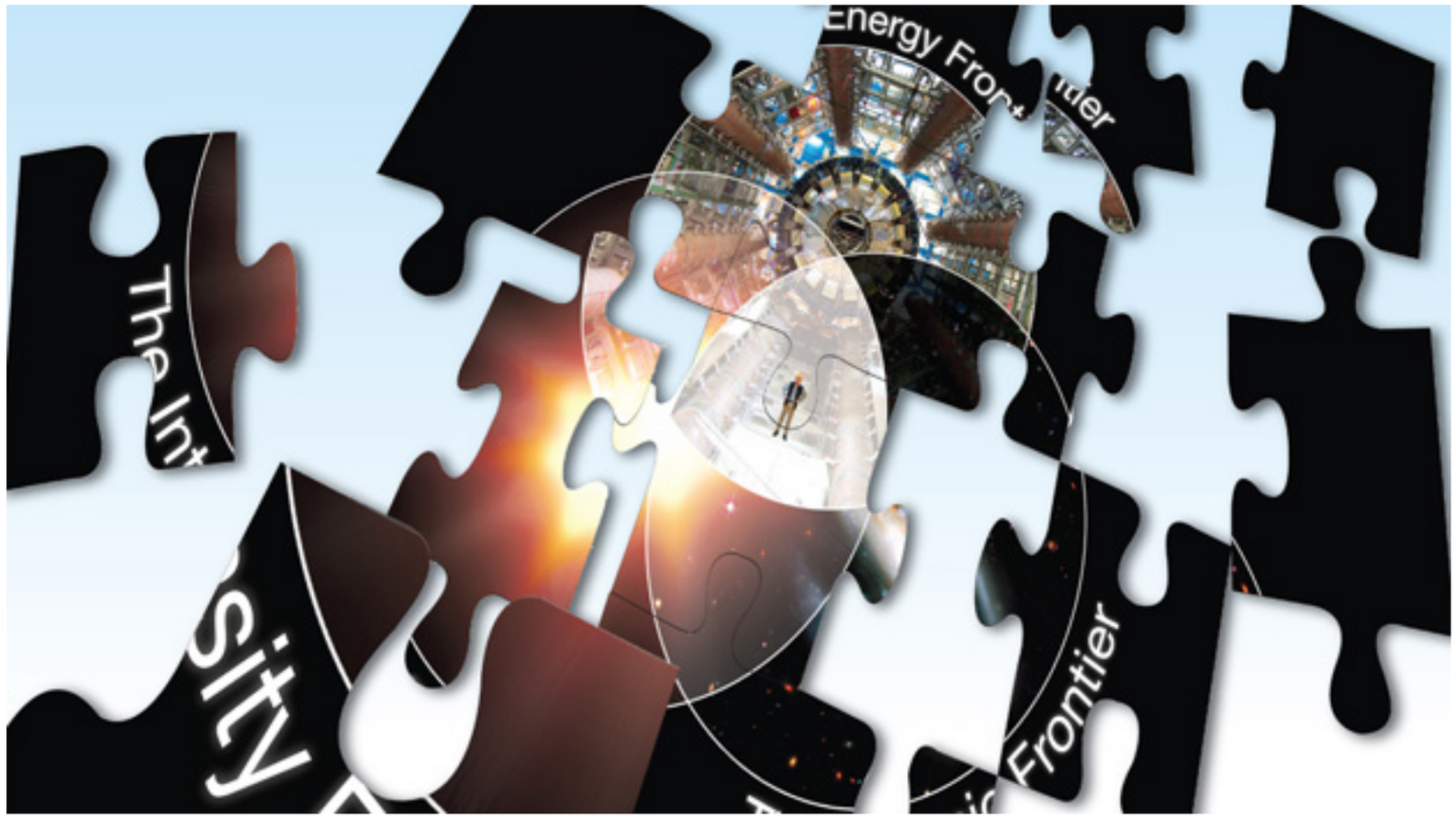

Instrumentation Frontier

Clarence Chang
Argonne National Lab

Cosmic Frontier Workshop 2013, SLAC

Participate in IF Snowmass process!

- We need your input!
    - What are the **long term** needs for CF science?
    - How are different technologies connected to CF science?
    - What new technology is required to scale up while reducing costs?
    - Un-conventional ideas?

Participate in IF Snowmass process!

