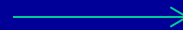


# Report on US Snowmass Community Planning Study



Graham W. Wilson  
Univ. of Kansas

**SNOWMASS** CSS 2013  
ON THE **MISSISSIPPI**  
JULY 29 - AUGUST 6, 2013

ORGANIZED BY THE DIVISION OF PARTICLES AND FIELDS OF THE APS  
HOSTED BY THE UNIVERSITY OF MINNESOTA

**STUDY GROUPS**

- Energy Frontier:
  - Chuj Bekas (Michigan State)
  - Michael Peskin (SLAC)
- Intensity Frontier:
  - Johnnie Hewett (SLAC)
  - Nancy Wheeler (Argonne)
- Cosmic Frontier:
  - Jonathan Feng (University of California, Irvine)
  - Steve Fitz (University of California, Santa Cruz)
- Frontier Capabilities:
  - William Barletta (MIT)
  - Madhukar Chhethan (SLAC)
- Instrumentation Frontier:
  - Isabel Dominguez (Argonne)
  - Howard H. Robertson (MIT, Rutgers)
  - Ron Lopez (Fermilab)
- Computing Frontier:
  - Lanlan Bawwrick (Fermilab)
  - Shawn Gerbasi (Indiana)
- Education and Outreach:
  - Elaine Barbeau (Fermilab)
  - Dan Corbett-Hessoney (Minnesota)
- Theory Panel:
  - Michael Dine (University of California, Santa Cruz)

**LOCAL ORGANIZING COMMITTEE**

- Maria Elena Corradi (Fermilab and University of Chicago)
- Dan Corbett-Hessoney (Minnesota, Chair)
- Priscilla Coleman (Minnesota)
- Lisa Everett (Minnesota)
- Alex Habbig (Minnesota, Duluth)
- Ken Helmer (Minnesota)
- Jody Kaplan (Minnesota)
- Toshi Kobayashi (Minnesota)
- Jeremy Meiss (Minnesota)
- Bridget McCoy (Minnesota)
- Manny Moshir (Minnesota)
- Jarek Nowak (Minnesota)
- Keith Olive (Minnesota)
- Gregory Pawlowski (Minnesota)
- Ron Pieling (Minnesota)
- Maria Palosa (Minnesota)
- Yongsheng Qian (Minnesota)
- Roger Rosack (Minnesota)
- Wesley Smith (Wisconsin)

**DPF EXECUTIVE COMMITTEE**

- Chair: Jonathan Power (University of Chicago)
- Chair-Elect: Ian Shipsey (Purdue University)
- Vice Chair: Rebecca Hadley (University of Maryland, College Park)
- Panel Chair: Pierre Renaud (University of Florida, Gainesville)
- Secretary/Treasurer: Howard Haber (University of California, Santa Cruz)
- Councilor: Stephen Casanova (Rice University)

**Members at Large**

- Jonathan Feng (University of California, Irvine)
- Lynne Ong (University of Rochester)
- Vivi Gerbasi (Rutgers University)
- Alvaro Vazquez (University of Illinois, Chicago)
- Robert Bernstein (Fermilab)
- Sally Seidel (University of New Mexico)

APS University of Minnesota

WWW.SNOWMASS2013.ORG

POSTER DESIGN BY  
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# What is Snowmass

- Community Summer Study organized by Division of Particles and Fields (DPF) and DPB of the American Physical Society (APS)
- Google “CSS 2013”
- Recent HEPAP meeting (Sept 5<sup>th</sup> 2013)
- Document the aspirations of the field (not in itself a prioritization process).

