Approved: 5-3-10
Date

MINUTES OF THE SENATE COMMERCE COMMITTEE

The meeting was called to order by Chairperson Karin Brownlee at 1:30 p.m. on April 28, 2010, in Room 548-S of the Capitol.

All members were present except:
Senator Tom Holland- excused

Committee staff present:
Ken Wilke, Office of the Revisor of Statutes
Reed Holwegner, Kansas Legislative Research Department
Kathie Sparks, Kansas Legislative Research Department
Marilyn Arnone, Committee Assistant

Conferees appearing before the Committee:
Senator Stephen Morris, President of the Kansas Senate
Professor Greg Snow, University of Nebraska
Professor Jim Cronin, University of Chicago
Professor Fred Sarazin, Colorado School of Mines
Dean Zollman, Head of Physics Department, Kansas State University

Others attending:
See attached list.

Hearing on SCR 1630 - Support of participation in Auger North cosmic ray observatory; formation of task force to lead collaboration with Colorado

Chairperson Brownlee opened the meeting commenting that the committee will probably learn a lot about astrophysics today. She thanked President Morris for bringing this project before the committee for a hearing on **Senate Concurrent Resolution 1630** and invited him to address the committee.

President Morris said that Kansas has a tremendous opportunity to take a leading role in an international research project with global and maybe even universal implications. The Pierre Auger Cosmic Ray Observatory is the world's premier project studying ultra-high energy cosmic rays. Auger South was built in Argentina and has been very successful. Now it has been proposed to build Auger North in Colorado, and Kansas has been asked to join the effort. If funding is approved, Auger North will be built in five years and will operate for 20 years or more. The possibility of expanding into Kansas was considered a strong advantage to the Lamar, Colorado, site due to Kansas' geography which is perfect for the project.

Development of this internationally recognized research facility has far-reaching economic and educational benefits for Kansas and the region including expanded research capabilities in particle physics; a world-class research reputation for Kansas; construction and permanent job development; rural economic development for western Kansas; opportunities to enhance and expand the state's research universities; and outreach and science literacy programs in K-12 education.

Kansas needs to officially voice its support of the Auger North project and through **SCR 1630** a task force can be formed to lead expansion into Kansas. Auger North is on the cutting edge of science and energy and Kansas has a brief window of opportunity to become a leader in the area of cosmic ray research. President Morris encourages the committee to move forward with thoughtful deliberation to approve this resolution. (Attachment 1) (Attachment 2)

Senator Lynn asked President Morris how he knew about this project. He replied that some Kansas businesses and universities had been interested in this project for awhile, and then scientists contacted him to see if the State of Kansas would be interested in this project as well. Since then there had been numerous meetings with people involved in the project for further information. The more meetings, the more excitement about the project.

Senator Faust-Goudeau asked how many jobs would the project create. President Morris said an estimated 120 jobs would result from the building of the project, more jobs from the building of the 4,400 specialized

tanks to hold the water, 400 scientists from around the world would be involved, and there would be a place for school children from Kansas and the surrounding states to visit also creating jobs.

Chairperson Brownlee called on Professor Greg Snow to introduce the Auger North presentation.

Professor Snow said the team of scientists were so pleased to come before the committee to share their excitement about the northern hemisphere version of the world class experiment studying these particles coming from outer space. Their purpose today is to provide information and answer questions so they can continue exploring the possibility of collaborating with Kansas universities, the State, and with western Kansas in a noteworthy science experiment. He introduced Professor James Cronin and Professor Fred Sarazin who will participate in the presentation.

Professor Cronin, a Nobel Prize winner, said the Auger North project is fundamental science. He said the first question is always, "What is it good for?" and the answer is that it is good for humanity to understand all basic aspects of nature. So in dealing with cosmic rays, scientists are dealing with something they know little about. The challenge to society for studying science is research, sometimes unguided research, which may or may not lead to things of great value. Scientists never know, but it has to be done. And it couples into the curiosity of children. Children may not be interested in things like the stock market, but they are interested in how nature works. Even the "way out" projects serve humanity.

Ultra High Energy Cosmic Rays are a naturally occurring phenomena that carries a macroscopic amount of energy from unknown sources outside our galaxy. Scientists want to study them to learn how they are produced and where they come from. A single cosmic ray can produce 10 billion particles on the ground spread over 20 square miles. They are the highest energy atomic particles in the Universe.

The South Pierre Auger Observatory is located in Argentina. Located there is an observatory and water tanks that have allowed scientists to collect exciting data since 2004. The first important paper published from the observatory was in 2007 and was named the most interesting discovery in the physical sciences by Science magazine of that year. It is hoped to complete the observatory by building in the north on an 8,000 square mile area in the United States presently near Lamar, Colorado. This project will take a huge amount of work and dedication. The group here today wants to encourage their colleagues in Kansas to join in the enthusiasm and risk taking to be approved in the United States.

Professor Snow continued the presentation. Professor Snow is the Coordinator of the Education, Outreach and Public Relations arm of the Pierre Auger Observatory. The South headquarters are in Malargue, Argentina whose population is about 8,000 people located in a remote part of the country. The observatory wanted to be a positive impact on the community so has participated in local parades, held science fairs and opened a visitor center where 54,000 visitors have passed through to date. There is also a school, an office building, a planetarium, and a science museum as part of the project. Science projects have created great interaction with teachers, students and the community. It is foreseen to have similar buildings and activities with the North Observatory. Professor Snow sees many economic, cultural, and educational benefits as well as tourism to both the States of Kansas and Colorado to participate in the North Pierre Auger Observatory.

