Validation for startup/shutdown simulation

Near-term ITER startup/shutdown scenario development will be used to determine if planned hardware provides sufficient flexibility in the face of prediction uncertainties. In particular, is the heating range sufficient to compensate for uncertainties in confinement?

These phases are outside the domain of previous transport model testing, so new tests - and new data - are needed.

ITER-similarity discharges are best for testing models used for ITER scenario work; also need 'similarity' for the I_p ramps: want the same τ_{ramp}/τ_{relax}
Availability of data from ITER-similarity plasmas is the bottleneck.

Full documentation is important for testing; I_p ramp-up/down phases, too.
The value is highest if critical parameters are measured ($q, T_i, T_e, n_e, Z_{eff}, \ldots$) so they are not free parameters in comparisons with theory.

fluctuation measurements are desirable, to compare with turbulence codes, and help to identify the microturbulence responsible for the transport.

Experimental data can also be used directly for heuristic simulations.

Heuristic approach to ITER survey

ITER surveys may be produced most quickly with simulations of current penetration based on specified $T_e(r)$ shapes taken from ITER-similarity experiments (both L-mode and H-mode shapes).

Find the range of acceptable magnitudes of $T_e(r)$; their achievability can be characterized by H-factors implied by the available heating power.

This also determines the range of desired heating in these phases.

Also learn whether the (less controllable) shape leads to undesirable l_i.

The shape is particularly important with strong H-mode pedestals.

Must H-mode be avoided in ramp up? Need H-mode in ramp down?

We can then assess the relationship between acceptable $T_e(r)$ and the heat fluxes predicted by validated transport models.

Will the models predict $T_e(r)$ shapes that differ from current tokamaks?

What parameter changes lead to the new shapes?

Can these changes be achieved/confirmed in new experiments?

EU-ISM validation activities

Imbeaux summary:
Data from JET, TS , AUG used for validation; few ramps-down.
Expect to have conclusions by the next T&C meeting in March.
Simulations of ITER will increase after validation work.
CRONOS using: fixed T shapes, Bohm-gyroBohm, Coppi-Tang
attempted to use GLF23 in some cases (unsuccessful?)
Wants to cooperate with ITPA plans.

Voitsekhovitch summary:
Using 11 ITER ramp-ups; ohmic, NBI, ICRH (on- & off-axis)
ASTRA using:
Bohm-gyroBohm good for NBI, central ICRH; x3.3 OH, off-axis
GLF23 works well for low power NBI (not usable for others?)
Coppi-Tang always needs significant increase; wrong T_e shape.
need some model for r/a>0.85; may test TGLF in future.
Will study JET ramp-up in helium.
Wants to cooperate with ITPA plans.

US validation activities

Jackson/Budny:
ITER-similar ramp phases to be submitted to PDB very soon.
four more shots with l_i scans are being prepared.

Kessel:
Further C-Mod experiments in hand, more planned.
need more TRANSP analyses; available in a few months.
can do heuristic simulations with TSC.
typically uses Coppi-Tang, but T_e shape is often wrong.

Mikkelsen:
'Standard' testing code available for (quasi) steady-state phases.
Coppi-Tang included; not Bohm-gyroBohm

Where do we go from here?

Collection of experimental data from ITER-similarity plasmas is a high priority.
No ITER-similar I_p ramp phases have been submitted to the Profile Database.
Full documentation is important for testing; I_p ramp-up/down, too.

DIII-D, JET, C-Mod, TS, AUG have discharges; TRANSP analysis not mature.
data from most tokamaks might be available by January.

Cross-calibration of simulation codes has begun, but more needs to be done.
try a different transport model for benchmarks? (not Coppi-Tang)
TGLF should (and could) be included in validation work.

The ITER-similarity experiments provide a fine starting point for analysis of the types of microinstabilities we might expect to find in ITER.
Are all tokamak's baseline ITER-similarity discharges in the same regimes?

Understanding L-H & H-L transitions is critical for ITER predictions.
Predicting the height of the temperature pedestal is also important,
but this is in the purview of the Pedestal and Edge ITPA group.