SMACS 0723

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Abstract

Your abstract.

1 Introduction

The galaxy cluster SMACS 0723 (SMACS J0723.3-7327) is one of the first targets to be imaged by NASA's James Webb Space Telescope (JWST). The massive cluster lies in the southern constellation Volans (the Flying Fish), at a distance of 4.24 billion light-years. The deep field image of SMACS 0723 covers an area only 2.4 arcminutes across. It shows the foreground cluster as it appeared 4.6 billion years ago. The images were taken on June 7,2022.

2 Comparison between hubble and JWST telescope images

image by jwst

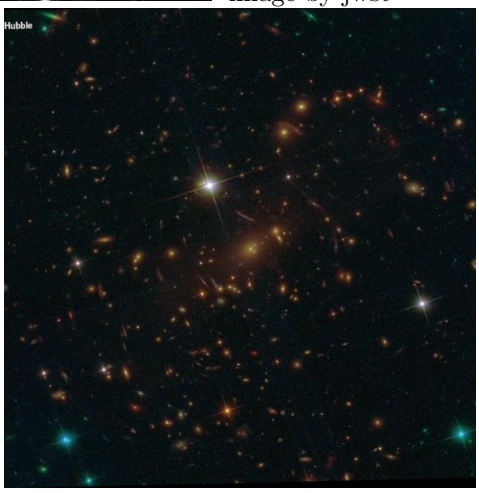

image by hubble

When James Webb telescope was sent in space it was its target to unveil the coloured image of the objects present in this cluster . The cluster had been previously observed by Hubble space telescope (HST) . On comparing both the image we can see a huge difference between them It was the first time when powerful jwst snapped an unpredictable deep field view.

3 Significance

NASA's James Webb Space Telescope (JWST) delivered its deepest and sharpest infrared image of a distant universe to date. Known as Webb's First Deep Field, the image is of galaxy cluster SMACS 0723. In December 1995 the Hubble Space Telescope, only five years old at the time, stared at one tiny patch of space about the size of a grain of rice held at arm's length.

This dark, apparently empty space became the site of the Hubble Deep Field. At the time this was the deepest image of space that had been achieved in visible light, the type of light our own eyes can see.

It showed that even in the emptiest parts of the sky, there are thousands of galaxies, far too faint for our eyes, or even most telescopes, to see. Later on, the Ultra Deep and Extreme Deep Fields would push even further, back to galaxies seen only a few hundred million years after the Big Bang.

The first image released in this opening set is Webb's own attempt. While even the shortest Hubble deep field took over a week to produce, Webb needed to stare for only 12 hours to achieve an image that almost certainly contains the most distant galaxy seen in infrared light.

An even smaller slice of the sky, this vast array of galaxies comes from a patch only the size of a grain of sand held at arm's length, a fraction the size of the Hubble fields.

Unlike Hubble's field, this image was deliberately focused on a specific galaxy cluster, named SMACS 0723. These are the larger whiteish galaxies near the centre of the image. Almost everything else is far more distant.

Because of the expansion of the Universe, the more distant a galaxy is, the faster it appears to be moving away from us. Something called the Doppler Effect causes these retreating galaxies to appear redder as their light gets pulled towards the red end of the spectrum. Thus, the smaller and redder a galaxy appears, the more likely it is to be amongst the most distant galaxies ever seen. Webb, with a much larger mirror and its focus on red and infrared light, is better suited to seeing these distant galaxies than the much smaller, blue-focused Hubble ever could. One odd feature of this image is how many of the lights appear distorted.

Galaxies appear stretched out into long arcs or smears that surround the centre of the image. This is a real effect, caused by gravity. Just like everything else, light is affected by gravity, its path curving when it encounters extremely massive objects. The galaxy cluster in the centre of the field is bending the light like a glass lens and focusing it. That means that these red arcs of light, which are actually exceptionally distant galaxies, are being magnified and brightened by a gravitational lens. Finally, the only relatively local things in this first image are some of the bright six-spiked lights. Some of these are stars from our own galaxy, their light so bright compared to everything else that the glare is being spread around the image in a characteristic pattern. This pattern is unique to Webb and is due to its unusual hexagonally shaped mirrors. However, even the brightest star in this image is far, far fainter than anything you could see with the unaided eye.

In a fraction of the time, and with far more detail, Webb has already surpassed the deepest image that Hubble has ever taken.

4 Reference

https://en.m.wikipedia.org/wiki/Webbhttps://www.deccanherald.com/science-and-environment/explained-significance-of-james-webb-space-telescopes-first-deep-field-image-from-nasa-1125923.html