Professor Fred Sarazin continued with what has been happening in Colorado. This project is state of the art in many respects. The scientists and students are just learning to use all the equipment. The Colorado Coalition for Cosmic-Ray Research involves several Colorado universities and the South East Colorado Economic Development. Their mission is "To promote the establishment of the northern hemisphere detector of the Pierre Auger observatory in southeastern Colorado." Hopefully, a similar coalition could be formed in Kansas with the state universities and an economic development partner in western Kansas. Colorado is doing serious work to prepare for the project and the group from the Colorado School of Mines consists of faculty, technicians, undergraduates, Msc students, PhD students and international visitors. The cost of $120 million for the Auger North proposal would could from the federal government, other countries, and Kansas. The Colorado contribution would be $12 million of that figure. Colorado's present commitment is $1.5 million. Other contributions from Kansas and Colorado would include in-kind contributions, infrastructure and incentives. The Auger North would be among the "Magnificent Seven" experiments in particle

astrophysics. Colorado looks forward to welcoming the researchers of Kansas universities among the members of the Auger collaboration and the State of Kansas as a partner to make Auger North a reality. (Attachment 3)

Dr. Dean Zollman stated that his physics department at Kansas State University is very interested in this project and happy that the committee is having this hearing In addition to what was covered in the presentation, a project of this nature automatically improves the prestige of the science and engineering departments that are involved and helps the recruitment of faculty, students and all kinds of people to come to the state and improve the higher education system.

Senator Kelsey asked how the land to put the water tanks is obtained. Professor Snow answered that a contract is drawn up with the landowners which spells out the terms and responsibilities. Basically it is voluntary, but a small incentive such as a tax break is sometimes offered. This project will only succeed if there is the buy-in of the landowners whose property the tanks are on. He emphasized that although there are 4,400 tanks, there is a distance of 1.5 miles between tanks and the impact on the operations of any individual landowner is minimized. The tanks are usually located at the intersections of two north-south roads and put in a very small corner of the property.

Senator Kelsey followed with the question of how much vandalism there might be to the tanks. Professor Snow said this is an issue to be addressed. Argentina has not had a vandalism problem except for few farmers who were curious to see what was inside the tanks. The tanks are usually placed in such a remote location that there is not much visibility for the ordinary person. It is also important to make the community feel the project is theirs to protect.

Senator Lynn asked about in-kind contributions regarding power lines, optic fibers, etc. and how will that be paid for. Professor Sarazin said that Colorado has found that putting tanks in at opportune times and the positioning of the tanks requires very little extra optical fiber and is not a huge cost.

Senator Lynn followed with the question of what happens after the 20 year period of the project. Professor Sarazin said that is still being discussed, but would continue with the scientific experiments and would hopefully be self-sustaining at that time. Professor Snow added that his outreach program had a budget for brochures, displays, etc. It is planned to have the visitor center self-sustaining after 20 years and possibly add admissions if necessary. There is also the possibility of grants to sustain the project.

Senator Brownlee asked if the end goal for the cosmic rays was to harness energy. Professor Snow said the answer is no. The energy that is produced is actually minuscule. The reason is to learn about these particles and what they add to our universe. When knowledge is moved forward all society benefits. There are technological spinoffs that will advance society, but the basic reason is fundamental scientific research.

Senator Kelsey moved that the name of Reggie Robinson be replaced with the name of Andy Tompkins on page two, line 24 of the resolution. It was seconded by Senator Lynn and the motion carried.

Senator Kelsey moved that the Resolution be favorably passed out of committee. Senator Lynn seconded the motion and the motion carried.

Written testimony was presented by Bernadette Gray-Little, Chancellor of the University of Kansas, supporting **SCR 1630.** (Attachment 4)

The next meeting is scheduled for May 3, 2010.

The meeting was adjourned at 02:45 p.m.

COMMERCE COMMITTEE GUEST LIST

DATE: 4-28-10

NAME	REPRESENTING
Dean Zollman	Kansas Stat Univ.
N. Sdomny	Wichita State U.
H. Meyer	Wichita State University
Sue Peterson	K-State
Emily C. Hawks	K State
Connie Meyer	Consts Reporter
DICK CARTER	MANHATTAN CHAMBER
Andy Schlapp	WSU
P. Van Slyke	Sen Pres Ofc
[illegible]	FHSU
Kevin Carr	KTEC
Doug Smith	KLPG
ROB RAINE	CITY OF WICHITA
Don Hineman	Rep., Dist. #118
Marjorie Werly	ESU
Victoria White	Pittsburg State U.
Berend Voogs	Heim Law Firm

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State of Kansas

Senate President

COMMITTEE ASSIGNMENTS

CHAIRMAN: ORGANIZATION, CALENDAR AND RULES
INTERSTATE COOPERATION

CHAIR/VICE CHAIR: LEGISLATIVE COORDINATING COUNCIL
PENSIONS, INVESTMENTS AND BENEFITS
NCSL STANDING COMMITTEES

MEMBER: AGRICULTURE
FEDERAL & STATE AFFAIRS
STATE FINANCE COUNCIL
CSG GOVERNING BOARD
ENERGY COUNCIL EXECUTIVE COMMITTEE

Testimony of Senate President Steve Morris
Kansas Senate Commerce Committee Hearing
SCR 1630, Supporting the Auger North Project
April 28, 2010

Madam Chair, and members of the Committee, thank you for the opportunity to appear before you today.

Kansas has a tremendous opportunity to take a leading role in an international research project with global and maybe even universal implications.

The **Pierre Auger Cosmic Ray Observatory** is the world's premier project studying ultra-high energy cosmic rays. The two part project was conceived 20 years ago. With international support and funding from the National Science Foundation and Department of Energy, **Auger South** was built in Argentina. It was completed under budget. In 2008, it began reporting results.

The proposal to construct the second component -- **Auger North** -- was recently submitted to international funding agencies by the Auger collaboration. **Auger North** will be seven times larger than **Auger South**, covering some 20,000 square kilometers in area with a construction cost of $127 million. If funding is approved as anticipated, **Auger North** will be built in five years and will then operate for 20 years or more.

The **Auger Collaboration** which involves 400 scientists from more than 70 universities in 17 nations originally identified a site near Lamar, Colorado for

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Auger North. The possibility of expanding into Kansas was considered a strong advantage to the Colorado site due to Kansas' geography which is perfect for the project.

Development of this internationally recognized research facility has far-reaching economic and educational benefits for Kansas and the region, including:

- Expanded research capabilities in particle physics
- A world-class research reputation for Kansas
- Construction and permanent job development
- Rural economic development for western Kansas
- Opportunities to enhance and expand the state's research universities
- Outreach and science literacy programs in K-12 education

How can we best position Kansas to be included in Auger North?

