COSMIC FRONTIER SUMMARY

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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)

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

What follows are incomplete summaries of the proceedings – see subgroup conveners for details
VIEWS FROM THE FUNDING AGENCIES

Kathy Turner (DOE), Jim Whitmore (NSF)

Insights and advice specific to the Cosmic Frontier; see web for full talks
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]
  - 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]
  – 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
  – 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!