Update on APS-DPP Community Planning Process

Scott Baalrud	*University of Iowa*
Nate Ferraro	*Princeton Plasma Physics Laboratory*
Lauren Garrison	*Oak Ridge National Laboratory*
Nathan Howard	*Massachusetts Institute of Technology*
Carolyn Kuranz	*University of Michigan*
John Sarff	*University of Wisconsin*
Earl Scime (emeritus)	*West Virginia University*
Wayne Solomon	*General Atomics*

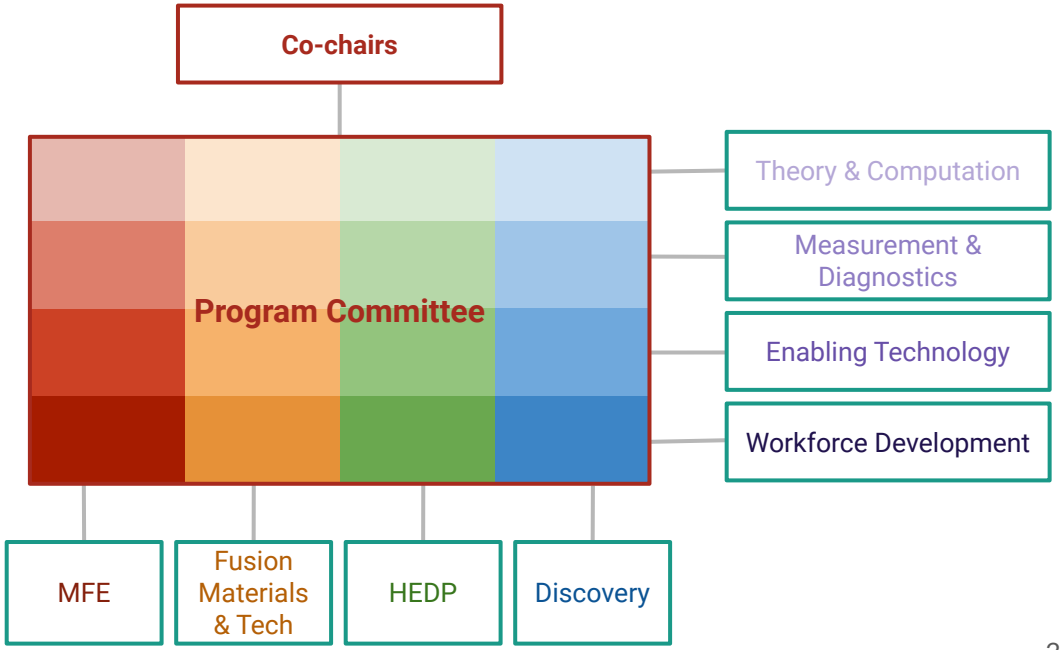
Goals

- To produce strategic recommendations for each of four topical areas and four cross-cutting areas, generated from community input
- Provide both near-term actionable recommendations and a long-term strategic outlook (**strategic plan**), highlighting opportunities for US leadership
- To the extent possible, to prioritize among these recommendations with community consensus
- To deliver these recommendations to FESAC by March, 2020

We fully recognize the opportunity that this activity represents for FES, and we are enthusiastic to make this process successful!

Organizational Structure

The **Program Committee** is organized in subgroups to produce **recommendations** in eight topical and cross-cutting areas



Program Committee

Magnetic Fusion Energy

Ted Biewer, ORNL
Dan Brunner, CFS
Cami Collins, GA
Brian Grierson, PPPL
Walter Guttenfelder, PPPL
Chris Hegna, Wisconsin
Chris Holland, UCSD
Jerry Hughes, MIT
Aaro Jarvinen, LLNL
Richard Magee, TAE
Saskia Mordijck, William & Mary
Gerald Navratil, Columbia
Craig Petty, GA
Matt Reinke, ORNL
Uri Shumlak, Washington

Fusion Materials and Technology

John Caughman, ORNL
David Donovan, UTK
Ken Hammond, Missouri
Paul Humrickhouse, INL
Robert Kolasinski, Sandia
Ane Lasa, ORNL
Richard Nygren, Sandia
Wahyu Setawan, PNNL
Steven Zinkle, UTK
George Tynan, UCSD

Program Committee

High Energy Density Physics

Alex Arefiev, UCSD
Todd Ditmire, UT Austin
Forrest Doss, LANL
Sean Finnegan, LANL
Arianna Gleason, Stanford/SLAC
Stephanie Hansen, SNL
Louisa Pickworth, LLNL
Jorge Rocca, Colorado State
Derek Schaeffer, Princeton
Cliff Thomas, LLE

Discovery Plasma Science

Daniel Den Hartog, Wisconsin
Dan Dubin, UCSD
Hantao Ji, Princeton
Yevgeny Raitses, PPPL
David Schaffner, Bryn Mawr
Steven Shannon, NC State
Dan Sinars, SNL
Stephen Vincena, UCLA

Program Committee is Committed to Success

- The program committee has been putting in a tremendous amount of work to enable a successful outcome in a short amount of time
- Weekly meetings of the program committees in the main topical areas, even twice-weekly meetings among MFE and FM&T
- Frequent Expert Group and Cross-cut Group meetings (~weekly)
- Periodic check-ins with David Newman and Don Rej
- Weekly meeting of all co-chairs
    - Biweekly meetings with Facilitator
    - Almost daily meetings among MFE co-chairs

