

Particle physics confronts experiment:

From colliders to cosmology

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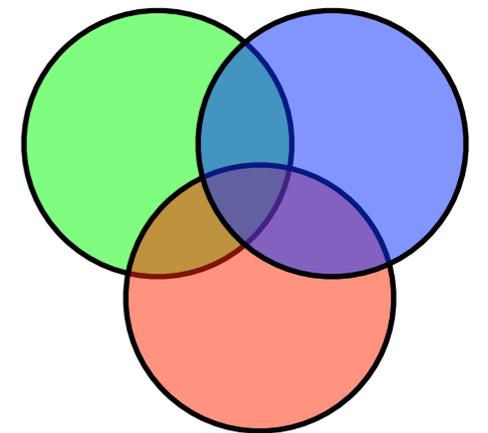
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Project summary:

HEP phenomenology workshops and visitor program

project:

- series of 3 workshops organized jointly by UC, FNAL, ANL
 - 1) **The Energy Frontier**
 - 2) The Precision/Intensity Frontier
 - 3) **The Cosmic Frontier**
- visitor program connected to the workshops



objectives:

- bring together local physicists, along with outside experts in selected topics
- encourage new interactions and collaborations, particularly among theorists and experimentalists

Workshop I:

The energy frontier

Most direct way to study new particles: produce them in high energy colliders

Tevatron and LHC crucial for particle theory: *what is the Higgs sector? Are there new (super)symmetries, new dimensions, new strong dynamics?*

Local strengths

- FNAL: Tevatron, host of LHC Physics Center
- UC, ANL: strong participation in Tevatron expts and ATLAS
- theory groups at UC, FNAL, ANL very productive in BSM investigations, simulation tools (Pythia, MadEvent, CPsuperH,...), QCD studies

Workshop goals

- theorists explore new BSM signatures
- develop theoretical techniques and simulation tools to confront data with BSM theories
- strengthen theory-experiment ties

Workshop II:

The precision/intensity frontier

Precision measurements and rare decays complement and potentially exceed direct collider reach for new physics

Neutrinos plausibly linked to very high energy scales: measure last mixing parameters; CP violation? does ν have distinct antiparticle?

Direct dark matter searches complement production at colliders, indirect observation cosmologically

Local strength

- **FNAL:** running expts MINOS, MiniBooNE, SciBooNE, future MINERvA, NOvA, and others; involvement in CDMS, COUPP dark matter; longer term - Project X neutrino and rare decay opportunities
- **UC:** Double Chooz, rare kaon decays at J-PARC, COUPP
- **ANL:** strong expt'l effort in MINOS, NOvA, also Double Chooz
- **Theorists** - expertise in lattice QCD, neutrino physics and BSM physics

Workshop goals

- explore connections between direct and indirect BSM searches in LHC era
- explore new neutrino interactions, connections between neutrino and collider physics

Workshop III:

Cosmic frontier: Chicago to the cosmos

previous workshops focus on understanding particle physics at short distance, in laboratory experiments

present workshop studies implications for cosmology, and astrophysics
*what is the nature of dark matter? what is mechanism of baryogenesis?
how does a supernova explode? how do pulsars get their kicks?*

Local strength

- UC/FNAL/ANL: theorists expert in relating collider phenomenology to mechanisms of electroweak baryogenesis (Carena, Wagner); exploring new interactions of interest to supernova dynamics (Harvey, Hill, Hill)
- FNAL/UC cosmology/astrophysics groups a valuable resource
- experiments relevant to SN neutrinos (Collar, UC); ANL developing effort in DES (Kuhlman); expertise in SN physics (Truran)

Workshop goals

- investigate relation between collider/laboratory constraints on electroweak physics, and cosmological measurements
- relate astrophysics phenomena (supernova detonation, pulsar kicks, supernova nucleosynthesis, ...) to laboratory measurements and particle physics explanations

Big picture: Whole > sum of parts

Goal:

Make Chicago area the most attractive place in the US to do particle physics

- attractive to visitors: access to theorists, experimentalists at UC, FNAL, ANL
(also build connections with Northwestern, UIC, NIU, IIT, UIUC...)
- attractive to hiring scientists at all levels
- wider base of expertise for local physicists at all levels

Building university/national laboratory relationship:

- priority of UC is to build in area of particle physics phenomenology
- Fermilab priorities include Tevatron, CMS; Project X on long term
- Argonne heavily involved in ATLAS
- dark matter searches ongoing in leading CDMS, COUPP expts.

Organizers building on success

PI's have strong connections between the 3 institutions

- Carena: FNAL scientist and part-time Prof. at UC
- Hill: UC Asst. Prof. (as of Oct 08), currently FNAL Res.Assoc.
- Wagner: UC Prof., head of ANL theory group

Previous workshop experience:

- Carena organized TeV4LHC workshop series (2004-5): brought together theorists, experimentalists; similar in spirit to our workshop I, but not focused on Chicago-area (though Chicago area physicists played big role)
- Wagner organized workshop on Strong Dynamics and Dynamical Chiral Symmetry Breaking (2007); origin of collaboration between Harvey, Hill and Hill on anomalous neutrino processes

Two facets of proposal enhance each other:

- workshops increase motivation of visitors to come to the Chicago area
- presence of outside experts enhances workshops, encourages participation of local physicists

Budget

For each workshop:

15 outside participants for 4 days	$[\$500(\text{travel}) + 4 \times \$125(\text{per diem})] \times 15$	15.0K
Coffee breaks	$[2(\text{per day}) \times 4 \text{ days} \times \$3/\text{person}] \times 50$	1.2K
Workshop dinner	$\$50 \times 50$	2.5K
Local transportation	$\$40 \times 25$	1.0K
Visitors	$[\$500(\text{travel}) + 14 \times \$125(\text{per diem})] \times 6$	13.5K
Total cost per workshop		33.2K
Total budget for workshops and visitors at the three institutions:		99.6K

Summary

- propose a series of 3 workshops with visitor program, based on 3 main particle physics thrusts: energy, precision, cosmology frontiers
- promote collaboration amongst Chicago area institutions, and between theory and experiment: the whole is bigger than sum of parts
- PI's are well placed to implement proposal, encourage continuation into long-term collaborations