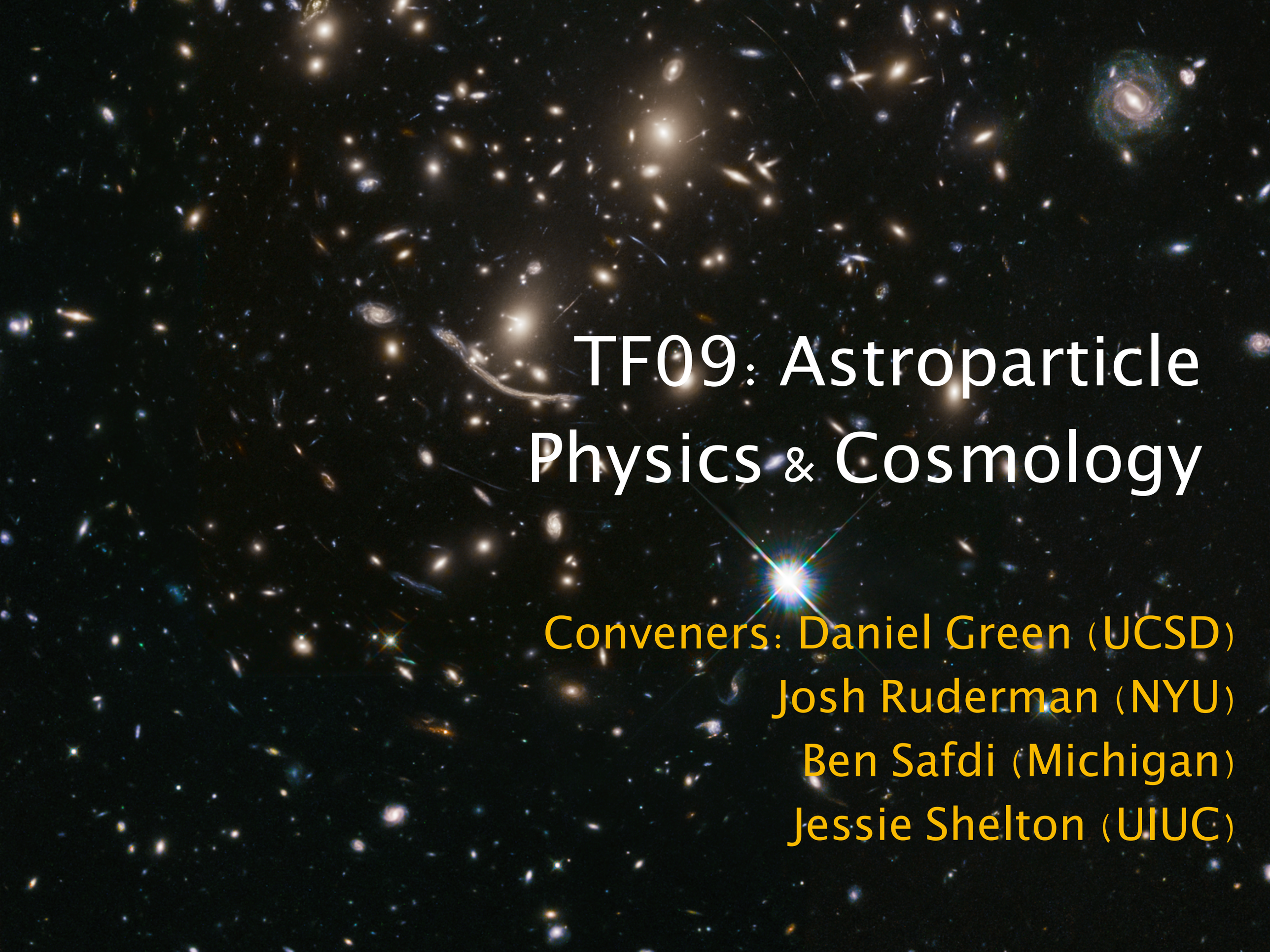


TF09: Astroparticle Physics & Cosmology

Conveners: Daniel Green (UCSD)
Josh Ruderman (NYU)
Ben Safdi (Michigan)
Jessie Shelton (UIUC)

Overview

Goal: Communicate the value of theoretical work

Mechanism: White papers & Snowmass meetings

Strategy: Identify key areas where theory has been (and will continue to be) essential (broadly defined)

We are NOT prioritizing areas of theory

May cut across multiple areas [cross-list white papers]

