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[Music throughout] What makes up most of the cosmos?

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Not stars or planets, or even atoms. It's something scientists call

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dark energy. And so far, no one has a good handle on what it actually is.

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Dark energy, first discovered in 1998,

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is an enigmatic pressure pushing the universe apart at an ever-faster clip.

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Scientists suspect it began flexing its muscles around five billion

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years ago -- beyond that, we know very little.

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Learning more about dark energy is one of the primary reasons NASA is

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building WFIRST, a new space telescope whose measurements will help us home

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in on this mysterious cosmic component. Without a better understanding of

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dark energy, our knowledge of the past and future evolution of the universe is

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incomplete. WFIRST will tackle the dark energy problem using

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different yet complementary wide-field surveys. A key aspect of them

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is a measurement called "redshift."■ Because space itself is

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expanding, the farther we look, the faster galaxies are moving away

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from us. This results in a measurable shift in an object's light toward

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redder colors. This redshift indicates how fast the expanding

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universe is carrying galaxies away from us. If we can also figure out a

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galaxy's distance by other methods, we can use both pieces of information

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to measure how the universe expanded while the galaxy's light was traveling to us.

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WFIRST will map out the positions and distances of

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millions of galaxies. This will allow astronomers to see how the distribution of

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galaxies has changed, revealing how dark energy has evolved over cosmic time.

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An alternative way to measure dark energy is by

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using exploding stars called type Ia supernovas. These blasts

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are caused by the total destruction of a white dwarf star and each one

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emits similar amounts of light. But the farther away they are, the fainter the explosions

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look. By measuring how bright type Ia supernovas appear

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to be, we have a way to measure their distances.

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It was comparing supernovae redshifts to their apparent

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brightness that astronomers discovered dark energy. These studies showed that

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explosions at greater redshifts were dimmer than they should be in any model

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where the expansion of the universe was not speeding up.

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WFIRST will study thousands of explosions reaching to even greater distances

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to measure dark energy's influence over time.

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A quirk of the early universe provides another way to pin down

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dark energy. In its first half-million years, the universe consisted of a

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hot, dense expanding fluid. Small density changes in the fluid

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excited sound waves that traveled throughout it. Although the waves, called

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baryonic acoustic oscillations, eventually ceased, astronomers

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have observed their faint imprint in the way that galaxies cluster together. This

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provides another way to measure galaxy distances. WFIRST will measure

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how this imprint changes through cosmic history, allowing astronomers to map

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the expansion of the universe in more detail and probe dark energy's effects over

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time. With each technique cross-checking the other,

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WFIRST's surveys will peer deeply into dark energy, providing important data

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to help scientists figure out what, exactly, it is, and how it

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will determine the ultimate fate of the universe.