

# Dark matter: Syracuse Professor's research focuses on WIMPs

By Travis Gulbrandson

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Scientists have long been searching for answers about what makes up most of the universe.

Through continuing searches for weakly interacting massive particles (WIMPs), they may be closer than ever before.

Dr. Richard Schnee, assistant professor of physics at Syracuse University, spoke at the University of South Dakota Thursday, Feb. 20, about WIMP-related research, its past and its future.

Schnee said the search for WIMPs is motivated by observations of cosmology and astrophysics that are "all consistent with a picture that the universe is geometrically flat, and that most of the energy density of the universe is in some cosmological constant, or dark energy."

Additionally, about 30 percent of the universe's energy density is

some kind of "dark matter," he said.

"It's non-baryonic, it's not made up of the same things that make up you, me or the rest of the earth," Schnee said. "This non-baryonic, cold dark matter can't be any particle that we know about, so therefore, this is the best experimental evidence that the standard model of particle physics is incomplete."

WIMPs are arguably the best candidates for what makes up dark matter, he said.

"There are a couple different ways you can actually end up with WIMPs making up this amount of the energy density of the universe," Schnee said. "First, if the WIMPs are produced thermally in the early universe, when the universe is a soup of particles, then if the particles are weakly-interacting, as the universe expands, they'll stop being able to find each other so you'll end up with some of these particles left over.

"In addition to that, if a WIMP is relatively light ... then WIMPs will have about the same abundance as the baryons. So, the WIMPs could be related to whatever caused an asymmetry between matter and anti-matter in the universe," he said.

There are three ways to detect WIMPs: Using colliders, indirect detection and direct detection.

Each of these methods uses interactions shown schematically between dark matter and standard particles, Schnee said.

If there are enough dark matter particles in an astrophysical body, they might interact with each other and annihilate, and then be detected with high-powered telescopes or satellites, he said.

"The three methods of detecting WIMPs are complementary to each other," Schnee said. "It's possible for any one of these three techniques to succeed while the other ones don't succeed. There are some

models that are easier to detect with colliders, and others with direct or indirect detection."

In addition, more information can be acquired if WIMPs are detected with more than one of these methods simultaneously.

"It's only by detecting WIMPs by several of these methods that we can learn all we would like to know about particle physics, astrophysics and cosmology," Schnee said.

For example, you can learn a lot of you detect a WIMP in a collider, but it's impossible to tell if the WIMP is stable, and therefore the dark matter in the universe.

"It's only by also detecting a particle of the same mass using direct detection that we know that same particle is the same dark matter in our galaxy," Schnee said.

There are about 20 such experiments trying to detect WIMPs that are either running or about to run, including one at

the Sanford Underground Research Facility at Homestake.

Another of these experiments is taking place at the Soudan Mine in northern Minnesota, SuperCDMS (cryogenic dark matter search).

"Direct detection has unique capabilities for answering fundamental questions about both astrophysics and particle physics," Schnee said. "It is possible that CDMS ... might already have detected WIMP interactions, but I would bet against it at this point. ...

"In the long range, CDMS technology provides a unique discovery potential for low-mass WIMPs, as well as a low-risk way forward for higher-mass WIMPs, and radon reduction is a critical part for this sensitivity for low-mass WIMPs," he said.

Schnee said results from the SuperCDMS experiment will be available in the spring.

## CARP

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<http://www.samsung.com/us/solvefortomorrow/projects/fishing-for-population-data.html>.

This will give people the opportunity to view the students' short video documentary, and the public will also be given the chance to vote for the VMS project.

"It's pretty nerve-racking. We faced that obstacle in our producing our documentary, and we're facing that obstacle again - how do you, in three minutes or 10 minutes, explain an entire issue to a group of people who really don't have any prior knowledge of what has happened?" Gault said. "How do you explain it to them so that they can understand it, and they can walk away saying, 'this is an issue we should address?'"

Gault's eighth-graders tackled this issue head-on after, at the beginning of the school year last fall, she provided them information about the Samsung contest.

"I gave them one week to identify an issue in the community that they would like to research, they submitted those ideas and then we voted on them as a

class," she said. "Every student in science class is involved in some way ... the entire eighth grade class of 105 students actually received the education, the extra testimony and conducted the research on Asian carp in the Missouri River. It was an entire classroom project."

A serious problem The students decided to focus on the Asian carp, also known as the Silver carp or the Bighead carp.

While many may have chuckled while watching a television program or video of boaters navigating a river filled with these fish - Asian carp are those crazy fish that fly out of the water, often landing in boats and striking their occupants - the students' work drew them to make a startling conclusion.

Asian carp are a menace, and they could drastically change the ecosystem of the Missouri River in South Dakota, even in the Yankton and Vermillion areas, if proper steps aren't taken.

Asian Carp are an invasive fish species that has endangered the natural habitat of the Missouri River and its tributaries. This fast growing "super species" has just recently been discovered on the stretch of river in close proximity to Vermillion.

The students' efforts have included becoming familiar with the Missouri River itself, and identifying the problems Asian carp may pose to it. Their work this school year also included settling on viable solutions to either solve that problem or hopefully alleviate it should it occur.

Their hard work garnered the attention of the Samsung contest officials. Out of nearly 2,400 applications from across the nation, Vermillion Middle School was chosen in late 2013 to represent the state of South Dakota as 1 of 51 state finalists.

This led the students to concentrate on the next step of their project - public awareness. They've produced a 3-minute video that concisely describes the risks Asian carp pose to the Missouri, and the steps that can be taken to minimize those risks.

