COSMIC FRONTIER SUMMARY

Jonathan Feng, Steve Ritz
and the Cosmic Frontier Working Groups

Community Planning Meeting, Fermilab

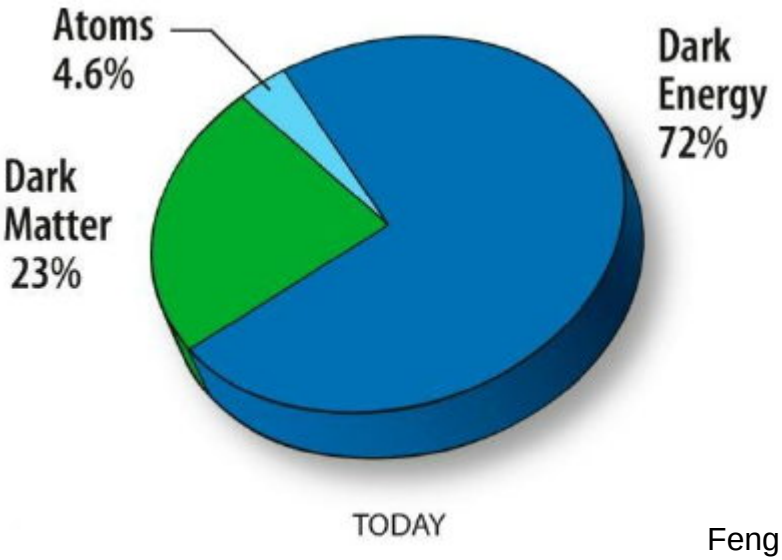
13 October 2012

FEATURES OF THE COSMIC FRONTIER

- The Cosmic Frontier is the home of several of the most outstanding questions in basic science today

- The Cosmic Frontier is motivated by indisputable, observationally confirmed evidence for BSM physics
  - Quiz: What percentage of the cosmos requires BSM physics? (Hint: It's more than 95%)

- Its questions are of great and obvious interest to other physicists, scientists, and the general public



FEATURES OF THE COSMIC FRONTIER

- The unusual diversity of the Cosmic Frontier implies potentially many opportunities for world-leading efforts
- The Snowmass process is an important opportunity for inter- and intra-frontier discussions
- Essential connections to other fields – where are the intellectual boundaries?
- Diverse funding sizes (large, small) and sources (DOE, NSF, NASA) provide flexibility, but how to support a field of smallish projects in a way commensurate with the science potential?

COSMIC FRONTIER FRIDAY AGENDA

Cosmic Frontier (Curia II)

9:30 - 9:35 Introductions

9:35 - 9:55 DOE (10 min. presentation + 10 min questions)

9:55 - 10:15 NSF (10 min. presentation + 10 min questions)

10:15 - 11:45 Subgroup charge presentations and coordination of overlaps, discussion (10 + 5 per subgroup)

11:45 - 12:30 Lunch

12:30 - 13:30 Some subgroups meet with Instrumentation/Capabilities (Curia II)

Subgroup parallel sessions:

CF1: Black Hole (WH2NW)

CF2: Theory (WH3NE)

CF3: One North (WH1NW)

CF5: Snake Pit (WH2NE)

CF6: Comitium (WH2SE)

What follows are incomplete summaries of the proceedings – see subgroup conveners for details

13:30 - 14:00 Some subgroups meet with Computing (Curia II); other subgroups continue their parallel sessions

