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

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

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

aspirations, not recommendations

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

“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

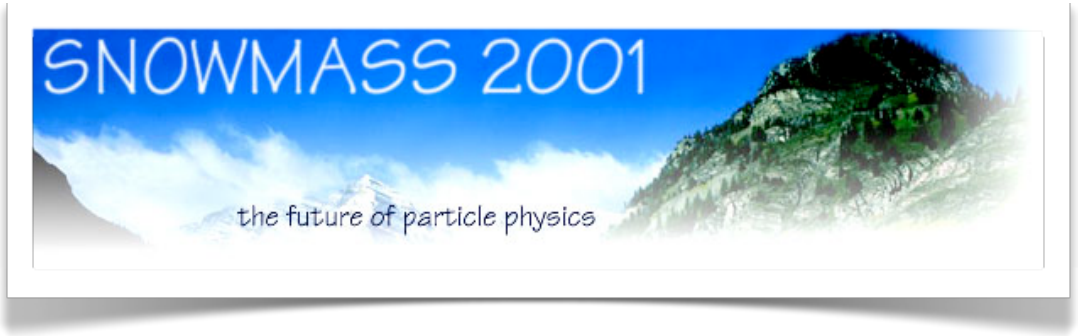
Snowmass ‘94 DPF Summer Study On High-Energy Physics: Particle And Nuclear Astrophysics And Cosmology In The Next Millenium

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.

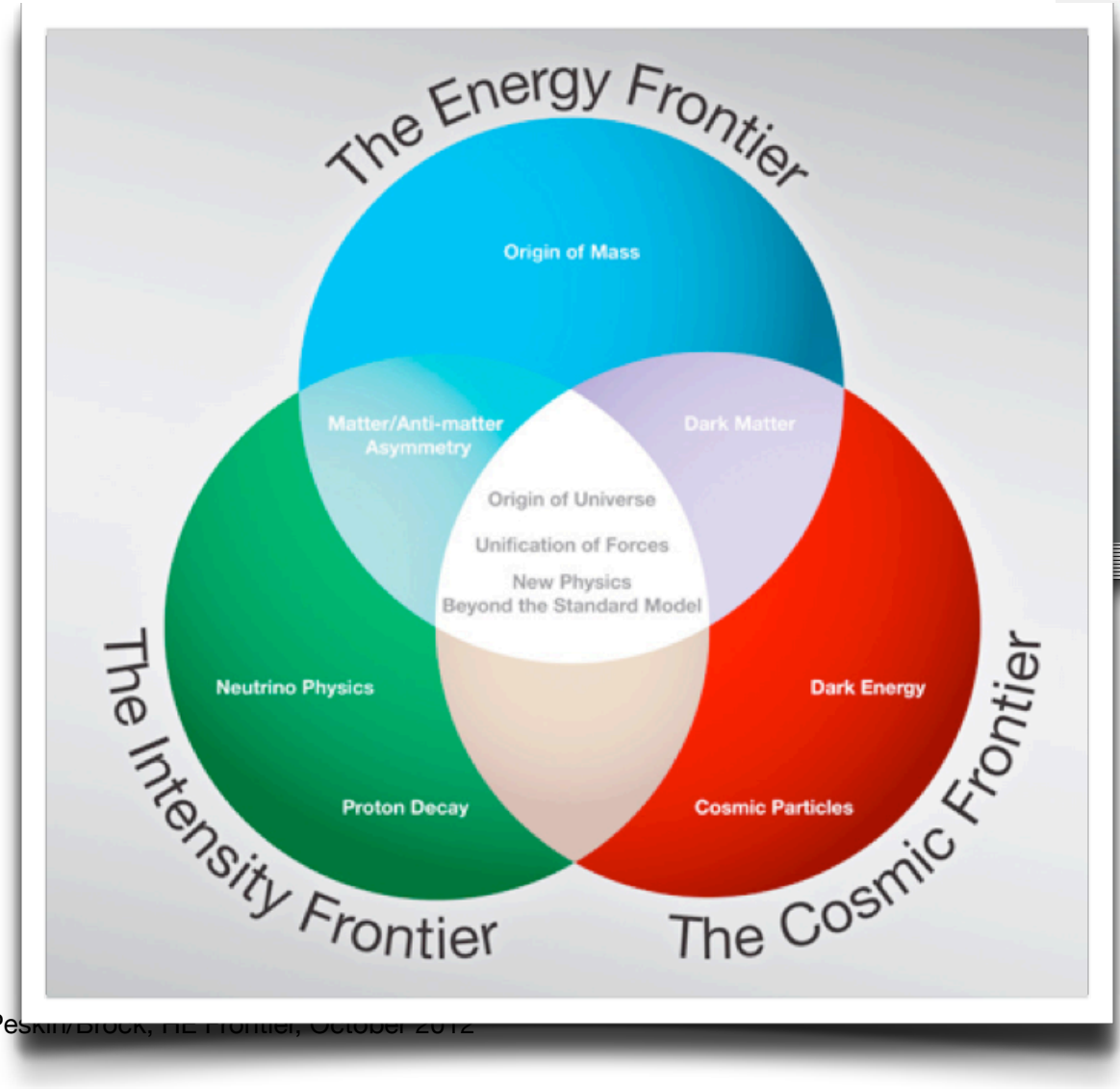
Most recent general meeting, 2001:

