

Terms of Reference for Cosmic Dawn Science Analysis Group
Co-Leads: Claudia Scarlata (Minnesota) and Steven Finkelstein (UT Austin)

Cosmic Dawn, when the first galaxies grew to fruition and began to affect the universe around them, has only recently begun to be studied observationally. The advent of the Wide Field Camera 3 (WFC3) on the *Hubble Space Telescope (HST)* has allowed large samples of galaxies to be discovered at $6 < z < 10$, spanning a time 0.5-1 Gyr after the Big Bang. While *HST* does not allow us to go to higher redshifts, the imminent arrival of the *James Webb Space Telescope (JWST)* will probe galaxy populations at $z = 10-15$ (and perhaps higher), placing the first direct constraints on the formation era of the first galaxies. However, *JWST* will have a limited lifespan, has a limited aperture size, and a limited wavelength range, which, for example, cannot directly detect the ionizing radiation that drives the reionization process during this epoch. It is imperative to begin planning now for how studies of Cosmic Dawn and associated processes will continue into the 2030's. The goal of the Cosmic Dawn SAG is to address the following points:

1. Identify questions that will likely remain unanswered after the conclusion of the *JWST* mission. This includes not only those questions which *JWST* is not suited to study, but also an exploration of those questions which might form based on likely *JWST* observations, and complementary observations to the full SKA surveys of the 2030's.
2. Assess the potential for the proposed NASA flagship missions (LUVOIR, Origins, Lynx and HabEx) to answer these questions.
3. Identify observational gaps that are not covered by the proposed NASA flagship missions and describe the capabilities that potential probe-class missions would require to close these gaps.
4. Examine the potential for panchromatic observations that can be done now with existing telescopes and data archives in support of these ideas.
5. Identify the need for coordinated programs between multiple observatories (including ground based), archives and/or numerical simulations.

The Cosmic Dawn Science Analysis Group (SAG) will include representatives from the COPAG and PhysPAG as well as solicit participation from the broader scientific community, with the goal to analyze the above questions and compose and publish a report, delivered to NASA HQ, by the end of 2020. For these purposes, we define Cosmic Dawn as inclusive of the physical processes relevant to the formation of the first stars and galaxies, and the reionization of the Universe, without a specific constraint on redshift. This group is for analysis only, and will not be making recommendations to NASA.