DivSOL TSG run time prioritization

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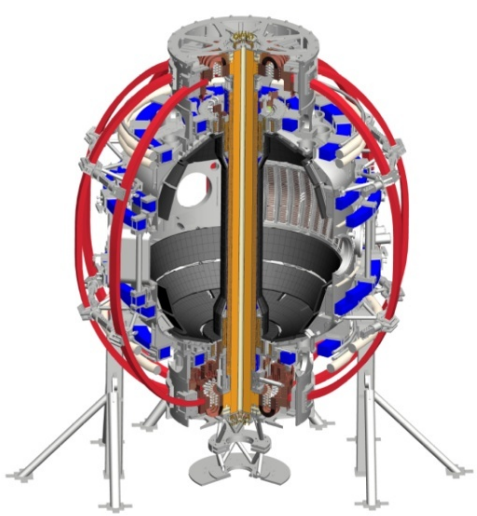

DivSOL TSG leads and/or contributes to several milestones in 2015 and 2016

- **FY 2015**
  - **R(15-1)**: Assess H-mode energy confinement, pedestal, and scrape off layer characteristics with higher B_T, I_P and NBI heating power
  - **R(15-3)**: Develop the physics and operational tools for obtaining high-performance discharges
  - ~~**IR(15-1)**: Develop and assess the snowflake divertor configuration and edge properties~~
- **FY 2016**
  - **R(16-1)**: Assess scaling and mitigation of steady-state and transient heat-fluxes with advanced divertor operation at high power density
  - **R(16-2)**: Assess high-Z divertor PFC performance and impact on operating scenarios

Proposed XPs

- SOL transport and turbulence
  - Heat flux and SOL width Scaling in NSTX-U, Travis Gray
  - Relaxation of the interchange instability and effect on SOL width with Li wall conditioning, Travis Gray
  - Relationship between lambda_q, S and Connection Length, Travis Gray
  - Initial NSTX-U edge characterization, Vlad Soukhanovskii
  - Relation between the midplane SOL pressure width and the divertor heat flux width, Robert Hager
  - SOL Width Scaling: Goldston's Heuristic Drift Model vs Critical Pressure Gradient Model, Egemen Kolemen
  - Investigation of ELM heat flux footprints with the variation of ELM regime, Kaifu Gan
  - Parallel Correlation of SOL Turbulence, Stewart Zweben

Proposed XPs

- Radiative divertor
  - Radiative divertor experiments, Vlad Soukhanovskii
  - Toroidal divertor flux deposition asymmetries due to localized gas injection, Jeremy Lore
- Impact of 3D fields on divertor
  - Interaction of applied 3D fields with detachment, Joon-Wook Ahn
  - Role of plasma response in the formation of lobe structures by 3D fields, Joon-Wook Ahn
  - Distinguishing between 3d magnetic field structures and transport, John Canik
  - S parameter under 3D perturbations, Egemen Kolemen
  - Divertor conditions and detachment characteristics in plasmas with 3-D fields, Alberto Loarte

Proposed XPs

- Snowflake divertor
  - Clarifying Snowflake divertor configuration physics, Vlad Soukhanovskii
  - Assessment of 3D field effects on the properties of the snowflake divertor, Gustavo Canal
  - Performance optimization of divertor detachment, Joon-Wook Ahn
  - Compare alternative advanced divertor configurations: X-divertor*, Snowflake, Egemen Kolemen
  - Detachment comparison study for Snowflake, X-divertor, Standard Divertor and long/short divertor leg*, David Eldon

* Also in Advanced divertors (see next slide)

Proposed XPs

- Advanced divertors
  - Transport and radiation in the high flux expansion divertor configuration with cusp-like fields, Vlad Soukhanovskii
  - Testing advanced divertors on NSTX, Mike Kotschenreuther
- Miscellaneous
  - Boundary diagnostic-optimized configuration (BDOC) for model comparisons, Vlad Soukhanovskii
  - ENDD Midplane Neutral Density Profiles in NSTX-U, Daren Stotler
  - Obtain 2D divertor density image using lithium emission, Oliver Schmitz
  - Effect of Lithium on SOL Power Balance, Travis Gray
  - Studies of low- and high-Z dust transport in NSTX-U, Roman Smirnov

Proposed run-time allocation
Guidance: 5 Tier I run days and 2-3 Tier II run days