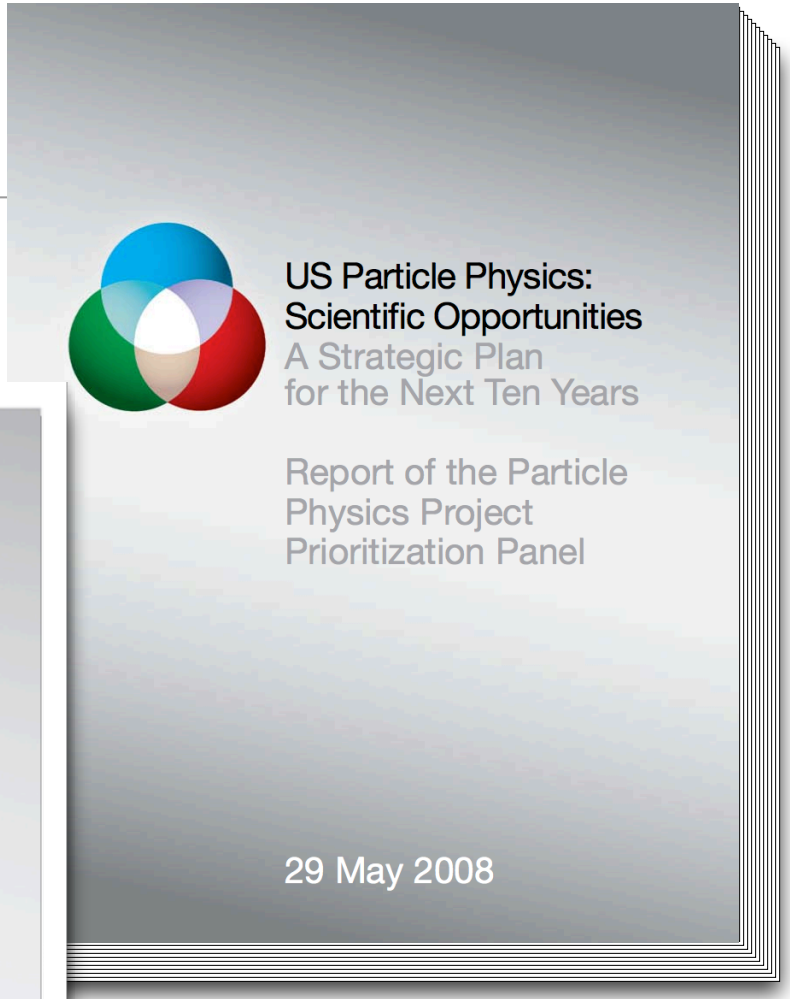


We have a theme

"the circles" were a gift from the 2008 P5

and we're organized around them





We have a wiki

http://www.snowmass2013.org

increasingly active

We have a set of Frontier Groups

Overall Workshop Leadership:

DPF Chair (2012), Pierre Ramond (Florida)

DPF Chair (2013), Jon Rosner (Chicago)

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

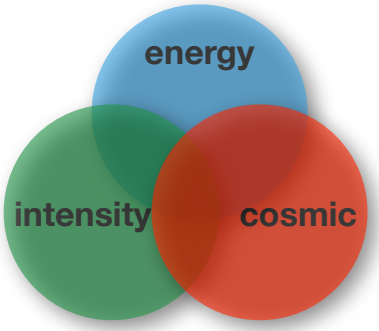
EO: **Education and Outreach** - Marge Bardeen & Dan Cronin- Hennessy

Ideas on Education and Outreach, events for the local community

We are bending the organization

to fit the circles, including overlaps

This is our sentiment:



This is our organizational reality:

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:

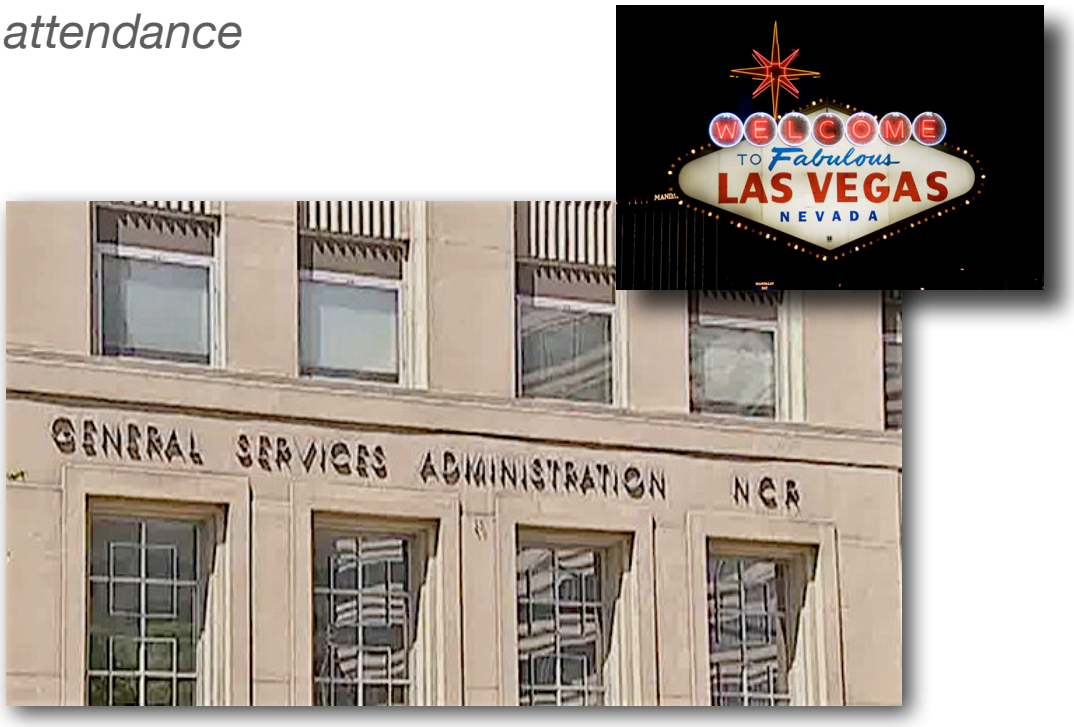
Snowmass shortened from

3 weeks

to 2 weeks

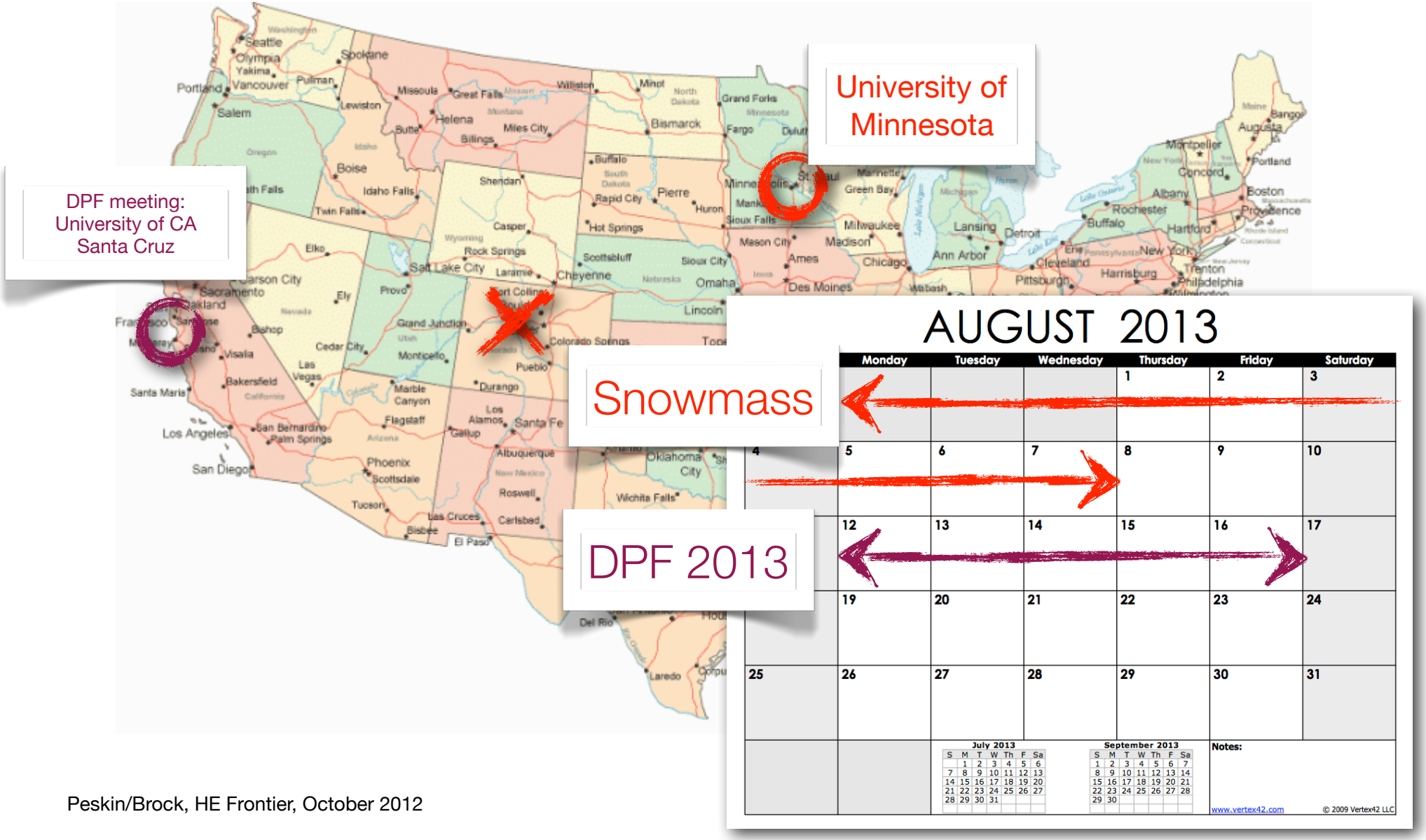
...to 9 days

@ the University of Minnesota

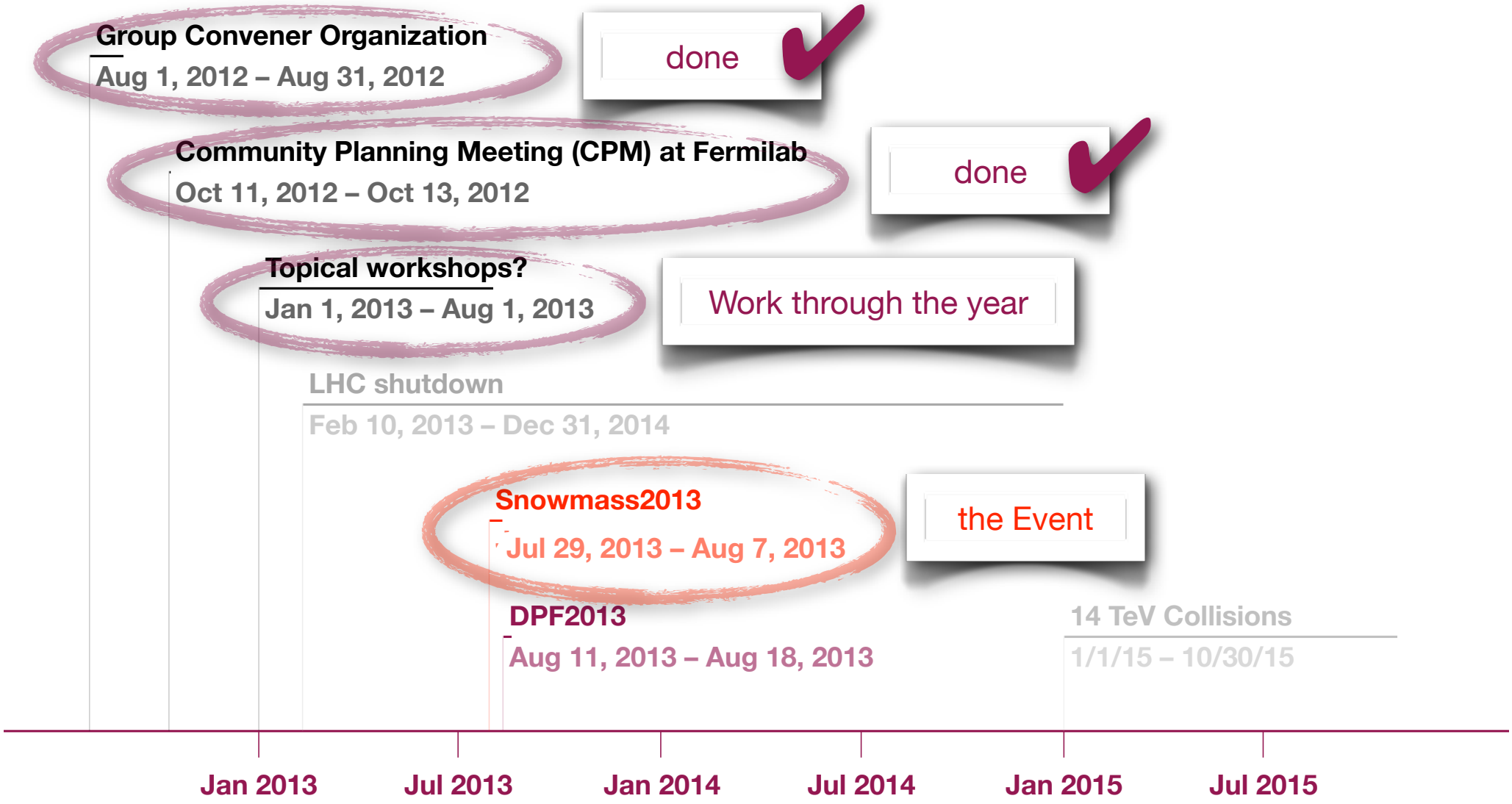


We have two proposals and a schedule

Decision is for the University of Minnesota.



We have a schedule



Snowmass2013 & DPF2013

Discussion, analysis, conclusions

executive summary @ the meeting

each subgroup writes a report

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:

Identified terrific subgroup conveners

most have been meeting together for about a month

Created necessary correlations among groups

Decided on technical "connective tissue" groups

Explicit liaisons between HEF and other frontiers

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

HE1: The Higgs Boson

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

HE2: Precision Study of Electroweak Interactions

Michael Schmitt (Northwestern), Doreen Wackeroth (Buffalo), Ashutosh Kotwal (Duke)

HE3: Fully Understanding the Top Quark

Robin Erbacher (Davis), Reinhard Schwienhorst (MSU),
Kirill Melnikov (Johns Hopkins), Cecilia Gerber (UIC), Kaustubh Agashe (Maryland)

HE4: The Path Beyond the Standard Model–New Particles, Forces, and Dimensions

Daniel Whiteson (Irvine), Liantao Wang (Chicago), Yuri Gershtein (Rutgers), Meenakshi Narain (Brown), Markus Luty (UC Davis)

HE5: Quantum Chromodynamics and the Strong Interactions

Ken Hatakeyama (Baylor), John Campbell (FNAL), Frank Petriello (Northwestern), Joey Huston (MSU)

HE6: Flavor Physics and CP Violation at High Energy

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

HEF broad Goals:

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

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

2. **What are the LHC high luminosity physics goals for**

   ..."Phase 1": circa 2022 with $\int \mathcal{L}\, dt$ of approximately 400 fb^{-1}

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

   How do the envisioned upgrade paths inform those goals?