Several ideas have come out of our discussions over the past several months with scientists involved in the **Auger North** project. A Kansas academic institution should join the **Auger Collaboration**. The institution would need to dedicate at least 1.5 full-time high energy physics faculty to the project. Wichita State University is best suited to that role and is in the best position to expand its faculty for that purpose.

Beyond earmarked research positions, Kansas would need to officially voice its support of the **Auger North** project. Through SCR 1630, we can form a task force charged with leading **Auger North**'s expansion into Kansas. We would want to consider including legislative leaders, and top representatives of the Governor's office, the Board of Regents, the Kansas Bioscience Authority, Kansas State, University of Kansas, and Wichita State University.

In talks with some of our regents, it was suggested we might want to support the recruitment by Wichita State of an 'eminent scholar' whose efforts would be devoted to the **Auger North** project. We may want to consider allowing the recruitment of an additional eminent scholar to KU.

We might wish to contemplate a tax incentive for landowners interested in participating in the **Auger North** project, similar to one offered in Colorado.

Because a proposal has already been submitted to the National Science Foundation and the Department of Energy, it is imperative that we bring our Congressional delegation up to speed as soon as possible.

Kansas has a brief window of opportunity to become a leader in the area of cosmic ray research. **Auger North** will proceed regardless of our involvement. It is on the cutting edge of science and energy. This project and its potential have fascinated me since I was first approached by a group of scientists many months ago. I encourage you to move forward with thoughtful deliberation to help establish Kansas as a world leader in cosmic ray physics. Thank you.

11:10 042810

IMPOSSIBLE PARTICLES

From deep space, cosmic rays come fast and pack a heck of a punch. They may also carry clues to the most vexing mysteries in the universe.

BY ANDREW GRANT

NOTHING ON THE TREEless plains of western Argentina seems to expend much energy. Cattle stand nearly motionless as they graze on the thin grass, which grows slowly in the dry heat and high altitude. A cylindrical water tank with a small solar panel and a skyward-facing antenna sits unobtrusively in the nearly motionless landscape. But hidden within this scene is plenty of drama. At any given moment, millions of projectiles from deep space are raining down, penetrating every object in their path. Each particle then vanishes without a trace—unless it happens to pass through the water tank, where it causes a minute spark visible to scientists thousands of miles away.

The tank is one of 1,600 spaced out at one-mile intervals over 1,100 square miles of land, an area bigger than Rhode Island. Collectively they make up the Pierre Auger Cosmic Ray Observatory, a $50 million physics experiment to study bits of atomic shrapnel that blast out from some of the most violent places in the universe. These energetic particles, called (somewhat misleadingly) cosmic rays, tell revealing tales about the exploding stars and black holes that have shaped galaxies and seeded the cosmos with the essential elements of life.

Traditional telescopes are blind to many of these cataclysms. Some 600 miles to the north, atop Chile's high mountains, some of the world's greatest observatories are surveying the distant universe in breathtaking detail, and yet they have little new to say about the inner core of a quasar, the edge of a stellar shock wave, or clumps of dark matter. Visible light and radio waves do not or cannot escape from such regions. Cosmic rays, which fly straight from the site of the conflagration, can.

To attain a new perspective on the cosmos, astronomers are teaming up with particle physicists to develop clever ways of detecting these wayward particles. Pierre Auger's water tanks represent one way to do it; experiments borne by balloon, like the Advanced Thin Ionization Calorimeter, are another. "To think of these devices as 'telescopes' is revolutionary," says Dan Hooper, a high-energy astrophysicist

The Advanced Thin Ionization Calorimeter, shown here in Antarctica before a 2005 launch, detected cosmic rays in the upper atmosphere.

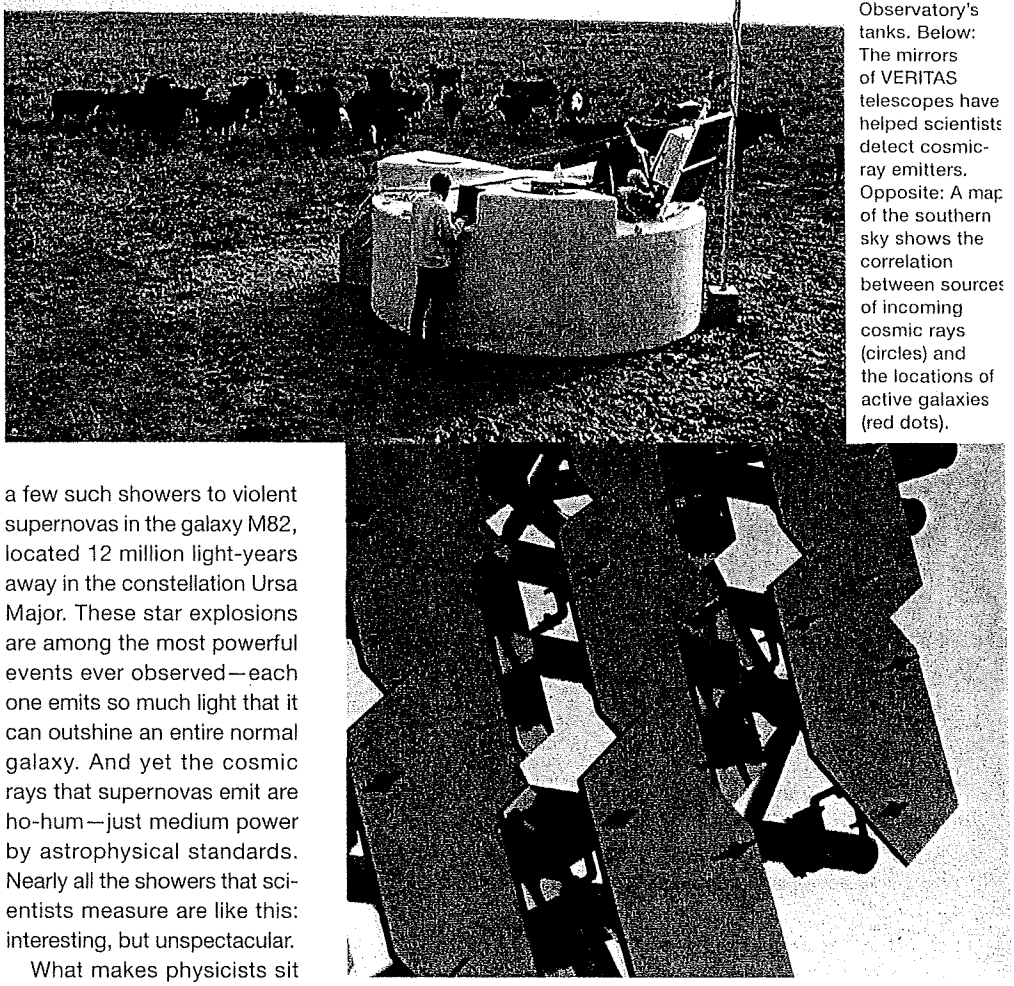
at Fermi National Accelerator Laboratory (Fermilab), outside Chicago. "Telescopes are not just something you look through and point at something. You have to be pretty creative."

