P5 Boundary Physics Working Plan for Snowmass 2002

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Assessment:

We need to assess the three machines, FIRE, Ignitor and ITER, in the area of boundary physics. To "assess" means,

1. What new physics is there to learn (the device's capability to contribute)? What new boundary science can we learn from each of the devices, with the given set of diagnostics?
2. The readiness to proceed (will a particular physics phenomenon impede the goals of the device). Is the physics basis from the boundary physics point of view well enough understood for each device that it is reasonable that the "target" plasma can be achieved?
3. The relation or contributions of these three tokamaks to other fusion concepts. How will the boundary science on this machine contribute to other magnetic fusion concepts, such as ST's and stellarators; i.e., is there significant overlap on the issues?
4. The impact of these three tokamaks on the overall fusion development path in this particular physics area.

Main Issues:

The main boundary physics issues can be grouped:

1. Power and particle exhaust sufficient for achievement of "target" discharge
2. Reasonable handling of transient events and localized heating
3. Impurity production and transport
4. Pedestal and SOL transport and scaling.

Sub-Issues:

1. **Power and particle exhaust sufficient for achievement of "target" discharge**
   - Survivability, can the machine be protected
   - High divertor pressures, while maintaining low main chamber pressures
   - Helium exhaust
   - Fuel pumping for density control
   - Induced flow to the divertor for impurity screening
   - Edge compatibility with current drive

2. **Reasonable handling of transient events and localized heating**

- ELMs for particle and power flux
- Disruptions (short section)
- Fast particles (current drive, fast ion orbit losses)

3. **Impurity Production and Transport**
   - Tritium retention – which material (carbon or metal)?
   - Helium transport in the core
   - Impurity production and screening in the divertor
   - Impurity production and screening in the main chamber

4. **Pedestal and SOL transport and scaling**
   - Uncertainties for extrapolation to next device.

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<u>Cross-Cutting Issues:</u>

Issues that we must discuss with the other subject areas,

- tritium retention (T2, T4)
- tritium recovery (T5)
- erosion/redeposition (T2)
- pedestals (P4)
- boundary diagnostics (E1)
- edge compatibility with current drive and heating techniques (P1, T3)
- fast particle loss to the first wall (P2)
- integrated issues/burn control (E2)