Status of the Fusion Simulation Project

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PPPL

Presented at the 2nd US/Japan Workshop on Integrated Modeling

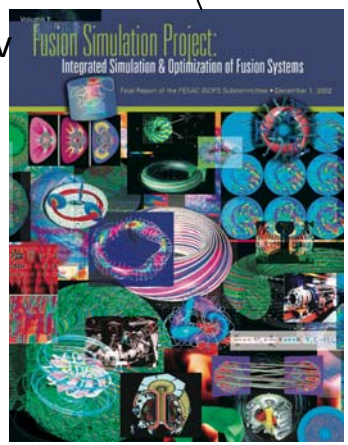
Sept 21, 2004
Princeton Plasma Physics Laboratory

Fusion Simulation Project (FSP) Timeline (Calendar Year)

02 03 04 Today 05 06

ISOFS FESAC subcommittee (Decker, Hazeltine)

Donald Batchelor
Randall Bramley
James Corones
Jill Dahlburg
Martin Greenwald
Stephen Jardin
Sergei Krasheninnikov
Alan Laub
Jean-Noel Leboeuf
John Lindl
William Lokke
Marshall Rosenbluth
David Ross
Dalton Schnack



Final Report: December 02

FSP Steering Committee (Willis)

Don Batchelor
Randy Bramley
John Cary
Ronald Cohen
Phil Colella
Stephen Jardin
Doug Post

Steve Eckstrand
Arnold Kritz

Final Report: September 04

Call for proposals for initial design of FSP ~ $ 2 M

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Start of project

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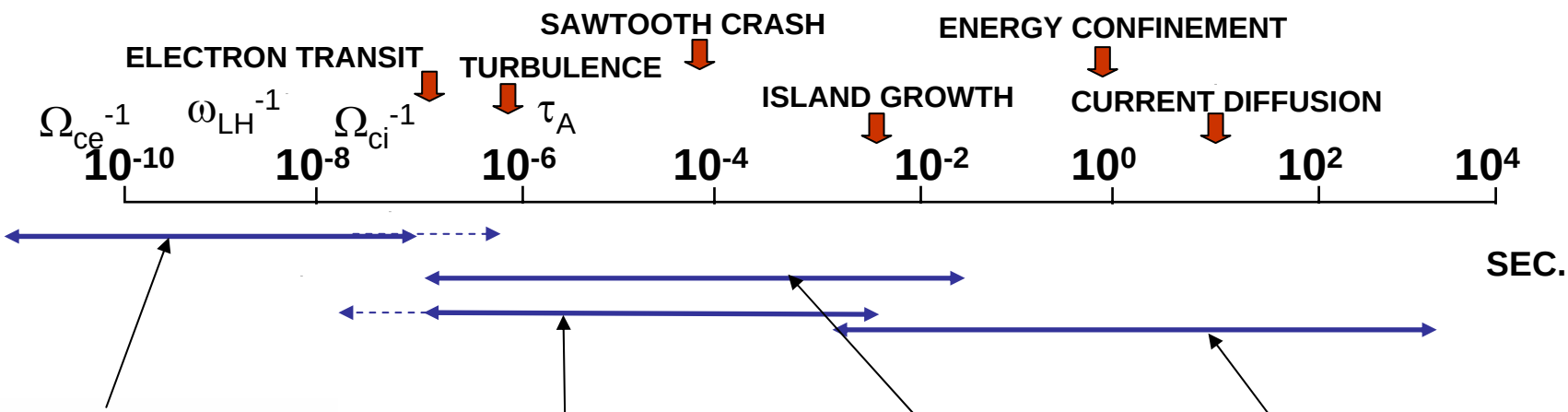
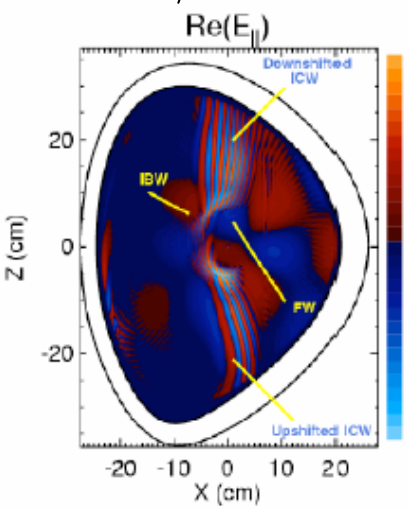
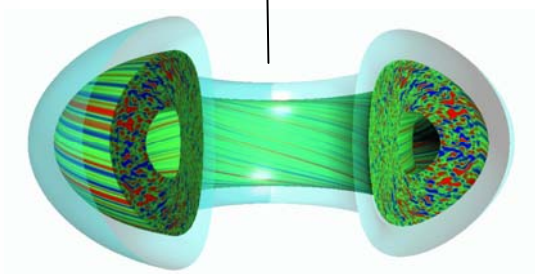
Challenge: Develop a practical code suite that can link across timescales for a burning plasma experiment.

