Energy Frontier Parallel Session

Ulrich Heintz
Brown University

task for parallel session

- Give authors of submitted or prospective whitepapers who are in attendance an opportunity for a brief presentation and discussion of their contributions.
- Discuss whether the submitted or proposed whitepapers adequately reflect the status and needs of the area. If not suggest possible additions.
- Discuss the draft Instrumentation Frontier report. Does it adequately reflect current work and future needs? How should it be changed?
- Discuss the structure for the summary report in your area.
- Are there questions we want to ask of the other Frontier groups?

Energy Frontier Physics Working Group

Date: **17 Apr 15:20 - 5:30 PM**

Conveners

Prof. Heintz, Ulrich (Brown University)

Place

Location: Duane Physical Labs, University of Colorado, Boulder
Address: Department of Physics Boulder, CO 80309-0390
Room: TBD

Timetable | Contribution List

Wed 17/04

Print | Full screen | Filter

15:00

Introduction	*Prof. Ulrich HEINTZ*	
TBD, Duane Physical Labs, University of Colorado, Boulder	15:20 - 15:35	
Summary of e+e- collider white papers	*Prof. Andy WHITE*	
TBD, Duane Physical Labs, University of Colorado, Boulder	15:35 - 15:50	
Triggers for hadron colliders at the energy frontier	*Wesley SMITH*	
16:00 *TBD, Duane Physical Labs, University of Colorado, Boulder*	15:50 - 16:05	
Level 1 Track Triggers at HL-LHC	*Dr. Ronald LIPTON*	
TBD, Duane Physical Labs, University of Colorado, Boulder	16:05 - 16:20	
Tracker and Vertex Detector for a Muon Collider	*Dr. Ronald LIPTON*	
TBD, Duane Physical Labs, University of Colorado, Boulder	16:20 - 16:35	

some thoughts on hadron colliders

hadron collider facilities

facility	$\sqrt{s}$	L	$\int Ldt$	time scale
LHC	14 TeV	10^{34}	300/fb	2015-2021
HL-LHC	14 TeV	5×10^{34}	3000/fb	2023-2030
HE-LHC	26-33 TeV	2×10^{34}	300/fb/year	>2035
VHE-LHC	42-100 TeV			>2035

We should not neglect the long-term vision – beyond HL-LHC

European Strategy for Particle Physics Preparatory Group: Physics Briefing Book, CERN-ESG-005

physics at the energy frontier

- characterize the Higgs boson
  - branching fractions
  - coupling constants, self-coupling
- vector-boson scattering
- SUSY
  - severely constrained by existing limits
  - light stop squarks (natural SUSY)
  - compressed spectra
- search for Exotic Phenomena

- ewk scale phenomena, W and Z bosons and their decay products
- maintain acceptance to relatively soft particles
- maintain large angular acceptance to minimize theoretical uncertainties and retain sensitivity to distinguish between different models should we find something new

example: extended Higgs sector

- want to distinguish sm and bsm scenarios if no other state is observed
- possible non-standard Higgs scenarios
  - ewk singlet mixed with sm Higgs
  - composite Higgs
  - 2HDM (incl. SUSY)
  - effective Lagrangians

precision for Higgs couplings

- what is the maximum deviation of Higgs couplings if only the 125 GeV h is observed?
- ewk singlet mixed with sm Higgs
  - 2 physical states: h, H ➔ $\delta\left(\frac{\Delta g}{g}\right) < 6\%$
- composite Higgs
  - H is pseudo-Goldstone boson

  ➔ $\delta\left(\frac{\Delta g_f}{g_f}\right) < 8\%$, $\delta\left(\frac{\Delta g_V}{g_V}\right) < 10 - 20\%$
- 2HDM
  - five physical states h, H, A, H±

  ➔$\delta\left(\frac{\Delta g_b}{g_b}\right) < 5 - 10\%$ for large tanβ, larger for small tanβ

Gupta, Rzehak, Wells - arXiv:1206.3560

precision for Higgs couplings

Coupling	300 fb^{-1} syst. (%)		3000 fb^{-1} syst. (%)	
	actual	scaled	actual	scaled
κ_γ	6.5	5.1	5.4	1.5
κ_V	5.7	2.7	4.5	1.0
κ_g	11	5.7	7.5	2.7
κ_b	15	6.9	11	2.7
κ_t	14	8.7	8.0	3.9
κ_τ	8.5	5.1	5.4	2.0

European Strategy for Particle Physics Preparatory Group: Physics Briefing Book, CERN-ESG-005

can it be done?

- expected precision and max deviations are of same order
- distinguishing sm and non-sm scenarios at hadron colliders is marginal
- can we improve the detector to make it possible?

limiting factors

- trigger
  - luminosity will increase by order of magnitude
  - need to keep acceptance large
  - more powerful trigger strategies
- pile-up
  - number of pp interactions/crossing will increase
  - need to keep resolutions stable
  - more powerful tracking
  - calorimeter with precise timing resolution
- radiation damage
  - radiation dose will increase
  - need to operate detector over years
  - develop radiation hard technologies

transformational capabilities

- fast timing resolution for trackers and calorimeters
  - distinguish particles from different interactions
  - important for H→$\gamma\gamma$
- significantly better hadron calorimeter resolution
  - jets from WW scattering
- others?

conclusion

- for EF summary white paper
  - we need to develop such thoughts further
  - include more physics topics
  - include lepton colliders
- need more communication with EF group
- need volunteers to help with this