COSMIC FRONTIER OVERVIEW

Jonathan Feng, Steve Ritz
and the Cosmic Frontier Working Group

Intensity Frontier Neutrino Subgroup Workshop, SLAC

6 March 2013

COSMIC FRONTIER GOALS

- Snowmass 2013 is a community-driven planning exercise sponsored by the APS's Division of Particles and Fields. Its goal is to develop the community's long-term physics aspirations. Its narrative will communicate the opportunities for discovery in high-energy physics to the broader scientific community and to the government.
- The Cosmic Frontier working group is charged with summarizing the current state of knowledge and identifying the most promising future opportunities at the interface of particle physics, astrophysics, and cosmology.
- Topics include dark matter, dark energy, the matter-anti-matter asymmetry, inflation, cosmic particles and fundamental physics, etc. – a long list that includes several of the most compelling and exciting topics in all of basic science.
- Snowmass 2013 is not a prioritization exercise, but will provide essential input to the next Particle Physics Project Prioritization Panel.

COSMIC FRONTIER ACTIVITIES

- 1982, 1988, 1996, and 2001 Snowmass processes culminated in 3-week meetings in Snowmass, Colorado
- The 2013 Snowmass process is different: culminates in an 8-day meeting at University of Minnesota, July 29 – August 6, 2013
- Much of the work has shifted to Pre-Meetings. For the Cosmic Frontier, these include
  - Community Planning Meeting, Fermilab, 11-13 October 2012
  - Cosmic Frontier Workshop, SLAC, 6-8 March 2013
  - SnowDARK: Non-WIMP Dark Matter, Snowbird, 22-25 March 2013
  - EF/IF/CF Theory Workshop, KITP Santa Barbara, 29-31 May 2013
- This Cosmic Frontier Workshop plays a crucial role in setting the course for discussions leading up to Snowmass in Minnesota

CONNECTIONS TO OTHER FRONTIERS

We have tried to resist fracturing along Frontier boundaries. There are important connections to all of the other frontiers and to other research communities. Many of them are present at SLAC this week:

- Assay and Acquisition of Radiopure Materials (AARM), Monday
- Deep Underground Research Association (DURA) Annual Meeting, Tues
- Frontier Capabilities: Non-Accelerator Facilities, Wed-Fri
- Intensity Frontier: Neutrino Subgroup, Wed-Thurs
- Snowmass Young, Wed-Fri

- **Energy Frontier**
  - Chip Brock (Michigan State), Michael Peskin (SLAC)
- **Intensity Frontier**
  - JoAnne Hewett (SLAC), Harry Weerts (Argonne)
- **Cosmic Frontier**
  - Jonathan Feng (UC Irvine), Steve Ritz (UC Santa Cruz)
- **Frontier Capabilities**
  - William Barletta (MIT), Murdock Gilchriese (LBNL)
- **Instrumentation Frontier**
  - Marcel Demarteau (ANL), Howard Nicholson (Mt. Holyoke), Ron Lipton (Fermilab)
- **Computing Frontier**
  - Lothar Bauerdick (Fermilab) and Steven Gottlieb (Indiana)
- **Education and Outreach**
  - Marge Bardeen (Fermilab), Dan Cronin-Hennessy (U of M)
- **Theory Panel**
  - Michael Dine (UC Santa Cruz)

COSMIC FRONTIER ORGANIZATION

- The working group is divided into 6 subgroups, which, in some cases, are divided into topical subgroups. For details of subgroup structure and activities, see
  http://www.snowmass2013.org/tiki-index.php?page=Cosmic%20Frontier

- CF1: WIMP Dark Matter Direct Detection (Priscilla Cushman, Cristian Galbiati, Dan McKinsey, Hamish Robertson, Tim Tait)
- CF2: WIMP Dark Matter Indirect Detection (Jim Buckley, Doug Cowen, Stefano Profumo)
- CF3: Non-WIMP Dark Matter (Alex Kusenko, Leslie Rosenberg)
- CF4: Dark Matter Complementarity (Dan Hooper, Manoj Kaplinghat, Konstantin Matchev)