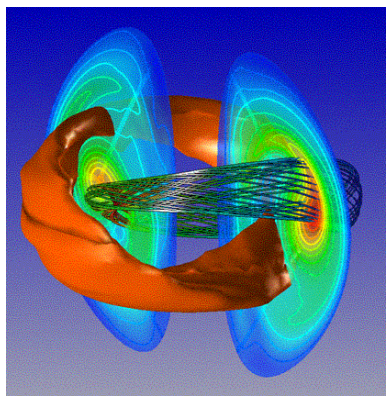




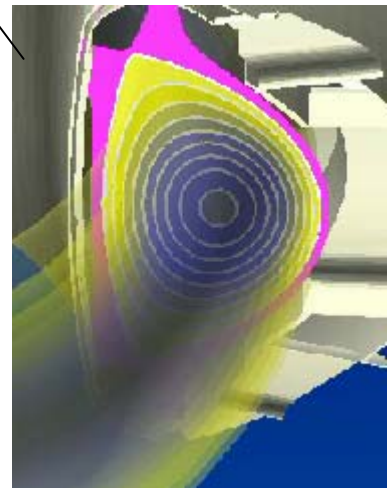
(a) RF codes



(b) Micro-turbulence codes



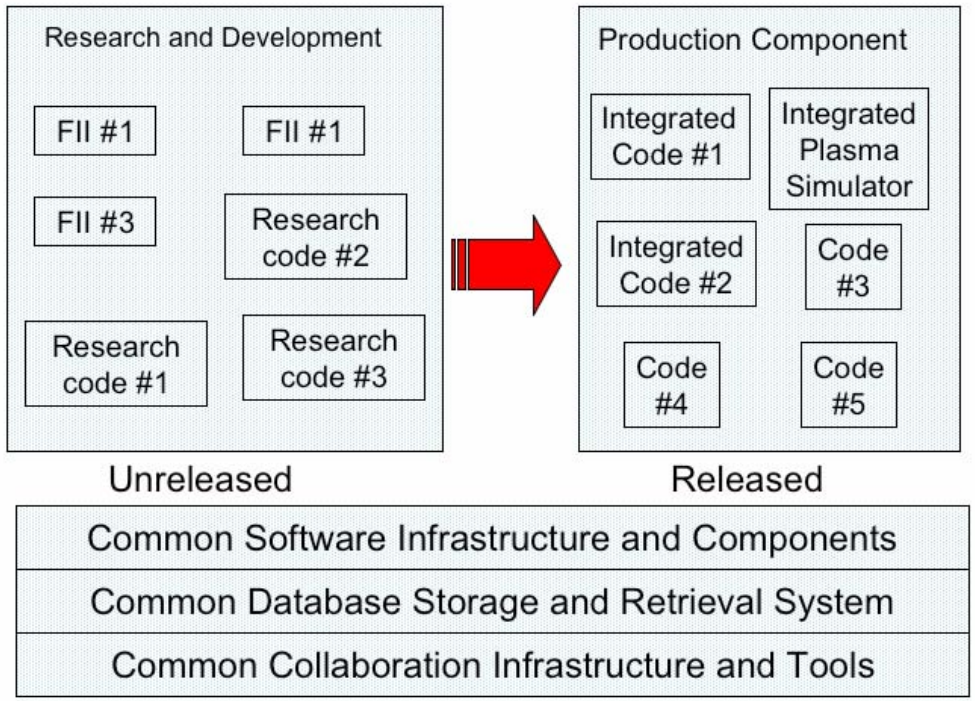
(c) Extended-MHD codes



(d) Integrated Plasma Simulations

We envisage 3 major elements of the project.

1. A production component