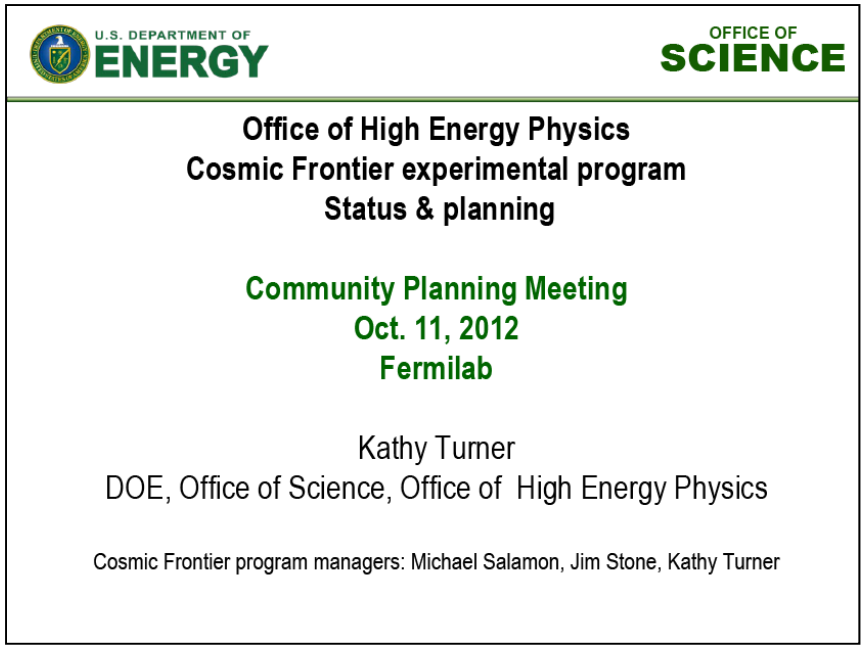
14:00 - 14:30 Break

14:30 - 15:30 Plenary session: 7 min reports from each subgroup on path forward; then, discussions of paths forward and main points for summary talk on Saturday

VIEWS FROM THE FUNDING AGENCIES

Kathy Turner (DOE), Jim Whitmore (NSF)

Insights and advice specific to the Cosmic Frontier; see web for full talks


U.S. DEPARTMENT OF ENERGY

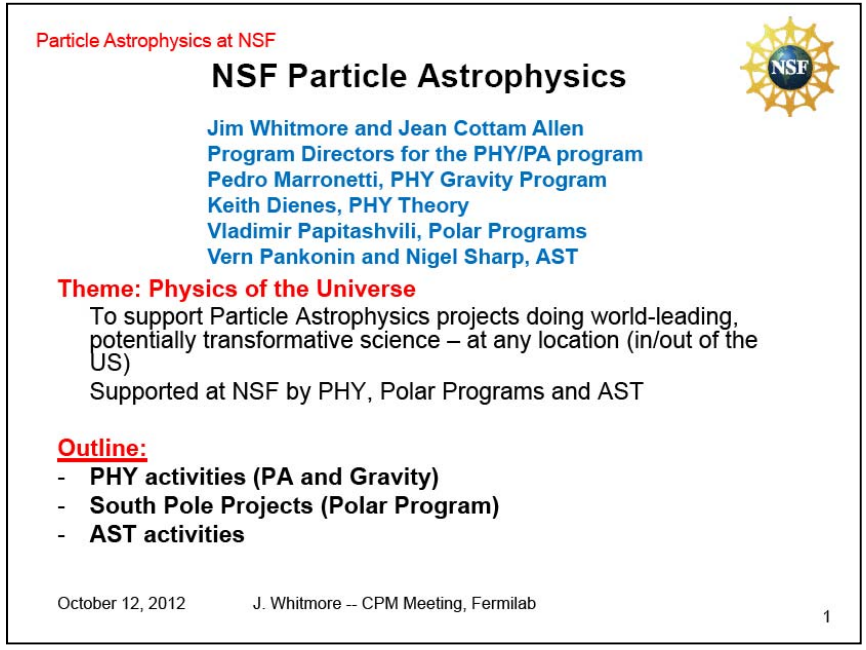
OFFICE OF SCIENCE

Office of High Energy Physics
Cosmic Frontier experimental program
Status & planning

Community Planning Meeting
Oct. 11, 2012
Fermilab

Kathy Turner
DOE, Office of Science, Office of High Energy Physics

Cosmic Frontier program managers: Michael Salamon, Jim Stone, Kathy Turner


Particle Astrophysics at NSF

NSF Particle Astrophysics

Jim Whitmore and Jean Cottam Allen
Program Directors for the PHY/PA program
Pedro Marronetti, PHY Gravity Program
Keith Dienes, PHY Theory
Vladimir Papitashvili, Polar Programs
Vern Pankonin and Nigel Sharp, AST

Theme: Physics of the Universe

To support Particle Astrophysics projects doing world-leading, potentially transformative science – at any location (in/out of the US)

Supported at NSF by PHY, Polar Programs and AST

Outline:

- **PHY activities (PA and Gravity)**
- **South Pole Projects (Polar Program)**
- **AST activities**