The young people have also gone public with their work, reaching out to civic leaders to explain the problem, their research, their proposed solutions, and what they've learned along the way.

A small group of the eighth-graders have presented their findings to the Vermillion City Council. On Feb. 10, they shared their work with the Vermillion School Board.

This experience - choosing a project, doing the research, producing a video, presenting to the public - has changed her students, Gault said. Their focus has shifted away from the Samsung contest, and to the Asian carp problem itself.

"Initially, what we knew about Asian carp were featured on funny videos on the internet. We all knew Asian carp as being the subject of a funny video where a silver carp would jump out of the water and hit somebody in the head," she said. "That changed for us very quickly as we were exposed to the data - that data that we accumulated and that data that we studied changed our opinion from this being just an entertaining issue to one that's very concerning.

"This issue, unaddressed, will result in the collapse of the ecosystem of the Missouri River," she said. "This is already happening in many different locations in America. The Illinois River - at this point - there is nothing but Asian carp there, and that will be unfortunately our future, too, unless we put our heads together and look for solutions. That's how everything changed for the students. It became something more than a

contest. It became something more than a funny video. It actually is meaningful to them."

Gault's students have concentrated on strategies for dealing with the invasive species that range from promoting a fishing industry to research into the development of a "bio-bullet" that would help control their population.

Her students also believe in pheromone research that is currently being done. Pheromones are being used to lure Asian carp to particular locations where they can be fished, or where they can be poisoned.

Gault said she is not surprised that her students have the chance to be top winners in the Samsung contest.

"Honestly, I didn't doubt it at all," she said, reflecting on her students' efforts this year. "... These students are capable of things we can't even imagine. If we look back to five years ago, I knew that to be true. I knew that in my class, personally, I wasn't doing enough for them in the aspect of just an ordinary classroom experience. Truly, in my heart, I knew that they were capable of more, and I think that it is my job as a teacher to give those students the opportunity to do more and to really test what they are capable of.

"They're smart, you just have to give them the opportunities to show all of us what they can do. It's something amazing to be a part of this as a teacher. To see these 10 students, for example, who presented to the city council and the school board, and the amount of work that they put in has really been impressive," she said.

Should the Vermillion students eventually learn that they aren't among the top winners in the Samsung contest, they still have reason to hold their heads high, Gault said.

"I've tried to get this message to them as clear as I can: it doesn't matter if we win this contest or not. What you have done is much more than most people do," she said. "You have become passionate about a subject. You have educated yourself about a subject, and you have taken it that one, next step, where you've shared your education and your passion with your community in order to make a difference."

To view the Vermillion Middle School's video, log on to [www.samsung.com/solve](http://www.samsung.com/solve) where the public will have the opportunity to vote for their favorite. The public voting began on Tuesday, Feb. 25, and ends March 14.

## CLAY COUNTY SHERIFF'S PRESS BRIEFING

02/16/14 17:21 - A deputy investigated a report of a past tense domestic assault in Irene and a related child custody dispute. No probable cause was found relating to the assault allegation and the child custody dispute was found to be a matter for Nebraska authorities.

02/16/14 23:53 - While investigating a one-car accident on Burbank Road, a deputy found the driver to be intoxicated and a juvenile passenger under the influence as well. The driver was arrested for DWI. The juvenile was released to parents and charges are under consideration by the States Attorney.

02/17/14 09:16 - A deputy investigated a minor non-injury accident involving a city owned vehicle in Vermillion.

02/17/14 10:53 - A patient was transported from the hospital in Vermillion to the Human Services Center in Yankton for a mental health committal.

02/17/14 12:51 - An inmate was transported to a doctor appointment and then returned to the jail.

02/17/14 15:36 - A rural resident reported that she has received reports of trespassers recently on her property near Wakonda. She requested deputies to watch the property for anyone who isn't supposed to be there.

02/17/14 16:09 - A caller from another state requested a welfare check of an elderly rural resident. The woman was found to be fine. She agreed to contact the caller.

02/17/14 19:19 - A deputy assisted the Sioux City Police Department by finding the registered owner of a vehicle involved in a gas drive off in Sioux City. The suspect was found to be living in Sioux City. This information was shared with the Sioux City Police Department.

02/17/14 20:39 - A vehicle was stopped for speeding at 61 mph in a 45 mph zone on University Road. The driver was cited for the offense.

02/18/14 12:26 - A deputy responded to a report of a non-injury two-car accident at the landfill involving a parked vehicle.

02/18/14 22:12 - A patient was transported for the hospital in Vermillion to the Human Services Center in Yankton for an

involuntary mental health committal.

02/19/14 08:20 - A report was received of numerous stop sign violations every day by traffic leaving the landfill on Bluff Road. Additional enforcement will be provided to this area to encourage compliance.

02/20/14 23:44 - A deputy responded to a one-

car rollover crash on Highway 46. The driver received minor injuries. An accident investigation was completed.

02/21/14 09:26 - County highway workers reported finding evidence of clandestine methamphetamine production near rural bridges north of Vermillion. Deputies and

agents responded and gathered evidence. The matter is under investigation.

02/21/14 15:35 - A deputy responded to a rural Beresford residence to investigate a report of damage to a mailbox.

02/21/14 18:08 - A

vehicle was stopped and the driver was cited for driving 70 mph in the 55 mph zone on 302nd Street.

02/21/14 20:11 - A vehicle was stopped and the driver was cited after driving 52 mph in a 35 mph zone near Wakonda.

Total Records: 17

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Room A

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RSVP is requested, but not required.  
Please call 605-339-6834 or email [mwhite@ortho-i.com](mailto:mwhite@ortho-i.com)

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