Boundary Physics Opportunities for 2009-2013

R. Maingi

Oak Ridge National Laboratory

NSTX 5 year plan boundary physics brainstorming meeting

Princeton, NJ

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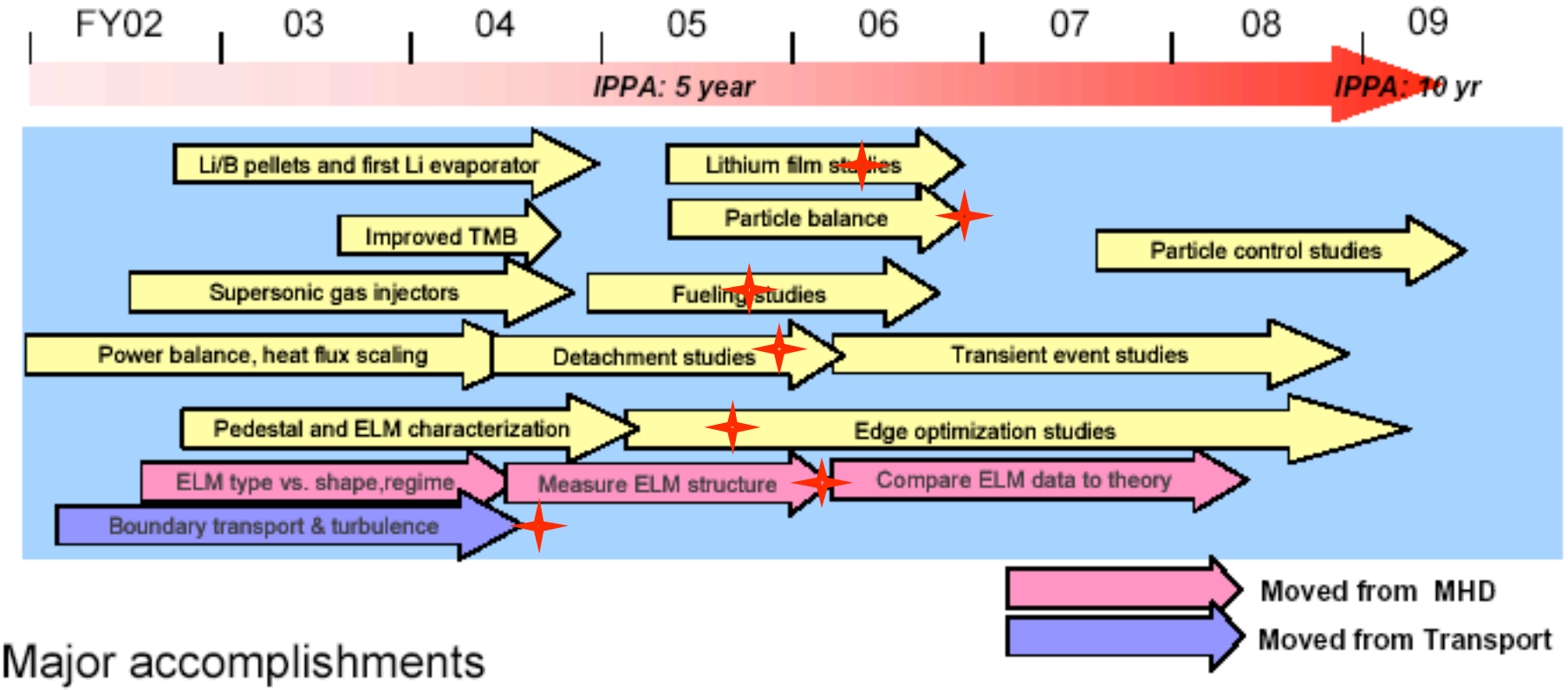
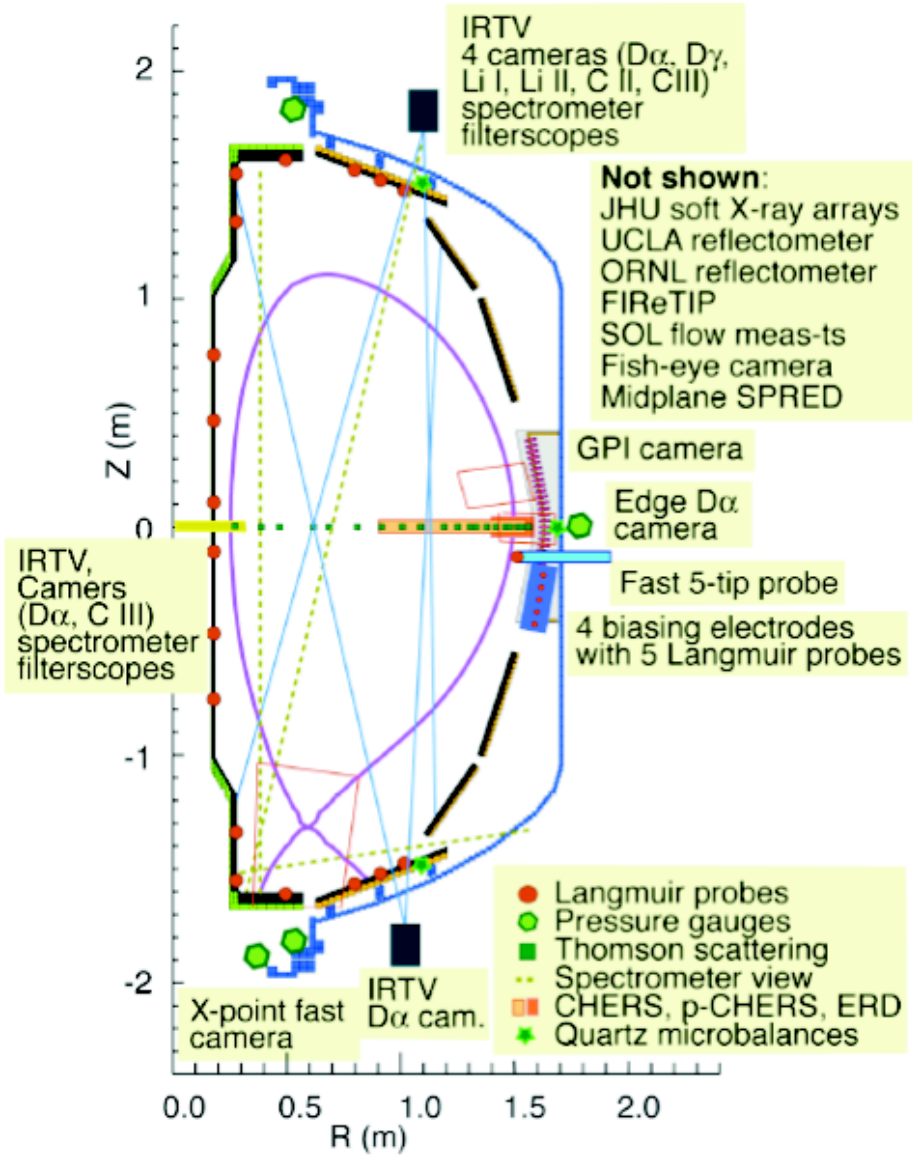
OAK RIDGE NATIONAL LABORATORY

