

Snowmass**2013**

(July 29-August 7, 2013)

High Energy Frontier

Michael Peskin

Chip Brock

TOC:

1. Snowmass status, overall
2. High Energy Frontier, in particular
3. What's next for the High Energy Frontier

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1. Snowmass status, overall

Snowmass is a creature of your APS Division of Particles and Fields

Not of HEPAP or the agencies

a long-range, “taking-stock” exercise

Considering the whole field, to:

explore our collective physics goals among ourselves

correlate them, if appropriate and create a compelling narrative

to the broader scientific community and the government

Participation by European and Asian colleagues is encouraged

aspirations, not recommendations

“Snowmass” is a Particle Physics brand

A long tradition, covering both general and focused agendas:

Snowmass’82 DPF Summer Study On Elementary Particle Physics And Future Facilities

Snowmass ‘84 DPF Summer Study On The Design And Utilization Of The Superconducting Super Collider (SSC)

Snowmass ‘86 Summer Study On The Physics Of The Superconducting Supercollider

Snowmass ‘88 DPF Summer Study On High-Energy Physics In The 1990s

Snowmass ‘90 DPF Summer Study On High-Energy Physics: Research Directions For The Decade

Snowmass ‘94 DPF Summer Study On High-Energy Physics: Particle And Nuclear Astrophysics And Cosmology In The Next Millenium

Snowmass ‘96 DPF/DPB Summer Study On New Directions For High-Energy Physics

Snowmass ‘01 APS/DPF/DPB Summer Study On The Future Of Particle Physics

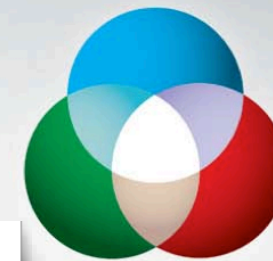
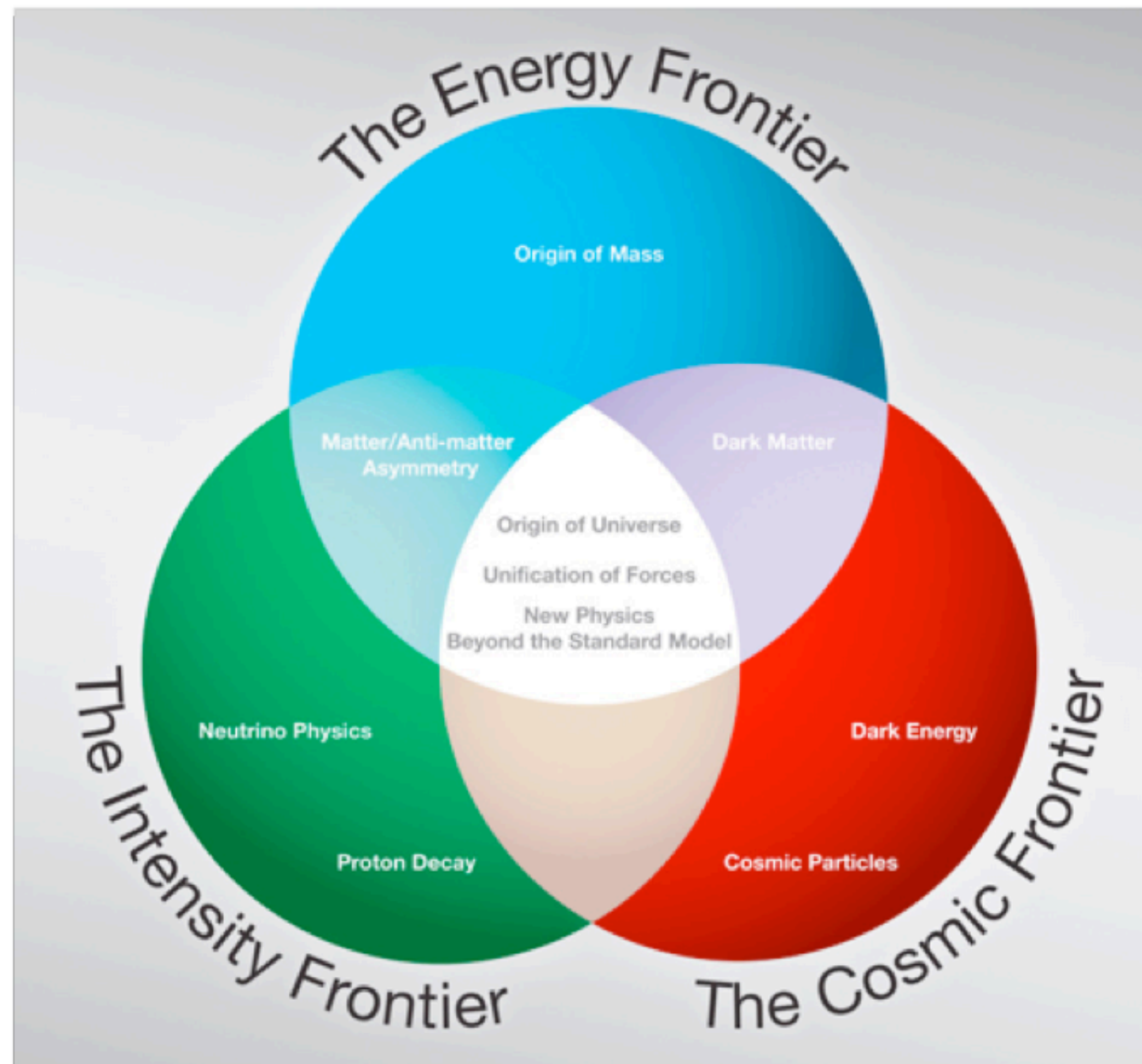
Snowmass ‘05: DPF Toward an International Linear Collider.

Most recent general meeting, 2001:



We have a theme

“the circles” were a gift from the 2008 P5
and we’re organized around them



US Particle Physics:
Scientific Opportunities
A Strategic Plan
for the Next Ten Years

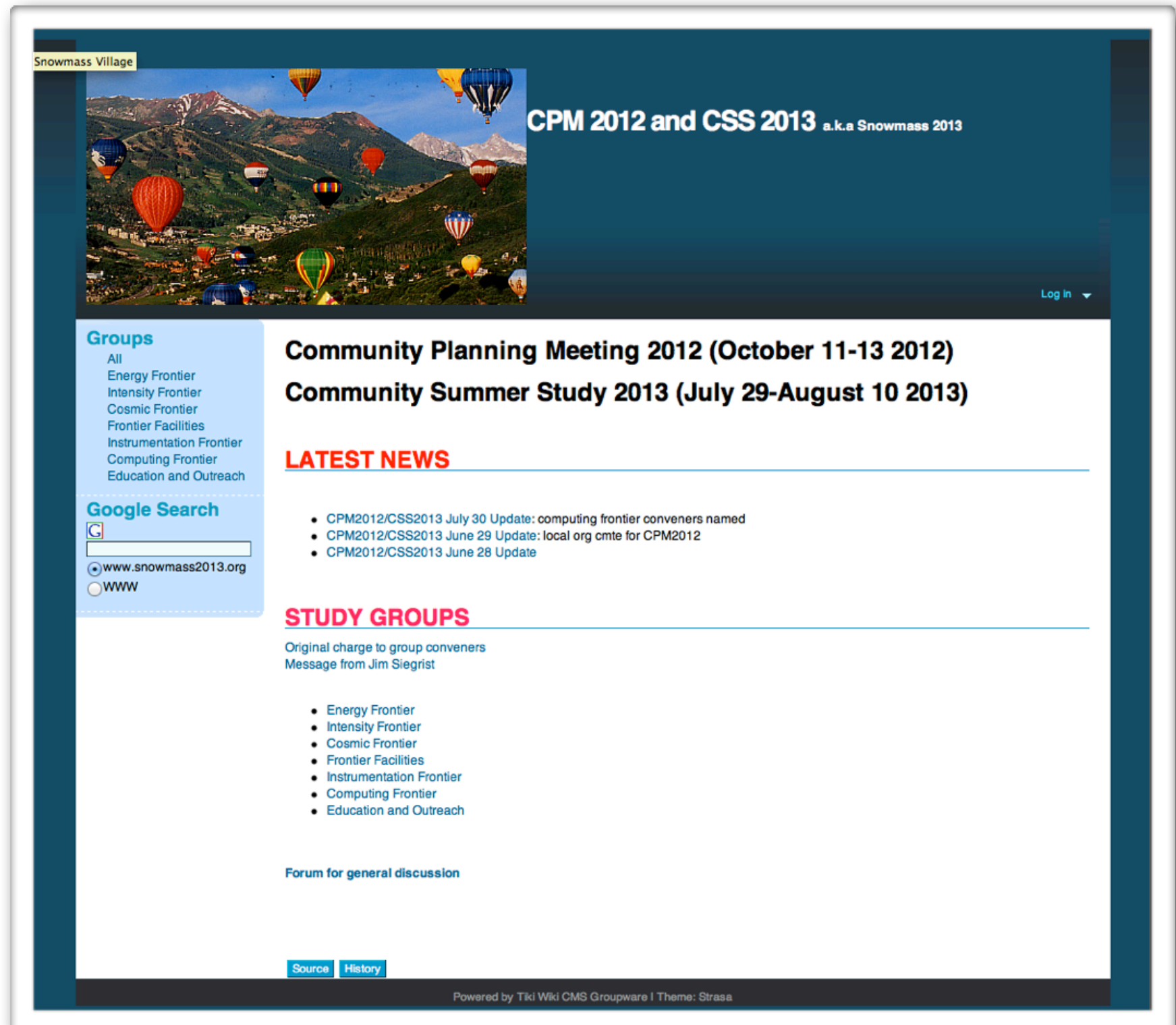
Report of the Particle
Physics Project
Prioritization Panel

29 May 2008

We have a wiki

<http://www.snowmass2013.org>

increasingly active



The screenshot shows the homepage of the Snowmass 2013 wiki. At the top, there is a banner image of a mountain valley with many hot air balloons. The text "Snowmass Village" is in the top left corner of the banner, and "CPM 2012 and CSS 2013 a.k.a Snowmass 2013" is on the right. Below the banner, the page is divided into several sections. On the left, there is a "Groups" sidebar with a list of categories: All, Energy Frontier, Intensity Frontier, Cosmic Frontier, Frontier Facilities, Instrumentation Frontier, Computing Frontier, and Education and Outreach. Below this is a "Google Search" box with a search bar and two radio buttons for "www.snowmass2013.org" (selected) and "WWW". The main content area on the right has a heading "Community Planning Meeting 2012 (October 11-13 2012)" and "Community Summer Study 2013 (July 29-August 10 2013)". Below this is a "LATEST NEWS" section with three bullet points: "CPM2012/CSS2013 July 30 Update: computing frontier conveners named", "CPM2012/CSS2013 June 29 Update: local org cmte for CPM2012", and "CPM2012/CSS2013 June 28 Update". Further down is a "STUDY GROUPS" section with a heading "Original charge to group conveners" and "Message from Jim Siegrist", followed by a list of study groups: Energy Frontier, Intensity Frontier, Cosmic Frontier, Frontier Facilities, Instrumentation Frontier, Computing Frontier, and Education and Outreach. At the bottom of the main content area is a link "Forum for general discussion". The footer of the page includes "Source" and "History" buttons, and a small text "Powered by Tiki Wiki CMS Groupware | Theme: Strasa".