2. A Research and Integration Component
3. A Software Infrastructure Component



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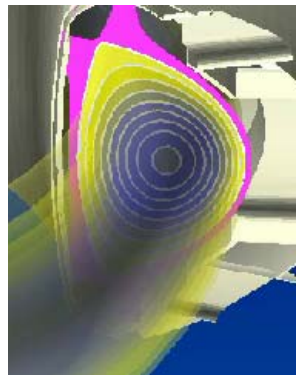
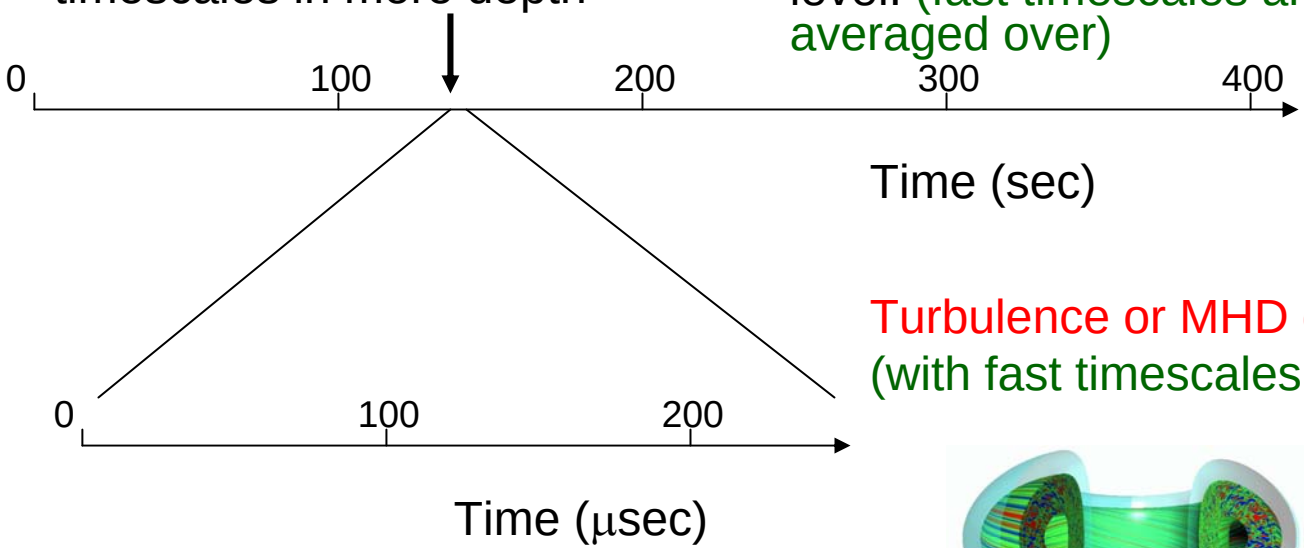
The production component will contain a suite of released interoperable codes, including the Integrated Plasma Simulator.