Community Outreach

- Announcement describing process and seeking program committee nominations sent to APS-DPP, ANS, IEEE, HEDSA, UFA, ECFS, and USBPO mailing lists.
  - Other announcements from topical areas are also often sent to some of these lists, as appropriate
- Google group
  - Acts as mailing list for interested individuals
  - https://groups.google.com/forum/#!forum/dpp-cpp
- Website
  - https://sites.google.com/pppl.gov/dpp-cpp

Avenues for Community Input

Advocacy Groups

- Self-organized groups of community members (not led by Program Committee)
- Provide input to process by submitting informational **white papers** or **initiative proposals**

Expert Groups

- Groups of technical experts, led by Program Committee members
- Open to participation from any and all interested community member
- Provide community review of initiative proposals

HEDP and DPS Expert Groups

Hydrodynamics: HED Hydrodynamics, Magnetized HEDP, Laboratory Astrophysics

High Intensity Laser Plasmas: Nonlinear Optics and Laser Plasma Interactions, Relativistic HED and High Field Science, Intense Beams and Particle Acceleration

HED Atomic Physics, Warm Dense Matter and Materials, Nuclear Physics

Theory and Computational Modeling

IFE Driver and Reactor Technology and High Yield Target Physics

Facilities and Diagnostics: Laser Facilities, Pulsed Power Facilities, X-ray Light Sources, Radiation Sources

Discovery Plasma Science

Create Disruptive Technologies
Understand the Plasma Universe
Advance the Foundational Frontier

MFE and FM&T Expert Groups

Magnetic Fusion Energy

Boundary & Divertor Plasma Physics
Transport & Confinement
Energetic Particles
Transients
Scenarios
Global Context and US Leadership

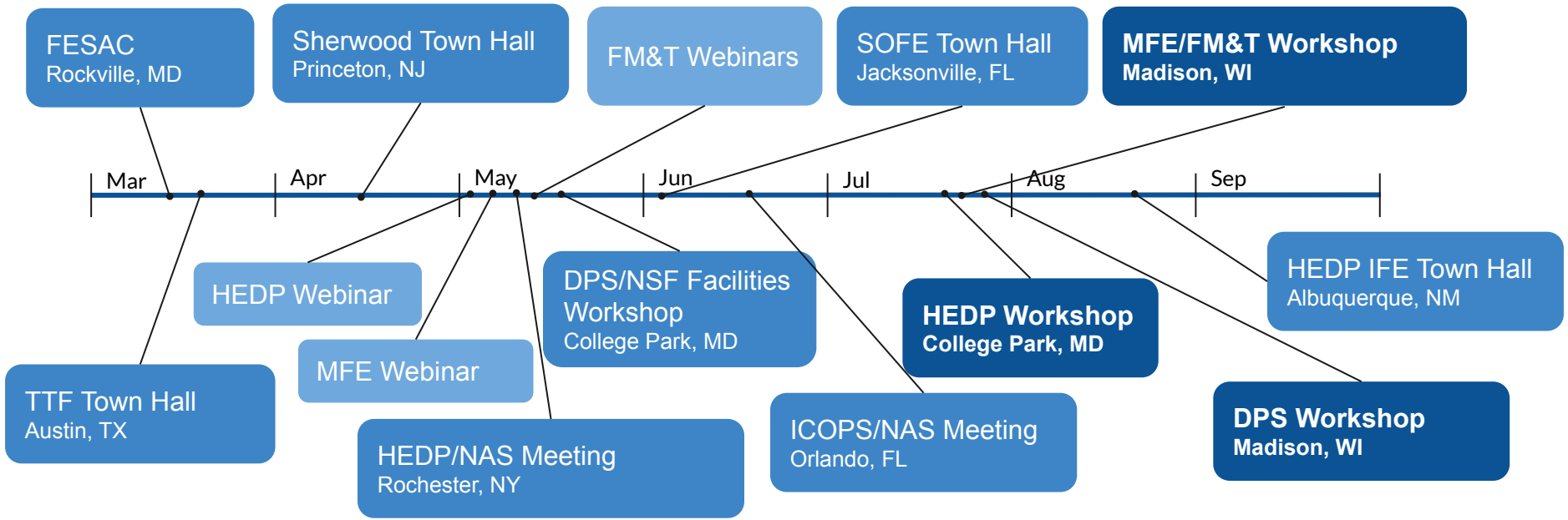
Fusion Materials and Technology

Fusion Materials
Blanket, Tritium, and Systems
Plasma Material Interaction & Plasma Facing Components
Magnets & Technology
Measurements & Diagnostics

Cross-cuts

- Four cross-cutting groups:
  - Enabling technology
  - Theory and Computation
  - Measurements and Diagnostics
  - Workforce Development
- The cross-cuts are the “glue” that unites the topical areas in FES
- Joint meetings of cross-cutting groups will become more important as we approach “Snowmass”

Events Since Last FESAC Meeting



Planning Process Moving into a New Stage

- First stage of community input was to gather community input on research opportunities and critical scientific gaps
  - Generally strong engagement from the community; over 200 initiatives, whitepapers, or revisions have been submitted
  - To the extent practical, we have been building on previous community planning activities and reports
- Next stage will be to assemble plans and get community feedback and buy-in
  - Program Committee will be compiling these plans from community input
  - Consensus is critical. Stakeholders will be given ample opportunity for feedback.

