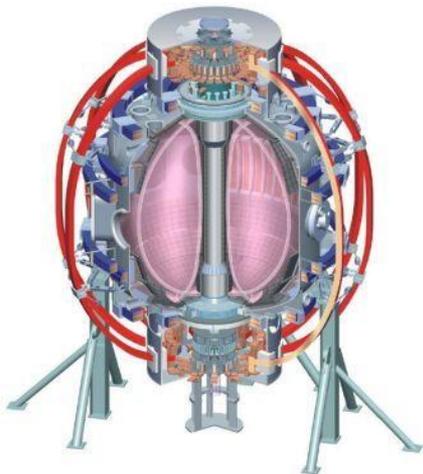


# Effect of 3-D fields on the radiative/detached divertor plasmas

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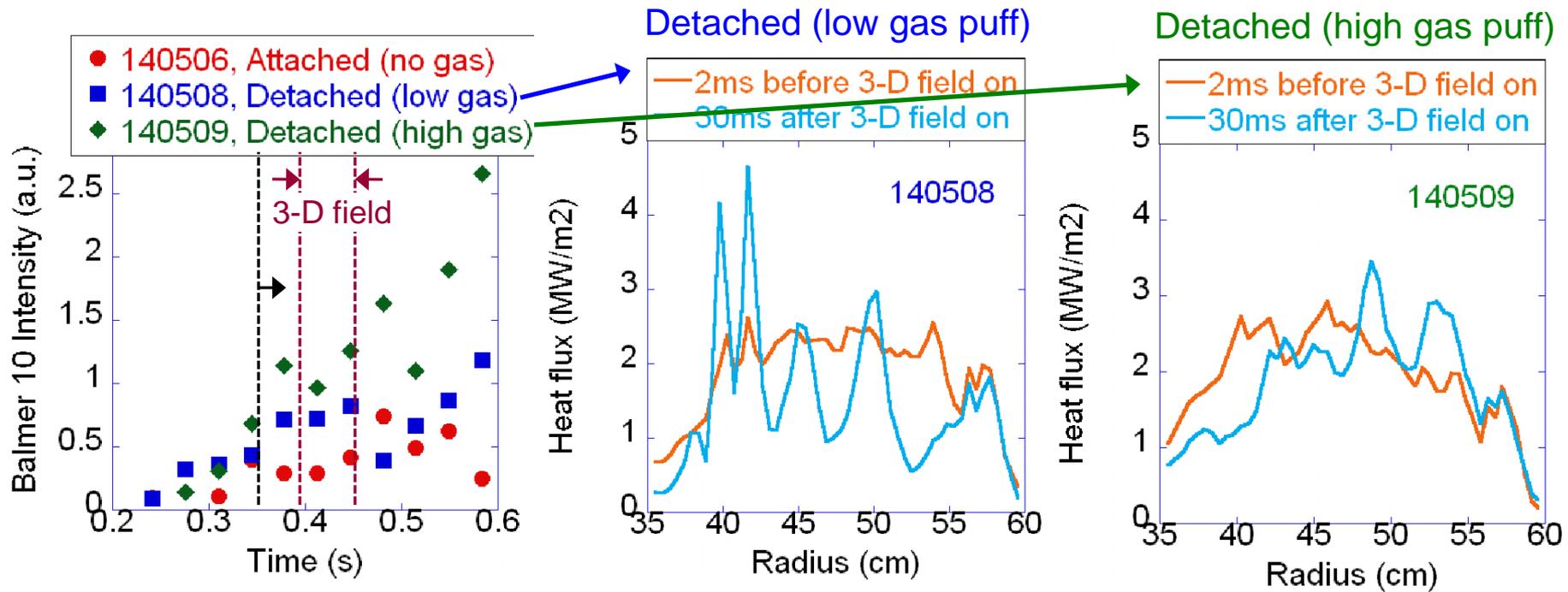
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# Motivation