# Snowmass

- Particle physics research in the United States has been a vibrant field since the middle of the past century. In the past thirty years the particle physics community has gathered periodically at Snowmass, Colorado, to take stock of its progress and chart its future. The last such meeting was held in 2001.
- In 2011, with the expected discovery of the Higgs Boson and the likelihood of advances in neutrino physics, the Division of Particles and Fields of the American Physical Society decided that the time was ripe for another "Snowmass" gathering.
- Preparatory meetings during 2012 and 2013 were launched by a Community Planning Meeting at Fermilab, October 11--13, 2012.
- The Community Summer Study ("known as Snowmass") meeting was held on the campus of the University of Minnesota, July 29 -- August 6, 2013.
  - This meeting brought together nearly 700 physicists to identify the critical research directions for the United States particle physics program and was the culmination of intense work over the past year that defined the most important questions for this field and identified the most promising opportunities to address them.

## Snowmass Process

- "Snowmass on the Mississippi" (the 2013 Community Summer Study) has been designed to address the questions the particle physics community wishes to answer over the next two decades, and how we plan to answer them.
- While we do not prioritize activities, our aim is to ask and answer hard questions. A subsequent prioritization panel with broad community representation will place these questions and answers within realistic budgetary scenarios.
- Our aim has been to produce a report, of length and emphasis similar to the Physics Briefing Book (2012) of the European Strategy Group, which such a panel will find useful in its deliberations.
- We also hope to convey the health and diversity of the U.S. program, in a global context, to our colleagues and fellow citizens.
- Although we found it convenient to retain the "frontier" categories of the previous P5 ("Particle Physics Project Prioritization Panel"), whose last report was issued in 2008, the division of the field into such categories should not obscure our focus on fundamental questions of physics, which, by their nature, cross such frontiers. These inter-frontier discussions have been a major component of the meeting in Minneapolis.

# Snowmass Working Groups

- **Conveners of “Frontiers”**



- **Energy:** Chip Brock, Michael Peskin
- **Intensity:** JoAnne Hewett, Harry Weerts
- **Cosmic:** Jonathan Feng, Steve Ritz
- **Instrumentation:** M. Demarteau, Ron Lipton, H. Nicholson
- **Facilities (“Capabilities”):** Bill Barletta, Gil Gilchriese
- **Computation:** Lothar Bauerdick, Steve Gottlieb
- **Education and Outreach:** Marge Bardeen; Dan Cronin-Hennessy
- **Theory:** Michael Dine

- **Subgroups:**

- Each group has several subgroups;  
see <http://www.snowmass2013.org> for details

# Intense Preparation

- **Snowmass was a process, not just one meeting.**
  - “By failing to prepare, you are preparing to fail.” Benjamin Franklin
  - There was a lot of preparation.
  - A sample of some of the working group meetings (Frontiers)

Group	Date(s) in 2013	Location(s)	Subject(s)
Energy	Jan 14-15	Princeton	Higgs Working Group
	Jan 14-16	UC Irvine	New Particles Working Group
	Feb 18-20	Duke Univ.	Electroweak Working Group
	Apr 3-6	Brookhaven	General meeting
	May 13-15	Fla. State	QCD Group
	May 29-31	KITP, UCSB	Theory: Joint with IF, CF, KITP programs
	Jun 30 - Jul 3	Univ. Wash.	General meeting after Lepton-Photon
See Energy Frontier Snowmass 2013 web page for other related workshops			
Intensity	February 13-15	Fermilab	Electric dipole moments
	March 6-7	SLAC	Neutrino (with Cosmic, DURA)
	April 25-27	ANL	General; with Project X
Cosmic	March 6-8	SLAC	With Capabilities, AARM (Mar. 4), DURA (Mar. 5)
	Mar 22-25	Snowbird	Non-WIMP dark matter
	May 29-31	KITP (UCSB)	Joint CF/EF/IF (see EF above)
Members of the Cosmic Frontier participated in other meetings in 2013 as well.			

