

# Island worlds in the vastness of the Universe

ASTROPHYSICAL SERIES: PART - 3

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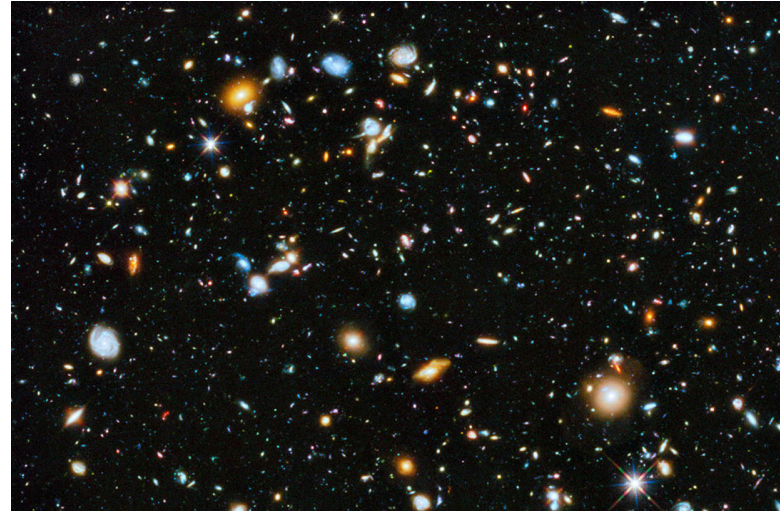
All the stars you see in the sky belong to our Galaxy, the Milky Way. But our naked eyes can't see everything: if you point a powerful telescope to any seemingly empty region of the sky, it will uncover hundreds and hundreds of other galaxies! Each of these galaxies is a world in itself, containing billions of stars and planets. Our Milky Way may be huge, but it is only one galaxy amongst hundreds of billions!

The Andromeda Galaxy is one of the nearest galaxies to the Milky Way. But it is already two million light-years away, which means it took two million years for its light to reach us: we see it as it was when there were still no humans on Earth! Because light takes time to travel from one place to another, we see distant galaxies not as they are right now, but as they were long ago in the past. The farther we look in space, the farther we see back in time.

Some of the faintest galaxies telescopes can see are ten billion light-years away, and we can thus probe the Universe as it was ten billion years ago. Galaxies at that time looked quite different than now. Whereas our Milky Way and the Andromeda Galaxy have beautifully smooth spiral shapes, galaxies were less regular and much lumpier ten billion years ago. Besides, they were forming much more stars.

## How do stars form?

Stars originate from cold gas clouds that are mainly composed of hydrogen, as hydrogen is the most abundant element in the Universe. Gravity pulls the gas particles together, up to a point where pressure and temperature are so high that nuclear fusion reactions start: atoms merge and form heavier elements, like helium, carbon,



*The Hubble Ultra Deep Field image uncovers a multitude of galaxies in a tiny region of the sky.* CREDIT: NASA, ESA, H. TEPLITZ AND M. RAFELSKI (IPAC/CALTECH), A. KOEKEMOER (STSCI), R. WINDHORST (ASU), Z. LEVAY (STSCI)

and even iron. These powerful nuclear reactions generate the incredible amount of energy that makes stars shine, and produce most chemical elements in the Universe, including the atoms of your own body. We are all made of stardust!

Galaxies progressively consume their gas reservoir to form stars. Also, giant stars often explode at the end of their lives, which eject some of the remaining gas out of their galaxy. The gas content of a galaxy consequently decreases with time, and this is the main reason why galaxies formed much more stars ten billion years ago. Nevertheless, our Milky Way still gives birth to a couple of stars each year!

## The Universe is not static

We often imagine the Universe as



nature  
conservation  
foundation

an unchanging ocean in which our Galaxy would be fixed for all times. But our Universe is not static. As stars form and die, galaxies evolve and change. The life of a galaxy is far from quiet, and can even be violent! Galaxies can indeed collide and merge with each other. For example, the Andromeda Galaxy will merge with our Milky Way in four billion years. But be reassured, although it will definitively change the night sky, it shouldn't disturb Earth and our Solar System that much!

For the moment, we are only able to

observe other galaxies from the distance. Each galaxy is unique and they all have different shapes and colours. But these worlds may seem too far away to be ever reachable. Do you think mankind will be able to explore them one day?

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- Giant stars usually explode at the end of their lives. The explosion is called a supernova, and can be as luminous as a whole galaxy. It generates huge winds that can expel some of the gas from the galaxy in which it happens.
- Andromeda Galaxy is about the same size as our Milky Way, and it is actually visible with the naked eye during dark moonless nights. It appears as a dim, hazy dot in the sky.
- Andromeda Galaxy and our Milky Way are both part of a group of galaxies named the Local Group.
- The Hubble Ultra Deep Field image taken by the Hubble Space Telescope reveals thousands of galaxies in an area which is hundred times smaller than the apparent surface of the moon.