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XP 1045: "Snowflake" divertor characterization in NSTX

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and NSTX Team

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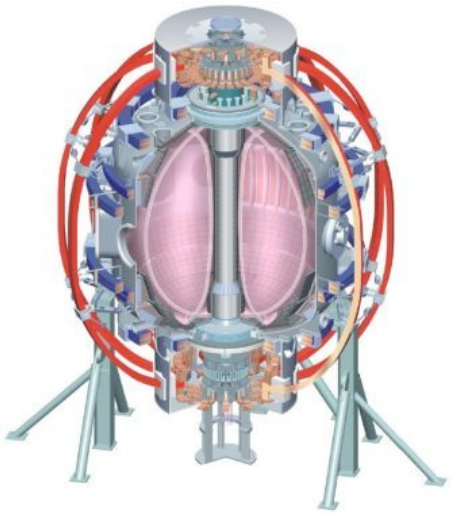

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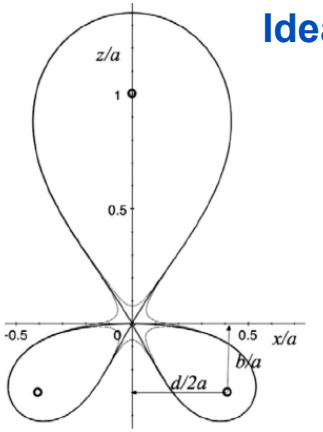
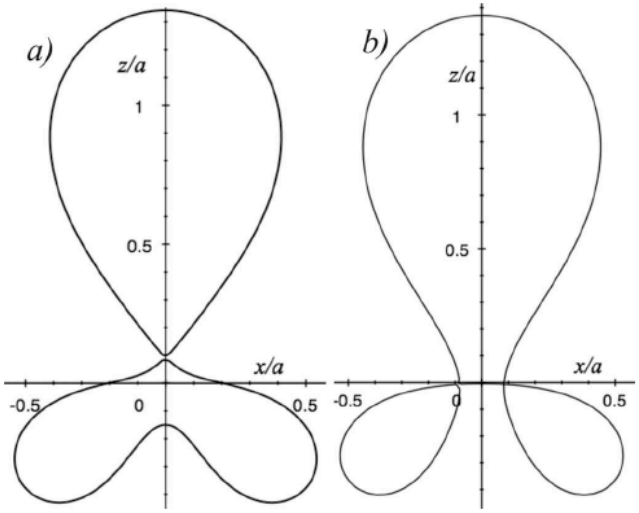
"Snowflake" divertor configuration may be a game changer for divertor tokamaks

- "Snowflake" divertor (SFD) configuration proposed and studied theoretically by D. D. Ryutov (LLNL)
  - Phys. Plasmas 14, 064502 (2007)
  - Phys. Plasmas, 15, 092501 (2008)
  - 34th EPS Conference on Plasma Phys. Warsaw, 2 - 6 July 2007 ECA Vol.31F, D-1.002 (2007)
  - Paper IC/P4-8 at IAEA FEC 2008
- SFD is obtained by creating a second-order poloidal null in the (lower) divertor **with existing divertor coils**
- Two cases – SFD-plus and SFD-minus
- Predicted properties
  - Large flux expansion (B_p/B small) and long parallel connection length
  - Null-pt flux tube squeezing – barrier for turbulence
  - Possibility of ELM control (increased edge magn. shear)
  - Enhanced null-point *grad B* drift (C. S. Chang's X-pt transport)

Ideal SFD





SFD-plus and SFD-minus

NSTX is making a contribution to the novel divertor geometry development for future devices

- XP 924 (2009) - Initial "snowflake" divertor studies in NSTX (0.5 day)
  - Obtained "snowflake"-like configurations for 100's ms
  - Magnetic configuration – very large flux expansion, longest connection length, largest divertor volume
  - Detachment of divertor OSP
    - Large heat flux reduction
    - Increased divertor P_{rad} and recombination
    - Reduced core P_{rad} and carbon density
  - No core confinement degradation

- NSTX is making a unique contribution to divertor studies among medium and large high-power tokamaks
  - TCV has been experimenting with "snowflake" divertor
  - "Snowflake" configuration is a candidate for heat flux mitigation in NSTX-U

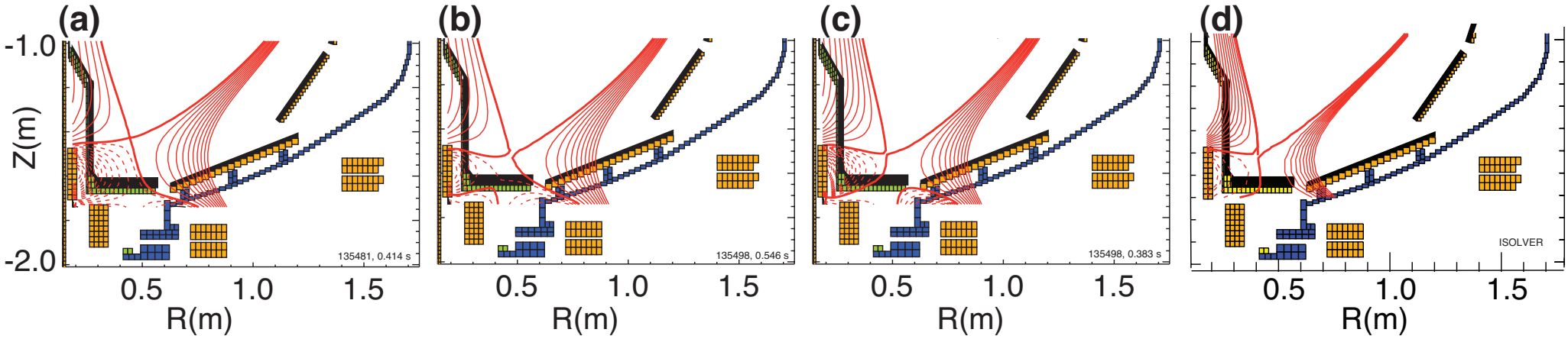
XP 1045 to continue "snowflake" divertor studies