THE FIRST THING TO KNOW about observing the universe with cosmic-ray eyes is that Earth's atmosphere destroys these particles before they reach the ground. A cosmic ray—usually a proton, but sometimes other particles—will slam into air molecules 50 miles or so above the surface, rapidly shedding energy and giving rise to a shower of billions of electrons, positrons, and muons that rain down onto the terrain below.

That is where Pierre Auger's network of water tanks comes in. The scientists chose them as detectors precisely because light moves more slowly in water than it does in air. A particle will come screaming through the atmosphere at close to light speed; as soon as it passes into the water, it finds itself in violation of nature's speed limit. Whenever electrically charged particles go faster through an insulating material (like water) than the speed of light would allow, they disrupt nearby electrons, causing a flash of light (known as Cherenkov radiation).

Scientists know that a particle shower has occurred when multiple tanks detect flashes at the same time. By combining data on the precise timing of the flashes from all the tanks, Auger physicists can reconstruct the collision that took place high in the atmosphere and determine the energy and direction of the original cosmic ray. That's why they call it a telescope.

In the six years that the Pierre Auger Observatory has been in operation in Argentina, it has detected 1.6 million particle showers. Recently scientists traced the origin of a few such showers to violent supernovas in the galaxy M82, located 12 million light-years away in the constellation Ursa Major. These star explosions are among the most powerful events ever observed—each one emits so much light that it can outshine an entire normal galaxy. And yet the cosmic rays that supernovas emit are ho-hum—just medium power by astrophysical standards. Nearly all the showers that scientists measure are like this: interesting, but unspectacular.



: Physicists prepare one of the Auger Observatory's tanks. Below: The mirrors of VERITAS telescopes have helped scientists detect cosmic-ray emitters. Opposite: A map of the southern sky shows the correlation between sources of incoming cosmic rays (circles) and the locations of active galaxies (red dots).

What makes physicists sit up in their chairs are those rare particles that are really, really energetic—100 million times more potent than the ones from M82. Such extreme particles are among the rarest things known to physics; they come down over any given square mile only two or three times per century. That is why the Auger network must cover so much ground. So far, says Paul Mantsch, a physicist and project manager at Auger, the observatory has seen about 50 of these ultrahigh-energy cosmic rays. (For comparison, the Hubble Space Telescope picks up many thousands of photons, or particles of light, from even the dimmest galaxies it observes.)

Scientists were startled when they started seeing these extreme particles in 1991 at the Fly's Eye Observatory in Utah. "There is no known mechanism—not in nature and certainly not from man—to speed up particles that much," Mantsch says. It is also not clear how those particles ever made it to Earth. Cosmic rays with this much energy should interact with microwave radiation in interstellar space and grow weaker. Yet the Utah particles and the "Auger 50," which traveled pretty close to the speed of light, seemed to arrive intact. So for Mantsch and his colleagues, the question is acute: Where did these impossible particles come from?

The incredible energy of the cosmic rays could be an important clue, Mantsch says. In order to arrive at such a speed, their source must be near-at-hand, in cosmological terms—within 250 million light-years. In 2007 astronomers working at Auger traced some of the ultrahigh-energy cosmic rays to nearby active galactic nuclei, the turbulent centers of violent galaxies. The source of all that commotion is thought to be a giant black hole, billions of times more massive than our sun. As these monsters feast on clouds of gas, their intense magnetic fields could thrust jets of high-energy particles out into space at virtually the speed of light. The scientists, though, are not yet entirely convinced; recent data have been inconclusive. "The active galactic nuclei seemed to make sense, but now it's a lot more up in the air," says New York University physicist Glennys Farrar, who works with researchers at the Auger Observatory.

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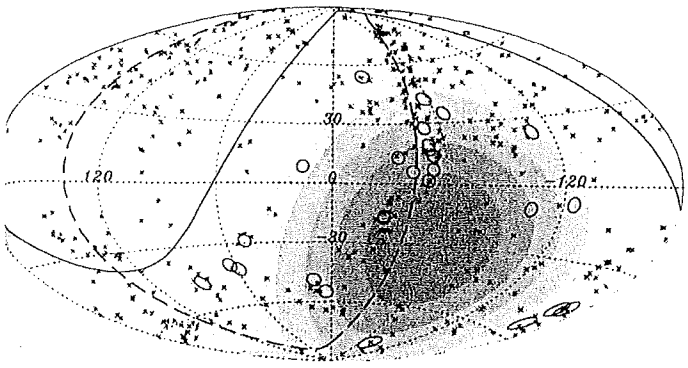

Some scientists think the sources of these impossible particles may be more exotic. UCLA astrophysicist Rene Ong has done sky surveys of possible cosmic-ray emitters using the Very Energetic Radiation Imaging Telescope Array System (VERITAS) in Arizona. He finds that most cosmic rays come from well-known objects that produce other forms of radiation, too—black holes emit X-rays, for instance, and supernovas glow with visible light. But Ong has found several regions that send out cosmic rays but apparently little else, like a lightning storm in a cloudless sky. Physicists have dubbed these mystery sources, which now number in the dozens, dark accelerators. "Are they something new? We don't know," Ong says. "We've been introducing as many mysteries as we've solved." Astronomers will now be training their best instruments on these parts of the sky.