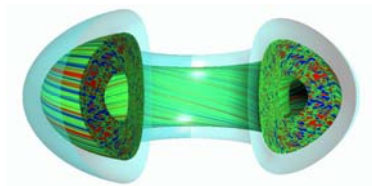
Will have capability to telescope in on time of interest to examine short timescales in more depth

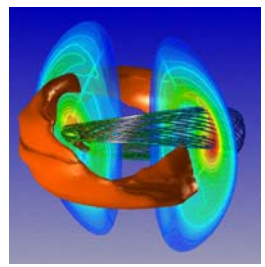
Integrated Plasma Simulator (IPS) will contain description of all phenomena at some level. (fast timescales are averaged over)





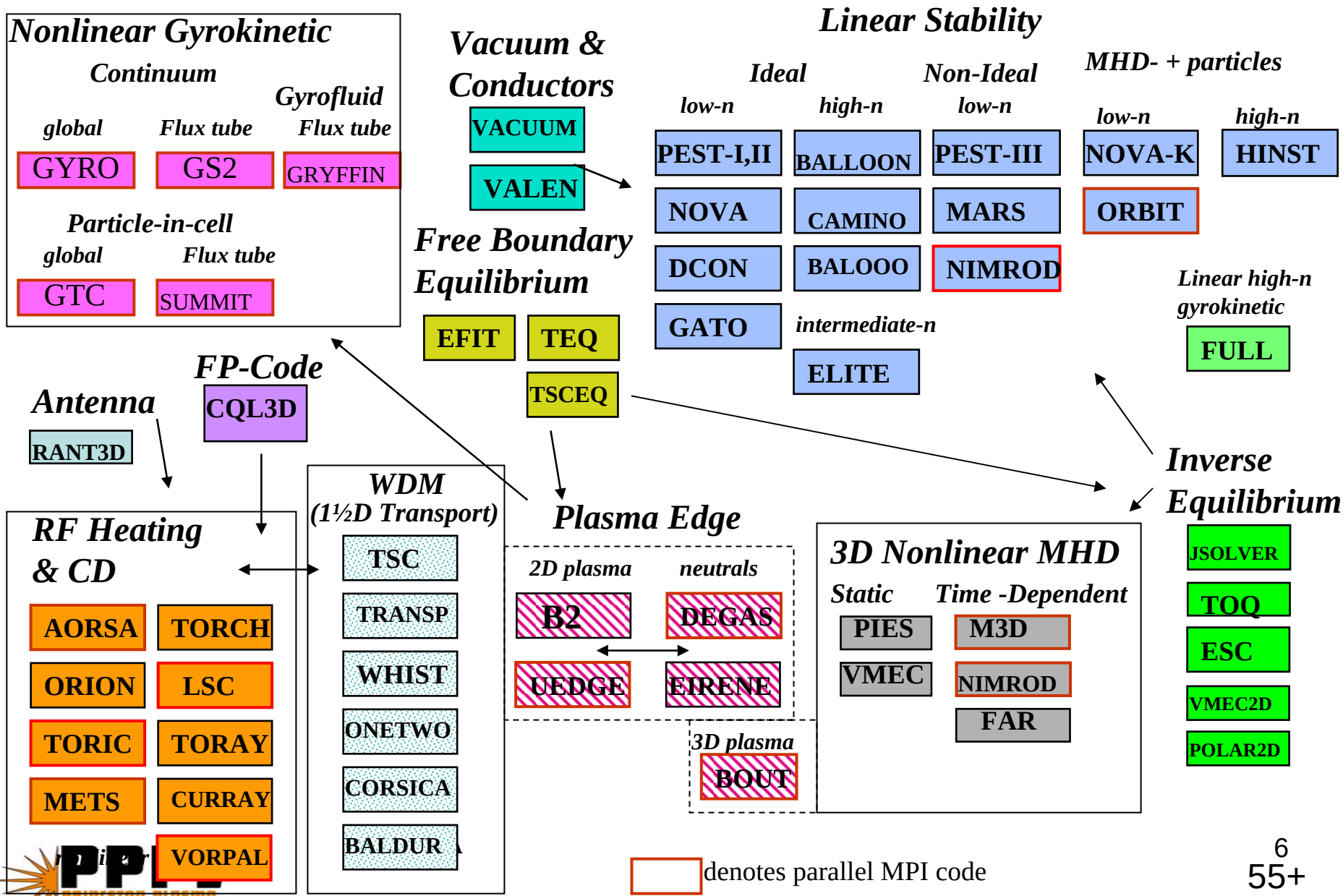
Turbulence or MHD codes
(with fast timescales being calculated)





In the foreseeable future, integration will mean looking at different timescale phenomena with different codes that talk to one another.