# EF working groups

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## **EF1: The Higgs Boson**

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

## **EF2: Precision Study of Electroweak Interactions**

→ Michael Schmitt (Northwestern), Doreen Wackerroth (Buffalo), Ashutosh Kotwal (Duke)

## **EF3: Fully Understanding the Top Quark**

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

## **EF4: 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)

## **EF5: Quantum Chromodynamics and the Strong Interactions**

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

## **EF6: Flavor Physics and CP Violation at High Energy**

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

# candidate accelerator parameterizations

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**5 pp colliders,  $(E_{cms}; \int \mathcal{L} dt) =$**

pp(14; 300, 3000), (33; 3000), (100, 3000) TeV, fb<sup>-1</sup>

**9 lepton colliders,  $(E_{cms}; \int \mathcal{L} dt) =$**

Lin ee\*: (250; 500), (500;500), (1000;1000) (1400;1400) GeV, fb<sup>-1</sup>

Cir ee: (250; 2500), (350,350) GeV, fb<sup>-1</sup>

$\mu\mu$ : (125; 2), (1500; 1000), (3000, 3000) GeV, fb<sup>-1</sup>

$\gamma\gamma$ : (125; 100), (200; 200), (800, 800) GeV, fb<sup>-1</sup>

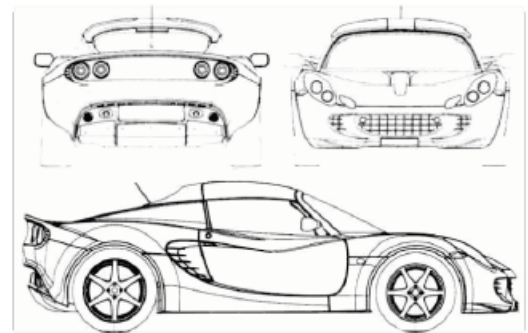
**1 ep collider,  $(E_{cms}; \int \mathcal{L} dt) =$  e/p: (60/7000; 50) GeV / GeV, fb<sup>-1</sup>**

\* incl polarization choices



# the Proposal Frontier

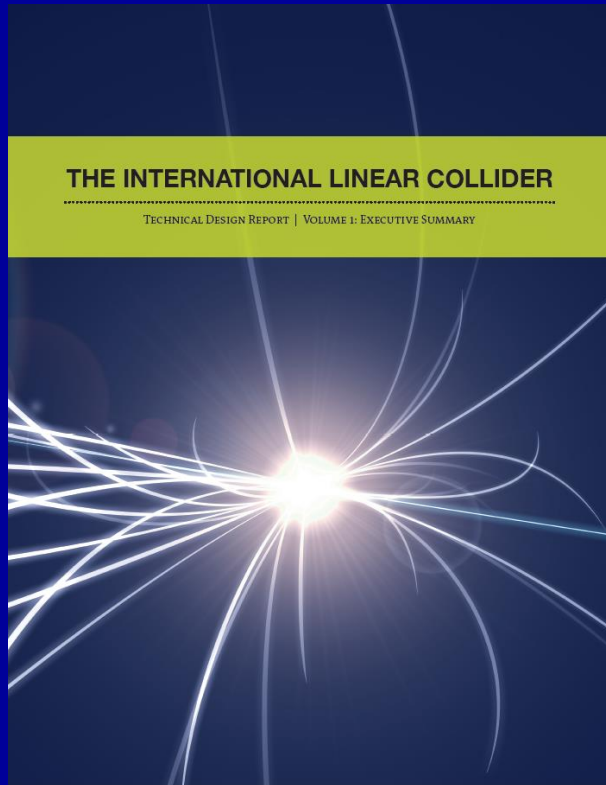
<b>LHC</b> 100/fb	<b>LHC</b> 300/fb	<b>LHC</b> 3/ab	<b>ILC</b> 250- 500GeV	<b>ILC</b> 1TeV	<b>CLIC</b> >1TeV	<b>MC</b>	<b>TLEP</b>	<b>VLHC</b>
years beyond TDR	TDR	LOI	TDR	TDR	CDR			



Brock/Peskin Snowmass 2013

People got the message that ILC is the machine to consider today

# ILC



Wide appreciation of the enormous preparation of the ILC project – and its technical readiness for a decision to move forward.