Snowmass Village

CPM 2012 and CSS 2013 a.k.a Snowmass 2013

Log In

Groups

- All
- Energy Frontier
- Intensity Frontier
- Cosmic Frontier
- Frontier Facilities
- Instrumentation Frontier
- Computing Frontier
- Education and Outreach

Google Search

☒ www.snowmass2013.org

☐ WWW

Community Planning Meeting 2012 (October 11-13 2012)

Community Summer Study 2013 (July 29-August 10 2013)

LATEST NEWS

- CPM2012/CSS2013 July 30 Update: computing frontier conveners named
- CPM2012/CSS2013 June 29 Update: local org cmte for CPM2012
- CPM2012/CSS2013 June 28 Update

STUDY GROUPS

Original charge to group conveners
Message from Jim Siegrist

- Energy Frontier
- Intensity Frontier
- Cosmic Frontier
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- Computing Frontier
- Education and Outreach

Forum for general discussion

Source History

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Overall Workshop Leadership:

DPF Chair (2012), Pierre Ramond (Florida)

DPF Chair (2013), Jon Rosner (Chicago)

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HEF: **Energy Frontier** - Chip Brock & Michael Peskin

Physics with hadron and lepton colliding beams

HIF: **“High” Intensity Frontier** - JoAnne Hewett & Harry Weerts

Similar to the High Intensity Frontier Workshop

CF: **Cosmic Frontier** - Steve Ritz & Jonathan Feng

Ground-based and satellite based studies

FF: **Frontier Facilities** - Bill Barletta & Gil Gilchriese

Accelerator and non-Accelerator Capabilities

IF: **Instrumentation Frontier** - Marcel Demarteau, Ron Lipton, & Howard Nicholson

Following the DPF Coordinating Panel for Advanced Detectors (CPAD)

CpF: **Frontiers of Computing** - Lothar Bauerdick & Steven Gottlieb

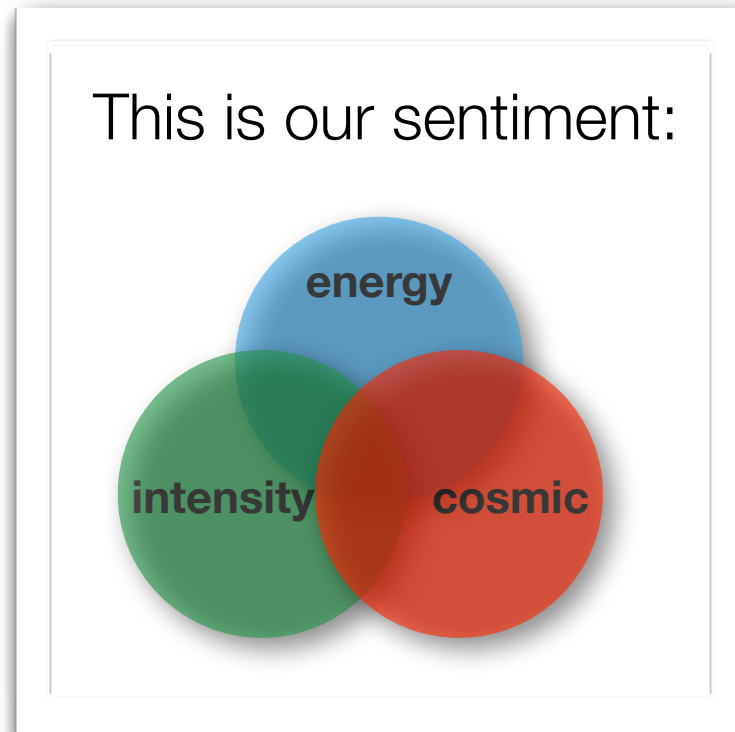
Brand new

EO: **Education and Outreach** - Marge Bardeen & Dan Cronin- Hennessy

Ideas on Education and Outreach, events for the local community

We are bending the organization

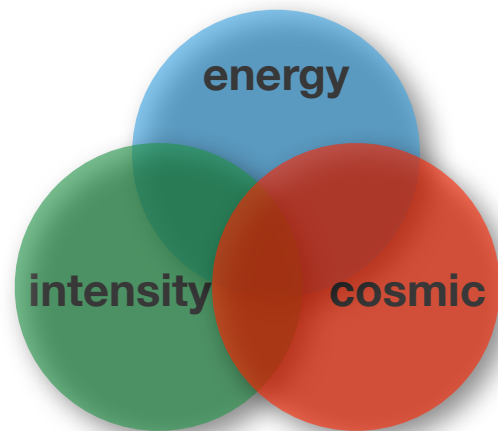
to fit the circles, including overlaps



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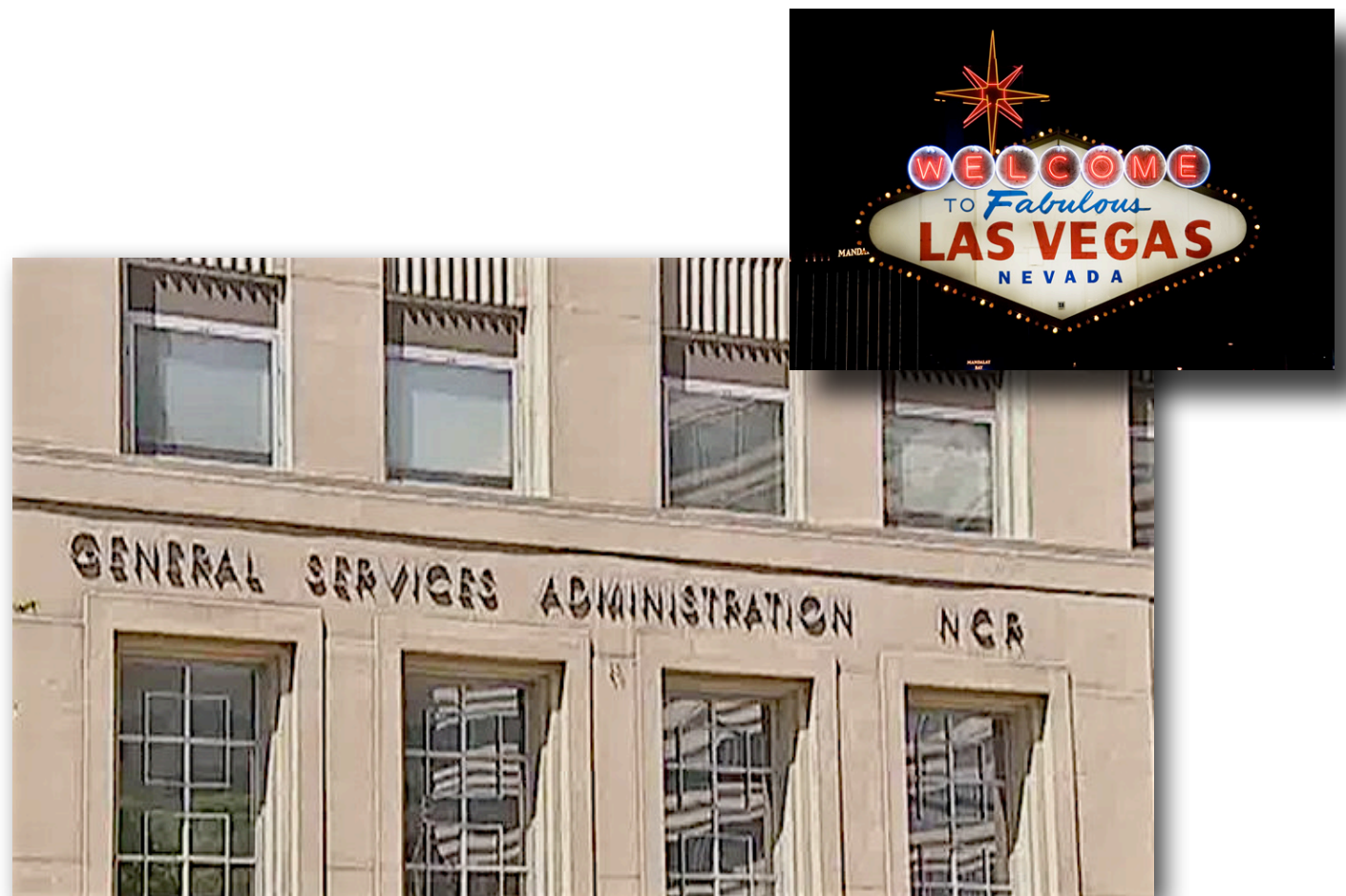
This is our sentiment:



This is our organizational reality:



Thank you, GSA.



Thank you, GSA.

GSA scandal fallout affects the venue

A known fallout:

Conferences limited to \$500k for DOE laboratory personnel

Goal is to try to not force labs to limit attendance

The consequence:

Snowmass shortened from

3 weeks

to 2 weeks

...to 9 days

@ the University of Minnesota



We have two proposals and a schedule

Decision is for the University of Minnesota.