HEDP Update

College Park Workshop - HEDP

- **HEDP 1st workshop was a success!**
- **> 100 participants in College Park, > 30 remote**
- **Initiatives were presented and discussed in expert group meetings**

Summary report on the first workshop:

https://drive.google.com/open?id=1fv5r9c2whTbSVJt6lLlNekYftVvqU6sh

Agenda - Day 1 and Day 2

Plenary Session

Overview

“Lightning Talks”

Breakout Sessions

“Lightning Talks” (~ 1 hour)

Discussion (~2 hours)

Plenary

Discussion Summaries

Breakout Session

Finish “lightning talks”

Finalize key opportunities of initiatives

Plenary Session

Area Summary Talks

Breakout Sessions

Fundamentals I (Hydrodynamics, Magnetized HEDP, Laboratory Astrophysics, Computation I)

Fundamentals II (Nuclear Physics, Warm Dense Matter & Materials, HED Atomic Physics)

Fundamentals III (Nonlinear optics and Laser Plasma Interactions, Relativistic HED and High Field Science, Intense Beams and Particle Acceleration, Computation II)

Facilities and Diagnostics (Laser Facilities, Pulsed Power Facilities, X-ray Light sources, Radiation sources, Enabling Technology, and Diagnostics)

Inertial Fusion Energy (Driver and Reactor Technology and High Yield Target Physics)

Discussion Rules for Breakout Sessions

- **Allow everyone a chance to speak**
- **Listen respectfully, without interrupting**
- **Criticize ideas, not people**
- **Be creative and have fun!**

When you disagree, back up to a broader idea that you can agree on

Summary Presentations and Reports

- **Identify Key Questions in area**
- **Identify Programmatic Benefits**
- **Discuss Execution and Timeline**
- **Discuss cross-cutting opportunities within HEDP and FES**

Summary report has similar format

The first HEDP workshop was a success!

- > 100 participants in College Park, > 30 remote
- We also had an IFE Townhall in Albuquerque in August
- We generated initial “tent-pole” initiatives from workshop discussions and output forming a bold vision for the future of HEDP within Fusion Energy Sciences.
- 2nd workshop will be Nov 12 - 14, 2019 in Palo Alto, CA

Draft “Tent-Pole” Initiatives

These initiatives all include experimental, diagnostic, and modeling aspect:

1. LaserNet US - A high intensity laser network for frontier plasma science in the US

2. Inertial Fusion Energy Science and Technology Program

3. Frontier HED Science on the LCLS MEC Instrument

4. Magnetized HED Science and Pulsed Power Technology

5. Particle and Radiation Sources

HEDP Webinars prior to 2nd workshop

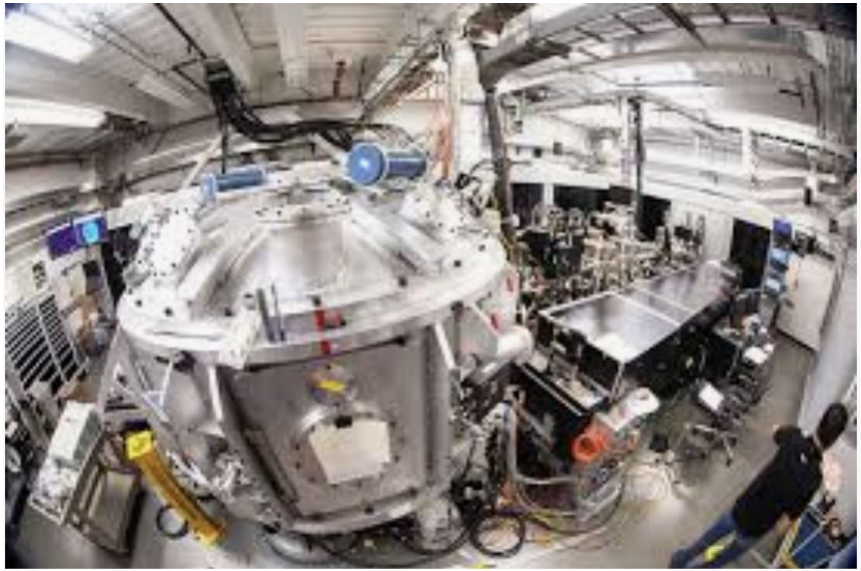
We will hold two webinars to discuss the initial “tent-pole” initiatives on October 29th and November 4th.