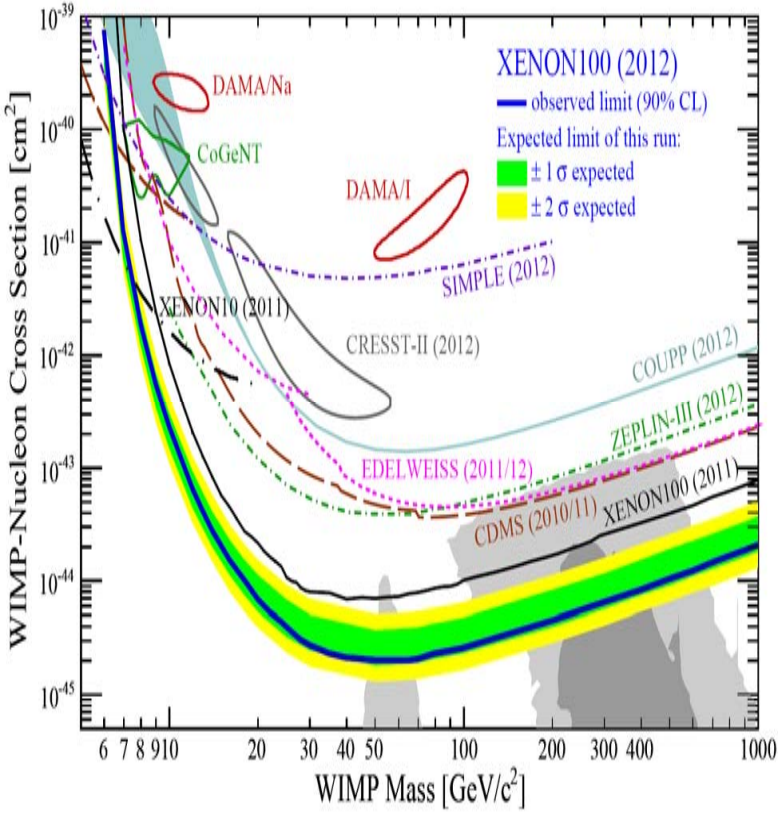
October 12, 2012 J. Whitmore -- CPM Meeting, Fermilab 1

CF1: DIRECT DETECTION OF WIMP DARK MATTER

Conveners: Prisca Cushman, Christian Galbiati, Dan McKinsey, Hamish Robertson, Tim Tait

- While we continue to refine our charge, we agree that an important organizing principle is: What set of experiments and complementary technologies would be required to answer the question: "Has dark matter been detected?"

- We had good participation, anticipate a process that will enable community buy-in. We will flesh out our charge based on the enthusiastic discussion with diverse input

