PHYSICS AND ASTRONOMY COLLOQUIUM

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The Physical Properties of the First Galaxies and the Reionization of the Universe.

One of the unsolved problems in astrophysics and cosmology is understanding the ``cosmic dawn", the period that encapsulates the formation of the first objects (stars and galaxies) in the Universe, and their effect on the young, evolving intergalactic medium (IGM). This was cited as one of the top three science objectives of the 2010 Decadal Survey of Astrophysics commissioned by the National Academy of Science. Following the Big Bang and formation of the Cosmic Microwave Background (CMB) the IGM of the Universe was filled with (electrically) neutral Hydrogen and Helium. Observations of the IGM in the Universe from today (13.6 billion years after the Big Bang) back to about 1 billion years after the formation of the CMB show it to be filled with ionized Hydrogen (and other elements). The period in between is known as the "epoch of reionization", when some process re-ionizes the baryons in the IGM. This process is presumed to be the UV radiation produced by the first stars and galaxies, but the evidence based on our measurements of galaxy properties is far from conclusive. I will discuss the process and constraints on reionization, and I will discuss our work to find and study the properties of the first galaxies using data from the Hubble Space Telescope. Our measurements of the physical properties of these galaxies has already constrained the rapidity of reionization. I will describe a new, large program that I have been awarded with the Hubble Space Telescope to measure the amount of nebular emission from the nascent galaxies identified in our imaging data, and I will discuss how we will use these forthcoming data to constrain reionization. I will also describe how future observations from the James Webb Space Telescope and the Giant Magellan Telescope will make definitive measurements of the properties of the first galaxies and on the process of reionization.

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