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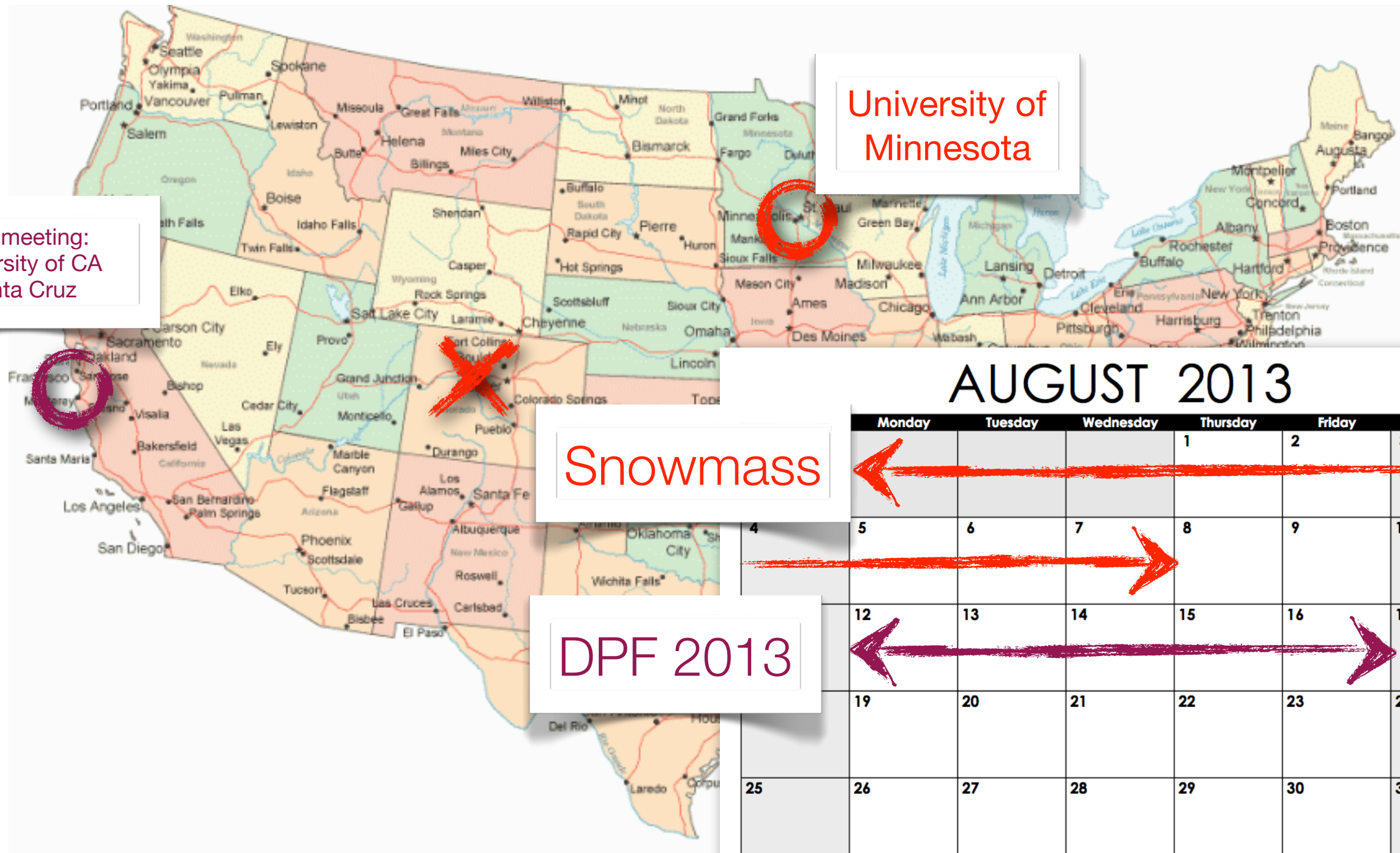
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We have a schedule

Group Convener Organization

Aug 1, 2012 – Aug 31, 2012

Community Planning Meeting (CPM) at Fermilab

Oct 11, 2012 – Oct 13, 2012

Topical workshops?

Jan 1, 2013 – Aug 1, 2013

LHC shutdown

Feb 10, 2013 – Dec 31, 2014

Snowmass2013

Jul 29, 2013 – Aug 7, 2013

DPF2013

Aug 11, 2013 – Aug 18, 2013

14 TeV Collisions

1/1/15 – 10/30/15

Jan 2013

Jul 2013

Jan 2014

Jul 2014

Jan 2015

Jul 2015

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Snowmass2013 & DPF2013

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Discussion, analysis, conclusions

executive summary @ the meeting

each subgroup writes a report

Snowmass2013 & DPF2013

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Publication

each subgroup of HEF will prepare a ~30 page summary of their work

there will be an eConf at SLAC repository for the Proceedings

and for individual contributions: white papers and individual projects

We anticipate a followup

An independent, P5 Strategic Planning Exercise

commissioned by HEPAP for DOE and NSF

We have a blessing

Jim Siegrist, Director OHEP

In 2008 HEPAP through the work of its P5 subpanel laid out a compelling strategic vision for the future of High Energy Physics.

Given recent exciting results at all the HEP scientific frontiers, and the ongoing evolution of budget projections and project plans, it is prudent to revisit the HEPAP/P5 plan with an eye towards examining the science options that have been put forward as well as emerging opportunities.

As a first step in this process, we need a strong scientific **case** that covers the range of opinion in the community. We would like to understand if our opportunities enable programs that are capable of achieving most or all of the scientific goals as the program considered in the 2008 roadmap, or whether some modifications to those goals and plans are needed.

To that end, a planning process that carefully considers the science opportunities and trade-offs involved, and can clearly elucidate the pros and cons of the various options, would be extremely valuable input for updating the HEP strategic plan.

2. High Energy Frontier, in particular

what we've done:

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Identified terrific subgroup conveners

most have been meeting together for about a month

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Created necessary correlations among groups

Decided on technical “connective tissue” groups

Explicit liaisons between HEF and other frontiers

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Additional group “infrastructure”

established direct connection with the established collaborations:

“Contacts and consultants”: ATLAS: Paul Tipton; CMS: Jim Olsen; LHCb: Sheldon Stone; ILD: Graham Wilson; SiD: Andy White; CLIC: Mark Thomson; Muon Collider: Ron Lipton

High Energy Frontier working groups

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HE1: The Higgs Boson

Jianming Qian (Michigan), Andrei Gritsan (Johns Hopkins), Heather Logan (Carleton), Rick Van Kooten (Indiana), Chris Tully (Princeton), Sally Dawson (BNL)

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HE6: Flavor Physics and CP Violation at High Energy

Soeren Prell (ISU), Michele Papucci (LBNL), Marina Artuso (Syracuse)

HEF broad Goals:

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1. In light of circa 2013 results what physics can be achieved before ~2018

...at design specifications with $\int \mathcal{L} dt \sim 100 \text{ fb}^{-1}$)?

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...“Phase 2”: circa 2030 with $\int \mathcal{L} dt$ of approximately 3000 fb^{-1}

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Specifically, to what extent is precision Higgs Boson physics possible?

3. Does a Higgs Boson @ $\sim 125 \text{ GeV}/c^2$ call for a “Higgs Factory”?

4. What are the physics cases for accelerators beyond 2025?

High energy LHC? High energy lepton collider? Lepton-hadron collider? VLHC?

Candidate scenarios to be addressed by all groups:

- A. *The LHC with $E = 14 \text{ TeV}$ and $L = 10^{34} \text{ cm}^{-2} \text{ sec}^{-1}$*
- B. *A luminosity upgraded LHC with: $E_{cm} = 14 \text{ TeV}$, $L = \sim 10^{35} \text{ cm}^{-2} \text{ s}^{-1}$*
- C. *An energy upgraded LHC*
- D. *e^+e^- lepton colliders $E_{cm} < \sim 1 \text{ TeV}$*
- E. *A circular e^+e^- collider operating as a Higgs factory.*
- F. *e^+e^- or gamma-gamma collider $E_{cm} > \sim 1 \text{ TeV}$*
- G. *A $\mu^+\mu^-$ collider.*
- H. *A lepton-hadron collider.*
- I. *A VLHC hadron collider with energy well above the LHC energy.*

- *It is important to point out critical points in energy or luminosity that are essential to realize physics goals.*
- *For experiments at hadron colliders, a specific question is the effect of the machine environment for high-luminosity running. Do high-luminosity conditions compromise the needed measurements? Are there detector designs or experimental strategies that can ameliorate these problems?*

operational: ✓✓✓✓
well engineered: ✓✓✓

engineered: ✓✓✓
well studied: ✓✓

under study: ✓
gleam in someone's eye: !

Candidate scenarios to be addressed by all groups:

- A. The LHC with $E = 14 \text{ TeV}$ and $L = 10^{34} \text{ cm}^{-2} \text{ sec}^{-1}$ ✓✓✓✓
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- C. An energy upgraded LHC !
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- E. A circular $e+e^-$ collider operating as a Higgs factory. !
- F. $e+e^-$ or gamma-gamma collider $E_{cm} > \sim 1 \text{ TeV}$ ✓✓
- G. A $\mu+\mu^-$ collider. ✓
- H. A lepton-hadron collider. ✓
- I. A VLHC hadron collider with energy well above the LHC energy. ✓

- It is important to point out critical points in energy or luminosity that are essential to realize physics goals.
- For experiments at hadron colliders, a specific question is the effect of the machine environment for high-luminosity running. Do high-luminosity conditions compromise the needed measurements? Are there detector designs or experimental strategies that can ameliorate these problems?

Common template Charge to each HEF Group:

1. Please provide a compact summary of the state of the search for X physics, including information from LEP, the Tevatron, and the LHC.

2. Please address the following goals for X physics in the future:

- ...tailored list of questions/goals follow, crafted by the sub-group conveners

3. Please guide your exploration of the above goals with the following scenarios/caveats:

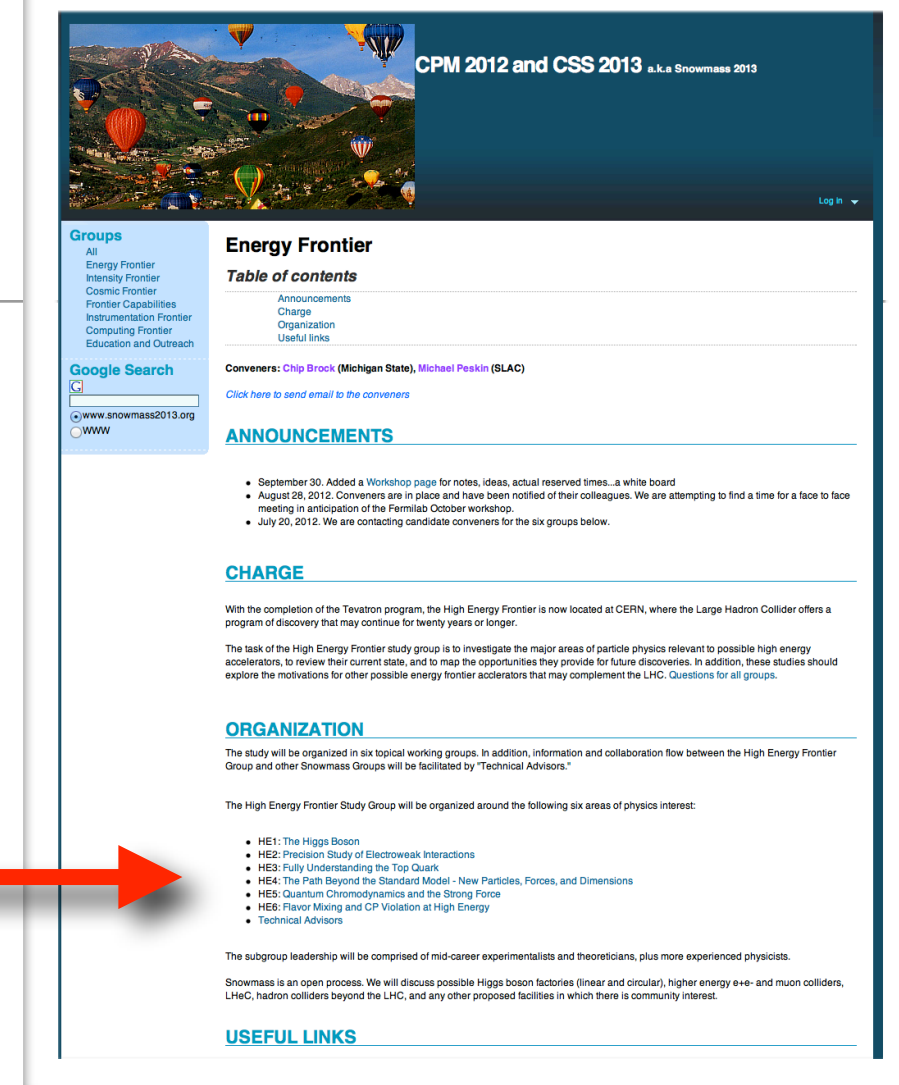
- Evaluate the above goals in the context of Candidate Facilities A-I. (Collaboration with the Facilities Frontier is expected.)
- Are new theoretical or simulation tools (for signal or backgrounds) required in order to achieve the goals?
- What are the detector and computing challenges that the above goals imply? (Collaboration with the Instrumentation and Computing Frontiers is expected.)

