COSMIC Cafés

Description of NOVA's *The Fabric of the Cosmos*
What is Space?

To most of us, space is an empty void. Well, it turns out space is not what it seems. Space is a dynamic fabric that can stretch, twist, warp, and ripple under the influence of gravity. Stranger still is a newly discovered ingredient of space that actually makes of 70% of the universe. Physicists call it dark energy, because while they know it's out there, driving space to expand ever more quickly, they have no idea what it is. Probing space on the smallest scal
es only multiplies the mysteries, with things going on that physicists can barely fathom. Someday we may find that just the way all the stuff that makes up our world is made of matter, so space itself may be made of some fundamental ingredient. Space, far from being empty, is filled with some of the deepest mysteries of our time.

Main Ideas

- To Newton, space was a framework—a passive stage for everything that happens in the cosmos. The action couldn't affect the stage and the stage couldn't affect the action.

- Einstein said that Newton was wrong and that space is something. Space is not unchanging—the speed of light is. So if speed is just the amount of space something travels in a given amount of time, the only way that the speed of light could remain constant is if space and time could change. In this new vision, space and time were woven together into what he called "space-time." For Einstein, space was in the eye of the beholder, having vastly different appearances depending upon the motion and speed of whoever's looking at it.

- Based on the idea that space-time is flexible, Einstein defined gravity as the warping of space-time caused by the objects in space—gravity as the shape of space itself. This view gave space properties (e.g., a flexible geometry that could curve, twist, stretch, bend, and ripple, like a rubber sheet).

- Higgs furthered the view that space is stuff, with intrinsic properties. His worked focused on particles and space at the subatomic (i.e., quantum) level. At this level, space is governed by a set of laws-called "quantum mechanics." According to quantum mechanics, space is filled with tiny particles that are constantly popping in and out of existence. Higgs imagined that at this scale, space is like an ocean. Particles are immersed in this ocean and gain mass as they move through it.

- Astronomers observe that the spread of the universe is accelerating rather than decelerating. Something must be overwhelming gravity, which would tend to pull the universe back together. This observation seems to support the idea that space is something, and a big mystery in physics today is finding the "stuff" that is causing the acceleration. It has been dubbed "dark energy."

- In one scenario, dark energy will continue to push the galaxies farther and farther apart—until ultimately, they'd be so far apart that the universe would become a cold, dark, and lonely place. In another scenario, termed the "Big Rip," the strength of dark energy might increase over time, becoming so strong that it would tear everything—including atoms—apart.