FUTURE COLLIDERS
U. S. POSITION/PLANS

J. Rosner – Collider Mini-Symposium - – March 24, 2014

Study by DPF to discuss long-range US HEP plans

- Meeting July 29 - Aug. 6 summed up efforts of 8 working groups
- Web site `http://www.snowmass2013.org/`
- Plenary talks July 29, August 5, and half of August 6
- 7/30–8/4: Parallel sessions (inter-group discussions), colloquia (early PM; non-experts welcome), panels (late PM)
- Colloquia and panels had ample time for audience participation
- "Elevator speech" initiative between early sessions

Two days of Snowmass-related reports at DPF 2013

- University of California at Santa Cruz, August 13-17
- Web site `http://scipp.ucsc.edu/dpf2013/`

SOME FRONTIER POINTS

Energy Frontier

Questions: Determine Higgs boson properties; make precise measurements of W, Z, t properties (reflecting on Higgs sector); search for new TeV-scale particles and phenomena

Approaches: LHC, first 13–14 TeV, then upgraded luminosity, perhaps eventually increased energy; complementary role of ILC (currently in a "wait and see" mode); large circular machines in Europe and/or China

Intensity Frontier

Questions: Neutrino masses (splittings, scale), mixings, CP violation, Majorana vs Dirac; value of precision measurements such as muon $g-2$; "sterile" neutrinos; reach of searches for rare processes ($\mu \to e$, $K \to \pi\nu\bar{\nu}$); "dark photons" (light, weakly interacting vector particles)

Approaches: LBNE/Project X; T2HyperK, small DAEδALUS cyclotrons; Swedish spallation neutron source; Antarctic ice (PINGU); many proposed short baseline experiments

CONCLUSIONS (1)

- Probe the highest possible energies and distance scales with the existing and upgraded Large Hadron Collider and reach for even higher precision with a lepton collider; study the properties of the Higgs boson in full detail.

- Develop technologies for the long-term future to build multi-TeV lepton colliders and 100 TeV hadron colliders.

- Execute a program with the U.S. as host that provides precision tests of the neutrino sector with an underground detector; search for new physics in quark and lepton decays in conjunction with precision measurements of electric dipole and anomalous magnetic moments.

- Identify the particles that make up dark matter through complementary experiments deep underground, on the Earth's surface, and in space, and determine the properties of the dark sector.

- Map the evolution of the universe to reveal the origin of cosmic inflation, unravel the mystery of dark energy, and determine the ultimate fate of the cosmos.

CONCLUSIONS (2)

- Invest in the development of new, enabling instrumentation and accelerator technology.
- Invest in advanced computing technology and programming expertise essential to both experiment and theory.
- Carry on theoretical work in support of experimental projects and to explore new unifying frameworks.
- Invest in the training of physicists to develop the most creative minds to generate new ideas in theory and experiment that advance science and benefit the broader society.
- Establish a nationally coordinated communication, education, and outreach effort, supported by a dedicated team, to convey the excitement and value of our field to others.

SOME U.S. EFFORTS

VLHC

Design largely complete before push toward ILC:

http://lss.fnal.gov/archive/test-tm/2000/fermilab-tm-2149.pdf

Spearheaded by D. Denisov (P. McIntyre: SSC tunnel?)

Muon Collider

Main U.S. spokesperson: Mark Palmer (Fermilab)

One key question: cooling in 6 dimensions $(\vec{x}, \vec{p})$

Superconducting RF cavities must function in strong magnetic fields

NuSTORM

Main U.S. spokesperson: Alan Bross (Fermilab)

Muon storage ring, a step on the way to Project X

Not clear that it is prominent on P5's radar

Technology

U.S. taking the lead in Nb_3Sn, SCRF (Barletta: Snowmass report)

NEXT STEPS

Snowmass Report

Proceedings include "White Papers" posted to arXiv by 9/30; referred to by ∼30-page subgroup reports

Summaries fed ∼30-page "Frontier" writeups (including Theory)

Executive summaries provided input to 30-page overview

360 pages largely submitted and edited by end of November

Report ⇔ European Particle Physics Briefing Book

`http://europeanstrategygroup.web.cern.ch/europeanstrategygroup/`

Setting forth main questions and means to answer them

Setting priorities

The work of a separate "P5" panel formed in September 2013

"Dear Colleague" letter: Names for panel sent to Andy Lankford

Community input from Snowmass Report and "Town Meetings"

P5 to report to HEPAP by mid-2014

P5 SCIENTIFIC DRIVERS

Use the Higgs as a new tool for discovery

Explore the physics associated with neutrino mass

Identify the new physics of Dark Matter

Test nature of Dark Energy in detail; probe physics of the highest energy scales governing the very early Universe

New particles and interactions; new physical principles

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My guess: P5 "Level A" (sequestration level for 3 yrs, 2%/yr thereafter) threatens some scientific drivers; "Level B" (pre-sequestration for 3 yrs, +3%/yr thereafter) might permit modest collider R&D; significant U.S. role in future collider initiatives only at "unconstrained" Level C