# *Why We Are Here*

Chris Quigg
*DPF / Fermilab*

Summer Study on the Future of Particle Physics

Snowmass · June 30, 2001

# *Welcome!*

More than 1000 participants . . .

More than 80 students . . .

More than 200 “young” . . .

More than 150 from outside US . . .

# *Thanks!*

DOE · NSF · NASA
DPF · DPB · IEEE / NPSS

Argonne National Lab
Berkeley Lab
Brookhaven National Lab / Brookhaven Science Associates
Cornell University / LNS / Wilson Synchrotron Lab
Fermilab / Universities Research Association
Jefferson Laboratory / SURA
Lawrence Livermore National Laboratory
Los Alamos National Laboratory
Oak Ridge National Lab / Spallation Neutron Source
Stanford Linear Accelerator Center / Stanford University

# Thanks to the Organizing Committee

## Particle Physics

Chris Quigg (DPF)
Sally Dawson (BNL)
Paul Grannis (Stony Brook)
David Gross (ITP/UCSB)
Joe Lykken (Fermilab)
Hitoshi Murayama (Berkeley)
René Ong (UCLA)
Natalie Roe (LBNL)
Heidi Schellman (Northwestern)
Maria Spiropulu (Chicago)

## Accelerators & Technology

Ron Davidson (DPB; PPPL)
Alex Chao (SLAC)
Alex Dragt (Maryland)
Gerry Dugan (Cornell)
Norbert Holtkamp (SNS)
Chan Joshi (UCLA)
Thomas Roser (BNL)
Ron Ruth (SLAC)
John Seeman (SLAC)
Jim Strait (Fermilab)

**the Local Organizing Committee . . . and the Convenors**

# *Surviving Snowmass 2001*

Altitude 2670 meters / 8764 feet . . .

Don't overdo . . . Go easy for first few days

Eat lightly, drink plenty of (NA) liquids

Get plenty of sleep · Listen to your body

Sunglasses! Sunscreen! PM storms!

# OXYGEN TO GO!

MAXIMIZE YOUR VACATION TIME. . . TRY BREATH OF LIFE OXYGEN

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*From the 1898–99 University of Chicago catalogue:*

"While it is never safe to affirm that the future of the Physical Sciences has no marvels in store even more astonishing than those of the past, it seems probable that most of the grand underlying principles have been firmly established and that further advances are to be sought chiefly in the rigorous application of these principles to all the phenomena which come under our notice .... An eminent physicist has remarked that the future truths of Physical Science are to be looked for in the sixth place of decimals."

# A Decade of Discovery Ahead . . .

- ▷ Higgs search and study; elucidate EWSB / 1-TeV scale
- ▷ CP violation in the $B$ system; Rare decays ($K$, $D$, . . . )
- ▷ Neutrino oscillations
- ▷ Top as a tool
- ▷ New phases of matter; hadronic physics
- ▷ Exploration!
  Extra dimensions / new dynamics / SUSY / new forces & constituents
- ▷ Proton decay
- ▷ What kinds of matter and energy make up the universe?
- ▷ Particle astrophysics and astronomy; precision cosmology; astroparticles

# . . . and Many Imaginative Ideas

- Refining known technologies to accelerate and collide electrons, protons, pushing the frontiers of energy, sensitivity, precise control

  brighter proton sources
  very-high-luminosity $e^+e^-$ "factories" for $B$, $\tau$ / charm, $\phi$, . . .
  high-field magnets, Tevatron "Tripler"
  Super-LHC
  Very Large Hadron Collider
  $e^+e^-$ Linear Colliders . . .

- Exotic acceleration technologies for electrons, protons (teach-in July 5)

- Exotic particles for accelerators and colliders

  muon storage rings
  $\mu^+\mu^-$ collider
  $\gamma\gamma$ collider . . .

- ▷ Fundamental physics with found beams (teach-in, CPU July 13)

  gravity wave detectors

  neutrino telescopes

  cosmic microwave background measurements

  cosmic-ray observatories

  $\gamma$-ray astronomy

  large-scale optical surveys

  ...

- ▷ Enabling technologies for accelerators, experiments, theory

  NPSS Technology Short Courses and Lunchtime Lectures from July 5

  David Larbalestier on Superconducting Materials (1230 - 1330)

  Juwen Wang (half day on room-temperature accelerating structures)

  Working groups E7, T7, ...