- Theorists
  - Help articulate science questions/vision
  - Sneak peak at science that will be answered
- Experimentalists
  - Your competition is probably already talking to us

Upcoming meetings

http://www.snowmass2013.org/tiki-index.php?page=Instrumentation+Frontier

LArTPC (Liquid Argon Time Projection Chamber Detector) R&D Workshop

20-21 March 2013 *Fermi National Accelerator Laboratory*
US/Central timezone

University of Colorado Joint CPAD Snowmass

JOINT CPAD SNOWMASS INSTRUMENTATION FRONTIER MEETING, APRIL 17-19, 2013, BOULDER, COLORADO

US Workshop on IC Design for High Energy Physics - HEPIC2013

from 30 May 2013 to 1 June 2013 (US/Pacific)
Lawrence Berkeley National Lab
US/Pacific timezone

Reports

UHECR	Paolo Privitera
UHEnu	Peter Gorham
Dark Energy	Gaston Gutierrez
Gamma Rays	Amanda Weinstein
Directional DM	David Nygren
Light DM	Matt Pyle, Javier Tiffenberg, Dan Mckensey
DM Observatory	Andrew Sonnenschein
CMB	Stephan Meyer
Axions	Jonghee Yoo
Spacetime structure	Craig Hogan

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Instrumentation and CF

- Critical and commercially unavailable
- Detector/technology is the experiment (or specific to it)
- Multiple experiments required to address science (lots of technologies)
- Lots of compelling science (lots of experiments)
- **CF Instrumentation is extremely broad**

More information

http://www.snowmass2013.org/tiki-index.php?page=Instrumentation+Frontier
http://www.hep.anl.gov/cpad/
http://www.snowmass2013.org/tiki-index.php?page=Instrumentation+Frontier+Whitepapers

area	Physics goal	tech in use	limitations	new technologies	
					Paolo Privitera
UHECR	identify sources and composition of UHECR study strong interactions at ~100 TeV CM energies	water cherenkov tanks Fluorecence telescopes	aperture e/mu separation xmax resolution	1) radio detection 2) UV telescope from space	
UHEnu	neutrinos are the only UHE messenger beyond local universe study weak interactions at ~100 TeV CM energies	optical cherenkov (ICECUBE)	limit in rate, not scalable	3) detection of coherent RF pulses (Askaryan)	Peter Gorham
Dark Energy	obtain spectroscopic information for LSST galaxies	mutifiber spectrograph with CCDs	not easily scalable to cover 50,000 gals.per square.deg	4) MKIDs	Gaston Gutierrez
Gamma Rays	indirect DM detection Axion like particle searches Lorentz invanriance	water tanks for air showers	limited energy reach and sensitivity	5) large area, fast, low noise + cheap photosensors 6) Water based scintillators 7) distributed DAQ with radio communication 8) relative timing better than 1nsec	Amanda Weinstein
		cherenkov telescopes	limited energy reach and sensitivity	10) large array of telescopes (CTA) 11) Fast ADCs 12) high resolution with FOV compact camera	
Directional DM	measure sideral anysotropy in nuclear recoils	Nuclear emulsions	can it be made practical?	13) columnar recombination detector	David Nygren
		Low pressure TPC	tension between increased mass and track range no scalable		
Light DM	detection of low mass DM from 1 GeV to 10GeV mass	low noise Ge detectors cryogenic Detectors	energy threshold, noise, nuclear recoil calibration	14)low noise CCD Si Detectors 15) cryogenic detectors with Luke gain	Matt Pyle, Javier Tiffenber
	detection of low mass DM from 1 MeV to 1GeV mass			15)single electron-hole detectors in Noble gas TPC 16)single electron-hole detectors in semiconductor 17)single photon in detection in cryogenic detector	
DM observatory	measurements on the wimp particles after discovery	assuming we have the G3 detectors	mass vs cross section degeneracy hard to overcome astrophysical uncertainties neutrino background	18)develop program with multiple nuclear targets	Andrew Sonnenschein
CMB		Satellites	small size telescope. High coast, long lead time	19) multimode detectors 20) engineered radiation coupling	Stephan Meyer
		Ballon	telescope size limited, focal plane size limited	21) microcalorimeter readout techniques	
		Ground	Sensitivity limited by atmosphere		
Axions					Jonghee Yoo
Spacetime structure	measure macroscopic quantum properties of geometry			holometer	Craig Hogan