- DivSOL TSG Leaders propose Tier I run time
  - SOL transport and turbulence – 1.5 days (R15-1), T. Gray and S. Zweben
  - Radiative divertor – 1 day (R16-1), J. Lore and V. A. Soukhanovskii
  - 3D fields – 1 day (ITER/ITPA), J.-W. Ahn and E. Kolemen
  - Snowflake divertor physics – 1 day (R16-1), G. Canal and V. A. Soukhanovskii
  - B2Li transition studies – 0.5 day, TBD
- Tier II run time and Piggyback
  - Advanced divertors (Eldon, Kolemen, Soukhanovskii, Kotschenreuther)
  - ENDD Midplane Neutral Density Profiles in NSTX-U, Daren Stotler
  - Boundary diagnostic-optimized configuration (BDOC) for model comparisons, Vlad Soukhanovskii
  - Effect of Lithium on SOL Power Balance, Travis Gray
  - Obtain 2D divertor density image using lithium emission, Oliver Schmitz
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R(15-1): Assess H-mode energy confinement, pedestal, and scrape-off-layer characteristics with higher BT, Ip and NBI heating power

Future ST devices such as ST-FNSF will operate at higher toroidal field, plasma current and heating power than NSTX. To establish the physics basis for future STs, which are generally expected to operate in lower collisionality regimes, it is important to characterize confinement, pedestal and scrape off layer trends over an expanded range of engineering parameters. H-mode studies in NSTX have shown that the global energy confinement exhibits a more favorable scaling with collisionality (BT tau_E ~ 1/nu*e) than that from ITER98y,2. This strong n*e scaling unifies disparate engineering scalings with boronization (tau_E ~ Ip^0.4 BT^1.0) and lithiumization (tau_E ~ Ip^0.8 BT^-0.15). In addition, the H-mode pedestal pressure increases with ~Ip^2, while the divertor heat flux footprint width decreases faster than linearly with Ip. With double BT, double Ip and double NBI power with beams at different tangency radii, NSTX-U provides an excellent opportunity to assess the core and boundary characteristics in regimes more relevant to future STs and to explore the accessibility to lower collisionality. Specifically, the relation between H-mode energy confinement and pedestal structure with increasing Ip, BT and PNBI will be determined and compared with previous NSTX results, including emphasis on the collisionality dependence of confinement and beta dependence of pedestal width. Coupled with low-k turbulence diagnostics and gyrokinetic simulations, the experiments will provide further evidence for the mechanisms underlying the observed confinement scaling and pedestal structure. The scaling of the divertor heat flux profile with higher IP and PNBI will also be measured to characterize the peak heat fluxes and scrape off layer widths, and this will provide the basis for eventual testing of heat flux mitigation techniques. Scrape-off layer density and temperature profile data will also be obtained for several divertor configurations, flux expansion values, and strike-point locations to validate the assumptions used in the FY2012-13 physics design of the cryopump to inform the cryo-pump engineering design to be carried out during FY2015.

R(16-1): Assess scaling and mitigation of steady-state and transient heat-fluxes with advanced divertor operation at high power density

Handling plasma power exhaust in the divertor region is a critical issue for ITER and FNSF. Of particular concern is the projected narrow scrape-off-layer (SOL) heat-flux width (observed to scale inversely with plasma current IP) projected for next-step tokamak devices that will operate at higher IP. By operating at twice the IP, Bt, and heating power relative to NSTX, NSTX-U will access narrow SOL widths and high parallel heat fluxes and will provide important contributions to understanding SOL cross-field transport scalings and to the development of techniques for mitigating high heat flux. Heat flux mitigation techniques to be tested both individually and in combination include: (1) magnetic balance (i.e. double-null operation), (2) radiative and partially detached divertor operation, (3) high flux expansion configurations e.g. “snowflake”, and (4) ELM pacing. Experiments will be performed to compare the efficacy of these techniques for reducing steady and transient heat fluxes, impurity production, and deleterious effects on the core plasma performance. To increase dissipative losses in the radiative divertor, D2 or impurity seeding will be used, enabled by an improved gas injection system. Detachment operating window for the highest SOL power and IP will be studied as a function of density and divertor seeding species (D2, CD4, Ne, Ar) in the standard and snowflake configurations. ELM-control/triggering techniques such as 3D fields and injected granules will be used to assess and reduce ELM-induced transient heat fluxes. Plasma control will be enhanced for long-pulse magnetic control of the double-null and the snowflake divertor configurations. Edge diagnostic data, i.e. infrared thermography, Langmuir probes, cameras, impurity spectroscopy, and bolometry will be compared to state-of-the-art numerical model predictions. These results will enable further development of high performance ST plasma scenarios with acceptable divertor power exhaust solutions, and aid in the validation of divertor power and particle exhaust models for ITER and FNSF.