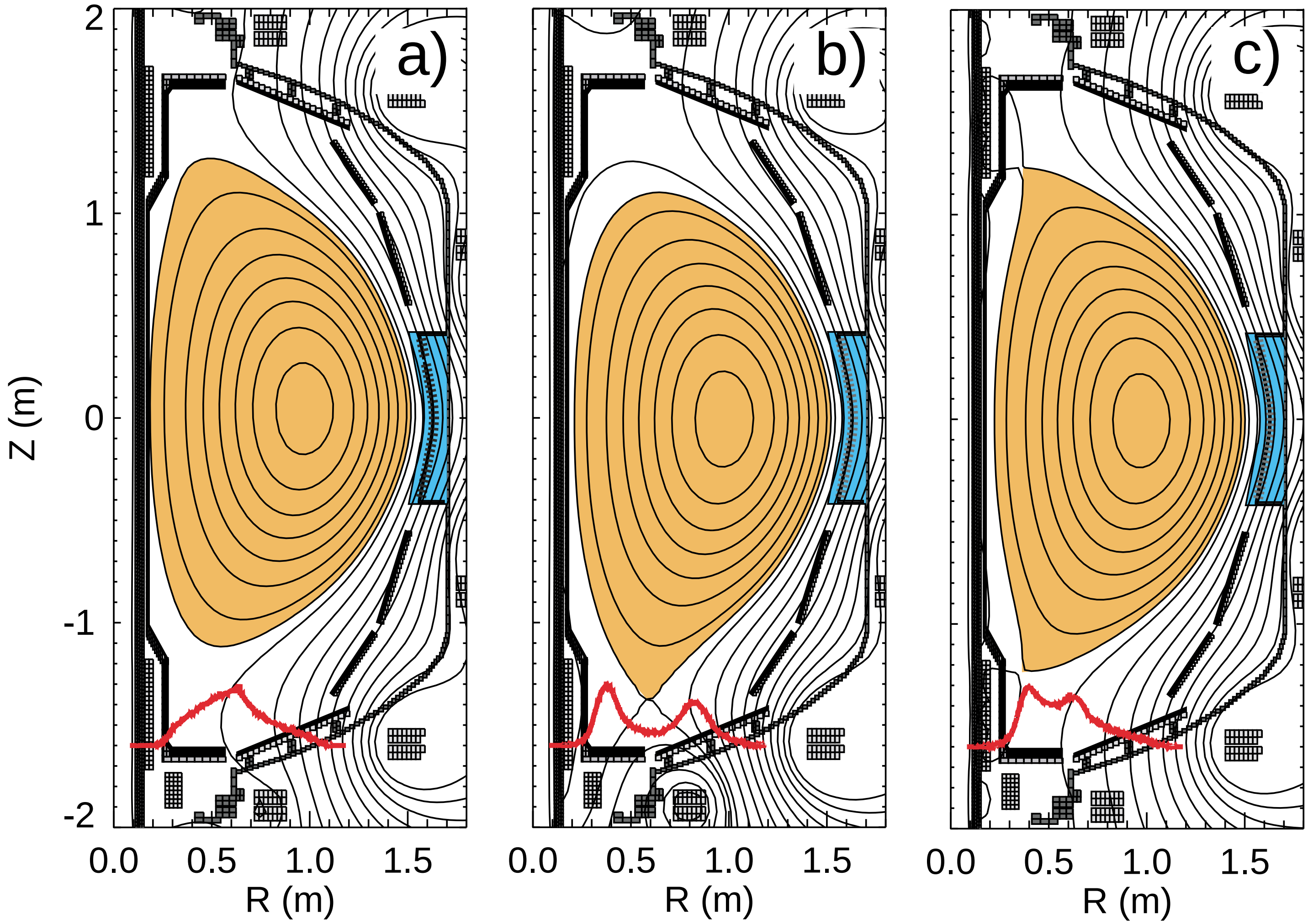
1D CCD cameras give Dα profiles





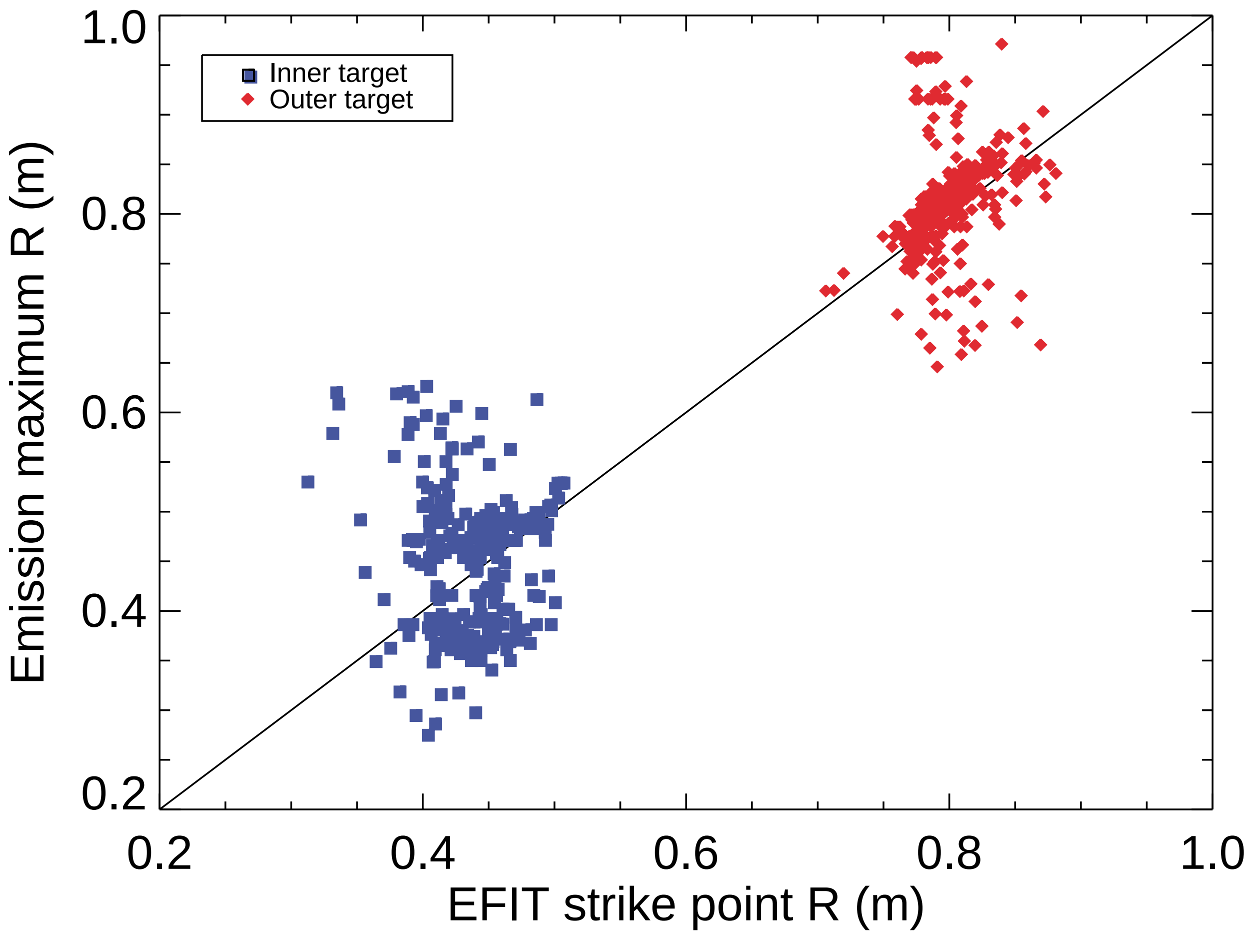


Separatrix position from Dα camera



a) - IWL, b) - LSN, c) - DND

Comparison of EFIT strike point location and Dα emission maxima



Divertor performance

- Critical subject of particle and power exhaust for long high power discharges
- Few available diagnostics to determine divertor regime (have we seen divertor detachement yet?)
- Analysis of divertor regimes in progress - involves correlation of midplane and divertor parameters such as neutral pressures, el. temperatures, densities and heat and particle fluxes
- New dedicated diagnostics ($D\alpha/D\gamma$, tile probes, divertor bolometry)
- Dedicated experiments will be proposed in FY'03

Summary

- Global analysis of fueling efficiencies and particle balance indicate need for more efficient fueling schemes (e.g. pellet injection) and active density control (e.g. cryo-pump)
- New and upgraded boundary diagnostics enable detailed analysis of local edge transport for the first time
- Joint effort on edge transport analysis in progress (see other talks in this session)

One reservoir particle balance equation

$$\frac{dN_p}{dt} = \Gamma_{gas} + \Gamma_{NBI} + \Gamma_{NBI\_cold} + \Gamma_{NBI\_cryo} + \Gamma_{wall} + \Gamma_{pump} + \frac{dN_n}{dt}$$

Change of particle inventory

Gas feed rate

NBI fueling rate

NBI cryopump rate

Wall fueling or pumping rate

TM pump rate

- Ion density $n_i = n_e \frac{Z - Z_{eff}}{Z - 1}$
- Fueling efficiency $\eta = \frac{N_i(t)}{N_p(t)}$ or $\eta = \frac{dN_i / dt}{\Gamma}$