We too have a wiki

<http://www.snowmass2013.org>

increasingly active

find each group's detailed charges



The screenshot shows the Snowmass 2013 website. At the top, there's a banner image of hot air balloons over a mountain range with the text "CPM 2012 and CSS 2013 a.k.a Snowmass 2013". Below the banner, the page is divided into several sections. On the left, there's a "Groups" sidebar with links to "All", "Energy Frontier", "Intensity Frontier", "Cosmic Frontier", "Frontier Capabilities", "Instrumentation Frontier", "Computing Frontier", and "Education and Outreach". Below this is a "Google Search" box. The main content area is titled "Energy Frontier" and includes a "Table of contents" with links to "Announcements", "Charge", "Organization", and "Useful links". Below the table of contents, it lists the conveners: "Chip Brock (Michigan State)" and "Michael Peskin (SLAC)". There's a link to "Click here to send email to the conveners". The "ANNOUNCEMENTS" section contains three bullet points about recent events. The "CHARGE" section discusses the completion of the Tevatron program and the High Energy Frontier's location at CERN. The "ORGANIZATION" section describes the study group's structure and lists six areas of physics interest: HE1: The Higgs Boson, HE2: Precision Study of Electroweak Interactions, HE3: Fully Understanding the Top Quark, HE4: The Path Beyond the Standard Model - New Particles, Forces, and Dimensions, HE5: Quantum Chromodynamics and the Strong Force, and HE6: Flavor Mixing and CP Violation at High Energy. It also mentions "Technical Advisors". The "USEFUL LINKS" section is at the bottom.

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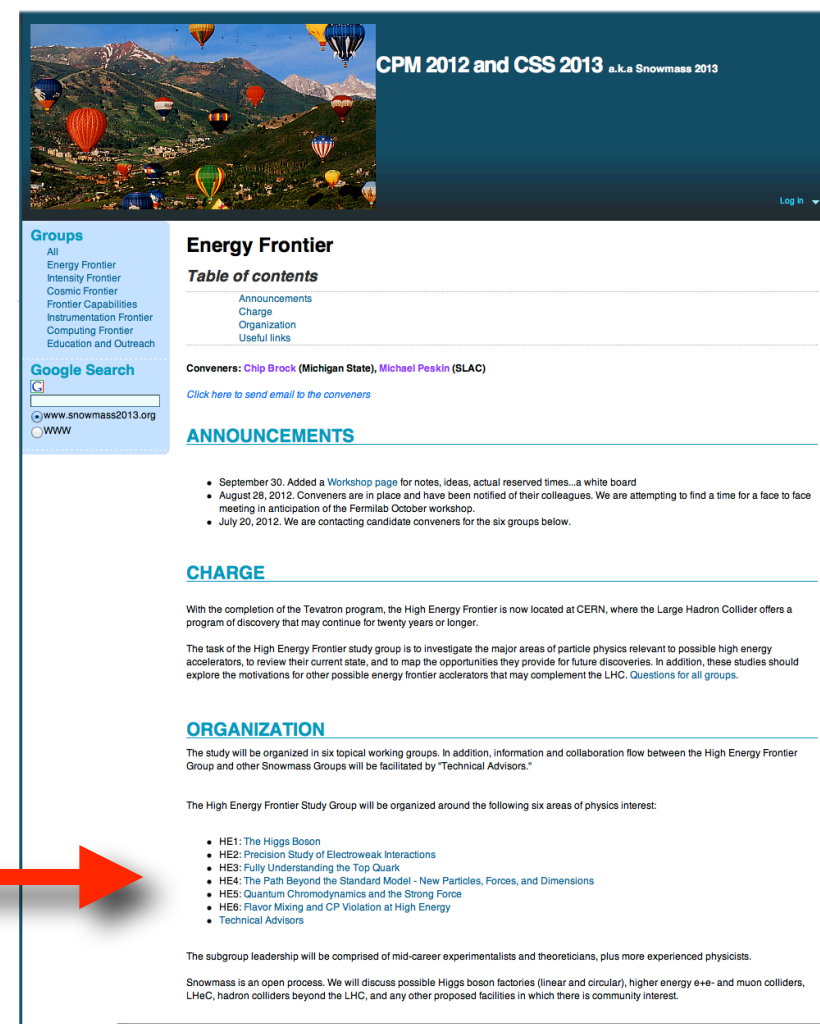
increasingly active

find each group's detailed charges

...and a facebook page

<http://www.facebook.com/HEFrontier>

Peskin/Brock, HE Frontier, October 2012



CPM 2012 and CSS 2013 a.k.a Snowmass 2013

Groups
All
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Cosmic Frontier
Frontier Capabilities
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www.snowmass2013.org
WWW

Energy Frontier

Table of contents

- Announcements
- Charge
- Organization
- Useful links

Conveners: **Chip Brock** (Michigan State), **Michael Peskin** (SLAC)

[Click here to send email to the conveners](#)

ANNOUNCEMENTS

- September 30. Added a *Workshop* page for notes, ideas, actual reserved times...a white board
- August 28, 2012. Conveners are in place and have been notified of their colleagues. We are attempting to find a time for a face to face meeting in anticipation of the Fermilab October workshop.
- July 20, 2012. We are contacting candidate conveners for the six groups below.

CHARGE

With the completion of the Tevatron program, the High Energy Frontier is now located at CERN, where the Large Hadron Collider offers a program of discovery that may continue for twenty years or longer.

The task of the High Energy Frontier study group is to investigate the major areas of particle physics relevant to possible high energy accelerators, to review their current state, and to map the opportunities they provide for future discoveries. In addition, these studies should explore the motivations for other possible energy frontier accelerators that may complement the LHC. [Questions for all groups.](#)

ORGANIZATION

The study will be organized in six topical working groups. In addition, information and collaboration flow between the High Energy Frontier Group and other Snowmass Groups will be facilitated by "Technical Advisors."

The High Energy Frontier Study Group will be organized around the following six areas of physics interest:

- HE1: The Higgs Boson
- HE2: Precision Study of Electroweak Interactions
- HE3: Fully Understanding the Top Quark
- HE4: The Path Beyond the Standard Model - New Particles, Forces, and Dimensions
- HE5: Quantum Chromodynamics and the Strong Force
- HE6: Flavor Mixing and CP Violation at High Energy
- Technical Advisors

The subgroup leadership will be comprised of mid-career experimentalists and theoreticians, plus more experienced physicists.

Snowmass is an open process. We will discuss possible Higgs boson factories (linear and circular), higher energy e+e- and muon colliders, LHeC, hadron colliders beyond the LHC, and any other proposed facilities in which there is community interest.



facebook Search for people, places and things

You are posting, commenting, and liking as High Energy Frontier Working Group, Snowmass 2013 — Change to Chip Brock

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Add a Cover

High Energy Frontier Working Group, Snowmass 2013

65 likes · 64 talking about this

Organization
The High Energy Frontier working group for the DPF Snowmass 2013 study.

About Photos Likes Events

Highlights

Status Photo / Video Event, Milestone +

Write something...

High Energy Frontier Working Group, Snowmass 2013
October 14 via mobile

Can someone confirm that they can post to the wall of this page? I want to be sure that I don't have to initiate every thread because I did something wrong in setup. Thanks.

26 Friends
Like High Energy Frontier Working Group, Snowmass 2013

Recent Posts by Others See All

The Intensity Frontier
Are we heading for a rematch of the 1968 World Serie...
Monday at 1:53am

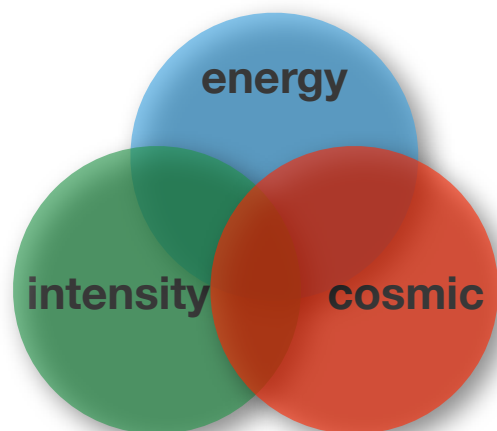
the overlaps

2 kinds of overlaps

Facilities, Instrumentation, and Computing Frontiers

Other Physics Frontiers groups

This is our sentiment:



This is our organizational reality:

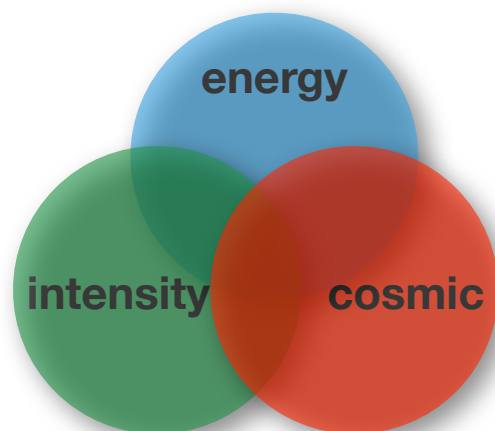


2 kinds of overlaps

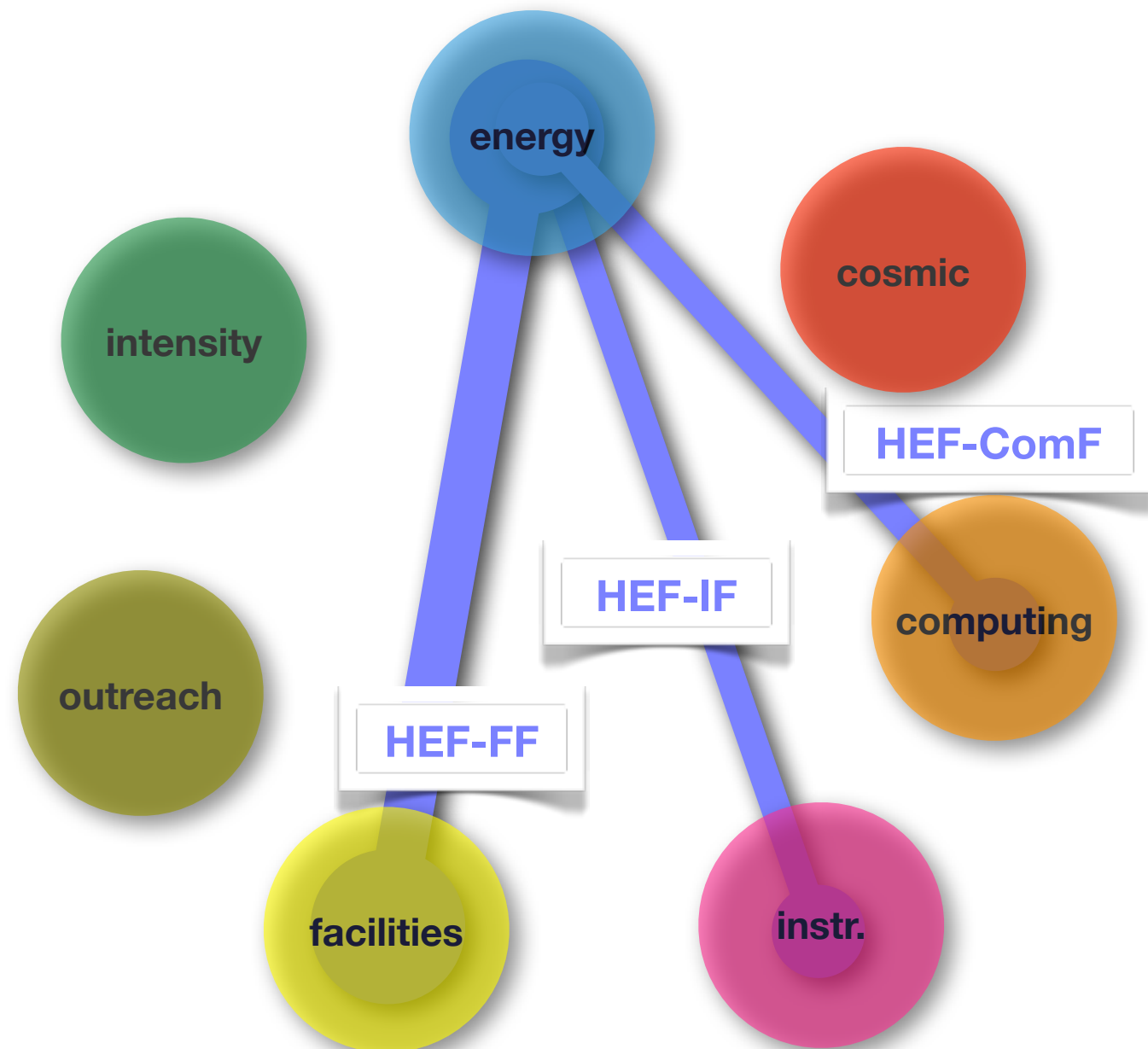
Facilities, Instrumentation, and Computing Frontiers

Other Physics Frontiers groups

This is our sentiment:



This is our organizational reality:

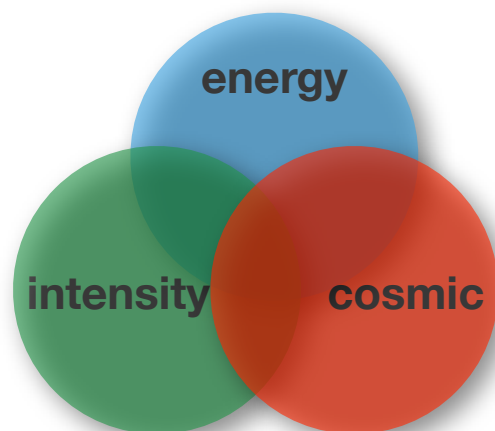


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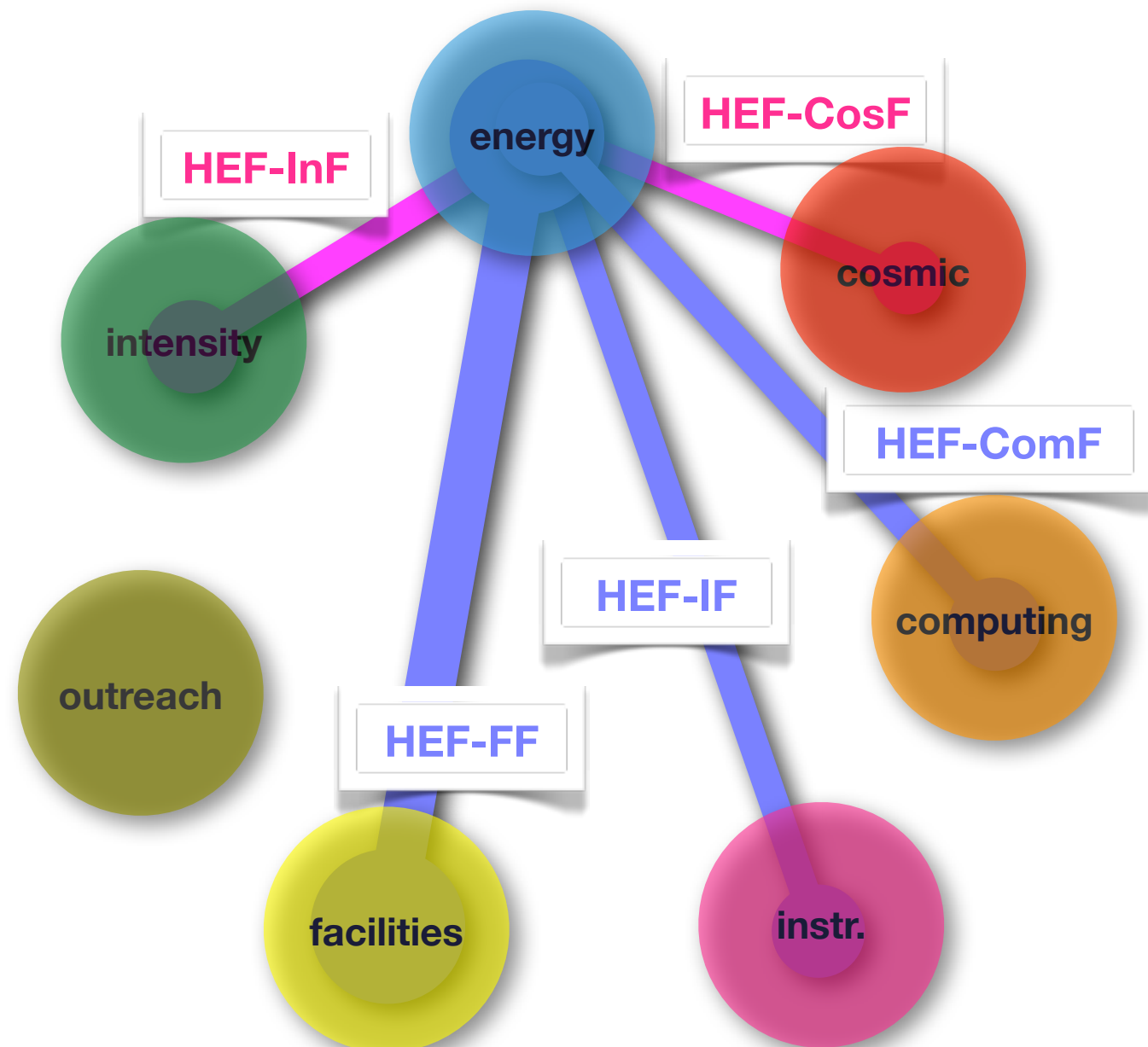
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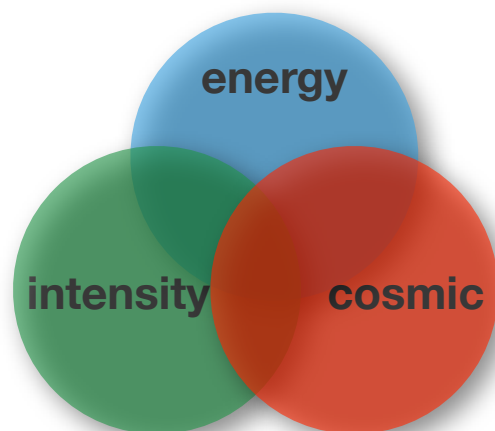


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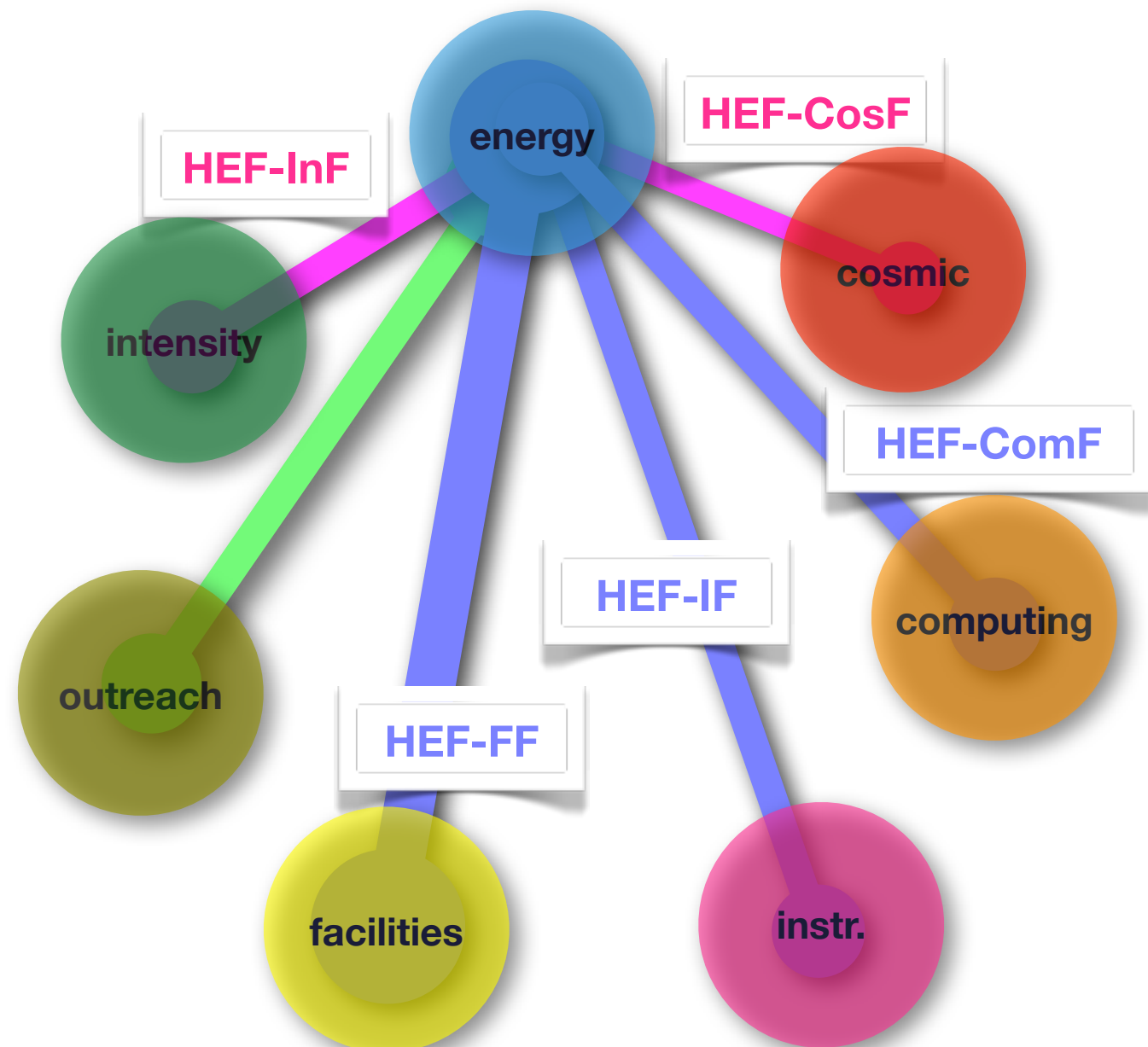
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“technical group”