Community members will also have the opportunity to present new initiatives or speak to specific “tent-pole” initiatives

2nd HEDP Workshop

The 2nd workshop will be held November 12-14, 2019 in Menlo Park, CA at the SLAC National Accelerator Laboratory

Goal: *Consensus on key scientific opportunities in HEDP*



Draft Agenda

Day 1

Initiative Overview

Initiative breakout session

Initiative plenary session

Day 2

Review of science reports

Facility/diagnostics breakout session

Facility/diagnostics plenary session

Cross-cutting breakout session

Day 3

Cross-cutting plenary session

Moderated discussion of HED strategic vision for FES

IFE town hall

DPS Update

Madison Workshop

- ~35 attendees in the areas of DPS
- ~25 initiative proposals
- Many excellent presentations spanning Discovery Plasma Science
- “Report on Reports” session: review of recent DPS community planning activities
- Initiatives were presented and discussed in expert group meetings

Summary report including an organizational plan and calendar of events:

https://docs.google.com/document/d/1f-JhMXaIYX9YIkre4dz39gL1m7Yxx2aHH80-r24AVg4/edit

Agenda

Day 1

- Report on Reports
  - Frontiers of Plasma Science (Skiff)
  - NSF User Facilities (Scime)
  - Enabling a Future Based on Electricity ... (Kushner)
  - WOPA (Zweibel)
  - NAS 2020 (Kushner)
- Group Discussion
  - Expert Group meetings

Day 2

- Joint MFE/FM&T/DPS Cross cut session
  - 4 speakers
- Broad Overview talks of DPS
  - 5 speakers
- Cross-Cut Breakout Sessions

Day 3

- Initiative Presentations
  - 15 presentations
- Expert group meetings
  - Identification of gaps
  - Evaluations
- Full workshop discussion

DPS: Revised Expert Groups

Previous Expert Groups

High Energy Density Lab Astrophysics
Solar and Magnetospheric Lab Astrophysics
Low Temperature Plasmas
Single Component Plasmas
Dusty Plasmas
Theory
Plasma-Surface Interactions
Laser Plasma Interactions

New Expert Groups

Create Disruptive Technologies
Understand the Plasma Universe
Advance the Foundational Frontier

Create Disruptive Technologies

- Topical Group Leads: Steve Shannon (primary), Yvgeny Raitses (secondary)
- Example topics: Plasma-based medicine, plasma-based chemical processing, plasma-based materials processing, microelectronics, neutron sources, plasma-based environmental technology, plasma-based biotechnology, plasma photonics, plasma-based agricultural technologies, etc.

Low-temperature atmospheric-pressure plasmas	Chunqi Jiang
Plasma Physics Challenges in Low Temperature Plasma Chemical Conversion for Environment, Biotechnology and Energy	Mark Kushner
Light sources from Laser-Plasma Accelerators	Jeroen van Tilborg
Capturing Appropriate “Strength of Coupling” Knowledge Base for Reactive Low Temperature Plasmas	Katharina Stapelmann
National Initiative in Low Temperature Plasma	Philip Efthimion

Understand the Plasma Universe

- Topical Group Leads: Hantao Ji (primary), David Schaffner (secondary), Stephen Vincena (secondary)
- Example topics: Magnetic reconnection, plasma turbulence, solar wind, coronal heating, astrophysical jets, collisionless shocks, etc

A Large Scale Turbulent Plasma Wind Tunnel	Michael Brown
Initiative: Facility for the study of Astrophysical Processes	Walter Gekelman
The Plasma Universe Initiative (PUI)	Hantao Ji
Efficient X-ray detection at high energies (>10 keV)	Sabrina Nagel
GDT Volumetric Fusion Neutron Source	Cary Forest

Advance the Foundational Frontier

- Topical Group Leads: Daniel Dubin (primary), Daniel Sinars (secondary), Daniel Den Hartog (secondary)
- Example topics: Strongly coupled plasmas, ultracold neutral plasmas, sheaths, non-neutral plasmas, dusty plasmas, quantum plasmas

Thoughts on Discovery Science: June 24, 2019	Paul Bellan
Microprobe quad chart	Michael Brown
Capturing Appropriate “Strength of Coupling” Knowledge Base for Reactive Low Temperature Plasmas	Katharina Stapelmann
Ultracold Neutral Plasmas for Controllable and Precision Plasma Physics	Jacob Roberts
Controlling charging in dusty plasmas	Edward Thomas, Jr.
Sheath Physics Initiative	Greg Severn

DPS: Plans leading to Snowmass

- Expert groups will articulate the major science questions to be addressed in each category
  - To be decided during expert group meetings
  - Follow from initiatives that support advocate for these priorities
- Program committee will develop a draft before snowmass
  - Priority science questions
  - Priority initiatives
  - Other recommendations

Rationale for organization/lessons from workshop

- Excellent science is happening across the diverse range of topics of DPS
- Our main challenge has been to get people to participate
  - Fatigue: Many recent planning meetings
  - Ongoing Plasma 2020 Decadal survey
- To address this, we have chosen a different format for our fall workshops
  - 4 Web-based workshops
  - 3 Forums at major fall conferences
- Increase participation by lowering the barrier to entry
- Bring the planning process to the meetings where people are already congregating

DPS: Calendar of Events

1. DPS-Wide Web Meeting (October 10)
2. Forums at fall conferences
   - APS-DPP (Oct. 22, 7:45pm)
   - AVS (Oct. 22, 7:00pm)
   - GEC (Oct. 29, 7:00pm)
3. Deadline for new or revised initiatives (November 8)
4. Web-based expert group meetings
   - Create disruptive technologies (Nov 22, 2:00pm)
   - Understand the Plasma Universe (Nov 25, 2:00pm)
   - Advance the Foundational Frontier (Nov 26, 2:00pm)
5. “Snowmass” (January)