These are the codes we have to start with on the production side



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Example of IPS
Present capability:

simulation of an entire burning plasma tokamak discharge (FIRE)

Includes:

RF, ohmic, fusion product heating

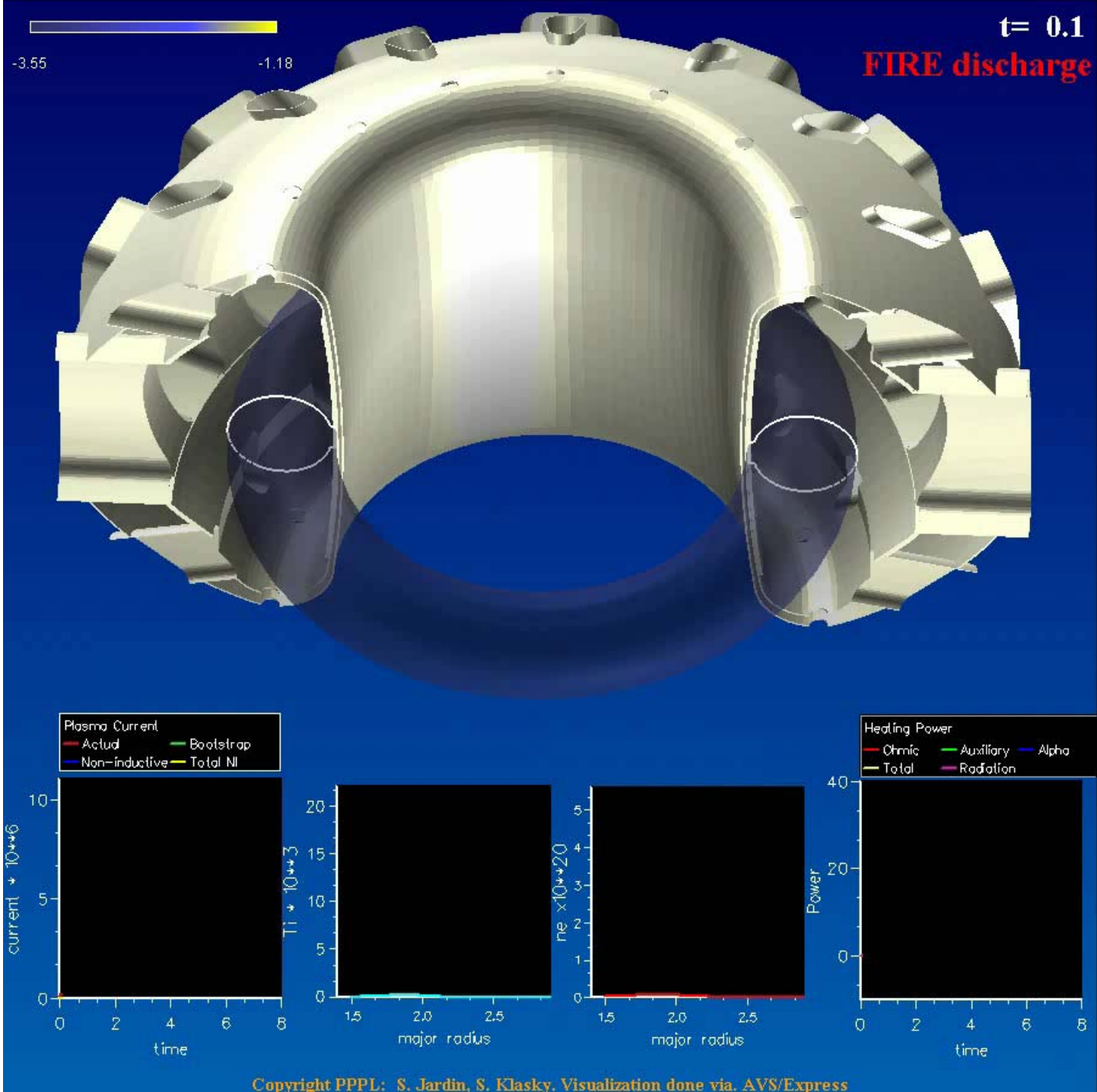
Microstability-based transport model

L/H mode transition

Sawtooth Model

Evolving Equilibrium with actual coils

Time points can be examined with other codes



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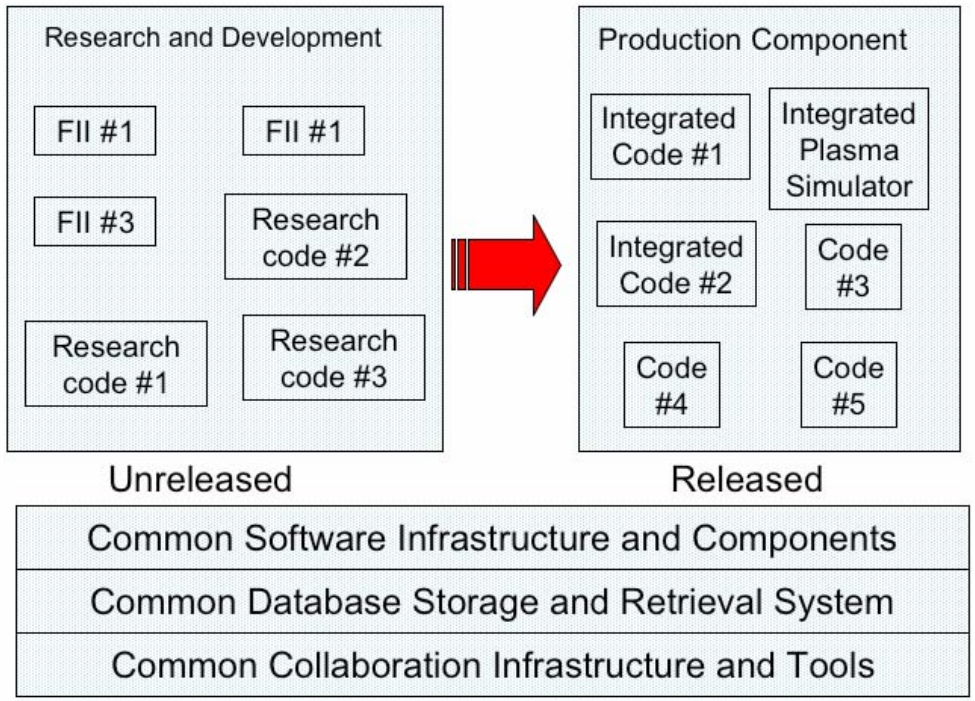
The Research and Integration Component

- Research needed to improve 3D first principles simulations of highly complex phenomena
  - Microstability, Macrostability, RF
- Focused Integration Initiatives (FIIs):
  - development of new simulation capabilities that allow the coupling of an ever-wider range of physical phenomena together in the same simulation,
    - Eg: effect of RF on MHD
  - preparing these capabilities for submission to the production component.

Software Infrastructure Component

The software infrastructure component will allow the codes to communicate in a seamless and efficient manner together with visualization capability and access to experimental data as appropriate.