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An explicit interface between the HEF physics groups and the FF, IF, and CF groups

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Technical Group:

Beate Heinemann (Cal), Tom LeCompte (ANL), Jeff Berryhill (FNAL), Eric Torrence (Oregon),

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Early in the new year:

Establishing common benchmark parameters for each Candidate Facility

in support of the physics groups

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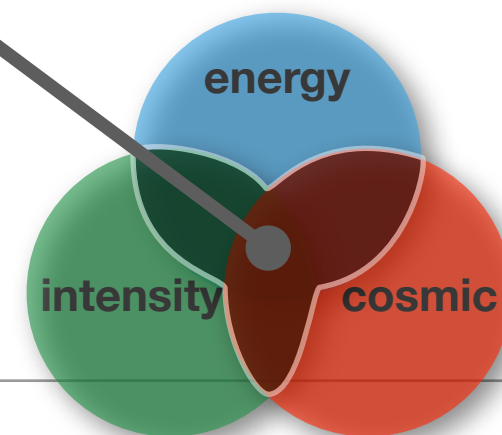
in support of the physics groups

Throughout the spring and workshop:

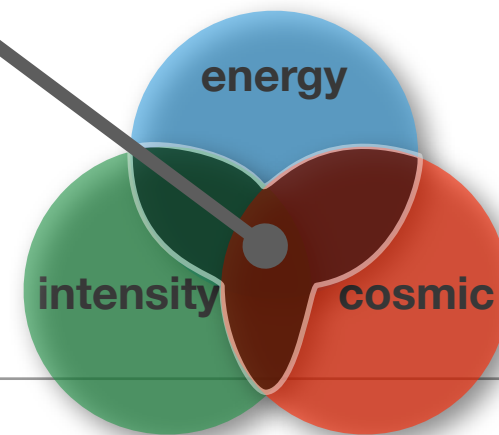
Liaison with the Facilities, Instrumentation and Computing Frontier Groups

Physics overlaps

this part!



this part!



Physics overlaps

Explicit dual-coverage conveners:

HEF & CF (Dark Matter): Lian-Tao Wang & Konstantin Matchev

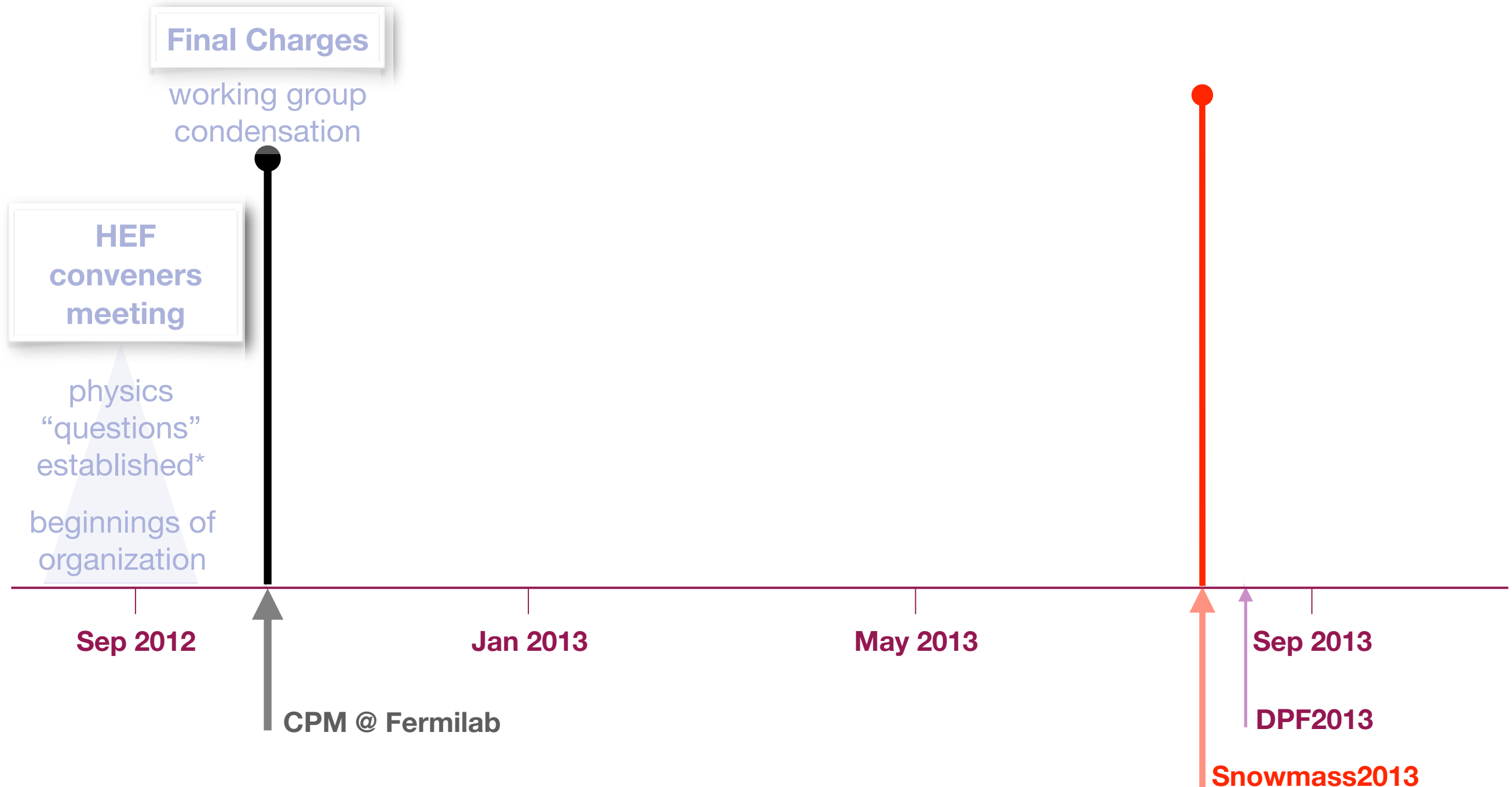
HEF & CF (Baryogenesis): Michele Papucci & Ann Nelson

HEF & HIF (b physics): Michele Papucci & Zoltan Ligeti

3. What's next for the High Energy Frontier

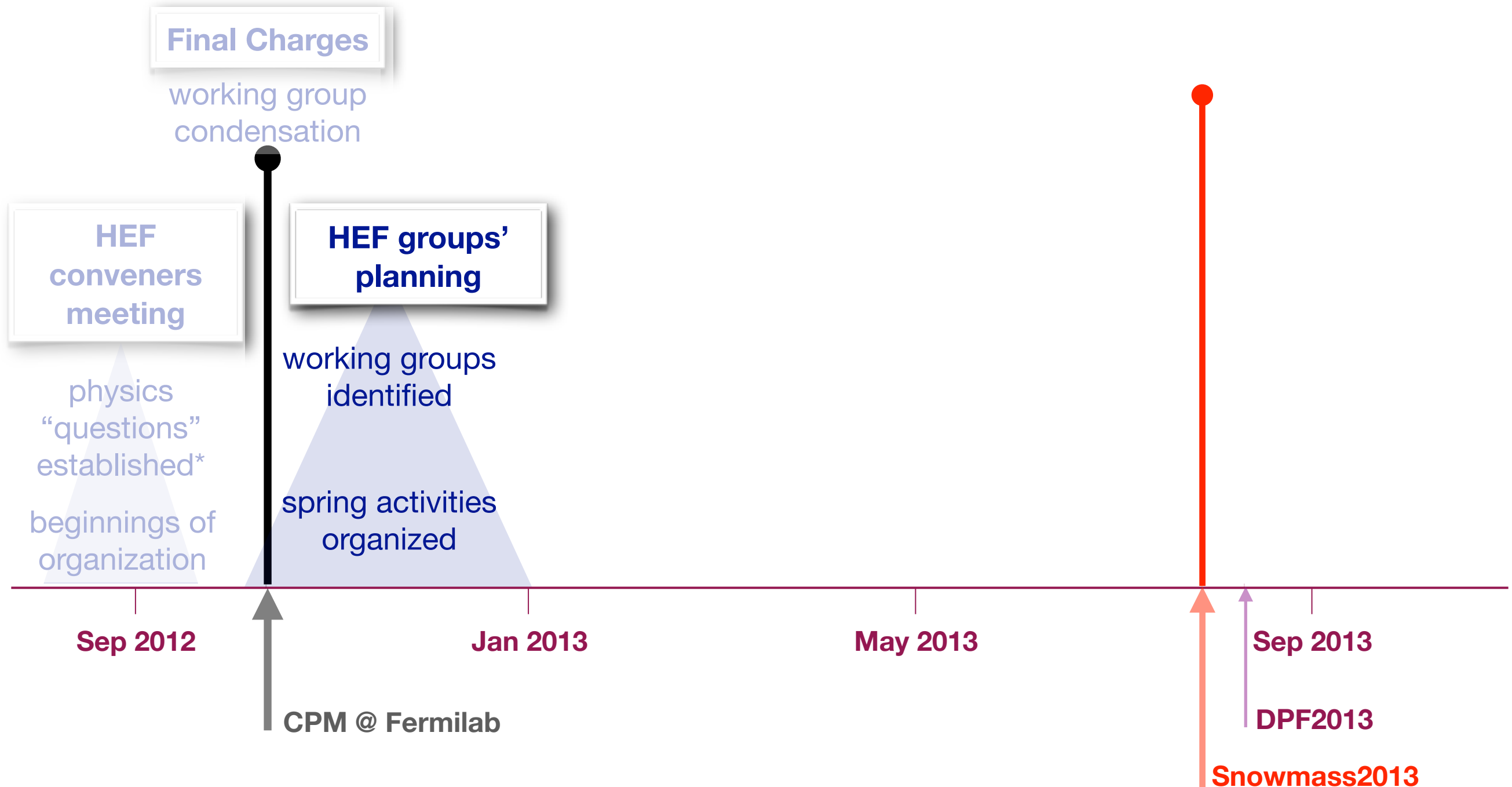
our to-do list

1. work.