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

3. **Does a Higgs Boson @ ~125 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 TeV and L = 10^{34} cm^{-2} sec^{-1}* ✔ ✔ ✔ ✔

B. *A luminosity upgraded LHC with: E_{cm} = 14 TeV, L = ~10^{35} $cm^{-2}s^{-1}$* ✔ ✔ ✔

C. *An energy upgraded LHC* !

D. *e+e- lepton colliders E_{cm} < ~1 TeV* ✔ ✔ ✔

E. *A circular e+e- collider operating as a Higgs factory.* !

F. *e+e- or gamma-gamma collider E_{cm} > ~1 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?*

Peskin/Brock, HE Frontier, October 2012

operational: ✔ ✔ ✔ ✔	engineered: ✔ ✔ ✔	under study: ✔
well engineered: ✔ ✔ ✔	well studied: ✔ ✔	gleam in someone's eye: !

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:

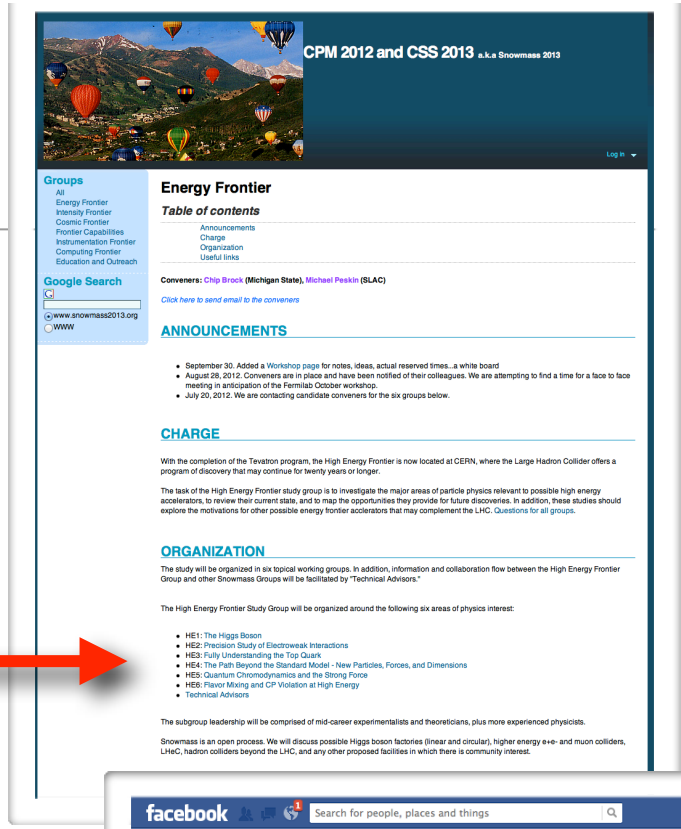
- Evaluate the above goals in the context of Candidate Facilities A-I. (Collaboration with the Facilities Frontier is expected.)
- Are new theoretical or simulation tools (for signal or backgrounds) required in order to achieve the goals?
- What are the detector and computing challenges that the above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

