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School cancellations left astronomer with no one to talk to during Abilene visit

By Brian Bethel

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Turns out the white stuff beat the dark matter.

A University of Texas at Austin astronomer scheduled to speak in Abilene on Tuesday had to return home when inclement weather canceled his scheduled talks.

Dr. Karl Gebhardt, an expert in black holes, dark matter and the most mysterious of all — dark energy, headed back to Austin "to safely return during daylight hours," said Tom Dolan, associate director of Texas Tech University at Abilene.

Gebhardt was to speak to students at the Academy of Technology, Engineering, Math & Science, college professors and Abilene Independent School District science and math teachers today.

The West Texas Science Center Board plans for Gebhardt to return later this spring or early next fall, Dolan said.

Speaking on Friday about his planned trip, Gebhardt was animated about the importance of science, particularly, astronomy, to America!s future success, while waxing rhapsodic about the potential to solve some of the universe!s deepest mysteries.

"It is so outside of the realm of everybody — including me," he said of the topics that he and other scientists on the cutting edge tackle. "It really makes you step back and appreciate what we are able to accomplish together."

Thinking about how the universe, the sun, the earth began is something that Gebhardt himself loves, he said, and the simplicity of nature — and our ability to understand "remarkable concepts" — is a driving force.

But he is the first to admit that in the past, those attempting to understand the cosmos have made "major mistakes."

"We!re kind of in a bind now in trying to understand our universe — trying to understand how the universe came into being, how you make a galaxy, how you make a star, how you make a planet," he said.

Much time and money has been spend in pursuit of such answers, he said, a frustrating circumstance in many ways, he said.

But it is possible that we are entering into a "golden age" of astronomy.

"We are learning so much, so fast over the last 10, 20 years," he said. "It!s only once when you understand the basic components of the universe, and I think we are living through that time right now."

Though it!s now his field, Gebhardt admits that he was never too "crazy for astronomy" growing up. But he remembers going to the science museum in Rochester, N.Y., where he grew up, taking delight in playing with various gadgets and watching how things

worked.

Naturally good at math, it wasn't until he got into graduate school, though, that he found astronomy. Physics was going into large collaborations, while astronomy still allowed one person with a telescope to make a profound difference.

“That really drew me in,” he said.

Economic success is driven by technological achievement, Gebhardt said, which is why educators should be concerned about America's place in the sciences.

“I would still argue that we're a leader, but you can start to see everyone in Europe and Japan starting to catch up to us,” he said. “That's not a good trend.”

Unraveling Our Ignorance

It's easy to confuse certain concepts, Gebhardt said, such as dark energy and dark matter. But black holes, dark matter and dark energy all have a common thread.

“They are representations of our ignorance,” he said.

A black hole represents our ignorance of what happens when you compress mass to very high density.

“All of our math breaks down, our physics breaks down,” he said. “We don't know how to model that yet. And so we just call these things a black hole — all the matter is going to this infinite singularity.”

Dark matter is our ignorance of why stars are moving so fast at the edges of galaxies, something we're close to getting a handle on.

“We think we're very close in physics to finding the dark matter particle,” Gebhardt said.

And dark energy? Best described as “beyond a mystery,” he said.

“It's a manifestation of our ignorance for how the universe evolves,” he said. “Our universe is expanding, it's actually getting much larger than any of our calculations can account for.”

Making such unknowns into knowns requires research, Gebhardt said, and he takes on such tasks from an observational standpoint, rather than a pen-and-paper approach.

“I'm working on characterizing these things much better,” he said, such as measuring the masses of black holes.

For dark matter, one must measure how such matter is distributed around a galaxy, looking at the motion of stars and then making a model to infer how dark matter is distributed.

“Once you can determine how the dark matter is distributed, then you can tie that to the many theoretical models that are out there for what the dark matter is,” he said. “You can understand how it interacts with normal matter and how it interacts with itself.”

The approach is similar for dark energy, requiring a way to map out how the universe expanded over time.

“We're trying to map out exactly how the universe expanded over time, as precisely as we can,” he said. With those observations, one can match facts to theories.

Such theories include radical notions such as laws of gravity being wrong or that the

way matter is distributed in the universe not being what we thought, possibly requiring subtle modification of our understanding of the Big Bang.

To help increase our understanding, Gebhardt and others will work with McDonald Observatory in the Davis mountains on the Hobby-Eberly Telescope Dark Energy Experiment — HETDEX.

According to its Web site, the project will collect data on at least 1 million galaxies that are 9 billion to 11 billion light-years away over a three-year period.

The result will be the largest map of the universe yet produced, allowing the project!s astronomers to measure how fast the universe was expanding at different times in its history.

Changes in the expansion rate will reveal the role of dark energy at different epochs, according to the Web site. Since various explanations for dark energy predict different changes in the expansion rate, by providing exact measurements of the expansion, the HETDEX map will eliminate certain competing ideas.

“As we push to earlier and earlier epochs, we begin to see a clearer picture of the first formation of the universe,” he said. “HETDEX will test some of these very early models, and I hope we can pin down what model it is.”

We are at a point scientifically, Gebhardt said, similar to the early part of the 1900s, when we were just beginning to unravel the inner contents of the atom.

“We don!t know the basic constituents of our universe yet,” he said. “Once we get that, then I!m hoping that same watershed happens. It!s like what!s uncovering inside the atom — what!s inside the universe?”