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**HEADLINE: Universe** just keeps on growing Astronomical Society hears three different scientific measurements reach same conclusion

**BYLINE:** BY STEPHEN STRAUSS Science Reporter

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**BODY:**

The Big Crunch is out; the Endless Expansion is in.

In what was agreed was an almost unprecedented concordance of results, astronomers using three different, unrelated measuring techniques have concluded that the **universe** shows all signs of **expanding** forever.

As a corollary of that, they told reporters in attendance at the winter meeting of the American Astronomical Society that:

The **universe** was indeed older than its oldest stars.

The universe had only a fifth to a quarter of the matter that theory suggests would be necessary for it to stop the expansion of the Big Bang and fall back in on itself -- the Big Crunch.

The central issue they were trying to resolve was what has been happening to the speed of matter that the explosive birth of the universe started hurtling outward. The force of gravity should be slowing that expansion. However, if there is enough gravity-exerting mass in the universe, it could bring that expansion to a halt and then start the universe collapsing in upon itself.

One way of determining that is by trying to compare how fast the universe was expanding in the past to how fast it is expanding now. Scientists have calculated a slowdown ratio that results in an eventual contraction -- a ratio they denote by the Greek letter omega.

Probably the most compelling evidence given yesterday for an endlessly growing cosmos were calibrations of the size

of the universe using changes in the brightness of supernovas as their yardstick. Supernovas are the explosions that mark the death of burned-out stars.

Their light gradually fades, but according to fixed principles that seem the same no matter how old the supernovas are. Over the past two years, highly accurate records of this brightening and fading have been calculated based on data from a variety of supernovas.

The final part of the equation is the so-called red shift, the stretching of light that is caused by the expansion of the universe over time. Using nearby supernovas as what they call a "standard candle," astronomers in the Supernova Cosmology Project, lead by Saul Perlmutter of the U.S. Department of Energy's Lawrence Berkeley National Laboratory, were able to compare the light from newly discovered distant supernovas to nearby ones.

"All the indications from our observations of supernovae spanning a large range of distances are that we live in a universe that will expand forever," Prof. Perlmutter said.

Using a completely different measure, Neta Bahcall, an astrophysicist at Princeton University, presented her evidence for what she termed a "lightweight universe."

She looked at the life histories of three giant clusters, that is, areas of the universe where hundreds of galaxies are clumped together. These three clusters collectively have more mass than 1,000,000,000,000,000 suns.

Fluctuation theory says that the less matter there was in the early universe, the sooner in time these clusters would have appeared.

Prof. Bahcall and her collaborators showed that three of the most massive of these clusters formed six to nine-billion years ago. The theory predicts that instead of three such clusters only 0.001 of them should have existed if there was enough initial mass in the universe to eventually stop expansion and start contraction.

To this Prof. Bahcall added: "Do we live in a lightweight universe? The bottom line . . . answer is Yes."

Finally, Ruth Daly of Princeton University presented an analysis she and her colleagues have made of the distances of radio galaxies from the earth. Her measurements almost exactly matched that of the supernovas and giant-cluster lightweight universe. "I can say with 95 per cent confidence the universe is not going to recollapse; it is going to expand forever," she told journalists.

Without a Big Crunch, the end of the cosmos will be what Prof. Bahcall described as "very cold and very dark."

Asked if there could be a hidden systematic error that explains how all three separate measures arrived at the same conclusion, all the scientists said the techniques were so different that this seemed highly unlikely.

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