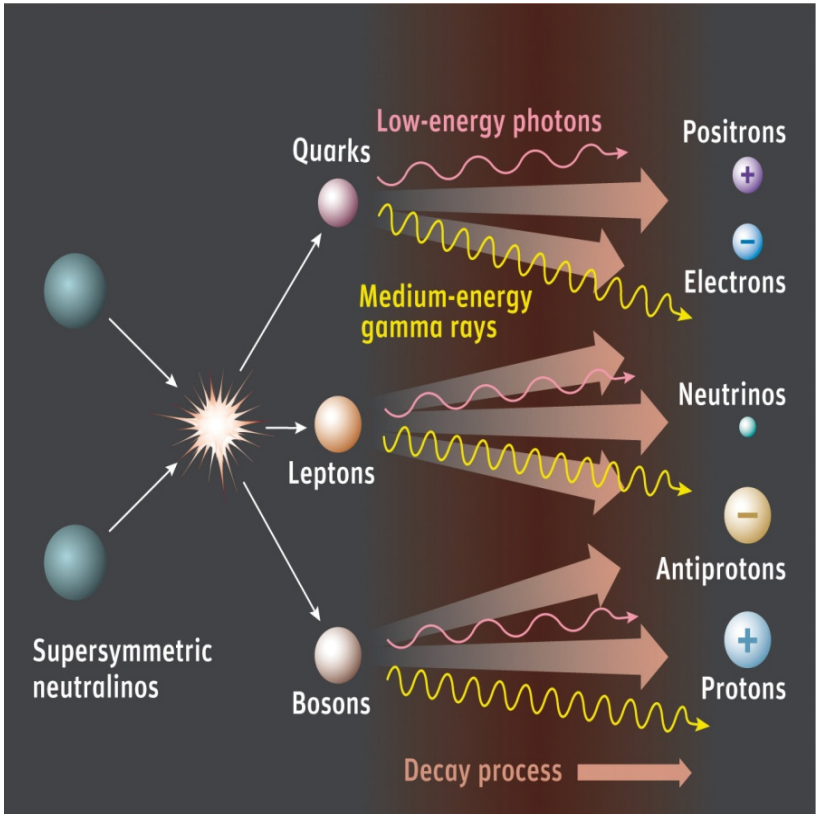


CF2: INDIRECT DETECTION OF WIMP DARK MATTER

Conveners: Jim Buckley, Doug Cowen, Stefano Profumo

- What would be lost if indirect detection were not pursued to discover dark matter? How can the case be made crisply and clearly?

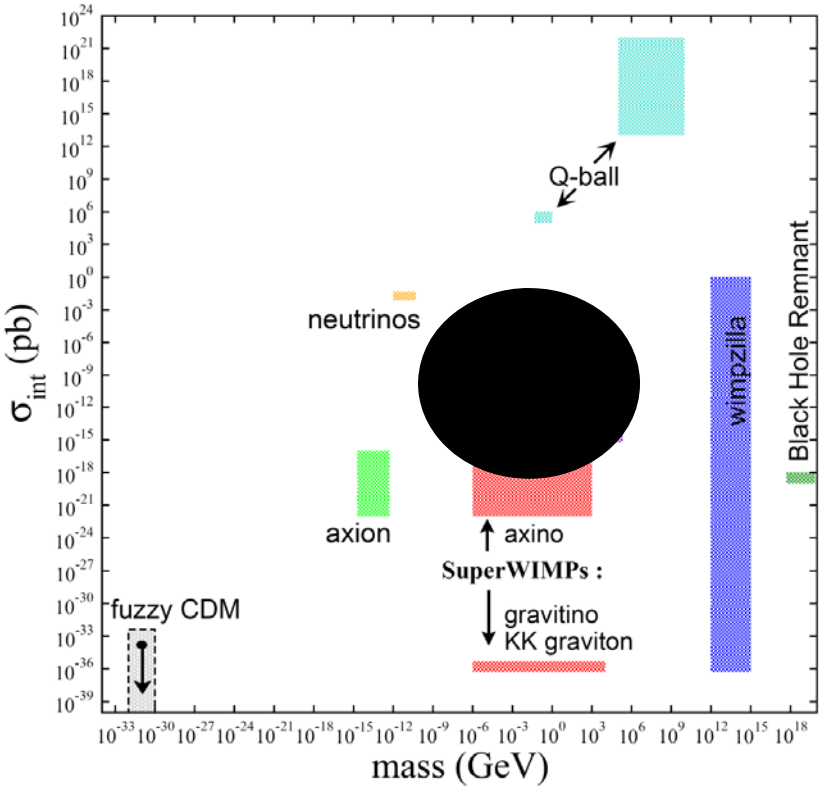
- Brief but productive discussion with Instrumentation and Computing Frontiers about photo detectors, data acquisition, high performance computing and other topics of common interest to CF1 and CF2



CF3: NON-WIMP DARK MATTER

Conveners: Alex Kusenko, Leslie Rosenberg

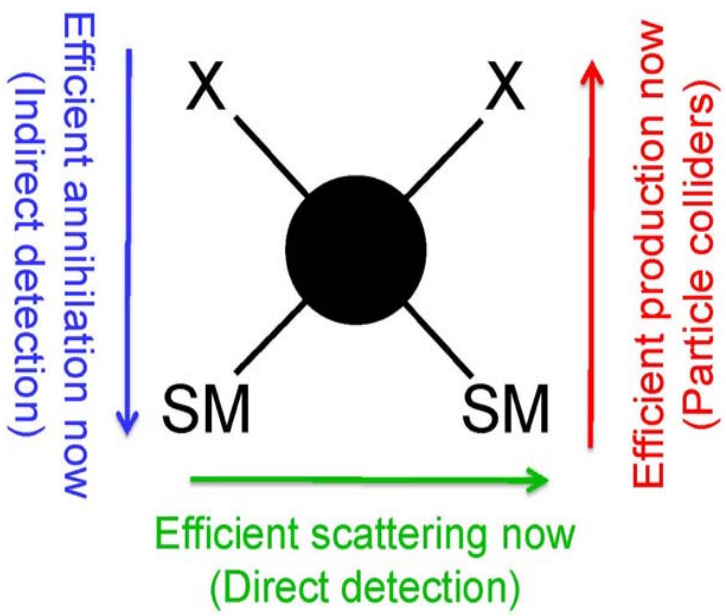
- Planning well advanced for axions and axion-like-particles
- Accelerating planning for other dark-matter candidates
- Continue identifying key theory and technological challenges
- Large overlaps with other groups and Frontiers
- Key questions are where the CF3 “boundaries” are and how to organize the diverse CF3 science