We too have a wiki

http://www.snowmass2013.org

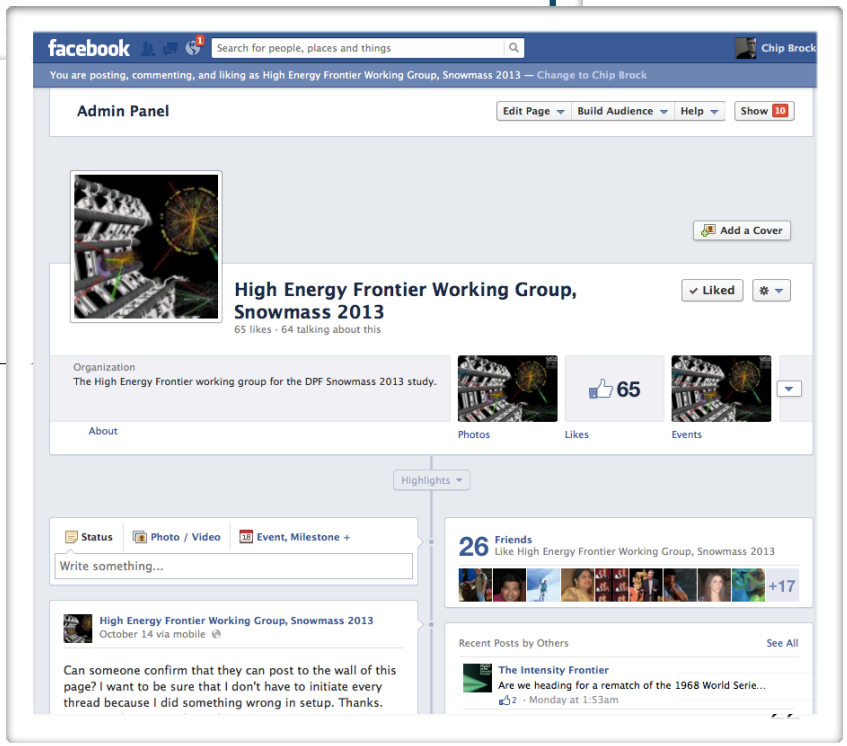
increasingly active

find each group's detailed charges



...and a facebook page

http://www.facebook.com/HEFrontier

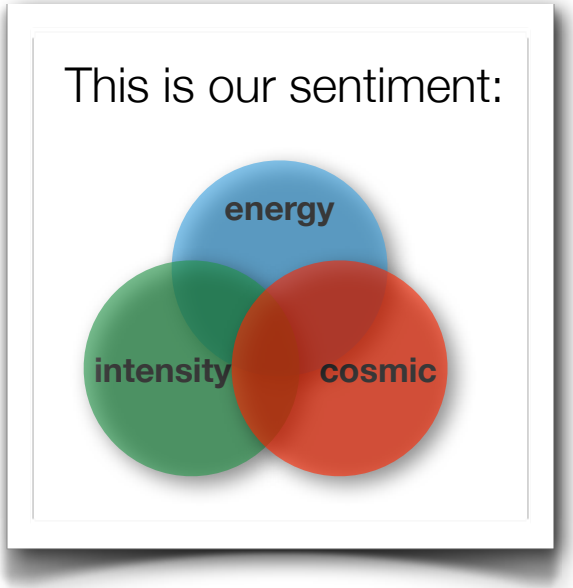


the overlaps

2 kinds of overlaps

Facilities, Instrumentation, and Computing Frontiers

Other Physics Frontiers groups



"technical group"

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

Technical Group:

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

Tor Raubenheimer (SLAC), Eric Prebys (FNAL)

Early in the new year:

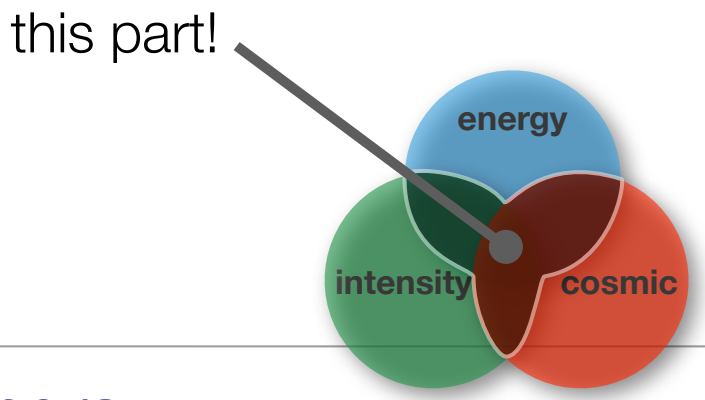
Establishing common benchmark parameters for each Candidate Facility

in support of the physics groups

Throughout the spring and workshop:

Liaison with the Facilities, Instrumentation and Computing Frontier Groups

Physics overlaps



Explicit dual-coverage conveners:

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

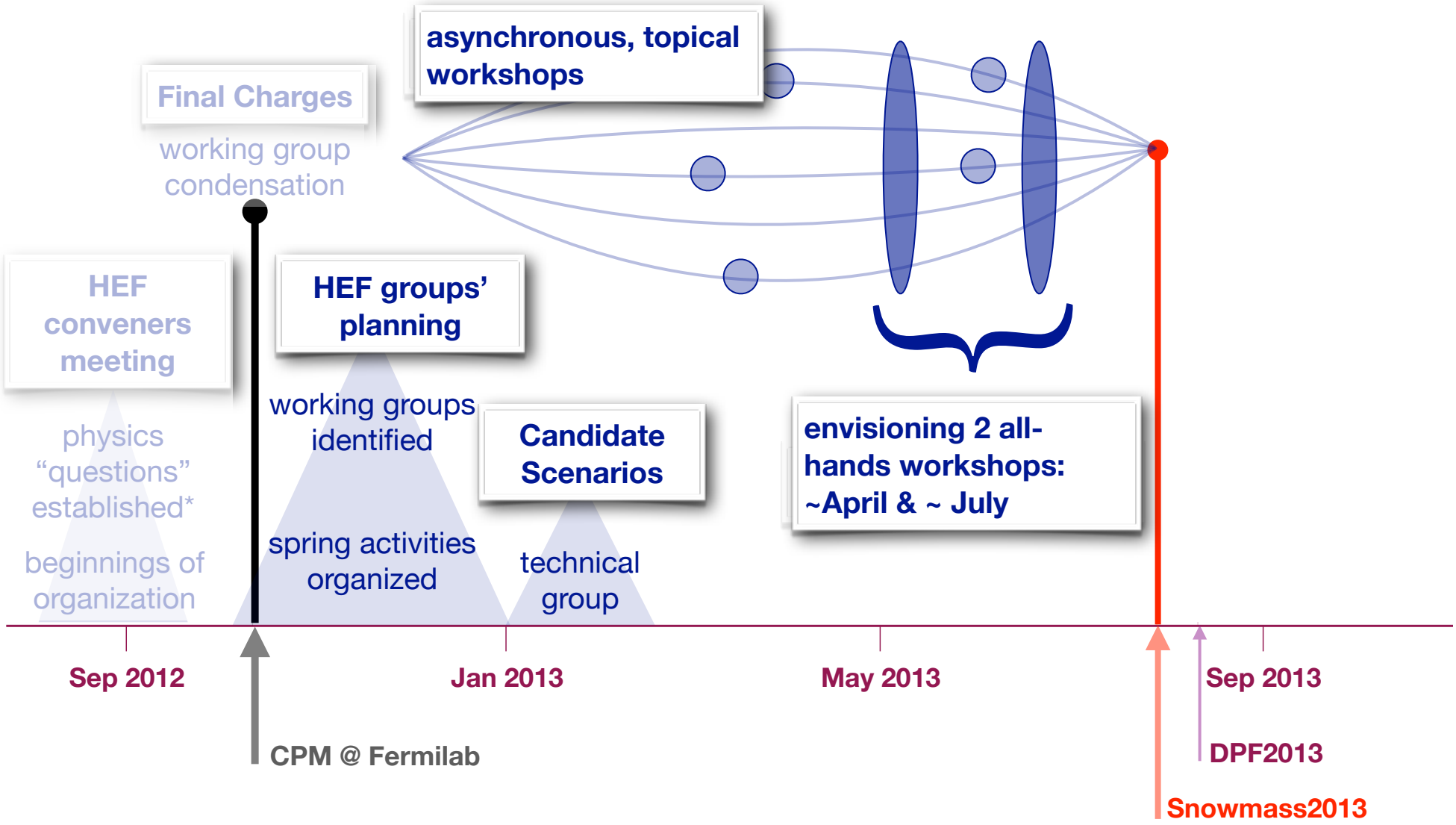
HEF & CF (Baryogenesis): *Michele Papucci & Ann Nelson*

