



# PHYSICS AND ASTRONOMY COLLOQUIUM

## Dr. John Wise

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### “The First Stars and Galaxies in the Universe”

#### Abstract

Cosmic structure forms hierarchically through smooth accretion and dark matter halo mergers. As a consequence, all galaxies are the product of the dozens of mergers over billions of years. However, one can ask, "What were the first stars and galaxies in the universe?" I will review the current state-of-the-art simulations of early galaxy formation, starting with the formation of the first stars, which are initially devoid of elements heavier than lithium and are suggested to have a characteristic mass of tens of solar masses. I will then present results from a suite of cosmological radiation hydrodynamics simulations that focus on the transition from the first stars to the first galaxies. Each simulation captures the radiative and chemical feedback from  $\sim 300$  first stars, leading to the formation of a  $10^9$  solar mass dwarf galaxy 700 million years after the Big Bang. I will show that momentum transfer from ionizing radiation plays an important role in providing turbulent support and mixing supernova ejecta, preventing the overproduction of stars and metals. This results in a stellar population with a tight metallicity distribution function centered at 0.01 of solar metallicity, agreeing with the observed luminosity-metallicity relation in local dwarf galaxies. I will also demonstrate that these faintest galaxies are the primary driver of the reionization of the universe, only to be suppressed by photo-heating at later times, perhaps evolving into a subset of dwarf galaxies in the local universe.

Wednesday, January 22, 2014

3:30 p.m.

Bob Wright Centre

Room A104