While Ong hunts for the source of the most powerful cosmic rays, other physicists are using the particles to pursue another cosmic mystery: dark matter, an invisible form of mass that rarely interacts with normal particles. We know of its existence only by its gravitational effect, even though it may outweigh ordinary matter five to one. "Whoever finds it gets a trip to Stockholm," says Joel Primack, a dark-matter theorist at the University of California at Santa Cruz.

How do you find something you cannot see? "You need a different type of telescope," Fermilab's Hooper says. A cosmic-ray detector may be just what is needed. Hooper wants to search for evidence of dark-matter particles colliding with one another. They would not emit visible light, but they might release energetic particles that scientists can detect.

In fact, physicists may have come across this signal already. Over the past few years, balloon and satellite cosmic-ray experiments have found high-energy electrons and their positively charged counterparts, positrons, in concentrations much higher than they would expect to see from the sun and other known sources of cosmic rays within our galaxy. Some theorists have attributed this strange excess to nearby pulsars—fast-spinning stellar remnants—but Hooper suspects that it comes from interactions between dark particles as they whip around the Milky Way.

To obtain more definitive answers, scientists need a complete census of the kinds of cosmic rays traveling through space, how fast they are moving, and the directions from which they are coming. Such precision calls for a detector that can take in cosmic rays directly. This July the Alpha Magnetic Spectrometer experiment (AMS) will start doing just that. AMS will dock with the International Space Station, where it will be able to intercept particles before they strike Earth's atmosphere. If the source of the excess particles is a single object like a pulsar, the experiment should reveal a subtle bump in the number of cosmic rays coming from one direction. A uniform distribution of particles, in contrast, would suggest that they originate in dark matter spread throughout the Milky Way. Such a finding would turn today's ideas about particle physics upside down. "If dark matter is producing these cosmic rays," Hooper says, "then you have to rule out the vast majority of the models we have now."

The study of cosmic rays truly pushes the limits of technology. The Auger Observatory is the biggest detector ever made, yet if scientists want to unravel the mystery of ultrahigh-energy cosmic rays, they will need a sample larger than 50. Fortunately, help is on the way.

SCIENTISTS ALWAYS CRAVE better equipment, but the study of cosmic rays truly pushes the limits. The Auger Observatory is already the biggest and most sensitive cosmic-ray detector ever made, yet if scientists want to unravel the mystery of ultrahigh-energy cosmic rays, they will need a sample much larger than 50. They will also need much better readings on where in the sky the particles come from. Fortunately, help is on the way. In 2013 Japan plans to send the Extreme Universe Space Observatory to the International Space Station, where it will look down at Earth for the flashes of ultraviolet light that occur when cosmic rays strike the atmosphere. On the ground, Auger scientists hope to build another observatory in Colorado—dubbed Auger North—that would cover seven times the area of the Argentine array. Between them, the two Auger projects would be able to scan the entire sky for cosmic rays.

Because these projects are expensive, scientists are also pursuing smaller, outside-the-box approaches. Looking out the window of her New York University office recently, Glennys Farrar saw something familiar to any New Yorker: wooden tanks of water on the roofs of nearby buildings. Farrar hopes to take advantage of the roughly 14,000 tanks that dot the city like alien spaceships. If she has her way, in a few years many of them will be retrofitted with about $5,000 worth of light sensors and electronics designed to detect minute flashes of light, like the Auger tanks. Cosmic-ray hunters will have made it to Broadway. ◨

2-3

Auger North

The Northern Site of the Pierre Auger Cosmic Ray Observatory

A world-leading cosmic-ray observatory in eastern Colorado and western Kansas

http://www.auger.org

Today's presenters
Prof. Jim Cronin, University of Chicago
Prof. Fred Sarazin, Colorado School of Mines
Prof. Greg Snow, University of Nebraska
Prof. Lawrence Wiencke, Colorado School of Mines

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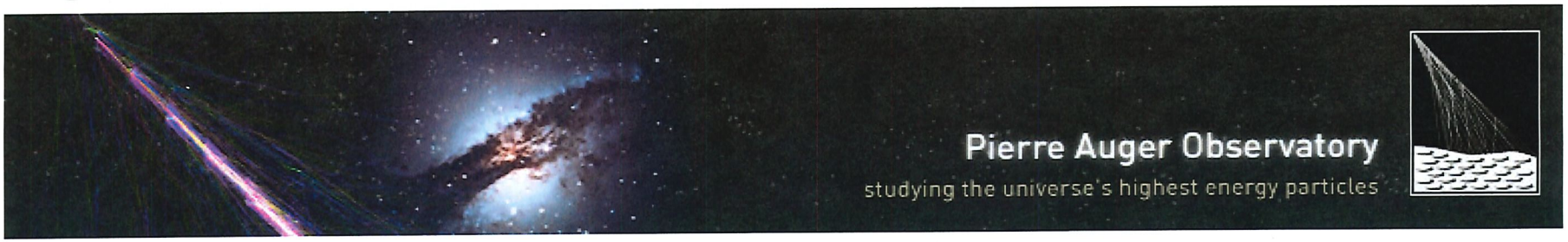
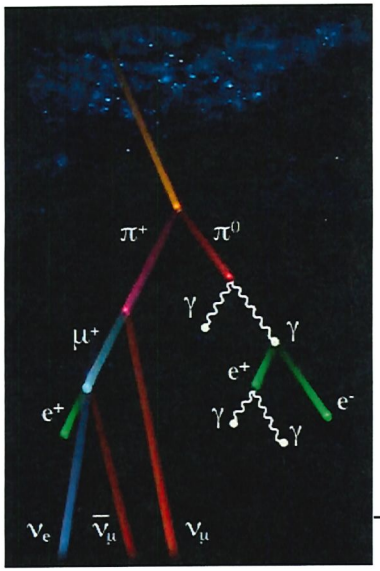
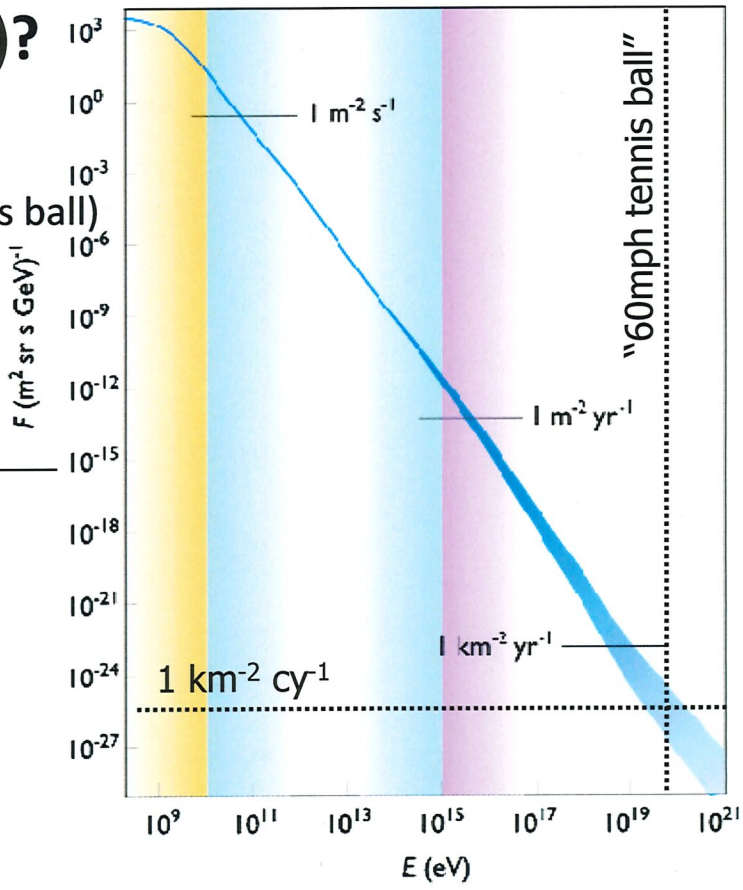


