Star Formation Histories of the Fossils of the First Galaxies

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Introduction

Understanding galaxy formation is a fundamental piece of our understanding the evolution of the Universe. A galaxy is simply a large collection of gas, stars, and dust which is gravitationally bound. Dwarf satellite galaxies are smaller galaxies which orbit more massive galaxies like our Milky Way. One of the key question in astronomy today is how stars form in galaxies throughout cosmic time. To investigate this question, we study the star formation histories of galaxies. A star formation history tells us when the galaxy began to form stars, and when the majority of its stars were formed.

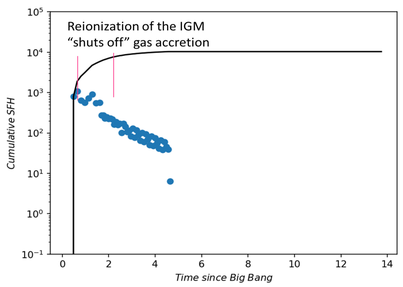
Method

We look at the star formation histories of galaxies modeled using the semi-analytic model Galacticus. Semi-analytic models use our understanding of the physics of star and galaxy formation and evolve the Universe forward in a computer. The details of the modeling with Galacticus can be found on Sachi Weerasooriya's poster.

Star Formation History

A fossil galaxy experienced more than 70% of it's star formation prior to reionization and today has an ancient stellar population and has no gas or current star formation.

Figure 1: *The blue points indicate how many stars are forming at a given time for a potential fossil. These stars are forming from gas in their host galaxies. Note that while star formation is not shut off by reionization, the number of stars forming drops and star formation ceases within about a billion years.*



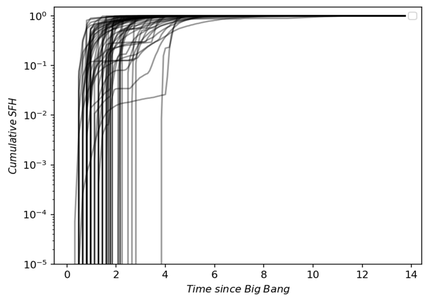
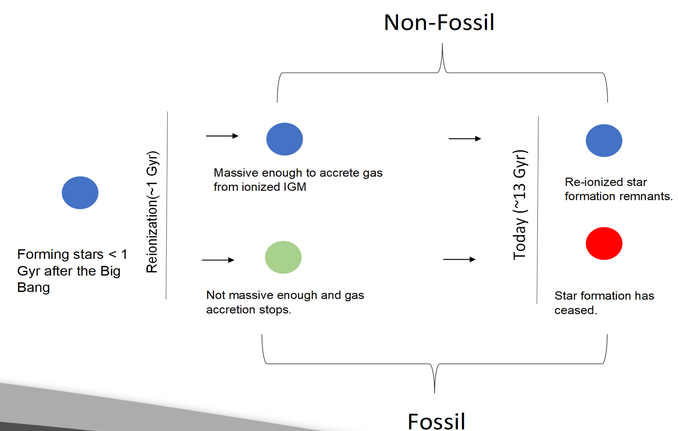


Figure 2: *This figure shows the cumulative star formation histories of 68 halos which may be fossils of reionization. To compute the cumulative star formation history , we determined the fraction of the current mass in stars which had formed by a given time. All our star formation histories have been normalized to mass in stars today.*

The Fossil of Reionization

During the first billion years after the Big Bang, the hydrogen in the Intergalactic Medium (IGM) went from neutral to ionized. When the hydrogen between the galaxies became ionized its temperature rises. While more massive galaxies barely noticed this transition, the lowest mass galaxies were unable to accrete gas from the hotter, ionized IGM. These low mass, fossils, formed stars out of their remaining gas, and then ceased star formation, less than 1.5 billion years after the Big Bang.



Future Work

We will select the fossil galaxies from the mass cut off required for a galaxy to continue to accrete gas after reionization and look at their star formation histories. Once some new physics for gas cooling in low mass galaxies during reionization is added to Galacticus we will determine how that changes our star formation histories.

Sci Com Statement

Astronomy, is the epidemy of all natural sciences; from the moment we try to calculate the number of stars in the sky. However, we have to stop and think, where exactly did those stars come from? We now know that stars are form within galaxies. However, exactly how this star formation happens in a galaxy is still not known. We look at star formation in the lowest mass galaxies from to study in detail the numbers of stars that form in the smallest galaxies in the Universe.