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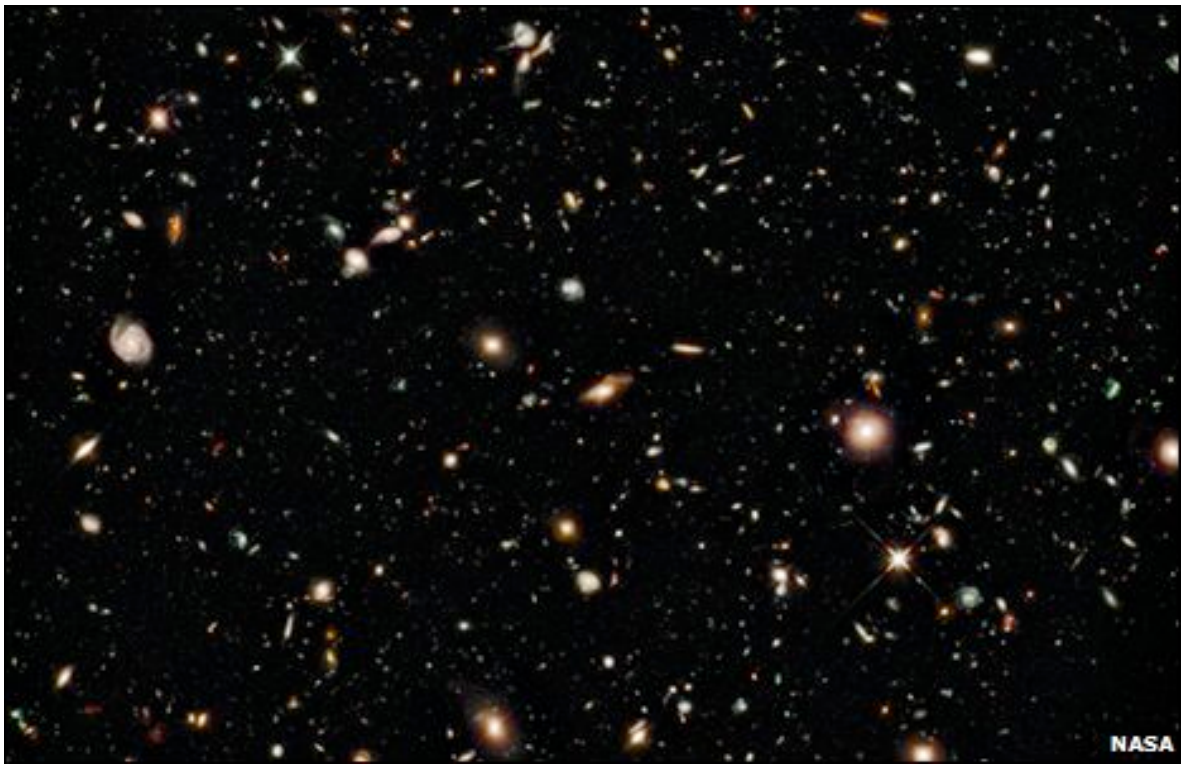
Hubble's role in search for aliens



Very distant galaxies have been spotted in the Hubble Ultra Deep Field

The powerful vision of the Hubble Telescope - which turns 20 this week - has expanded our cosmic horizons and brought into sharper focus a new set of mysteries about the universe that is our home, writes astronomer royal Sir Martin Rees.

To those whose science is gleaned from the media, astronomy may seem to be on a roll. And it is.

We have established, in outline, a consensus picture of how, from a hot dense beginning nearly 14 billion years ago, our expanding universe developed galaxies, stars and planets.

We can set our entire solar system in a grand evolving scenario stretching back to a Big Bang - an era when everything was hotter than the centres of stars, and expanding on a timescale of a few seconds.

Only in the past 10 years have we learnt that large numbers of "worlds" exist in orbit around other stars.

Present techniques aren't sensitive enough to find an earth-like planet, but the ones so far detected - mostly as big as Jupiter or Saturn, the giants of our own solar system - may well be the largest members of other planetary systems as varied and interesting as ours.

If there is life on Mars, it is very primitive.

But could some newly discovered planets orbiting other stars harbour biospheres as complex as our Earth's, perhaps with intelligent life?

That question can now be seriously addressed.

Iconic image of the "Butterfly Nebula", showing the end stages of a star

There are on-going searches for transmissions that might be "artificial" in origin.

These efforts are privately funded: they have a hard time getting public funding because the topic is encumbered by "flaky" associations with UFOs, and so forth.

Despite the heavy odds against success, I certainly support these efforts, because of the philosophical import of any detection of a manifestly artificial signal.

Even if we couldn't make much sense of it, we'd have learnt that "intelligence" wasn't unique to the hardware inside human skulls, and had emerged elsewhere.