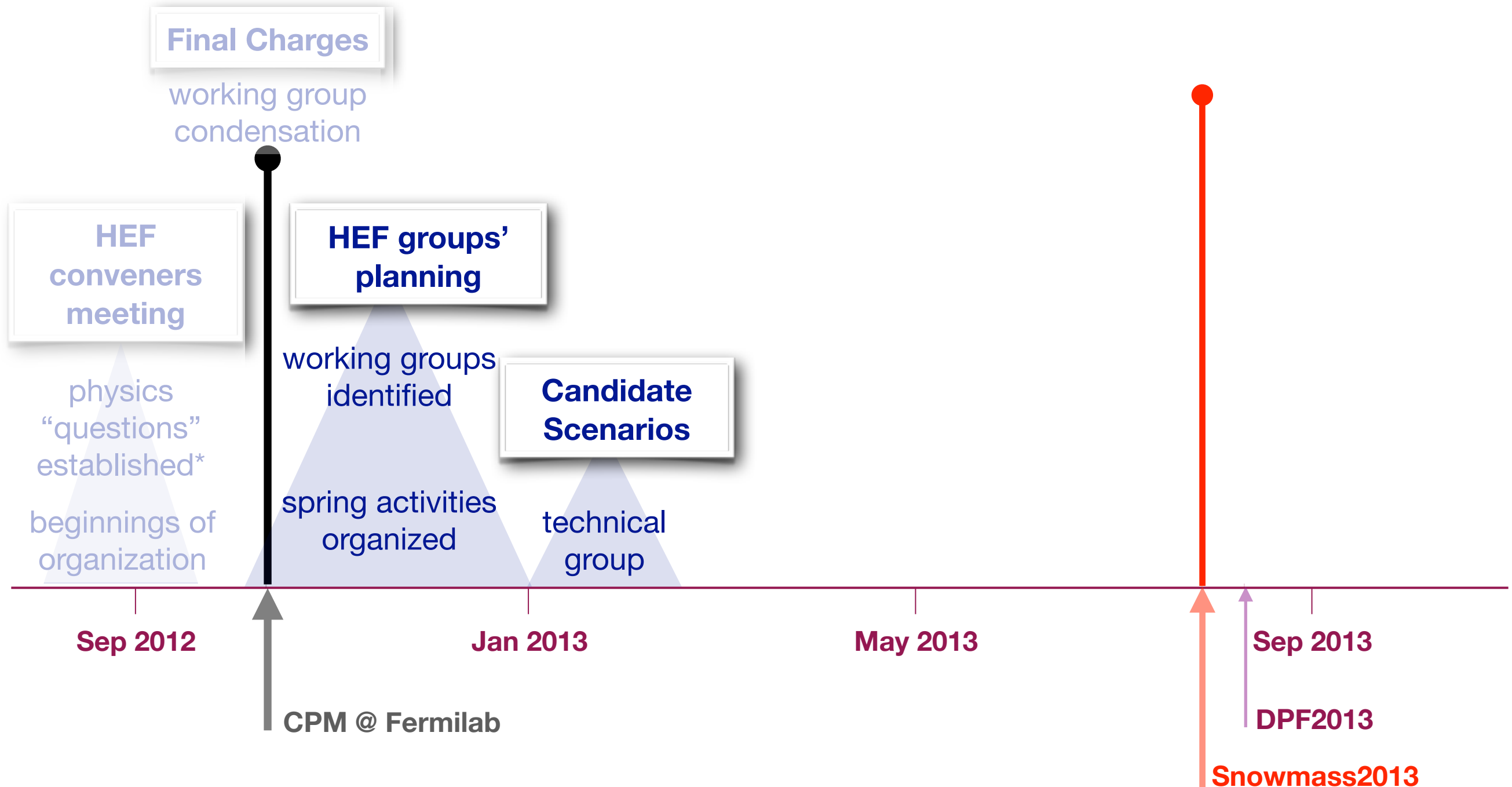
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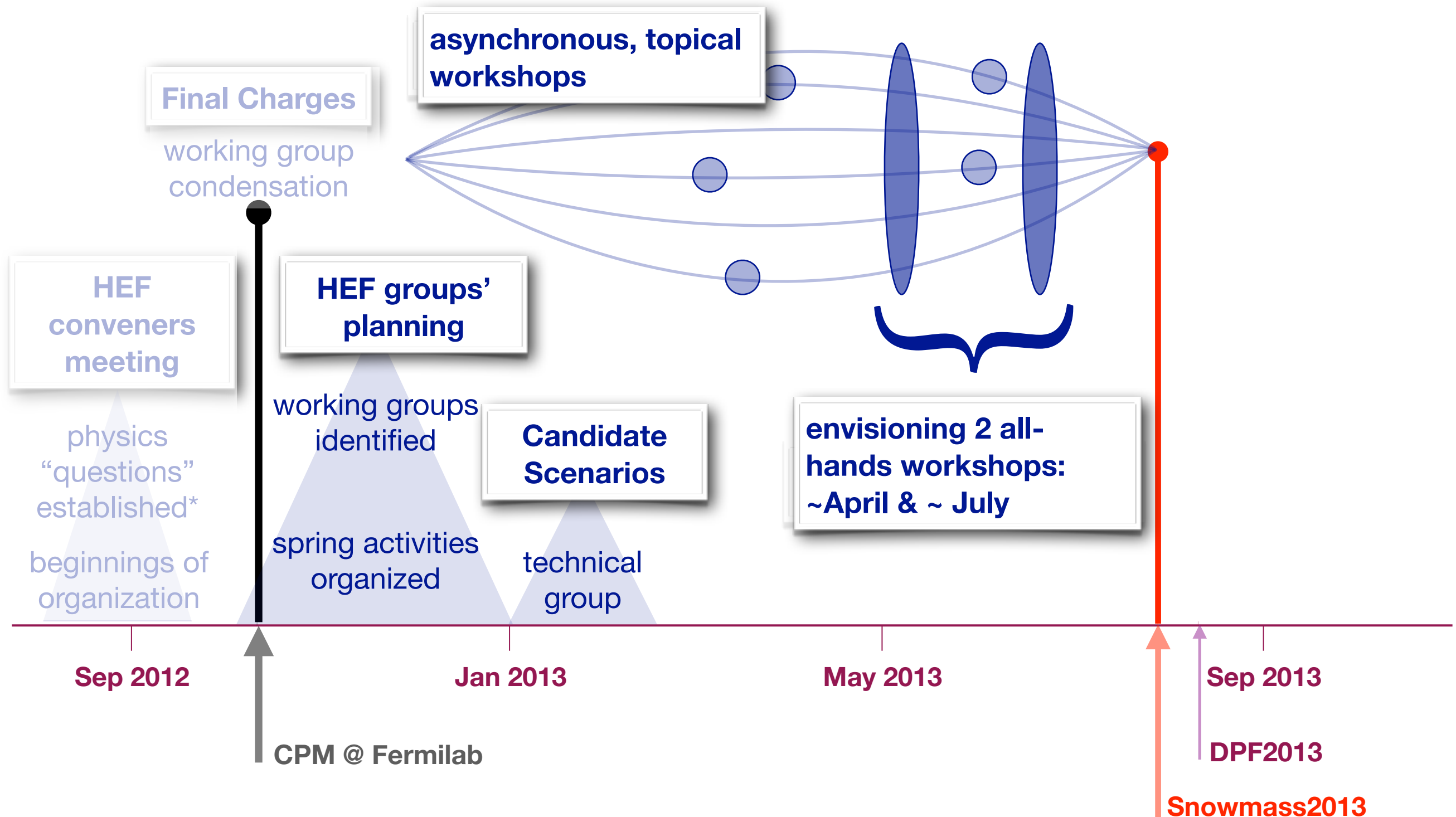
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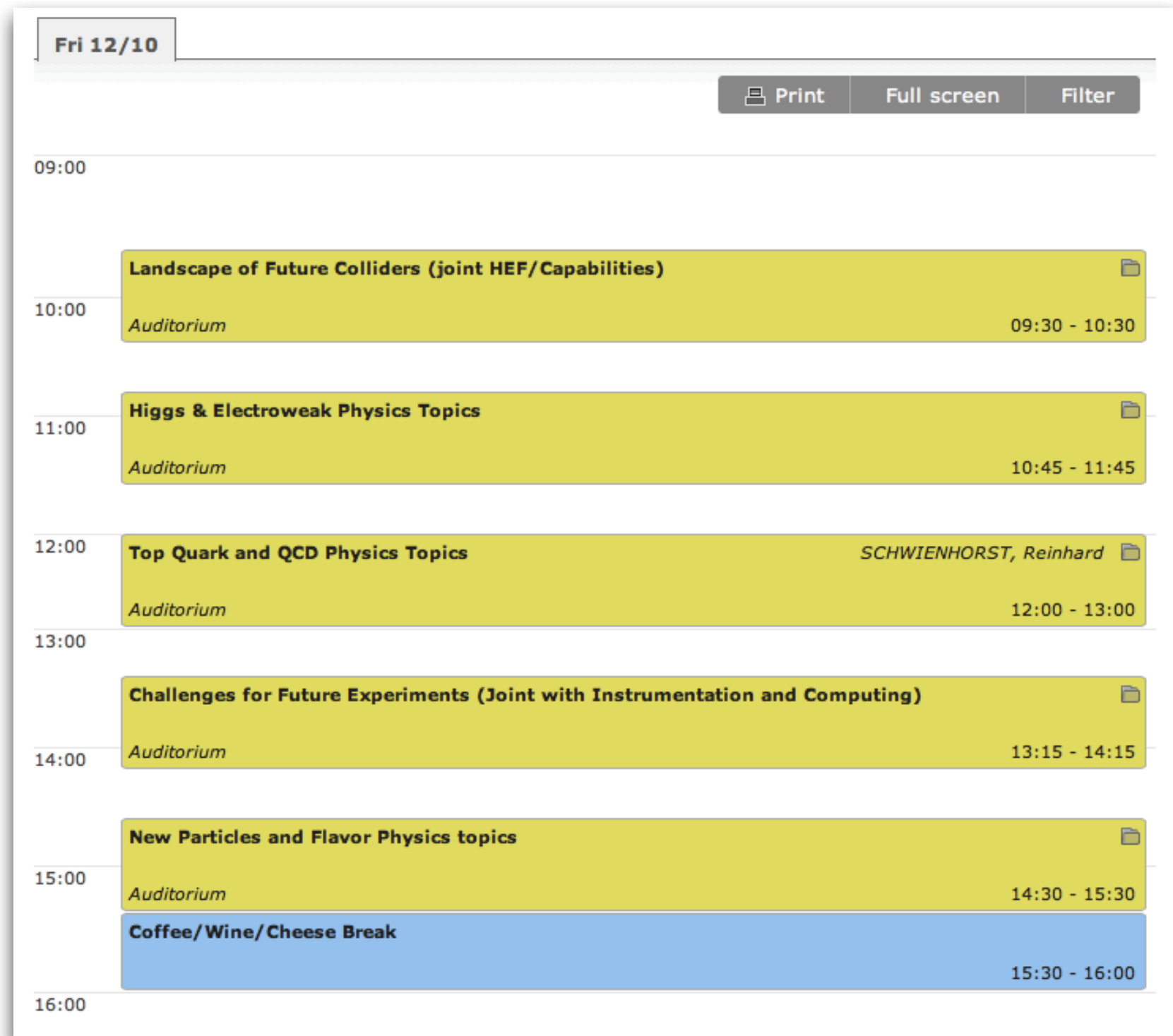
our to-do list

1. work.