MFE / FM&T Update

Madison Workshop

- July 22–26 at the University of Madison, WI
- Goal: to discuss, debate, and evaluate the initiatives that Advocates put on the table
- ~170 attendees, >100 unique white papers, ~60 presentations (plenary or in topical areas)
- **All** initiative proposals were discussed in Expert Groups, Cross-Cutting groups, or plenary sessions
- **All** initiative proposals received written feedback from one or more expert groups by Sep. 1
- Presentations, scribe notes from discussion sessions, and feedback to Advocacy Groups are all publically available on DPP-CPP website [https://sites.google.com/pppl.gov/dpp-cpp]

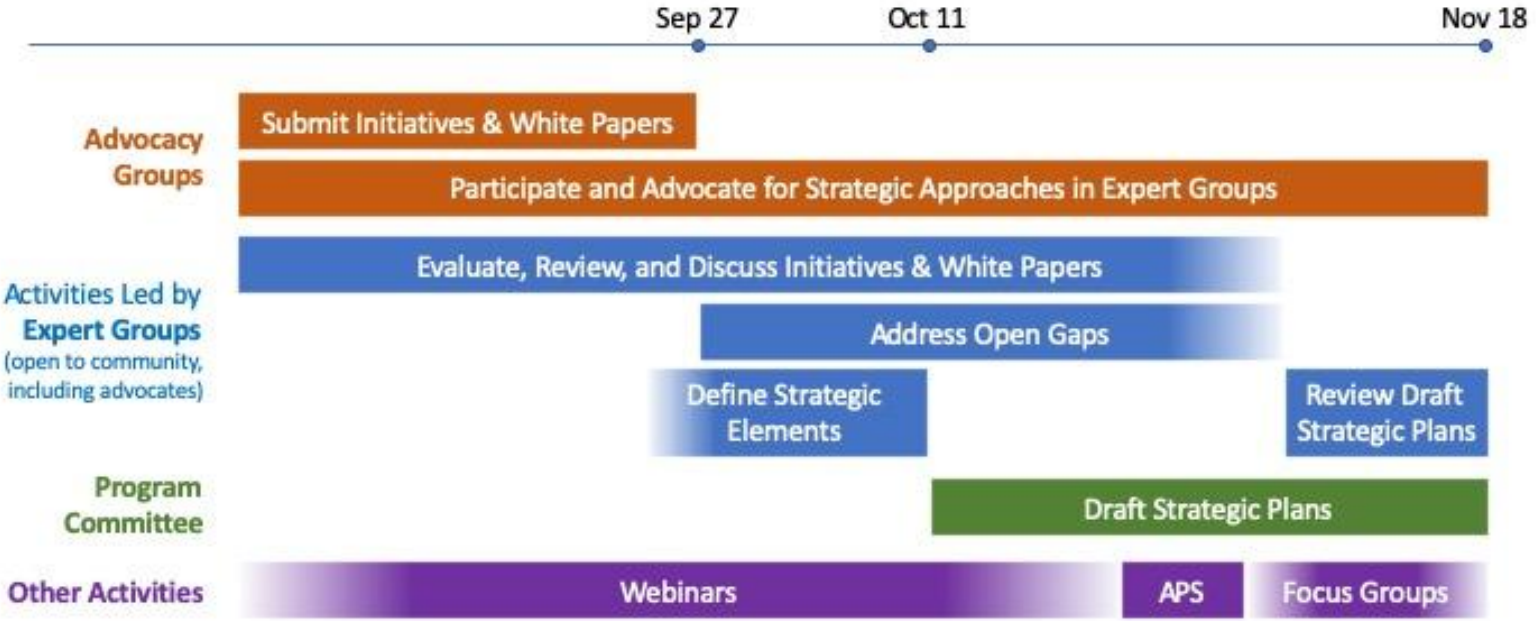
Agenda: Presentations (morning), breakouts (afternoon)

Monday	Theme Ia: Identifying the Elements for a Balanced MFE Program in the 2020s		Theme Ib: Materials and Technology Future Directions	
Tuesday	Theme II: Science and Technology Challenges on the Path to Fusion			
	Power Handling	Heating and Sustainment	Modeling and Design	Materials, Blankets, Diagnostics
Wednesday	Theme III: Cross-cutting Opportunities for the Fusion Energy Sciences Theme IV: The Role of Public/Private Partnership on the Path to Fusion			
Thursday	Theme V: The Path to a Fusion Pilot Plant			
Friday	Theme VI: Summary of Workshop Accomplishments and Moving Forward			

