

Moving Towards Reactor Relevant Conditions

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Shift Towards Understanding/Demonstrating Advanced Performance in Reactor Relevant Conditions

- **Initial goal of AT research on DIII-D was an existence proof**
 - We wanted to show that at least one type of AT regime existed
 - This goal has been largely met for both the high-bootstrap and hybrid AT regimes
 - High beta
 - High confinement
 - Stationary conditions (approaching steady-state conditions for the high-bootstrap regime)
- **It is time to use our new tools and abilities to move AT research to the next level — reactor relevant conditions**
 - We should not get stuck on the existence proof stage (it's not fly paper)
 - Also there is the question of the relevancy of the physics learned

What Do We Want? What Do We Need?

- **What are reactor relevant conditions?**

- Low rotation
- Equal electron and ion temperatures
- Low collisionality
- Divertor heat flux solution (ELM suppression, radiative divertor)
- ★ May have long ranging effects on AT scenario development

Rotation & T_i/T_e → Transport → Pressure Profile → Stability Limits

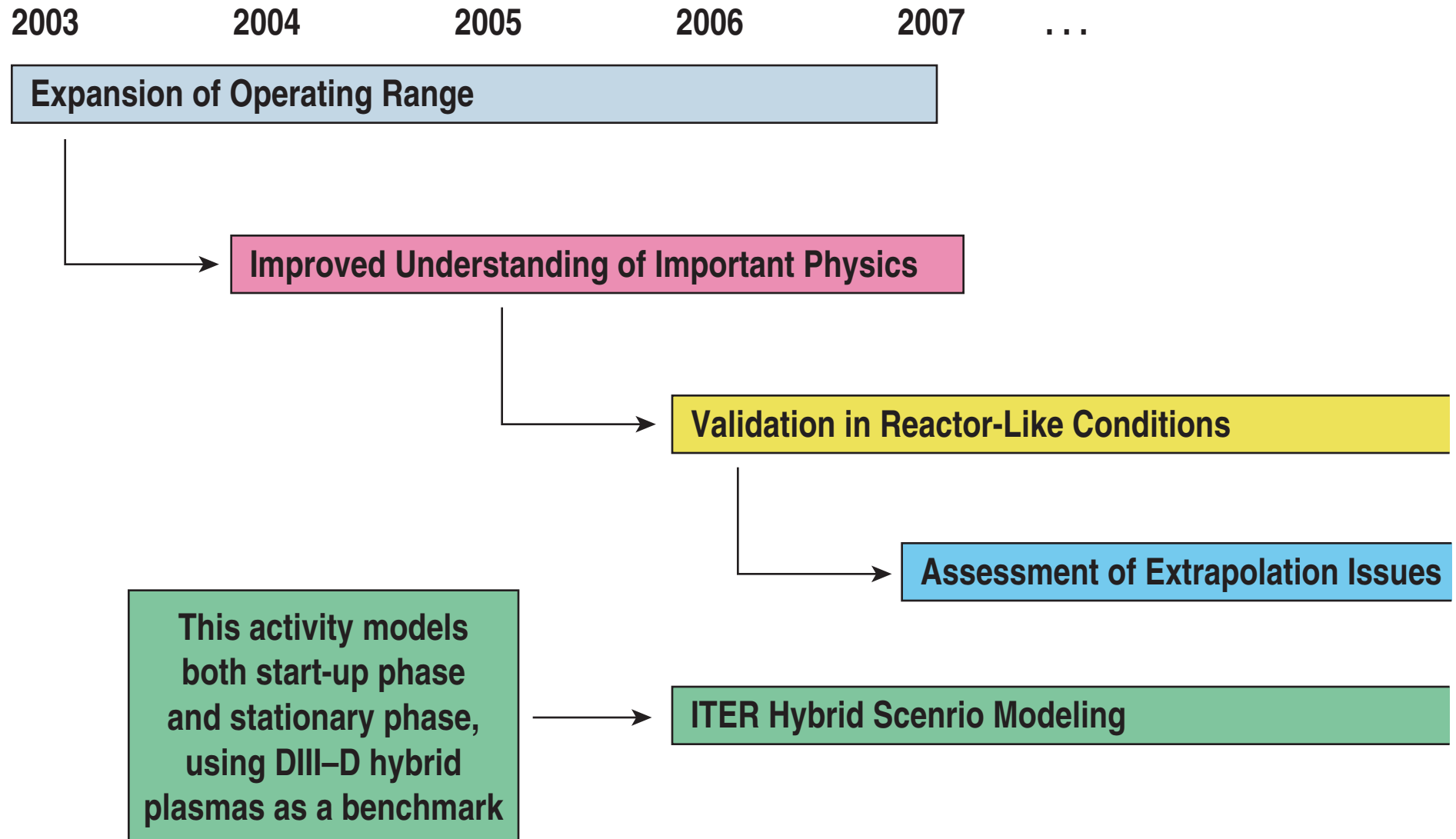
- **What tools will we have on DIII-D?**

- Co and counter NBI
- ECH/ECCD
- ICH/FWCD
- I-coils/C-coils
- Impurity injection

The Proposal

- **AT scenario development on DIII-D should move towards studying reactor relevant conditions**
 - First, study separately
 - Low rotation and $T_e \approx T_i$ at low ν^*
 - ELM suppression
 - Radiative divertor
 - Second, put as many of these elements together as possible
- **Next step is to extrapolate present-day scenarios to burning plasma conditions**
 - If we did a good job on the reactor relevant conditions, then this is primarily an extrapolation in ρ^*

Hybrid Scenario Development Time Line



The Benefit

- **Reactor relevant conditions actually make some things easier**
 - Higher electron temperature increases bootstrap current fraction
 - Off-axis current drive effectiveness increases with higher electron temperature and lower collisionality
 - High power fast wave coupling may benefit from (even require) ELM suppression
- **Extrapolation of AT scenarios and physics understanding to burning plasmas will be more straightforward and convincing**

Plausibility

- **Tools are (mostly) well in hand**
 - Low rotation demonstrated with mix of co & counter NBI
 - Existence proof of ELM suppression
 - Started work on radiative divertor
 - ECH power is being increased
 - ICH power is questionable at this time
 - Coupled ≈ 3 MW into ELMing H-mode in the 1990's, but with a bigger engineering staff
 - ELM suppression may make it easier to couple high power to AT scenario
- **Need to apply transport modeling to the question of how much electron heating and current drive will be required**
 - TGLF needed to get electron thermal transport right