COSMIC FRONTIER ORGANIZATION

- CF5: Dark Energy and CMB (Sarah Church, Scott Dodelson, Klaus Honscheid)
  - Cosmological Distances (Alex Kim, Nikhil Padmanabhan)
  - Growth of Structure (Dragan Huterer, David Kirkby)
  - Cross-Correlations (Jason Rhodes, David Weinberg)
  - Novel Probes of Dark Energy (Bhuvnesh Jain, Chris Stubbs)
  - Inflation (John Carlstrom, Adrian Lee)
  - Neutrinos in the Cosmos (John Carlstrom, Adrian Lee)

- CF6: Cosmic Particles and Fundamental Physics (Jim Beatty, Ann Nelson, Angela Olinto)
  - CF6-A Cosmic Rays, Gamma Rays and Neutrinos (Gus Sinnis, Tom Weiler)
  - CF6-B The Matter of the Cosmological Asymmetry (Ann Nelson)
  - CF6-C Exploring the Basic Nature of Space and Time (Aaron Chou, Craig Hogan)

CF/NEUTRINO OVERLAPS: EXAMPLES

- CF1: WIMP Direct Detection: neutrino “background” and $0\nu\beta\beta$ decay
- CF2: WIMP Indirect Detection: high-energy neutrinos
- CF3: Non-WIMP Dark Matter: sterile neutrino dark matter
- CF4: DM Complementarity
- CF5: DE, CMB: detecting neutrino mass and abundance in the cosmos
- CF6: Cosmic Particles and Fundamental Physics: leptogenesis, UHE neutrinos

- Joint sessions: e.g., Wednesday, 4pm: CF 6 + Nu 5 A5: Neutrino Physics from Astrophysics

- Neutrino Workshop participants are also invited to join the CF meeting on Friday
  - 9am - 12:30pm parallel talks
  - 1:30pm - 5:30pm plenary summary talks

AGENDA: FINAL CF PLENARY SESSION

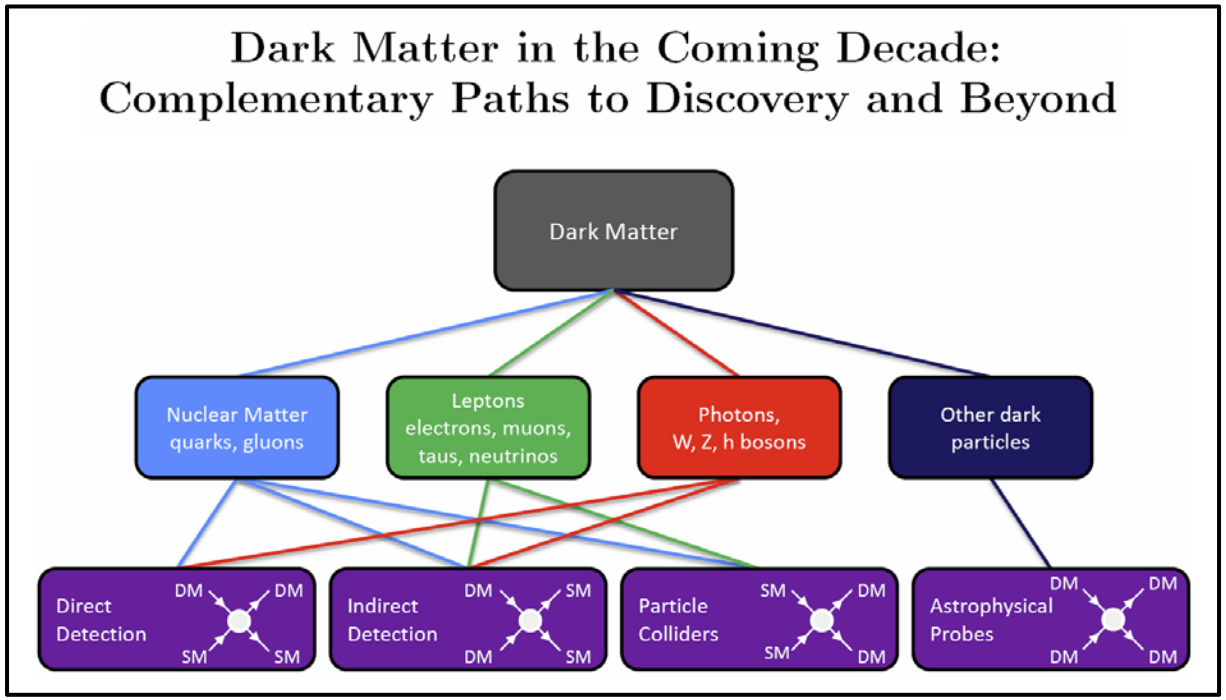
Includes subgroup summaries, instrumentation frontier talk, and talks from Jon Rosner and Steve Ritz about the Minnesota meeting and future plans