Extensive documentation and participation by the ILC community helped a great deal to inform a broader community.

# Snowmass Reports

- Extensive contributions from ILC community to the Physics Groups.
- Reports are being finalized.
- Executive summary expected to recognize ILC as a unique, compelling and ready scientific opportunity.
- Contributed White Papers from the ILC community.
- Snowmass Reports will inform the prioritization process (P5)

# P5

## P5 Composition

- **Composition:**

- **Members chosen for their combination of expertise and broad view of field**
  - Solicited nominations widely; ~800 nominations, for ~400 individuals
  - Consulted widely, including SR, agencies
- **Composition intended to cover range of expertise and roughly reflect demographics of field**
- **Size chosen as optimal for efficacy, considering above**

**Steve Ritz** (UCSC) - **chair**

**Marty Briedenbach** (SLAC)

**Bob Cousins** (UCLA)

**Andre de Gouvea** (Northwestern)

**Marcel Demarteau** (ANL)

**Scott Dodelson** (FNAL/Chicago)

**Bonnie Fleming** (Yale)

**Fabiola Gianotti** (CERN)

**Francis Halzen** (Wisconsin)

**JoAnne Hewett** (SLAC)

**Wim Leemans** (LBNL)

**Joe Lykken** (FNAL)

**Dan McKinsey** (Yale)

**Lia Merminga** (TRIUMF)

**Toshinori Mori** (Tokyo)

**Tatsuya Nakada** (Lausanne)

**Steve Peggs** (BNL)

**Saul Perlmutter** (Berkeley)

**Kevin Pitts** (Illinois)

**Kate Scholberg** (Duke)

**Rick van Kooten** (Indiana)

**Mark Wise** (Caltech)

**additional member - TBC**

**Andy Lankford** (UCI) – *ex officio*

**possible additional *ex officio* members**

(*e.g.* writing assistance)

# P5 Charge

## Charge: Deliverables (1)

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- “...develop an updated strategic plan for U.S. high energy physics that can be executed over a 10-year timescale, in the context of a 20-year global vision for the field.”
- “...an assessment of the current and future scientific opportunities over the next 20 year period.”
- “...a critical examination of the investments...to ensure the vitality, scientific productivity, and discovery potential of U.S. high energy physics research...”
  - “...examine current, planned, and proposed U.S. research capabilities and assess their role and potential for scientific advancement;
  - assess their uniqueness and relative scientific impact in the international context; and
  - **estimate** the time and resources (facilities, personnel, R&D and capital investments) needed to achieve their goals...technical readiness and feasibility...”
- “...consider the appropriate balance of small, mid-scale, and large experiments and identify, where possible, multiple or complementary pathways to address the important scientific questions.”

## Charge: Deliverables (2)

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- *“...examine the need to maintain a healthy and flexible domestic infrastructure so that the U.S. high energy physics program can deliver science results regularly throughout the coming decade.”*
- *“...include an explicit discussion of the extent to which it is necessary to construct, maintain, and/or upgrade leading domestic HEP facilities in order to maintain a leadership position in this global scientific effort, while at the same time maintaining a healthy balance that preserves essential roles and contributions for national laboratories and universities and enables opportunities for global coordination of large initiatives.”*

## Charge: Deliverables (3)

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- *“...articulate...the approximate overall level of support that is needed in the HEP core research and advanced technology R&D programs to achieve these opportunities in the various scenarios.”*
- *“...provide a detailed perspective on whether and how the pursuit of possible major international partnerships (such as LHC upgrades, Japanese-hosted ILC, LBNE, etc.) might fit into the program...in each of the scenarios.”*

# Summary

- The year-long Snowmass process is wrapping up. (proceedings due Sept 30th).
- ILC was well represented in a complex, multi-location, bottom-up organization.
- P5 expected to give due consideration to ILC hosted in Japan
- Encouraging signs of more support in the US for ILC.