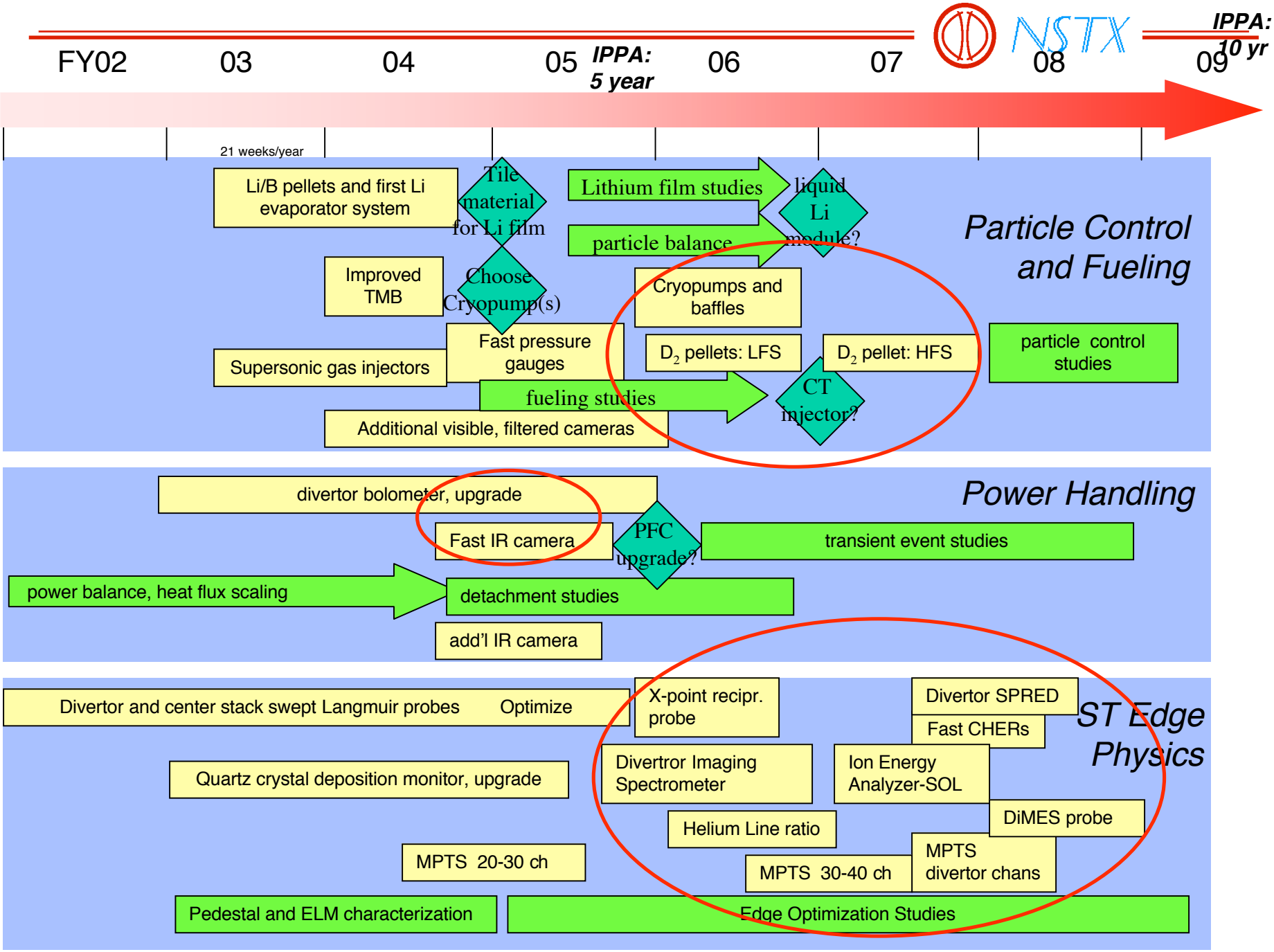
Boundary Physics Research



- Major accomplishments
  - Demonstrated particle pumping potential of Lithium conditioning
  - Demonstrated improved fueling efficiency of super-sonic gas injection
  - Characterized and controllably reduced divertor heat flux
  - Characterized ELM types, discovered small "type-V" ELM regime
  - Pursuing pedestal similarity experiments
  - Detailed comparisons of edge turbulence measurements to theory
  - Novel mass deposition measurements with quartz microbalance

Boundary physics diagnostics in 2007





NSTX 2004-2008 plan document - red ovals represent diagnostics not implemented

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Opportunities in boundary physics for 2009-13

- Liquid lithium test in diverted machine with hot SOL
- What sets the H-mode pedestal widths?
- What determines the ELM regime?
- What sets the SOL width?
- How does an ST divertor extrapolate?
- Test X-divertor? Optimize shape (secondary PP, closed…)
- Does the fueling method affect performance in an ST?

Opportunities in boundary physics for 2009-13

- Liquid lithium test in diverted machine with hot SOL
  - Better core confinement?
  - Controlled Z_{eff}?
  - Improved edge stability?
  - Reduced recycling and core fueling?
- What sets the H-mode pedestal widths?
  - Transport, stability or fueling?
  - How can the pedestal be optimized?
  - Does the pedestal limit core performance?
- What determines the ELM regime?
  - Transport, stability or fueling?
  - Are there steady small ELM regimes? How to extrapolate?

Hardware 09?

Diagnostics?

More Thomson

More ERD

Improved EFC to avoid Locked Modes

Run Time

Opportunities in boundary physics for 2009-13

- What sets the SOL width? — **Div. LP**
  - Existing models predict 1-2mm; λ_q^{mid} ~ 6-10mm — **Fast IR**
  - Role of turbulence? Gyro-motion? Transient events? — **Run Time**
  - How about λ_n^{mid} and λ_T^{mid} — **Manpower**
  - Scaling with I_p, B_t, P_{NBI}
- How does an ST divertor extrapolate? — **Run Time**
  - P/R correct parameter? $q_{||}$? $q_{\perp}$? — **2D DivTS?**
  - Role of magnetic balance, divertor volume? — **Hardware**
  - Radiative or detached divertor compatible with good τ_E? — **Hardware**
- Test X-divertor? Optimize shape (secondary PP, closed…)
- Does the fueling method affect performance in an ST?
  - Gas puffing vs. Pellets vs. CTs?
  - Should we consider a divertor cryopump? — **Hardware**