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- ▷ Many of our goals are difficult.
- ▷ Timely success is in doubt for many experiments.
- ▷ Getting to the answers is important!

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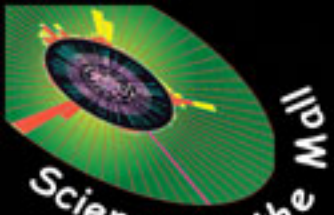
## . . . and neither will the glorious futures that lie beyond.

- ▷ We need to do more to prepare our possible futures.
- ▷ The scope of our science has grown; funding has not.
- ▷ We can communicate much more effectively the wonders of our science.
- ▷ International cooperation will make many more futures possible: choices can be when and where, not this or that.

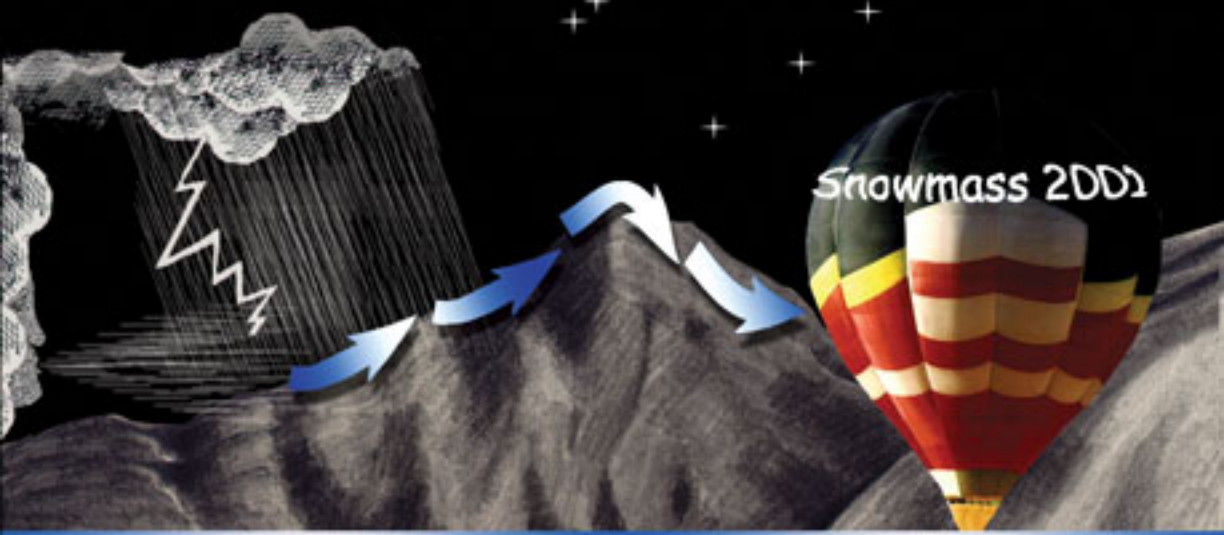


# Snowmass 2001

## Science Weekend

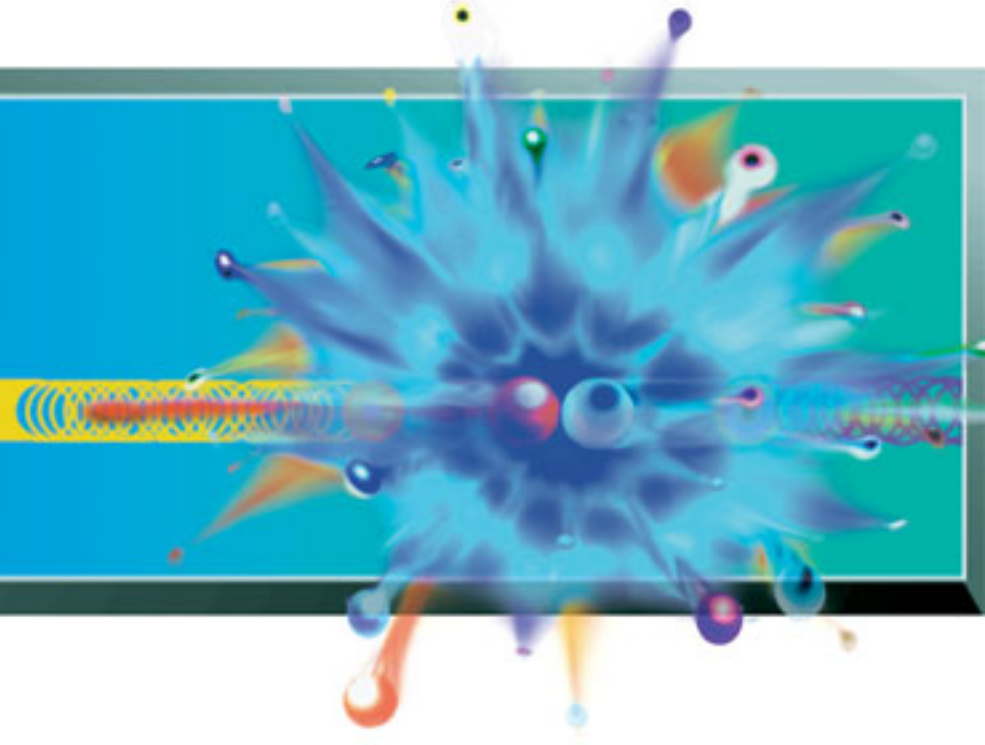
**Saturday, July 7 and Sunday, July 8**

**Snowmass Village, Colorado**




Major funding for Science Weekend is provided by the National Science Foundation, the U.S. Department of Energy, Universities Research Association, the IEEE Council on Superconductivity; and by the Division of Particles & Fields and the Division of Physics of Beams of the American Physical Society. Additional support comes from the Adler Planetarium, the National Center for Atmospheric Research, the ATLAS and CMS collaborations, and other public-spirited individuals and organizations.

# QuarkNet



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## Topography

▷ What is the fabric of space and time? . . . the origin of space and time?

$M_P^2 = M_*^{n+2} \bar{R}^n$
$\Delta n^2 \propto e^{-\mu^2 l^2}$

# Some Goals for Snowmass 2001

- ▷ Survey our aspirations for particle physics over 30 years.

  DPF preparing illustrated survey of grand themes.

- ▷ Assess the current state of development of accelerator protoprojects and advanced accelerator research, and understand the investment we must make (financial and human capital) to bring the most promising lines to maturity.

  DPB preparing Snowmass Accelerator R&D Report.

- ▷ Look beyond our immediate goals for measurements and searches to contemplate the shape of a more complete, more ambitious theoretical framework. How should theoretical vision shape our experimental goals?