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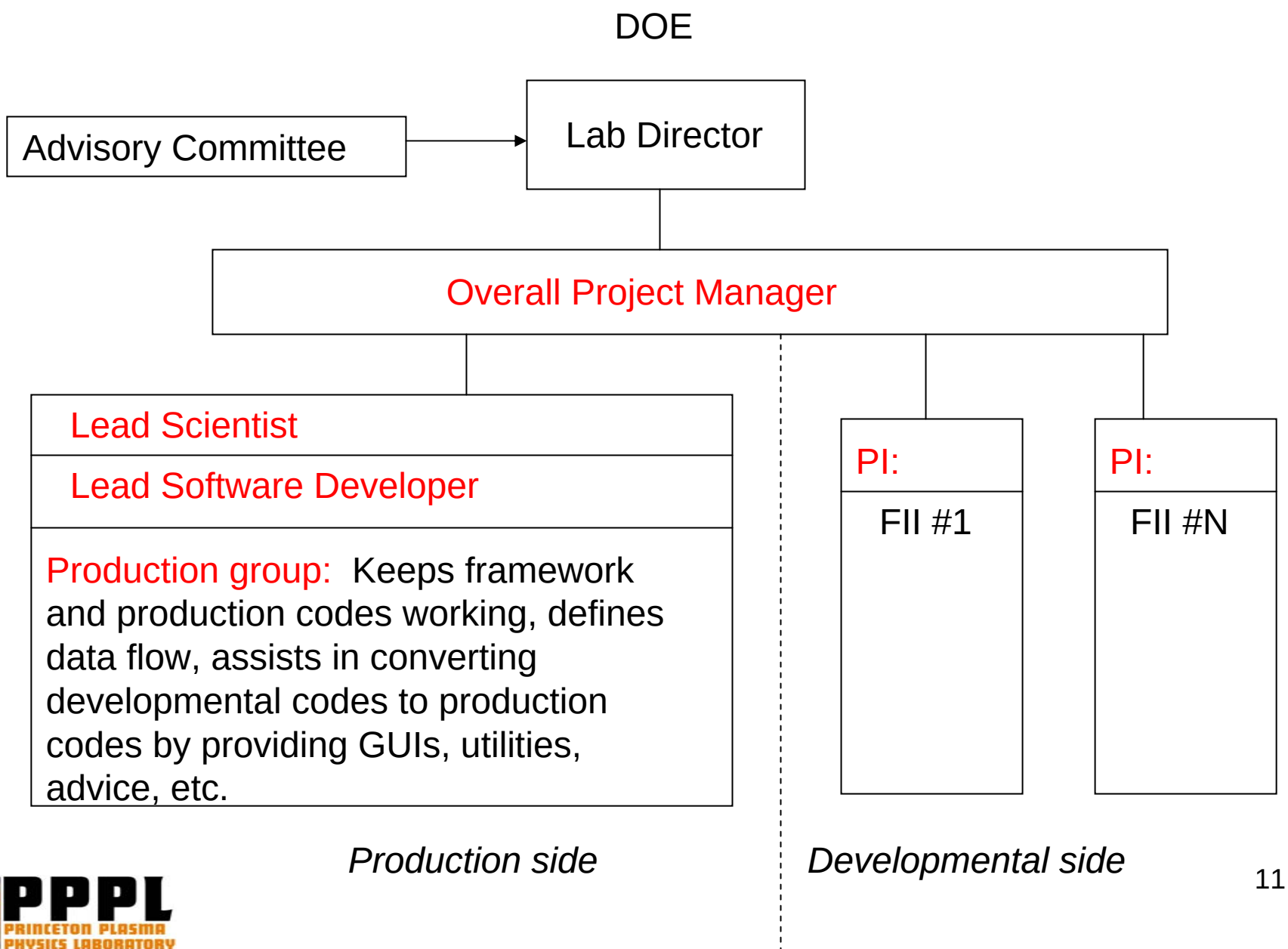
ITER is to be the primary customer.

- ITER is the first priority facility for DOE-SC
- Customer focus is essential for success.
- ITER provides a definite goal and sets a schedule..
  - Facility design
  - Plasma scenario development
  - Control system design and tuning
  - Experimental shot design
  - Data analysis

Possible management organization---with lead lab