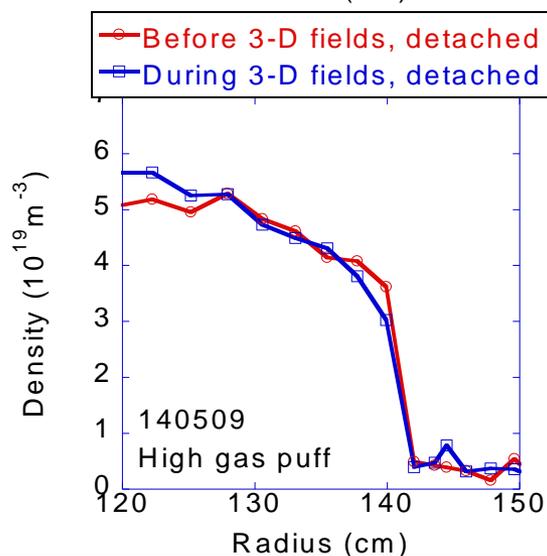
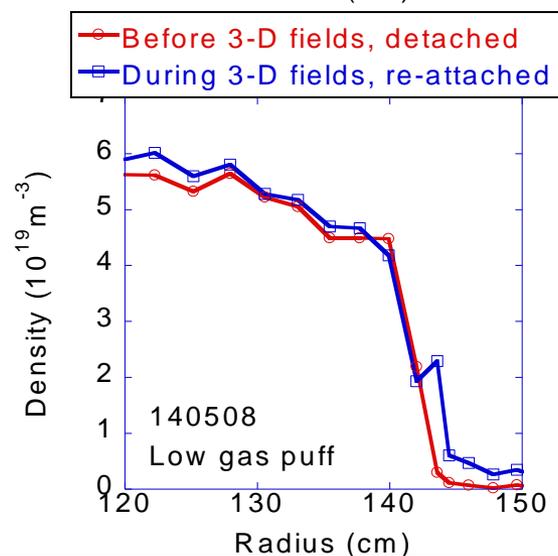
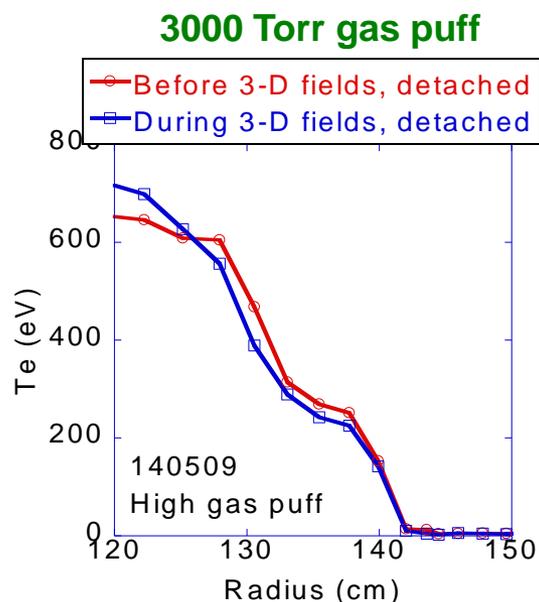
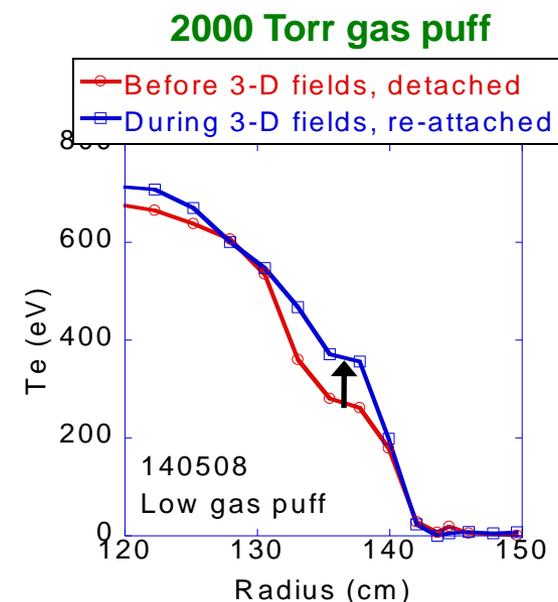
- Key ITER issues:
- Would 3-D fields to be applied for ELM control in ITER be compatible with detachment and highly radiative divertor as required for stationary power flux control in ITER ?
- Can one maintain a pedestal plasma as required for fusion performance and at the same time keep the divertor power flux control with 3-D field?

# Applied 3-D fields can reattach detached plasma but it can be avoided by high gas puffing



- Applied 3-D fields make the **detached divertor plasma re-attach** in medium divertor gas level, leading to a peaked heat flux profile again
- If the divertor gas puffing is high enough, plasma stays in the detached regime even with 3-D field applied

# Divertor plasma re-attachment is accompanied by pedestal $T_e$ profile increase



- Pedestal  $T_e$  profile significantly decreases during detachment and it jumps back up when the re-attachment occurs by 3-D fields application (low gas puff)
- Pedestal  $T_e$  stays decreased in the high gas puff case
- Density profile shows little change by the applied 3-D fields
- In these conditions 3-D fields can increase  $T_e$  without affecting  $n_e \rightarrow$  changes of thermal transport with 3-D fields ?

# More work is definitely needed to understand/extend the results of XP-1026 to resolve key ITER issues

- The results of XP-1026 in 2010 has begun to provide an answer to this question but more experiments are needed to determine the physics mechanisms that affect  $T_e$  and  $n_e$  near detached divertor plasma conditions
- Parameter scans ( $I_p$ ,  $I_{3-D}$  and  $P_{NBI}$ ) are proposed in 2011 with the goal of determining
  - Dependence of results on plasma collisionality versus plasma density
  - Dependence of results on magnitude of 3-D fields and alignment of perturbation with edge magnetic field line pitch
  - Effect of plasma response (H-mode versus L-mode and higher versus lower  $\beta$  in H-mode)
- Initial experiments with impurity seeding should be carried out in 2011 to determine the effect of recycling versus non-recycling impurities on the effects of 3-D fields on detachment

# Experimental plan

- Parameter scans (Density,  $I_p$ ,  $I_{3-D}$  and  $P_{NBI}$ ) are proposed in 2011 with the goal of determining
  - Density scan (2 points; early and later phases during H-mode), 2 shots
  - $I_p$  scan (=alignment scan): 1.2MA, 1MA, and 700kA, 6 shots
  - $I_{3-D}$  scan: 500A, 1kA, 1.5kA, 6 shots
  - $\beta_N$  can: 2MW, 4MW, and 6MW of NBI power, 6 shots
- Impurity seeding experiment with  $N_2$  and Neon
  - Divertor gas puffing with  $N_2$ , 3 shots
  - Divertor gas puffing with Neon, 3 shots

Request 1.5 day of run time  
(Minimum of 1 day)

# Backup slides