Ultra High Energy Cosmic Rays (UHECR)?

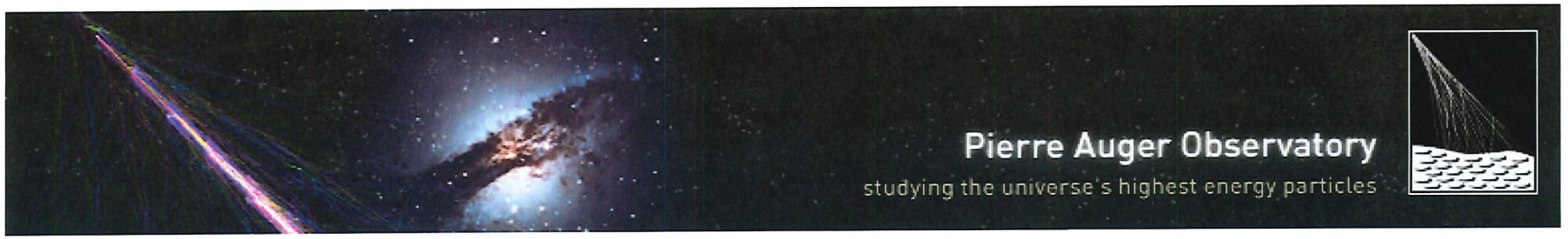
Naturally occurring phenomena
Sub-atomic particles (protons, nuclei)
Each carries a macroscopic amount of energy (60mph tennis ball)
From unknown sources outside our galaxy

Very low rate. About 1 per square km per century



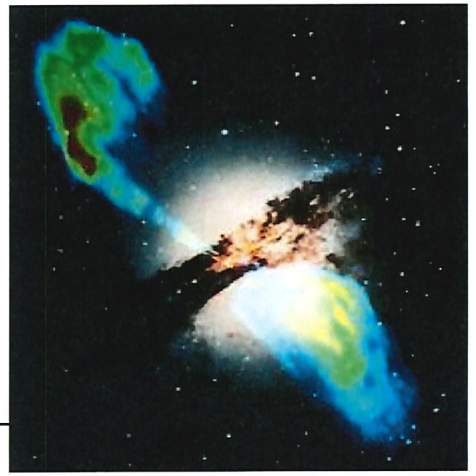


Ultra high energy cosmic rays interact in the atmosphere
Create huge showers of secondary particles: 20+ sq mi. footprint

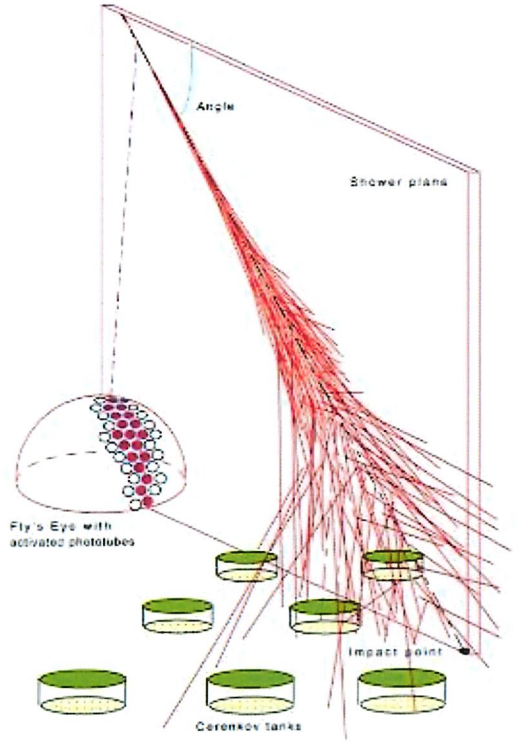


Why Study Them?

Highest energy atomic particles in the Universe.
Signature of the most energetic astrophysical processes in nature.
One hundred times more energetic than CERN LHC.
How are they produced and where do they come from?



A new window in the Universe

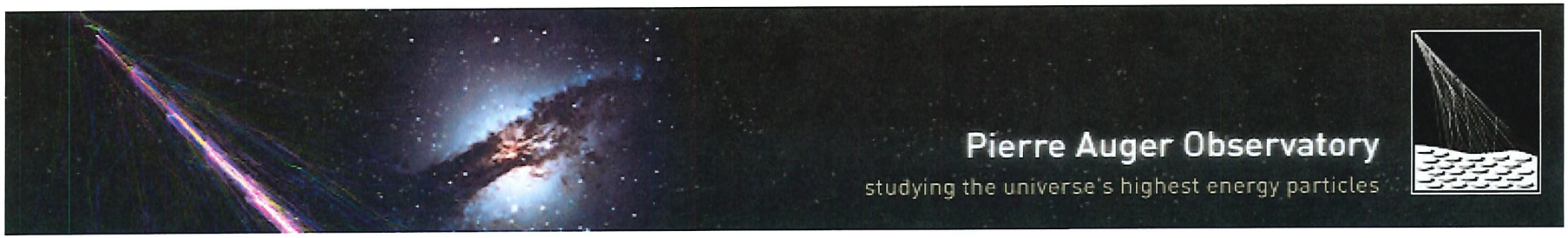


How?

