Earth not center of the universe, surrounded by 'dark energy': cosmologists report

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Earth's location in the Universe is utterly unremarkable, despite recent theories that propose toppling a foundation of modern cosmology, according to a team of University of British Columbia researchers.

Polish astronomer Nicolaus Copernicus's 1543 book, On the Revolutions of the Heavenly Spheres, moved Earth from being the centre of the Universe to just another planet orbiting the Sun. Since then, astronomers have extended the idea and formed the Copernican Principle, which says that our place in the Universe as a whole is completely ordinary. Although the Copernican Principle has become a pillar of modern cosmology, finding conclusive evidence that our neighbourhood of the Universe really isn't special has proven difficult.

In 1998, studies of distant explosions called "type Ia supernovae" indicated that the expansion of the Universe is accelerating, an observation attributed to the repulsive force of a mysterious "dark energy." However, some scientists put forward an alternate theory: They proposed that the Earth was near the centre of a giant "bubble," or "void," mostly empty of matter, and strongly violating the Copernican Principle. If this were the case, gravity would create the illusion of acceleration, mimicking the effect of dark energy on the supernova observations.

Now some advanced analysis and modeling performed by UBC post-doctoral fellows Jim Zibin and Adam Moss and Astronomy Prof. Douglas Scott is showing that this alternate "void theory" just doesn't add

up. Their findings are published today in the journal *Physical Review Letters*.

The researchers used data from the Wilkinson Microwave Anisotropy Probe satellite, which includes members from UBC on its international team, as well as data from various ground-based instruments and surveys.

"We tested void models against the latest data, including subtle features in the cosmic microwave background radiation – the afterglow of the Big Bang – and ripples in the large-scale distribution of matter," says Zibin. "We found that void models do a very poor job of explaining the combination of these data."

The team's calculations instead solidify the conventional view that an enigmatic dark energy fills the cosmos and is responsible for the acceleration of the Universe. "Recent advances in data collection have brought us to the era of precision cosmology," says Zibin. "Void models are terrible at explaining the new data, but the standard dark energy model works very well.

"Since we can only observe the Universe from Earth, it's really hard to determine if we're in a 'special place,'" says Zibin. "But we've now learned that our location is much more ordinary than the strange dark energy that fills the Universe."

The journal paper is available online at link.aps.org/abstract/PRL/v101/e251303 .

Source: University of British Columbia