CF1 Summary		
Panofsky and Kavli Auditoriums, SLAC		13:30 - 13:45
CF2 Summary	*BUCKLEY, James*	
Panofsky and Kavli Auditoriums, SLAC		13:45 - 14:00
CF3 Summary		
Panofsky and Kavli Auditoriums, SLAC		14:00 - 14:15
CF4 Summary	*MATCHEV, Konstantin*	
Panofsky and Kavli Auditoriums, SLAC		14:15 - 14:30
CF5: Dark Energy Summary	*DODELSON, Scott*	
Panofsky and Kavli Auditoriums, SLAC		14:30 - 15:00
CF5: CMB Summary	*CHURCH, Sarah*	
Panofsky and Kavli Auditoriums, SLAC		15:00 - 15:30
Break		
SLAC		15:30 - 16:00
CF6 Summary	*OLINTO, Angela et al.*	
Panofsky and Kavli Auditoriums, SLAC		16:00 - 16:30
Instrumentation Frontier	*CHANG, Clarence*	
Panofsky and Kavli Auditoriums, SLAC		16:30 - 16:40
Summer Meeting Plans: The Grand Scheme	*ROSNER, Jonathan*	
Panofsky and Kavli Auditoriums, SLAC		16:40 - 17:00
Cosmic Fronter Summer Meeting Agenda Update and Paths Forward	*RITZ, Steve et al.*	
Panofsky and Kavli Auditoriums, SLAC		17:00 - 17:30

CF DELIVERABLES: SHORT TERM
DM COMPLEMENTARITY DOCUMENT

- Before the Snowmass process began, DOE and NSF asked for a community document summarizing dark matter discovery approaches and their relation to each other

- A preliminary draft is now available on indico and will be presented at 6pm today in the CF4 parallel session in Kavli Auditorium; all welcome



CF DELIVERABLES: LONG TERM SNOWMASS SUMMARIES

Contributed Papers from collaborations, groups, individuals

- Send to Subgroup Conveners
- Submit to https://www-public.slac.stanford.edu/snowmass2013 to be included in Snowmass e-proceedings (harvested from arxiv.org on September 30, but post long before then to have impact)

~30-page CF Subgroup Summaries (written by CF Working Group participants, due Summer 2013)

~30-page CF Summary (written by all CF Conveners with broad input, due by Snowmass in Minnesota)

~30-page Snowmass-wide Summary (written by Frontier Conveners with broad input, presented in bullet form at DPF 2013 in Santa Cruz)

COSMIC FRONTIER HOME PAGE

http://www.snowmass2013.org/tiki-index.php?page=Cosmic%20Frontier

USEFUL LINKS

- Cosmic Frontier-related Pre-Meetings and Meetings of Interest
  - CETUP* Dark Matter Workshop, Lead/Deadwood, South Dakota, June 24-July 5, 2013
  - Snowmass Theory Meeting, KITP Santa Barbara, May 29-31, 2013
  - SnowDARK 2013: Non-WIMP Dark Matter, March 22-25, 2013
  - Cosmic Frontier Workshop, March 6-8, 2013
  - Closing in on Dark Matter, Aspen Winter Conference, January 28, - 3 February 3, 2013
  - Community Planning Meeting, Fermilab, October 11-13, 2012
- Previous Prioritization Studies and Studies of Specific Topics
  - DOE Community Dark Energy Task Force Report 2012
  - NSF Astronomy Portfolio Review 2012
  - Particle Physics Project Prioritization Panels (P5 2008, 2010)
  - New Worlds, New Horizons and CFP and PAG Panels (Astro2010)
  - Particle Astrophysics Scientific Assessment Group (PASAG 2009)
  - Dark Matter Scientific Assessment Group (DMSAG 2007)
  - Dark Energy Task Force (DETF 2006)
  - NASA Physics of the Cosmos (PCOS) Program
  - Task Force on Cosmic Microwave Background Research (TFCR 2005)