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ReNeW Theme 5 ST Panel – Research Thrust Development - UPDATE

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ReNeW Theme 5: Optimizing the Magnetic Configuration Workshop

Thursday, March 19th, 2009 – AM Thrust Update Session

Princeton Plasma Physics Laboratory

ST Panel breakout session (Wed 1-5:30 PM) - Agenda

- Brief summaries of present 12 research needs areas (from community-circulated draft document ST section)
 - This completed the “input” portion of the workshop
 - Discussion of research needs
- Development of research thrusts
 - Guidance (from Panel Lead Wed. working lunch)
 - Three “Theme level thrusts” planned by ExCom
 - ST “Panel level main thrusts” are consistent with these
 - ST “Panel level sub-thrusts” provide detail to main thrusts
 - Review of initial research thrust formation by ST Panel (v1.6)
 - Continued development from email-iterated (version 1.7)
 - Completed new version (1.8)
- Open discussion

ST Panel Thrust Deliverables

- ONE slide summary, main thrusts alone
- ONE slide summary, main thrusts and sub-thrusts
- Panel members responsible to cover research needs associated with thrusts to fill out the balance of more detailed template
 - Follows format from a Theme 3 panel
 - Target completion by end of workshop

ST Research Thrusts Comprise Needs for CTF, DEMO

Integrated, innovative scientific and technical knowledge for a reduced complexity and cost, high beta / high confinement plasma

5 Main Thrusts

- Plasma Start-up and Ramp-up Innovations with Low Transformer Flux
- Plasma-Material Interface at High Heat Flux and low collisionality/density
- Electron / Ion Confinement in High Beta, Broad Current Plasma
- Understanding Integrated Continuous, High Beta, Low ν ST Plasma
- Normally-conducting radiation-tolerant magnets ← (long-term enabling capability)

Effort Level Guidance: Short (black) Moderate (purple) Long: (red) – TBD!

ST Research Thrusts Comprise Needs for CTF, DEMO

Integrated, innovative scientific and technical knowledge for a reduced complexity and cost, high beta / high confinement plasma

- **Plasma Start-up and Ramp-up Innovations with Low Transformer Flux**
 - Plasma start-up without center solenoid (CHI, plasma guns, EBW, PF induction)
 - Plasma ramp-up via neutral beam injection and RF
- **Plasma-Material Interface at High Heat Flux and low collisionality/density**
 - Cross-cutting heat flux control with advanced geometry divertors at low-A
 - Cross-cutting study of liquid metal divertor: low recycling, liquid metal wall
 - Particle control research for continuous, high beta, low ν plasma
 - Understanding SOL / divertor electron / ion heat transport at low-A
- **Electron / Ion Confinement in High Beta, Broad Current Plasma**
 - Cross-cutting research on electrostatic / electromagnetic-driven turbulence
 - Cross-cutting study and control of fast particle driven electron transport
 - Transport study in low recycling liquid metal wall/high field ST at optimized-A
- **Understanding Integrated Continuous, High Beta, Low ν ST Plasma**
 - Reliable stability sustainment in high beta, very low- I_i , optimized-A
 - Disruption / transient avoidance via CTF-relevant profile and mode control
 - Self-consistent high confinement with high power plasma-material interface
 - Continuous heating / fueling / current drive for high beta CTF, DEMO plasma
- **Normally-conducting radiation-tolerant magnets**
 - Center-post magnet / internal control coil engineering science at high neutron flux
 - Center solenoid options for low-A plasma start-up

Effort Level Guidance: Short (black) Moderate (purple) Long: (red) – TBD!

Guidance to fill in longer description of thrusts

- Research thrust / sub-thrust name
 - simply copy existing name(s)
- Thrust “size” indicated by very rough estimate of duration
 - (as done in Theme 3)
 - short ~ 5 years, medium ~ 10 years, long ~ 20 years
 - Responsible panel members should provide their estimates
- Work Description
 - Fill in a few lines from your “single slides”
 - no need to be exhaustive – just a few words/sentences ok for now
- Benefit to Fusion
 - Follow example guidance (ITER, CTF, DEMO, or as you like)
- Cross links – use table on NEXT slide

ST Panel Research Needs: Summary and Cross-links

ST Panel Research Need ↔ ReNeW Cross-cutting Theme

- ❑ Plasma start up/ramp-up
 - ❑ Plasma-material interface
 - ❑ Electron energy transport
 - ❑ Magnets
 - ❑ Stability / Steady-State Control

 - ❑ Integration
 - ❑ Disruptions

 - ❑ RF Heating and Current Drive

 - ❑ Ion scale transport
 - ❑ Fast Particle Instabilities
 - ❑ NTMs

 - ❑ Continuous NBI systems
- ❑ Theme 2 HPSS: Auxiliary systems
 - ❑ Theme 3 Plasma-material interface
 - ❑ Theme 2 HPSS: Validated Modeling
 - ❑ Theme 2,3 HPSS: Magnets
 - ❑ Theme 1,2,3 BP/HPSS/PMI: Off-normal events; Control; Int. Comp.
 - ❑ Theme 2: HPSS Integration
 - ❑ Theme 1,2 - BP/HPSS: Off-normal events
 - ❑ Theme 2,3 HPSS/PMI: Auxiliary systems; Internal Components
 - ❑ Theme 1 BP: Confinement
 - ❑ Theme 2 BP: Off-normal events
 - ❑ Theme 1,2 BP/HPSS: Off-normal events; Control
 - ❑ Theme 2 HPSS: Auxiliary systems

- Also, connection between ST-CTF and Theme 4 materials issues

EXAMPLE for longer description of Research Thrusts

Research Thrust (main/sub-thrusts)	Time frame	Work description	Benefit to fusion	Cross-links
<p>1. Test stands and laboratories, including Helium H/T and modeling</p> <p>Goal: Provide needed knowledge for PFC components development with relevant materials for ITER and DEMO</p>	short	<p>Upgrade and construct new testing facilities including fission and proposed neutron source facilities</p> <p>Upgrade and construct new He loops</p> <p>Develop He-cooled component</p> <p>Enhance modeling and testing efforts</p> <p>Enhance tokamak test station and lab (e.g. DiMES, PISCES) testing and measurements capabilities</p> <p>Evaluate different diverter configurations and components</p> <p>Configuration and maintenance assessment</p>	<p>ITER</p> <p>CTF</p> <p>DEMO</p>	<p>with HFP theme</p> <p>Material panel</p> <p>Safety panel</p> <p>Tritium panel</p> <p>RAMI</p>
<p>2. RESEARCH THRUST TITLE</p> <p>Goal: SHORT GOAL HERE</p>	<p>Short</p> <p>Medium</p> <p>Long</p>	Describe research here	<p>ITER</p> <p>CTF</p> <p>DEMO</p> <p>etc.</p>	Theme II: Off-normal events
<p>2a) SUB-THRUST TITLE</p> <p>Goal: GOAL HERE</p>	Short	Describe research here	CTF	Theme III: PMI

- From Theme 3, with new suggested template on 2nd row

USE THE NEXT SLIDE AS TEMPLATE

ST Panel Research Thrust Template

Research Thrust (main/sub-thrusts)	Time frame	Work description	Benefit to fusion	Cross-links
2. RESEARCH THRUST TITLE Goal: SHORT GOAL HERE	Short Medium Long	Describe research here	ITER CTF DEMO etc.	Theme II: Off-normal events
----- 2a) SUB-THRUST TITLE Goal: GOAL HERE	Short	Describe research here	CTF	Theme III: PMI