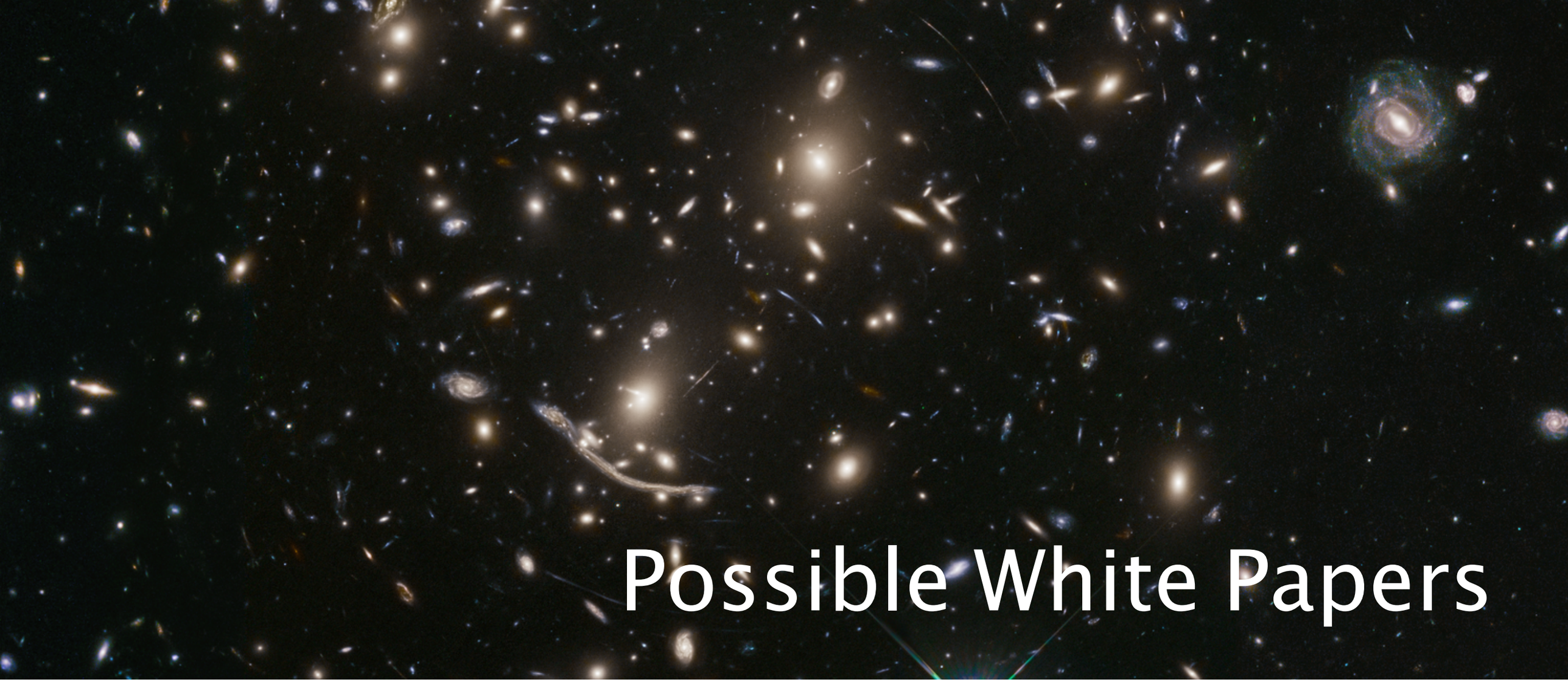
How to get involved

- Join email lists and Slack (#tf09-astro_cosmo)
- Fill out our TF09 google form
- Join calls / attend workshops & conferences
- Most importantly – help write white papers

Community input is key:
Brings out best ideas
Shows broad support for theory

What is a theory frontier white paper?

- No studies!
- A combination of
  - a focused review of previous work
  - a sketch of areas where theoretical development is necessary for future scientific payoff
- Will be posted to arXiv



Possible White Papers

Inflation, Dark Energy and Connections to Formal Theory

Inflation is famously sensitive to physics at the Planck scale. Inflationary model building in QFT and String Theory connects questions in fundamental physics and cosmological observables. In addition, the nature of de Sitter space is a question of broad theoretical interest and informs the nature of accelerated expansion in the later universe.

- Connect formal questions with observations
- Set key targets in experiments (e.g. B-modes)

Data-Driven Cosmology (CMB, LSS, BBN, 21cm)

Theoretical tools play a central role in developing new ways to probe the fundamental physics of the universe and disentangling answers about fundamental laws from astrophysical effects.

- Modeling key to understanding cosmic surveys
  - E.g. N-body / analytic for LSS
  - E.g. foregrounds and B-modes
- New statistical techniques
- Machine learning (?)

Early Universe Model Building

New models motivated by the hierarchy problem, dark matter, baryogenesis, the strong CP problem, and the experimental landscape inspire new experiments, analyses, and theoretical questions

- Expanded space of DM models and signatures
- Cosmic solutions to the hierarchy problem
- New directions in baryogenesis
- Connecting terrestrial and celestial probes

Indirect Detection (Cosmology + Astrophysics):

Theoretical progress in understanding indirect signatures of dark sectors in astrophysical and cosmological settings, including gravitational and gravitational wave signatures, leads to new analyses and interpretations of current data.

- Cosmic rays (charged, photons, neutrinos)
- Gravitational probes of dark matter
- Stellar cooling (etc)
- Novel CMB / LSS signatures and analyses
- Gravitational waves from phase transitions (etc)

Theory Meets the Lab

The quest to discover signatures of dark sector physics has inspired theorists to develop new experiments and new analyses of existing data.

- Theory leads to novel signatures
- Theorists have led the way on new experiments
  - Axion experiments
  - Sub-GeV dark matter constraints from existing data
  - New sub-GeV experiments

Your ideas here!

- This breakdown meant to be suggestive, not restrictive
- This process needs your ideas!
- You can sign more than one white paper
- You can submit white papers to more than one frontier and more than one group within a frontier

Questions and Discussion