(1) Measure the footprint of the air shower hitting the ground.
A single cosmic ray can produce 10 billion particles on the ground spread over 20 square miles.

(2) Detect the tiny amount of light it induces by interacting in the atmosphere

Detecting cosmic-ray showers

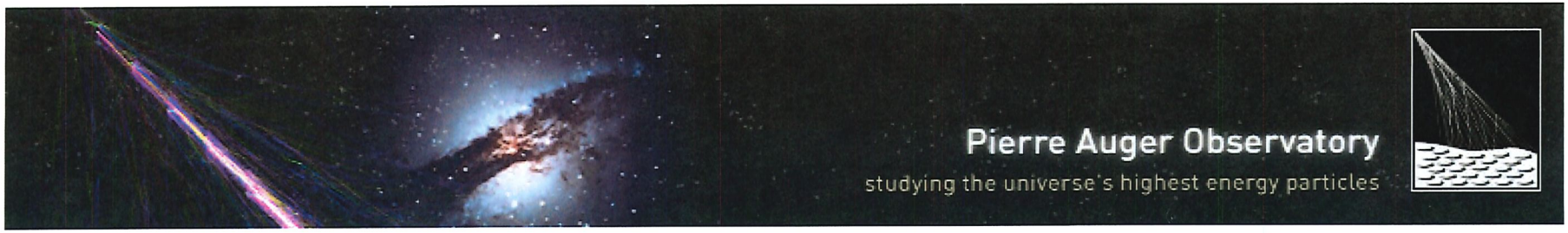


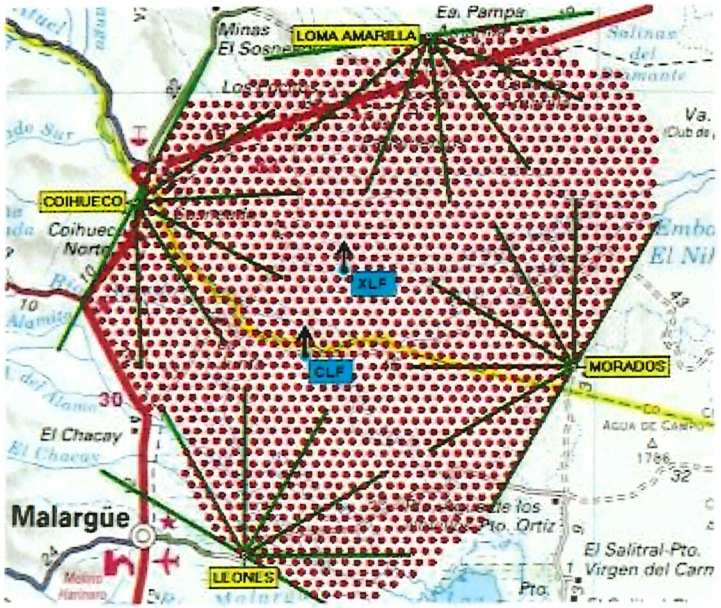
Portugal
Netherlands
Argentina
Australia
Bolivia*
Brasil
Czech Republic
France
Germany
Italy
Poland
Mexico
Slovenia
Spain
United Kingdom
USA
Vietnam*

The Pierre Auger Observatory

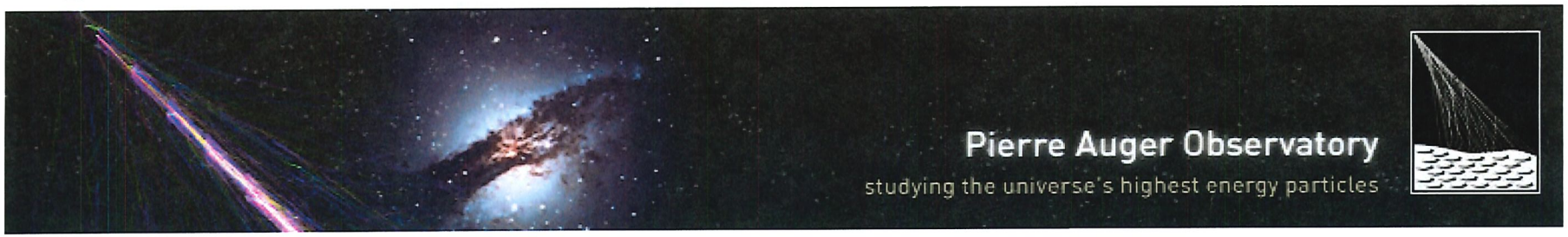
38° South, Argentina, Mendoza,
Malargue 1.4 km altitude, 850gm/cm²

PIERRE AUGER OBSERVATORY


Pierre Auger Observatory
studying the universe's highest energy particles


LOMA AMARILLA
COIHUECO
XLF
CLF
MORADOS
LEONES
Malargüe
El Chacay
Minas
El Sosneado
Es. Pampa
Coihueco Norte
Pto. Ortiz
El Salitral-Pto.
Virgen del Carm
35 miles

