

Suggested elements of FESAC Panel Question 3a on ST
June 16, 2008

3a): How would the ST program address and resolve the most crucial scientific questions ahead of it for this goal – startup/sustainment, transport and boundary physics? [co-authors: Roger Raman, Aaron Sontag; Bill Dorland, Dick Majeski; Rajesh Maingi, Prashant Valanju/Mike Kotschenreuther]

Start-up/sustainment:

- What is the scientific basis for current start-up - from no plasma current to full operating current - using either no central induction, or only small central induction (in order to retain low A)?
- Could one design a current start-up system with high confidence that it would work, if one had to do it today?
- If not, would future start-up R&D be easier or harder for the ST than for the tokamak, and why?
- What is the scientific basis for current sustainment in achieving the ST goal?
- Are there unique physics issues to the ST relative to the tokamaks in this regard?

Transport:

- What is the scientific plan to address electron transport in the ST, in view of the present observation of much higher electron thermal diffusivity in the ST relative to tokamaks of similar current (but higher toroidal field and lower β)?
- Is there an impurity accumulation issue if the ions have neoclassical confinement in the presence of large driven rotations?
- How about transport in pedestal and SOL plasmas?
- Is the physics extrapolable from conventional tokamaks?

Boundary physics:

- In what ways are plasma-wall issues similar to or different from a conventional aspect ratio tokamak?
Particular questions:
- Are radiative/detached divertor solutions compatible with low plasma density operation that may be required to achieve high auxiliary current drive needed for the ST goal?
- Are high flux expansion solutions proposed for the ST for heat flux mitigation compatible with efficient divertor pumping needed for particle control?
- What are the advantages and disadvantages of cryo-pumps for achieving density control for the ST goal?
- What are the potential advantages and disadvantages of liquid Lithium divertor and wall concepts relative to the much more advanced state of knowledge of solid-material divertor concepts and cryo-pumping?
- Is core fueling beyond NBI (using for example pellets for CTs) really needed, or is edge gas fueling sufficient? (If gas fueling works for JET, why couldn't it be made to work for the ST goal, which may have smaller minor radii, based on the relative sizes of the neutral mean free path?)