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

3. What's next for the High Energy Frontier

our to-do list

1. work.



Last Friday, lots of organization

all day presentations from conveners

Last Friday, lots of organization

separate evening meetings of all groups

	New Particles (Chair: Daniel Whiteson)	Flavor (Chair: Soeren Prell)	Top Quark (Chair: Reinhard Schwienhorst)	QCD (Chair: Joey Huston)	Higgs (Chair: Chris Tully)	Electroweak (Chair: Michael Schmitt)
19:00						
20:00	*Theory (WH3NE)*	*Conjectorium (WH3NW)*		*Westwing (WH10W)*	*Sunrise (WH11NE)*	
21:00						

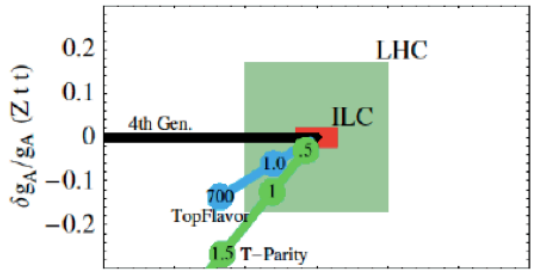
3. Organize a set of simulation studies to
Higgs physics measurements for the range
capabilities under consideration by the Fa
search sensitivities for non-minimal Higgs
a) To what degree can a particular e
at 125-126 GeV is the Standard M
measured properties of the Higgs

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

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

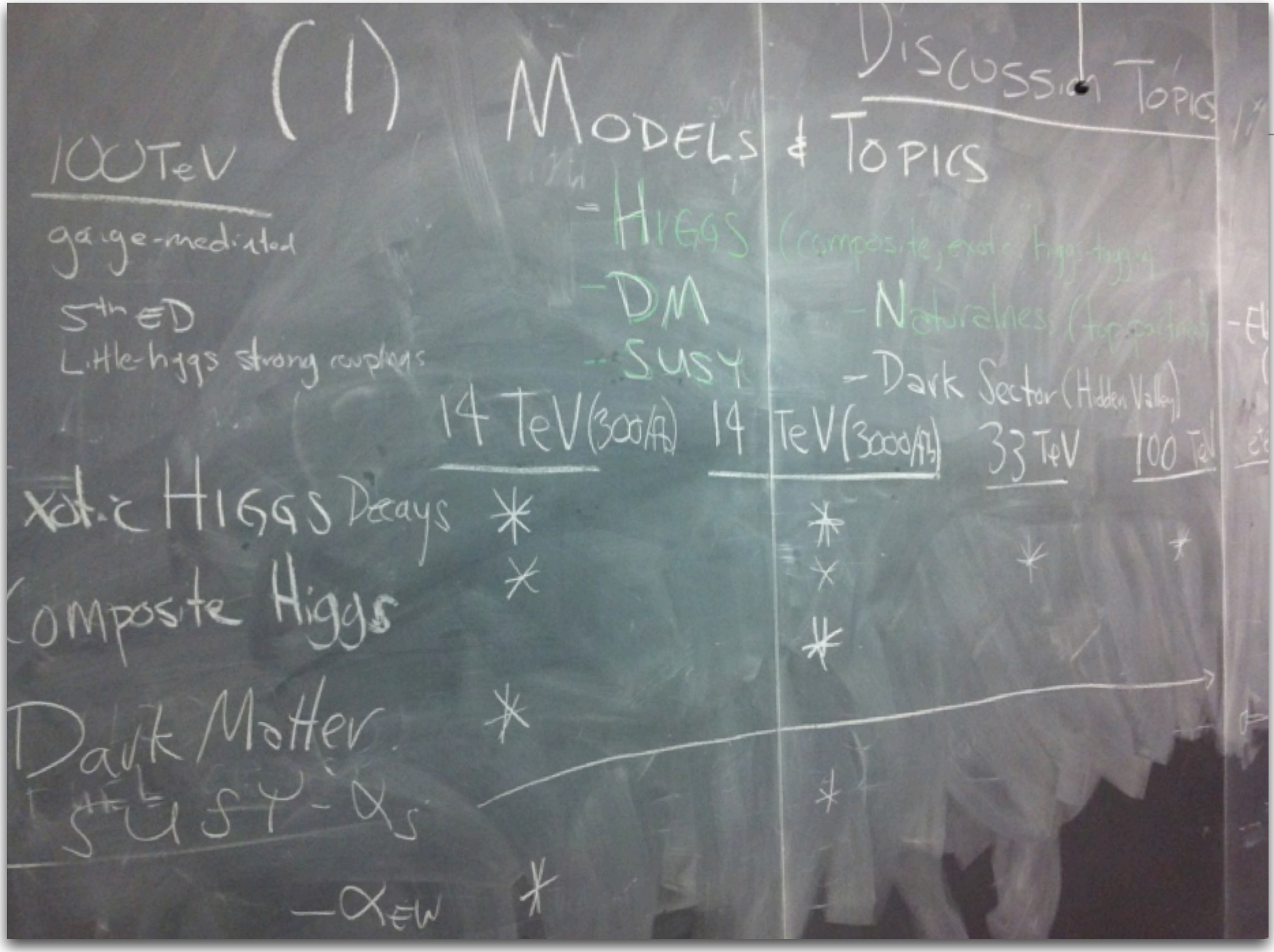
dependent quantity. Does this ambiguity have an impact on the measurements of the top quark mass at a hadron collider with the current or ultimate precision?

