

Dark Energy

Director of IPMU

Hitoshi Murayama

Imagine you are a kid in the park, competing with other kids on how high you can throw a ball. Your ball is going straight up, the higher it goes, the slower it becomes, because of the Earth's gravitation pull. But as you watch the ball, it suddenly starts picking up speed, going faster and faster, and disappears from sight. You scream, run home, until you can tell Mom your story. And you find Mom doesn't believe you on this one.

This is exactly what happened in 1998. Saul Perlmutter, my colleague in Berkeley, tried to measure precisely the way Universe has been slowing down as it gets bigger. Sure enough, he found the Universe is getting bigger. The expansion was slowing down for about first seven billion years, but then it started to pick up speed and now is getting faster and faster. He screamed to the world about this discovery, so did his competitors.

Scientists are naturally skeptical, and did not believe this discovery right away. But later measurements showed the same result. Not only that, this discovery *solved* other mysteries of the Universe. For example, we can determine the age of a star reliably. And many of them were found to be *older than the Universe!* But if the Universe is accelerating, its expansion was slower in the past. Then it should have taken longer than we thought to become as big as it is now, and is indeed older than the oldest stars we've seen. With the new discovery, things started to all make sense.

But why is the Universe picking up speed? It seems to gain energy from nowhere. As the Universe expands, *something* is gaining energy and pushing the expansion, a kind of anti-gravity. We call it *dark energy*. We don't know what it is, but believe dark energy is whopping 73% of the energy in the Universe.

Recently we hosted the *godfather* of dark energy, Michael Turner from Chicago to present his views on the nature of dark energy. He also talked to the general public in the evening. It was extremely well attend, especially for a talk given in English, thanks to live and funny translations by Naoshi Sugiyama. Read them talk about dark energy and IPMU in this issue.

It is now clear that gravity, which we all believed to understand since Newton, is a new frontier. To reveal the nature of dark energy, we need to figure out how gravity, which governs large objects such as the Universe itself, meshes together with quantum mechanics, which governs small objects such as electrons, neutrinos, and quarks. Hiroshi Ooguri tells you about the latest attempts in this big quest towards the unified theory of elementary particles and the Universe.

