Ask A Genius 42 - Informational Cosmology 18

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Scott: With respect to the galaxy-size, so we're going to scale down and away from apparent T=0 to individual galaxies, those are in either of two classifications: proton-rich and neutron-rich, which are new.

Proton-rich are likely to be younger, active, and not burnt out. Neutron-rich are after all of the proton energy has been burnt out. When you're burning high-proton galaxies, and they are alight, they expand space and time moves fast(er).

But over time, the space they inhabit collapses, over deep time, and the protons run out, and they neutrons fill them up. You get a neutron-rich galaxy, like embers left burning after a fire.

Rick: The universe has roughly 10^11 galaxies. New research says it might be more than that by a factor of 10, and the average galaxy contains about 100 million stars. If you're developing a model of the universe as information processors, you'd expect galaxies to be some kind of processing unit.

Given that there are so many galaxies, and they fall roughly or have a not completely wild variation in structure, a galaxy is a blob of stars. The blobs can have a number of different structures. They can have gas and lots of other stuff going on.

But a galaxy is a relatively definite agglomeration of matter. You'd expect, if the universe is an information processor, then a galaxy has fairly specific roles with the processing and storing of information. It seems like it could be a given. There are other units that fit, if indeed the universe is an information processor.

Galaxies are made of a hundred million stars on average and other stuff like interstellar gas, quasars, blackish holes, and stuff like planets. A bunch of stuff within galaxies. One thing you definitely have in galaxies, for sure, are stars. Stars have a specific information processing role, and stars are made of atoms. So, atoms have a fairly specific information processing role.

You've got cars made out of atoms. Atoms stick together in specific ways that are useful for making your car go. Tires, the tire assembly that include the wheel too. Altogether, the car works like a car. But you can break down the cars functions are various scales to talk about the roles of tire atoms. Atoms in a tire are linked together flexibly so the tire can grab the road.

The atoms in the engine block are linked together fairly rigidly so the engine can work like the engine. But you can talk about the various components and their various functions and how they fit into some larger thing. You would expect galaxies to have some larger function in the overall business of the universe.

You were talking about new galaxies that were burning protons through fusion, nuclear fusion, which means you take an element that is richest in protons, which is hydrogen. It is close to 100%. Its nucleons are close to 100% protons.

When you can burn it through fusion turning it into helium, where its nucleons and helium, around half of the nucleons are now neutrons, they are protons who have fused and become neutrons. You can't burn neutrons.

But you can probably do somethin' with them in a neutron star, but under normal physics a neutron is basically a burnt proton. A young galaxy, according to big bang theory, starts out being a bunch of gas, interstellar or intergalactic gas, that has come together – tighter and tighter and tighter and tighter as it forms a blob gravitationally.

And that gas is roughly ¾ hydrogen and ¼ helium left over from the big bang and some trace elements, as the gas further coalesces into proto-stars the gas clumps up even further to the point that the pre-star.

There's enough gravitational pressure, the pre-star coalesces, and eventually there's enough pressure to cause nuclear fusion when you start turning protons into neutrons when you smash them together under tremendous pressure.

Hydrogen nuclei quickly progress from deuterium. A hydrogen nucleus is one proton, and you can fuse them and make deuterium which is one proton-one neutron, and then tritium which is one proton-two neutrons.

Then you hit a stable point when you get to helium, which is two and two. When you do enough of this, you can burn helium and turn them into even heavier elements. Under most circumstances, depending on the size of the star, oxygen is a stopping point for a lot of stars and iron is a stopping point for a lot of larger stars.

And then you've run out of fuel. Same way, you can only burn a piece of paper once. All of the chemical potentials to release energy have been released and now the paper is ash. You'd have to turn the ash into something that can burn, chemically. You have new young universes that are proton-rich, able to light up and burn all of their protons.

Then you have all of these neutron-rich universes in which everything is burnt up, and burnt out. You've got white dwarfs, brown dwarfs, blackish holes. This is after 20, 40, 50, 100 billion years. Most of everything is burned out.