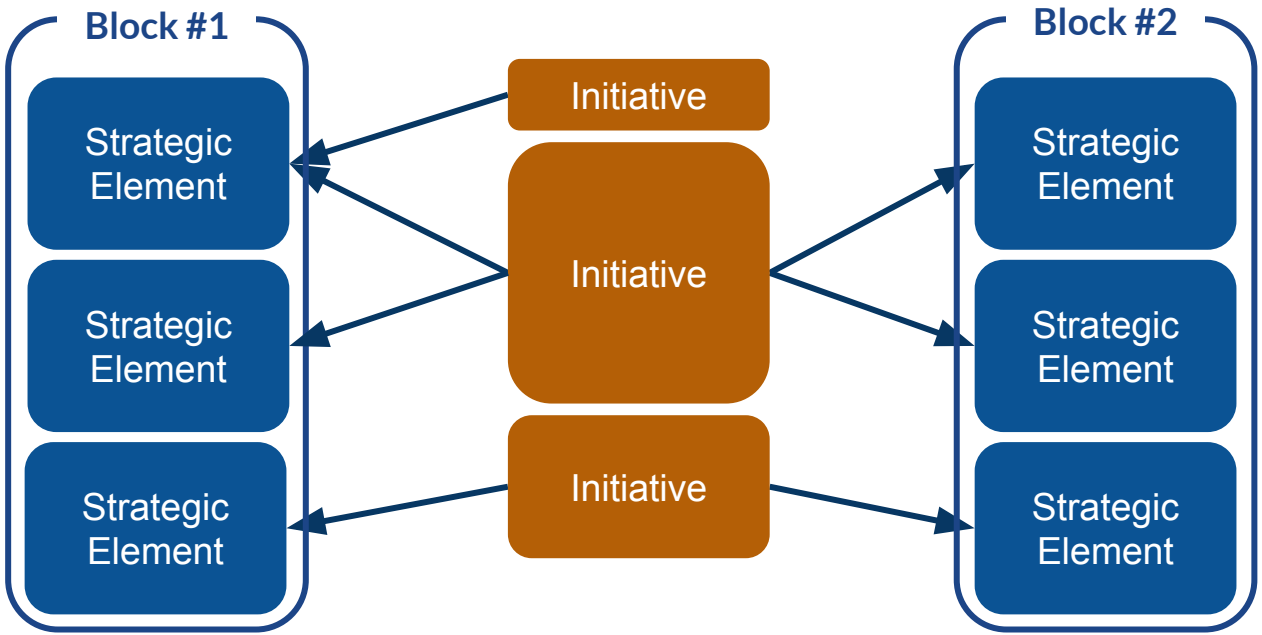
Observations from Madison

- Encouraging show of engagement and enthusiasm from MFE/FM&T community
  - Private industry was also engaged—presentations from INFUSE, ARPA-E, and Fusion Industry Association; strong attendance & participation from some companies
- People generally liked the expert group discussion format for evaluating initiatives
- Interaction between MFE and FM&T sparked many new ideas and discussions
- People liked Madison workshop, but want the next workshop to be different
  - Next workshop needs to focus on assembling a strategic plan
  - More plenary sessions—get people all focused on the same set of high level questions

Activities Before Knoxville Workshop



EGs Build Elements and Blocks from Initiatives



Strategic Blocks represent different approaches to closing all the gaps identified by each Expert Group

Expert Groups Are Defining Strategic Elements

- **Strategic Element**: a set of one or more initiatives that, in combination, seek to address a common gap (or set of gaps) in a coherent way
  - Will reference all relevant initiative proposals (doesn't need to endorse them)
  - Broad initiatives can be part of multiple strategic elements
  - Can include sequencing, where appropriate
- **Example**: "Solve tokamak disruptions" Strategic Element
  - Initiative(s) to develop new techniques for mitigation
  - Initiative(s) for targeted modeling activities
  - Initiative(s) for collaboration with international facilities to access specific conditions
- Where initiatives overlap, extract or generalize common elements that have consensus support

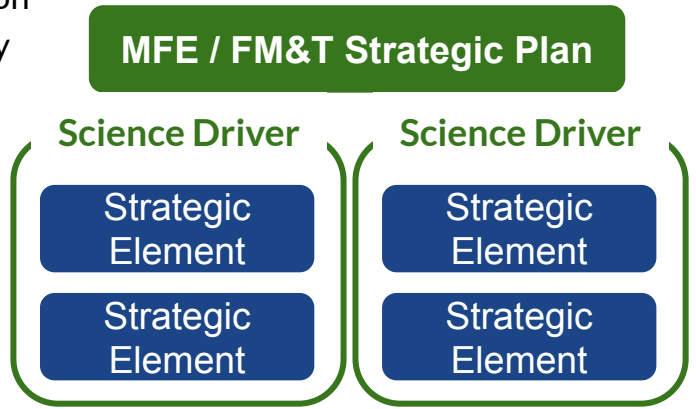
Expert Groups Are Defining “Strategic Blocks”

- **Strategic Block**: a set of Strategic Elements that are needed to close all of the gaps identified by an Expert Group.
  - Multiple strategic blocks can be generated by an EG, representing different approaches to closing the gaps
  - This is similar to “Strategic Approach” as defined by WG1.
  - Here, Strategic Blocks are explicitly organized by Expert Group
- **Example**: Strategic Block for Transients EG
  - Strategic Element to solve tokamak disruptions
  - Strategic Element to quantify MHD limits in Stellarators
  - Strategic Element to solve ELMs
- If gaps can’t be closed by the submitted Initiatives alone, EGs should define necessary Elements themselves in an open, transparent, and generic way [e.g. ELM suppression]

PC Will Draft Strategic Framework(s) Before Knoxville

- Framework consists of science drivers and associated candidate recommendations based in part on the strategic blocks generated within the EGs
  - PC will work across EG boundaries to make a more coherent organization
  - Continue to draw upon (and cite) the full range of submitted initiatives
- All recommendations will be traceable to community discussions and reports
- Identifies future decision points and possible areas of contention
- Summary and “opening presentation” distributed to community ahead of Knoxville workshop
  - Forming the basis of discussions and polling activities to be conducted at Knoxville.