Peering back in time

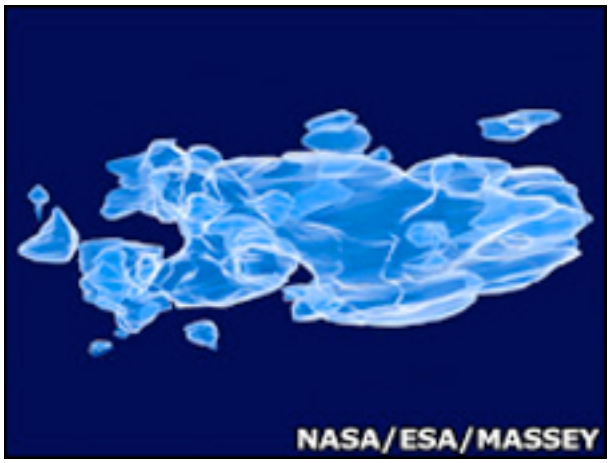
But let's now enlarge our cosmic horizon further. Our galaxy, with its hundred billion stars, is similar to millions of others visible with large telescopes.

Andromeda, the nearest big galaxy to our own lies about two million light years away. Its constituent stars are orbiting in a disc, seen obliquely.

The nearest few thousand galaxies - those out to about 300 million light years - have been mapped out in detail.

As we probe deeper into space, towards our horizon, we probe further back in time (because the light now reaching us set out a long time ago): we see the universe as it was when it was younger and more close-packed.

And we can now see very far back.



Hubble's 3D map showing the cosmic "scaffold" of dark matter, upon which stars and galaxies are assembled

Among the iconic images from the Hubble Space Telescope are those that show a small patch of sky, less than a hundredth of the area covered by a full moon.

Viewed through a moderate-sized telescope, these patches would look completely blank.

But these ultra-sensitive long exposures reveal many hundreds of faint smudges of light - a billion times fainter than any star that can be seen with the unaided eye.

But each is an entire galaxy, thousands of light years across, which appears so small and faint because of its huge distance.

A huge span of time separates us from these remote galaxies.

They are being viewed when they have only recently formed: we are looking back more than 90% of the time to the Big Bang.

In the beginning...

These remote galaxies have not yet settled down into steadily-spinning "pinwheels" like Andromeda.

Some consist mainly of glowing diffuse gas that hasn't yet condensed into stars.

SOME KEY HUBBLE TELESCOPE DISCOVERIES TO DATE
In what was a prime mission objective, Hubble fixed the Universe's age at about 13.7 billion years - later confirmed by other instruments
Hubble's ability to detect faint supernovae contributed to the discovery that the expansion rate of the Universe is accelerating
Hubble was one of two telescopes to make the first direct images of planets orbiting another star - historic images made public last November
Hubble provided the first direct measurements of the three-dimensional distribution of dark matter in space

When we look at Andromeda, we sometimes wonder if there may be other beings looking back at us.

Maybe there are.

But on these remote galaxies there surely aren't. Their stars haven't have had time to fuse pristine hydrogen into carbon, oxygen and silicon - the atoms needed for planets and life.

What about the far future? Six billion years from now, when the sun dies, the galaxies will be more widely dispersed, and will be intrinsically somewhat fainter because their stellar population will have aged, and less gas will survive to form bright new stars.

But what might happen still further ahead?

A very surprising discovery aided by the Hubble Telescope is that the galaxies are dispersing at a rate that is actually accelerating, under the influence of some mysterious force.

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The best long-range forecast, therefore, is that the cosmos will continue to expand, becoming ever emptier, ever darker and ever colder.

We can't predict what role life will eventually carve out for itself: it could become extinct; on the other hand, it could achieve such dominance that it can influence the entire cosmos.

The latter is the province of science fiction, but it can't be dismissed as absurd.

After all, it's taken little more than one billion years for natural selection to lead from the first multi-cellular organisms to Earth's present biosphere (including us).

And what about the very beginning?

The first tiny fraction of a second of cosmic history is still shrouded in mystery, because the conditions then - the densities, temperatures, and so forth - would have been far beyond those we can simulate in the lab.

Here we enter a realm where theorists can only speculate.

One of my favourite magazine covers showed a red circle, beneath the caption "the universe when it was a trillionth of a trillionth of a trillionth of a second old -- actual size".

According to a popular theory, our universe "inflated" from a hyper-dense blob no bigger than that, under the influence of a cosmic repulsion 120 powers of ten fiercer than the force that drives the galaxies ever-further apart today.

In the past two decades, the Hubble Telescope (and its counterparts on the ground) have hugely expanded our cosmic horizons - but, as always in science, this progress brings into sharper focus a new set of mysteries which will challenge the next generation of astronomers and fascinate all who wonder about the universe that is our home.

Sir Martin Rees is astronomer royal, master of Trinity College, Cambridge, and president of the Royal Society

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