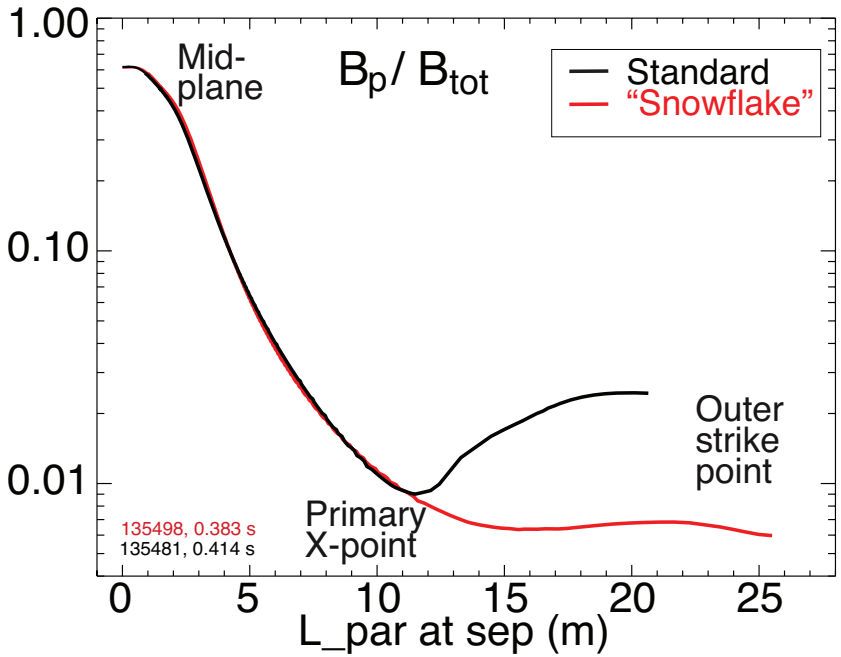
- "Snowflake" divertor configuration will be obtained as in 2009 by using PCS OSP control and two div. coils (PF1A and PF2L)
  - Candidate FY2010 shot 137983 (suggested by E. Kolemen)
  - Separately, will also attempt to obtain SFD-minus using PF1B

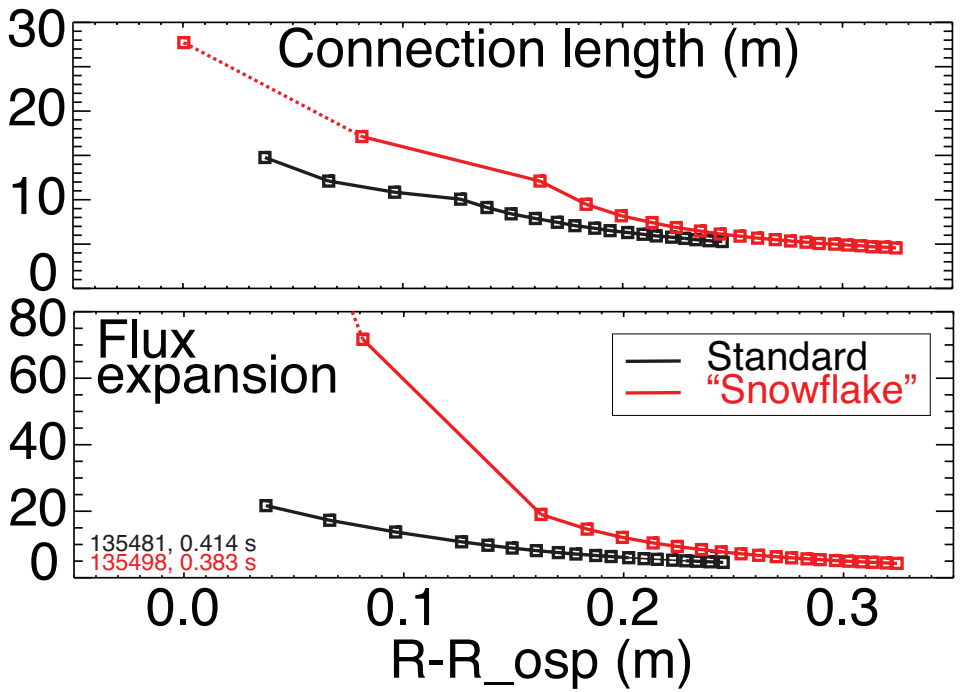
- Goals for XP1045 this year:
  - SOL and divertor transport and turbulence
    - Measure heat flux profiles in abs. units w / two-color IR camera
    - Obtain data in a range of P_{SOL} (P_{NBI} = 2-5 MW, I_p = 0.8-1.2 MA)
    - Synergy with LLD pumping (scan LITER rate?)
    - Comparison of midplane and divertor turbulence (GPI + fast vis. cam.)
    - Detachment characteristics (probes, new spectroscopy)
    - Impurity sources and core density, P_{rad}
  - Pedestal stability

Backup

Results from XP 924







Results from XP 924

Divertor configurations: **Standard**, **Snowflake**