- ▷ Examine the importance of scale diversity for a healthy and productive future.

- ▷ Educate ourselves about the full range of possibilities before us.

  We must know enough to judge critically, to improve the arguments, to articulate our goals effectively. HMOs in E1 – E6.

- ▷ Listen carefully to our young colleagues, who will help create our common futures.

  Young Physicists Forum, July 17

- ▷ Take advantage of opportunities to interact with the HEPAP Subpanel.

  Technical work carried out at Snowmass will undergird the recommendations the subpanel makes.

- ▷ Consider the international dimensions of what we hope to achieve.

  International lab directors
  Global Accelerator Network Discussion July 3
  Reports from ECFA and Japan HEP Planning Committees

▷ I believe we must articulate a comprehensive vision of particle physics (and the sciences it touches) to make our case effectively to ourselves, to other scientists, and to society at large.

At the same time, we have a special responsibility to examine the prospects for the most ambitious accelerators, which are major drivers of our scientific progress.

If we judge the science to be rich, and if we can make the cost and technical risk attractive, we will want to pursue all the leading possibilities: linear colliders, hadron colliders reaching far beyond the TeV scale, muon storage ring, and muon collider.

The vision we present should include the scientific promise of all these instruments, and a strategy for deciding what, where, and when that includes the organic R&D investment we will need to evolve the right set of instruments to serve our science.

- Thanks to the work of many people, the moment is upon us to probe, shape, and judge the idea of a linear collider as a possible next big step for particle physics.

  Evaluating a linear collider and working to define a scientifically rich, technically sound, fiscally responsible plan is a homework problem for the entire community.

  Everyone must come to an informed judgment.

- Think about how to make our dreams happen. Creating a future is not accomplished when we draw our individual conclusions or read the subpanel recommendations.

Your

passion,

energy,

creativity,

and commitment

will change the world.