The framework will form the basis of the strategic plan emerging out of Knoxville discussions and drafted following the workshop



EGs Will Review Framework(s) Before Knoxville

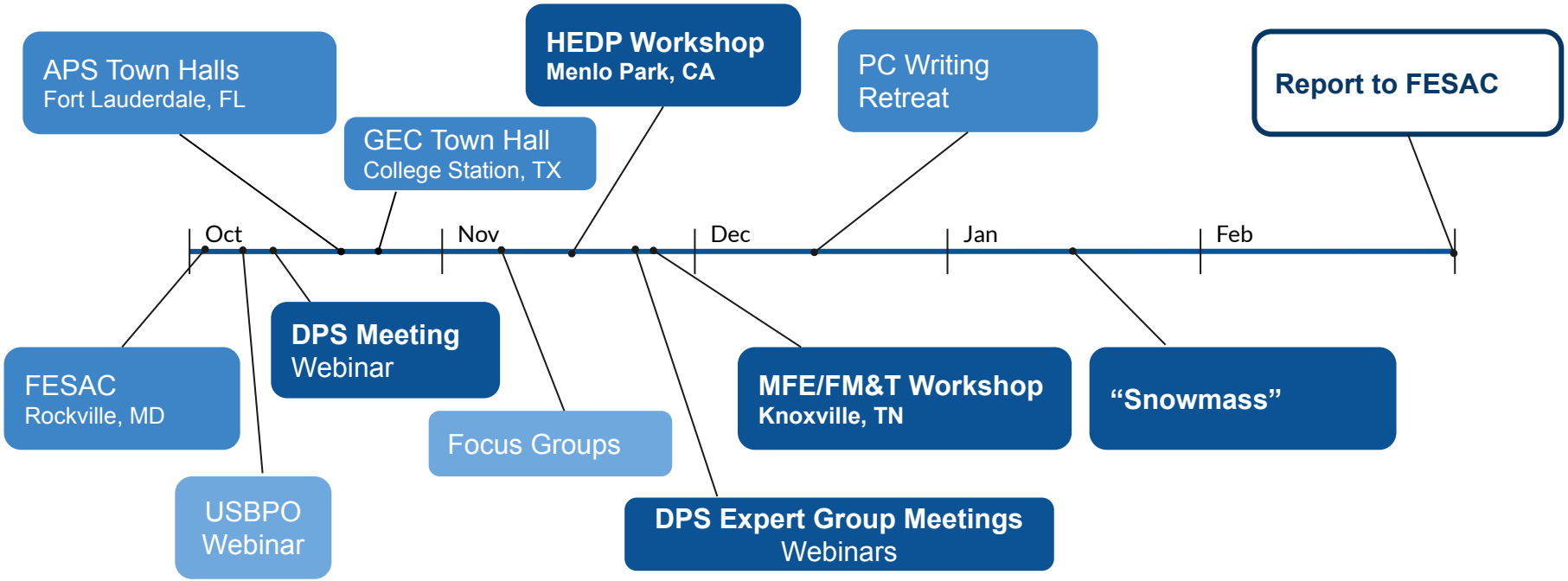
- Framework(s) developed by PC will be posted publicly for review before Knoxville
- This will give opportunity for “sanity check”
  - Have we missed anything crucial?
  - Is there anything that will impede consensus?
- Expert Groups will be explicitly asked to review content before Knoxville
  - Ensure that Framework(s) cover all gaps
  - Ensure the accuracy of technical statements
  - Ensure that content is traceable to community discussions and does not contradict the consensus of the EG

Knoxville Workshop

- Nov 18--22 at UT Conference Center in Knoxville, TN
  - Register now! https://utconferences.eventsair.com/mfefmt
- Plenary presentations and breakout sessions on
  - high-level questions
  - framework(s)
  - areas of contention
  - recommendations
- Goals:
  - A set of near term, actionable recommendations for pursuing research opportunities
  - A long-range vision for the path to fusion energy
  - (Maybe) coarse prioritization or sequencing of recommendations
  - *We will go as far as time and consensus allow.*

Forging a Strategic Plan

Upcoming Events



“Snowmass”