- Lepton collider: study Ztt and γtt couplings

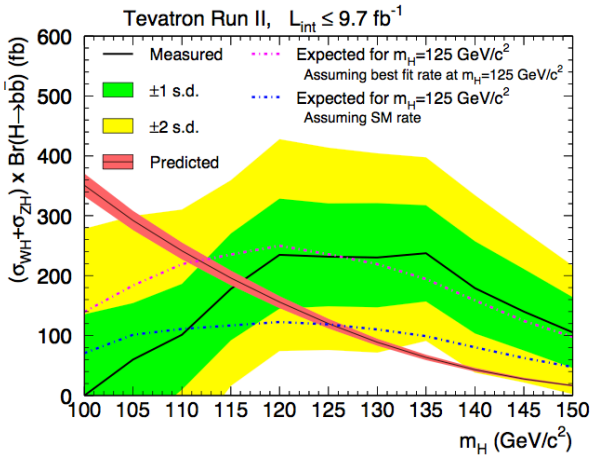


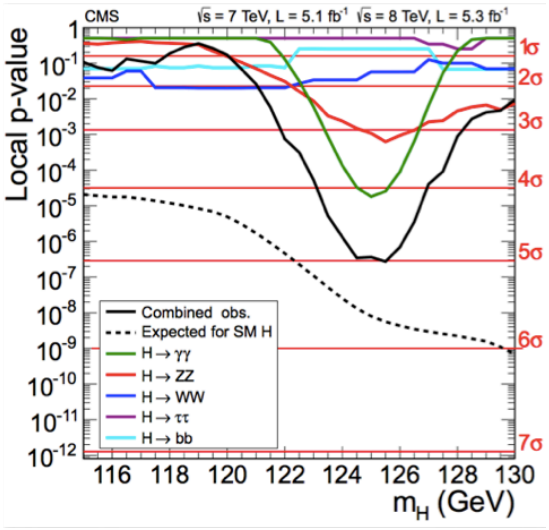
Question 1b

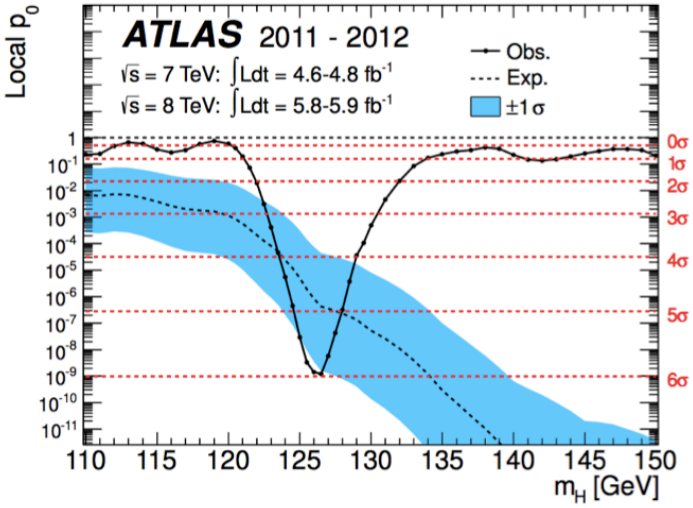
- Once we have the NLO and NNLO calculations, how do we (experimentalists) use them?
- If a theoretical calculation is done, but it can not be used by any experimentalists, does it make a sound? Or create a citation?


(1)
Models & Topics
Discussion Topics
100 TeV
gauge-mediated
5th ED
Little-higgs strong couplings
-Higgs (composite, exotic higgs, ...)
-DM
-SUSY
-Naturalness (top partners)
-Dark Sector (Hidden Valley)
14 TeV (3000/fb)
14 TeV (3000/fb)
33 TeV
100 TeV
exotic Higgs Decays
Composite Higgs
Dark Matter
SUSY-QCD
$-\alpha_{EW}$

everything is in better focus now







and we have to Follow the Physics

*that's what **Snowmass Does***

a word of caution:

There is real misunderstanding about "Snowmass"

somewhere around DC

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}

We need the space to imagine the next ideal steps

***Then* P5 – not us – will add constraints**

Conclusions

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

Snowmass2013 will guide HEPAP Strategic Planning

Your colleagues need to be involved!

http://www.facebook.com/HEFrontier

http://www.snowmass2013.org/