CF4: DARK MATTER COMPLEMENTARITY

Conveners: Dan Hooper, Manoj Kaplinghat, Konstantin Matchev

- Need proposals for the framework to discuss complementarity soon. Explore benchmark models and effective models of DM in collaboration with HE4. There is a group now in place to work on this. [Contact: Hooper, Matchev, Tait, Wang, Whiteson]
- Contact people outside the HEP community (observers, simulation experts) to get input on the astrophysics intertwined with dark matter searches. [Contact: Kaplinghat]
- Discuss optimistic and pessimistic outcomes for each approach (direct, indirect, colliders, astrophysics) in the context of outcomes for the others. [All CF4 conveners]



+ Astrophysical probes of DM properties (warmth, self-interactions, …)

CF5: DARK ENERGY AND CMB

Conveners: Sarah Church, Scott Dodelson, Klaus Honscheid

- Identified contact person for each charge bullet
  - Dark energy [Honscheid]
  - Modified gravity [Dodelson]
  - } Probably merge
  - Inflation [Church]
  - Neutrinos [Dodelson]
  - Multiple probes [Dodelson]

- Key questions to be answered
  - Dark Energy – New opportunities? (e.g. multi-object spectrograph)
  - Inflation – what comes after the current generation of CMB polarization experiments?
  - Neutrinos -- synergies between astrophysical limits and particle physics limits
  - Multiple probes – what is needed to fully exploit the science listed above
  - Tests of more exotic physics?

CF6: COSMIC PARTICLE AND SPACETIME PHYSICS

Conveners: Jim Beatty, Ann Nelson, Angela Olinto

- Plans before March CF meeting: call for white papers, work on each of the topics in our charge statement
- Found volunteers for charge topics to whom new ideas or offers to help should go
  - Physics of Interactions beyond Laboratory Energies [Angela Olinto, Jim Beatty]
  - The Matter of the Cosmological Asymmetry [Ann Nelson, Michele Papucci, Pedro Schwaller, Carlos Wagner]
  - Cosmic Particles as Probes of Fundamental Symmetries and New Particles [Gus Sinnis]
  - Neutrino Physics from Astrophysics (with IF3) [John Beacom, Hallsie Reno]
  - Exploring the Basic Nature of Space and Time – the Fermilab Holometer (prototype example of relatively cheap, speculative expt) [Chris Stoughton, Aaron Chou]
  - Other gravity waves [???]

PLANS

- Bi-weekly telecon with agencies/other frontiers; bi-weekly CF telecon
- Cosmic Frontier Workshop at SLAC, 6-8 March 2013
  - Registration opens Dec 2012: http://www-conf.slac.stanford.edu/cosmic-frontier/2013
  - Local organization led by Richard Partridge
  - Joint with Frontier Capabilities, possibly Instrumentation, Computing
  - In coordination with AARM meeting on March 4, DURA meeting on March 5
- Additional meetings with subgroup activity, including
  - Jan 28-Feb 3, Aspen: CF4 (DM Complementarity)
  - March 22-25, Snowbird: CF3 (Non-WIMP DM)
  - May 13-17, KITP (UCSB): Multi-messenger Probes of DM
- Written Summaries
  - Shortly after Cosmic Frontier Workshop: ~2+15 page DM Complementarity document for government decision makers
  - Shortly after CSS 2013: ~200 page Summary of the Cosmic Frontier
- New participants (particularly junior ones) are welcome in all subgroups!