Last Friday, lots of organization

all day presentations from conveners



Last Friday, lots of organization

separate evening meetings of all groups

3. Organize a set of simulation studies to Higgs physics measurements for the range capabilities under consideration by the Fa search sensitivities for non-minimal Higgs

- a) To what degree can a particular e at 125-126 GeV is the Standard M measured properties of the Higgs

- Exception is the PDF uncertainty effort to constrain the PDFs within the is 10 MeV at the Tevatron, total M_W un
- We need to address specific PDF degree question:
 - Can we achieve total uncertainty Tevatron? 5 MeV at the LH

- There may be particles that can be prim identified in a flavor (or lepton # or bary violating (or at least non trivial) channel
- classic examples are RPV decays in SU flavor gauge bosons - others??

19:00

20:00

21:00

New Particles
(Chair: Daniel
Whiteson)

Theory
(WH3NE)

Flavor (Chair:
Soeren Prell)

Conjectorium
(WH3NW)

Top Quark
(Chair:
Reinhard
Schwienhorst)

QCD (Chair:
Joey Huston)

Westwing
(WH10W)

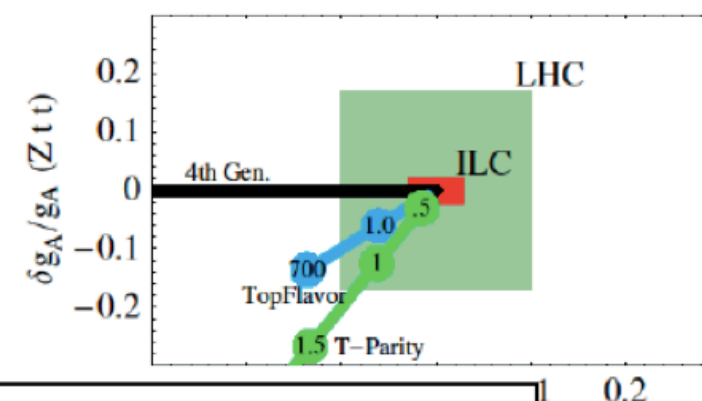
Higgs (Chair:
Chris Tully)

Sunrise
(WH11NE)

Electroweak
(Chair:
Michael
Schmitt)

dependent quantity. Does this ambiguity have an impact on the measurements of the top quark mass at a hadron collider with the current or ultimate precision?

- Lepton collider: study Ztt and γtt couplings



Question 1b

- Once we have the NLO and NNLO calculations, how do we (experimentalists) use them?
- If a theoretical calculation is done, but it can not be used by any experimentalists, does it make a sound? Or create a citation?

(1)

100 TeV

gauge-mediated

5th ED

Little-higgs strong couplings

MODELS

- Higgs

- DM

- SUSY

14 TeV (300/fb)

14 TeV (3000/fb)

33 TeV

100 TeV

Exotic Higgs Decays *

Composite Higgs *

Dark Matter *

SUSY - α_s

- α_{EW} *

Discussion Topics

& TOPICS

(composite, exotic, higgs-toggling)

- Naturalness (top partners)

- Dark Sector (Hidden Valley)

*

*

*

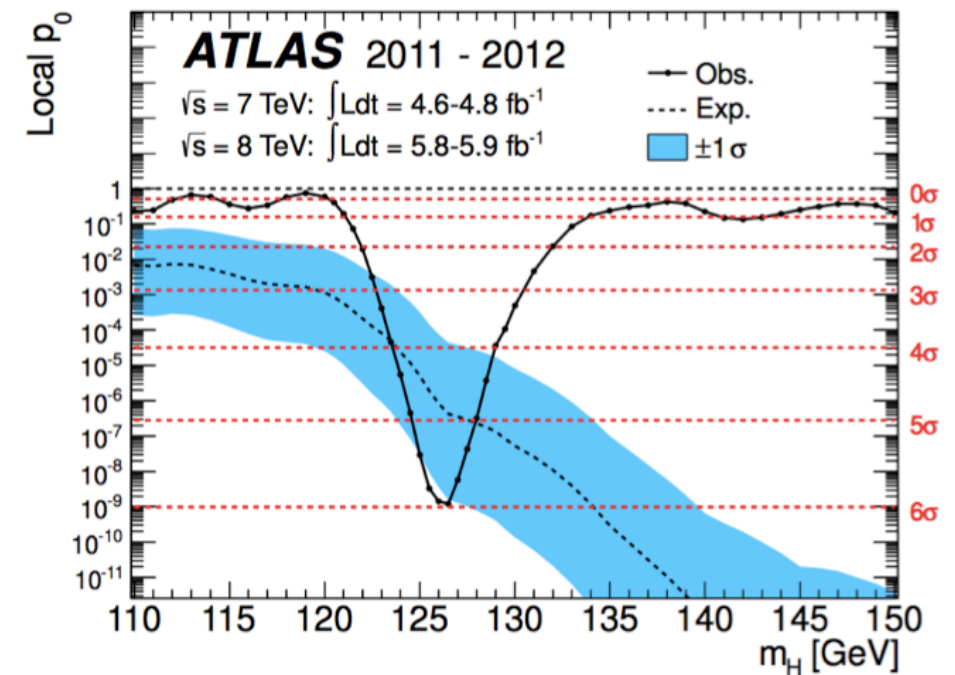
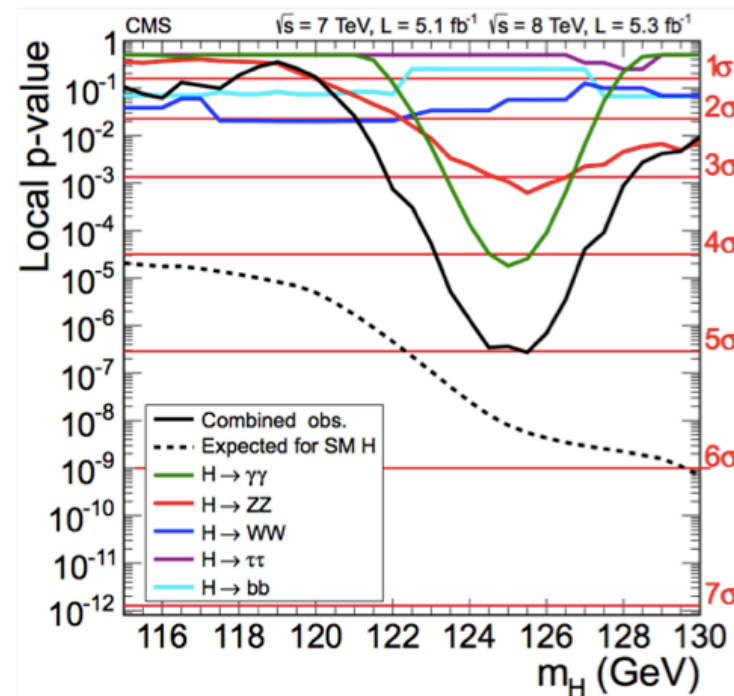
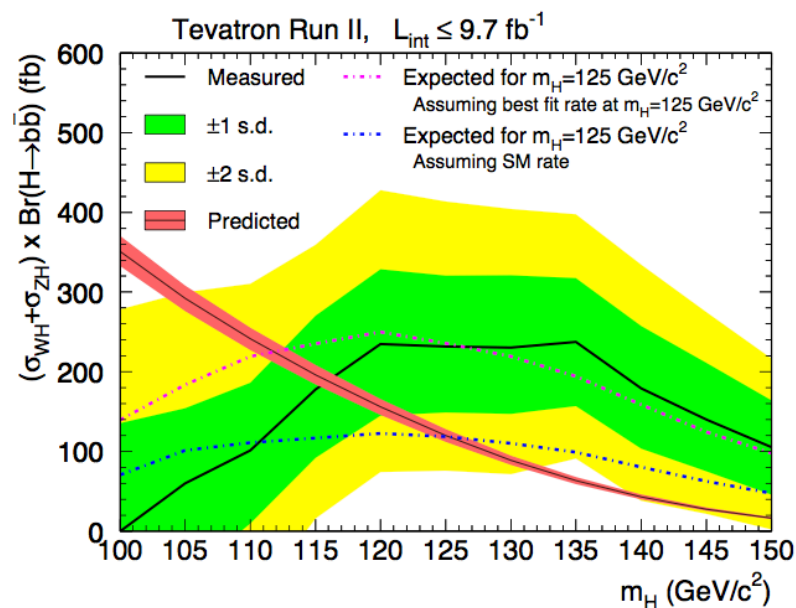
*

*

*

*

everything is in better focus now



and we have to **Follow the Physics**
that's what Snowmass Does

a word of caution:

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There is real misunderstanding about “Snowmass”

somewhere around DC

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There is real misunderstanding about “Snowmass”

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N.B.: “Following the Physics,” worldwide

- *does not mean upending the US “plan”*
- *it does mean acting like scientists*

to understand the future consequences of an amazing year:
the i) Higgs-like thing and ii) θ_{13}

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Then P5 – not us – will add constraints

Conclusions

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Yes. This Snowmass is a big deal

U.S. participation is essential!

European and Asian participation is essential!

For HEF, the Higgs payoff will still be fresh

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Your colleagues need to be involved!

 Find us on
Facebook <http://www.facebook.com/HEFrontier>

 <http://www.snowmass2013.org/>