

Comp-Cosmic liaison report

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Cosmic Frontier areas

All areas are now holding regular meetings, some joint meetings. **Main topics of discussion: understanding boundaries between areas, organising LOIs**

- CF1. Dark Matter(DM): Particle-like (i.e. detect WIMP dark matter recoil in Xe)
- CF2. Dark Matter: Wave-like (i.e. detect dark matter Axion in tuned cavity)
- CF3. Dark Matter: Cosmic Probes (i.e. detect dark matter as it affects observations of motions of stars,galaxies,clusters)
- CF4. Dark Energy (DE) and Cosmic Acceleration: The Modern Universe (characterize DE through measurements of galaxy clusters/clustering)
- CF5. Dark Energy and Cosmic Acceleration: Cosmic Dawn and Before (CMB-S4, 21-cm)
- CF6. Dark Energy and Cosmic Acceleration: Complementarity of Probes and New Facilities (compare early and late measures of DM, DE, H_0 the Hubble Constant)
- CF7. Cosmic Probes of Fundamental Physics (i.e. emergent Space-Time, exotics)

Requirements and opportunities: Simulations

- Obvious links to CompF1, CompF2, Comp3, Comp4...
- Cosmology simulations:
 - Typically require vast amounts of HPC
 - Eg HACC
 - Strong overlap with Theory frontier/CompF2
- Instrument simulations: for design and optimisation of instrument
 - Eg Rubin observatory PhoSim effort
 - Strong overlap with Accelerator/Instrument frontier
 - Is this covered by CompF2?
- Image/data simulations: for data challenges
 - Can be fast/approximate or slow/high fidelity
 - Typically large in the sense of HTC rather than HPC
 - Is this covered by CompF2?

Cosmic Frontier Experiments (past, present, and future):

SDSS I-III, DES: (past, present): Data available for reproc/analysis

DESI: (present/future): large spectroscopic instrument

VRO/LSST -- large imaging survey

DAMA/Libra, LZ, SuperCDMS, ADMX, XENON, PandaX-II, many more --
DM direct detection

CMB-S4 -- large microwave background survey

LIGO Gravitational Wave Detector and Follow-ups

Redshifted 21-cm 'cosmic dawn' **EDGES and followup**

Other radio projects (**SKA**)

Event Horizon Telescope (**Black Hole imaging**)

Massive spectroscopic surveys (VRO followup)

Space based **WFIRST, Euclid, Gaia**

Requirements and opportunities: Experiment data production/analysis

- Obvious links to CompF1, CompF3, CompF4, CompF5, CompF7...
- Realtime computing for running experiments
 - May be easily handled by small on-site clusters
 - May need large-scale resources HPC for special circumstances
 - Eg DUNE supernova neutrino detection
 - May need HPC continuously during operations
 - Eg Rubin observatory 'alert processing system' for Supernovae, Near Earth Asteroids
- Post-processing of data eg for annual releases
 - Typically need vast amounts of HTC
 - Eg Rubin observatory, SKA, WFIRST, 21-cm, LZ
- Need algorithms that will scale appropriately [Comp-F1]

Requirements and opportunities: Experiment data production/analysis

- Vast storage needs and new access patterns will push storage architecture [CompF4]
 - Industry is heading to non-posix access, object stores. How will we design SW/algorithms to use this?
 - Cost is a significant concern here -- balancing 'keep everything indefinitely' vs. 'reprocess reproducibly on demand'?
- Most experiments will have a vast data store (Exabyte-scale)
 - Balance between analysis processing close to the data and bringing subsets of the data 'back home' is challenging at exabyte scale.
 - Bring end user's code to the storage? [CompF5]
 - How to avoid mis-use or inefficient use of central experiment resources by end-users? [CompF7?]

Other requirements and opportunities

- Authentication and access to resources: Need way to authenticate users within a collaboration or subgroup (tokens? FedID?)
- Portable workflows: Cosmic Frontier teams will need to run both simulations and data analysis at multiple locations (local cluster, cloud, HPC). Need appropriate algorithms/infrastructure to do this.

Opportunities to communicate

- Community planning meeting cross-cut sessions will be a good way for us to synch up with other areas
 - E.g. suggested CPM session by CosmicF4-6: Computing in the Cosmic Frontier. Compute infrastructure dedicated to Cosmic Frontier. Multiple experiments sharing the same workhorse machine would really improve ability to combine and cross-correlate data at pixel level and used common set of tools and environment
- Some cosmic frontier groups are holding/planning town halls