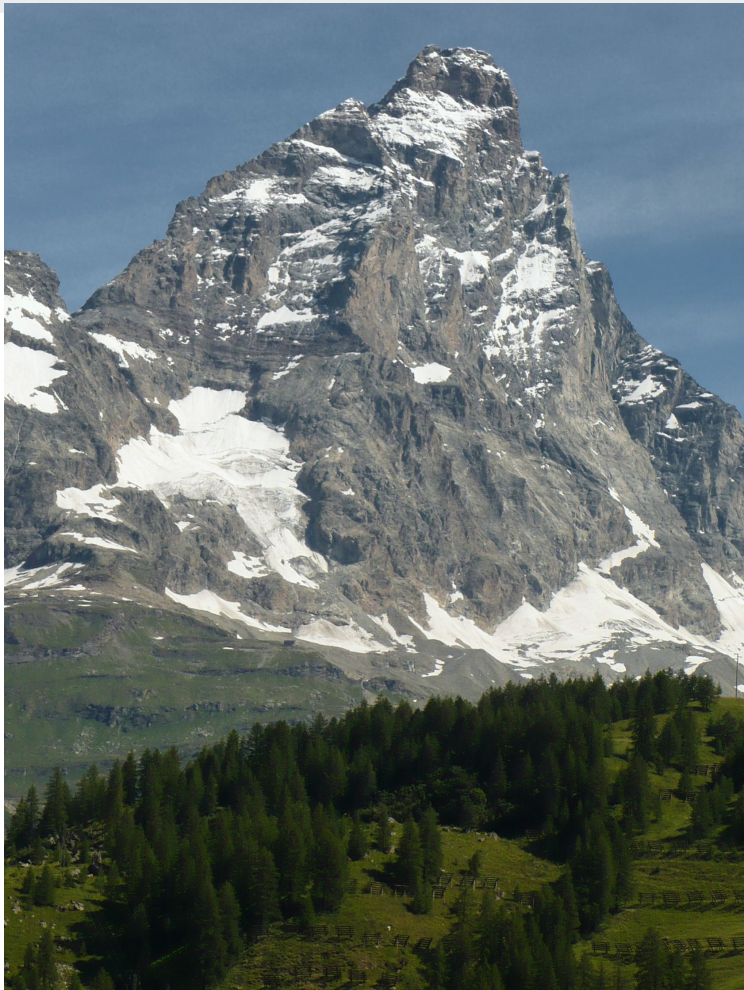
- Community-wide meeting to combine input from topical areas into a **coherent plan for FES** and to get **community feedback and buy-in**
  - Topical areas are expected to have well-formed plans coming into Snowmass
- Targeting week of Jan. 13, 2020
  - To facilitate participation by avoiding conflicts with other major conferences and academic calendars
  - To remain on track to deliver report to FESAC before March, 2020
- Saralyn Stewart is providing logistical support. Presently negotiating with hotels.
- Program committee will likely have a retreat in Dec. to set agenda and prepare input
- Different from previous “Snowmass” meetings—this will (probably) not be for downselecting among proposals for new facilities.

Facilitator is Assisting with Strategic Planning

- We are working with Laurie Moret to assist with strategic Planning
  - Professional facilitator; worked with APS to develop corporate strategic plan
- She will be running sessions to train PC members
  - How to moderate discussion sessions effectively
  - How to organize and structure strategic plans
- She will be running focus group sessions to get feedback from interest groups
  - Early career; underrepresented demographic groups; university scientists; etc.
  - Do these groups feel that they are involved in the process and that their concerns are being addressed? We want to know this **before** we draft any plans or recommendations.
- She will be present at our upcoming workshops to help moderate discussions and advise the PC

Challenges

- We anticipate challenges ahead, but we are optimistic that we can overcome them.
- How will we gauge / ensure consensus?
- How will we create a coherent plan?
- How will we balance the Energy and Science missions of FES?



Gauging and Ensuring Consensus

- What is consensus? **A plan that everyone can support, formed in a process where everyone's voice was heard.**
  - Doesn't mean that everyone agrees with everything.
  - Consensus is not the tyranny of the majority.
- To facilitate consensus, it is our job to:
  - Ensure that all stakeholders are participating.
  - Give the community many opportunities for input and feedback.
  - Clearly reflect the community's input in the recommendations.
  - Understand and address the concerns of interest groups (focus groups).
  - Use polling (not voting) to document and gauge consensus as we proceed.
  - Communicate that this is not a zero-sum game. **Consensus will benefit us all.**

Making a Coherent Plan for FES

- Presently, topical areas are functioning mostly independently
  - Close interaction between MFE and FM&T areas
- Different topical areas will (hopefully) be bringing consensus recommendations into Snowmass
- “Snowmass” meeting will be the opportunity to merge plans into coherent plan for FES
- Our goal is that all stakeholders will be able to understand and support the recommendations from all topical areas
- Cross-cutting groups are set up to identify challenges and opportunities across entire FES scope

Balancing Energy and Science

- MFE and FM&T areas are fundamentally driven by an energy goal. This has been underscored by the recent National Academies report.
- HEDP and DPS are more driven by scientific exploration, but also have significant practical application.
- There is strong desire within the community that our recommendations reflect the energy mission of MFE/FM&T. We will strive to address the scientific and technological challenges inherent to that mission.
- We will not cross-prioritize among MFE/FM&T, HEDP, and DPS. These areas have somewhat distinct goals, and prioritization among these goals should be set by DOE or Congress.

Summary

- We are pleased with our rate of progress and the level of engagement from the community
  - We have received a tremendous amount of input from most areas of the community
  - The first round of workshops succeeded in generating the discussion and output that we wanted
  - We are entering a new stage of the planning process, where we will be writing plans and getting community feedback and buy-in
- There are challenges remaining, but we are optimistic for a successful outcome
  - We are working with a professional facilitator to help us chart a successful course
  - We are drawing on the experiences of other planning activities to guide our process
- **We remain on track to deliver a consensus report to FESAC before March 2020**

Thank You!