3-5

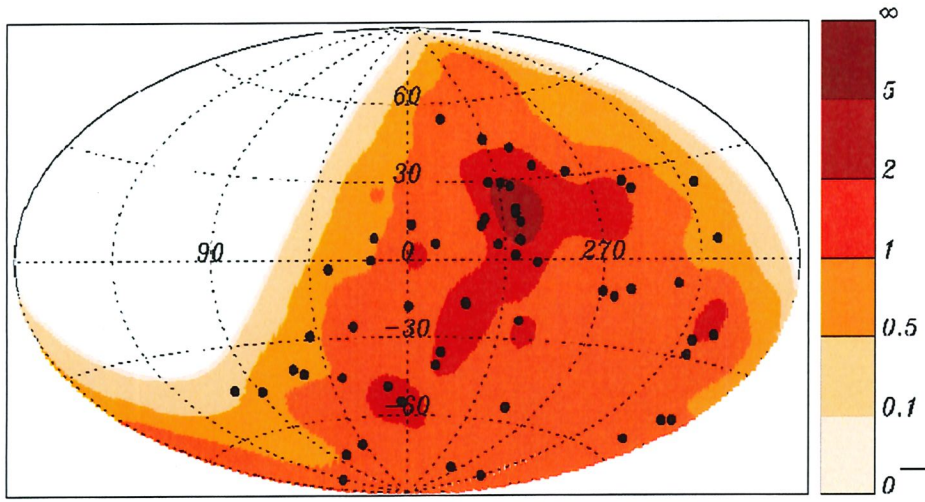


First Results

UHECR seem to come from galaxies with massive black holes at the center and emitting vast amounts of radiation.

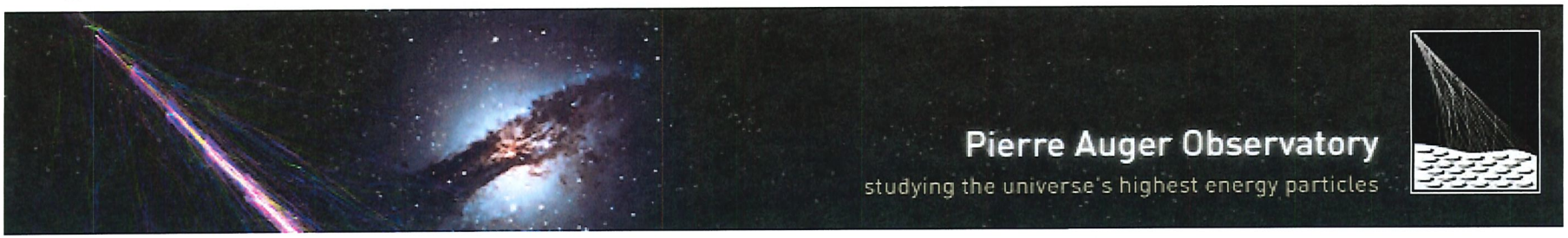
Beginning of a new era of Particle Astronomy

Top discovery of 2007 in the Physical Sciences by *Science* Magazine.



Correlations of UHECR events with Active Galactic Nuclei (AGN) locations

3-6



Auger North

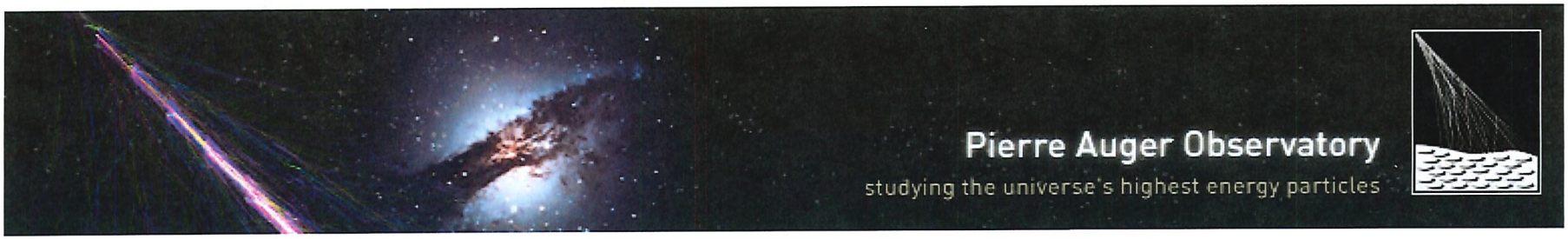
Observe the northern hemisphere sky
Optimized to detect the highest energy cosmic-rays
Larger (8000 sq mile vs 1200 sq mile) and possibly spanning over two States!

Timeline:

2005 Colorado wins Auger North site competition
2007 First science results from Auger South
2007 Based on these results, design for Auger North is expanded
2008 Auger North design report
2009 (Spring) Funding proposals submitted (By US and collaborating countries)
2010 R&D: Atmospherics and test array installed or to be installed near Lamar

Tentative
2013 Construction begins – 5 year duration
2014 Start of Preliminary Data Collection
2018 Construction Completed
2018-2038 Operational Lifetime – 20 Years

3-7



Elements of the Pierre Auger Observatory (South / North):

Surface Detector

Water Tanks:
1600 / **4400**

Fluorescence Detector

Buildings:
4 / **5**
Telescopes:
24 / **39**
Calibration facilities:
2 / **6**

HQ & Visitor Center

Building:
1 / **1**

Assembly Building

Building:
1 / **1 (larger)**

Cost:

Auger South: $53M (built on budget)

Auger North: $120M (estimate)

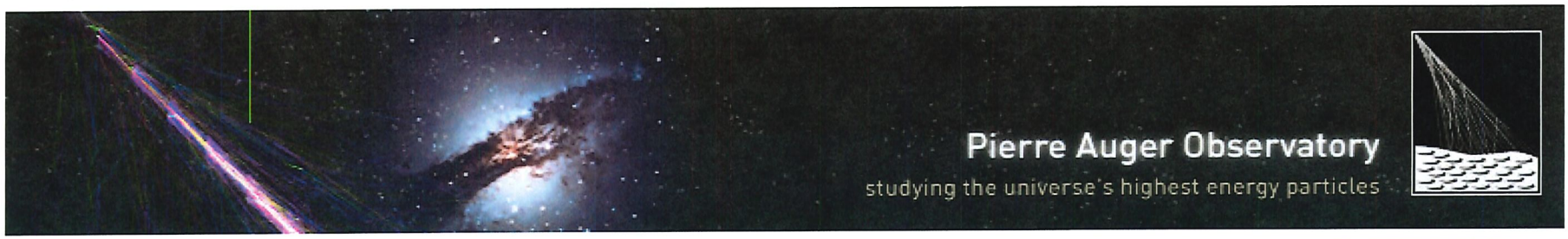
3-8

AUGER NORTH
"All-Colorado" Layout

Colorado

Kansas

Lamar



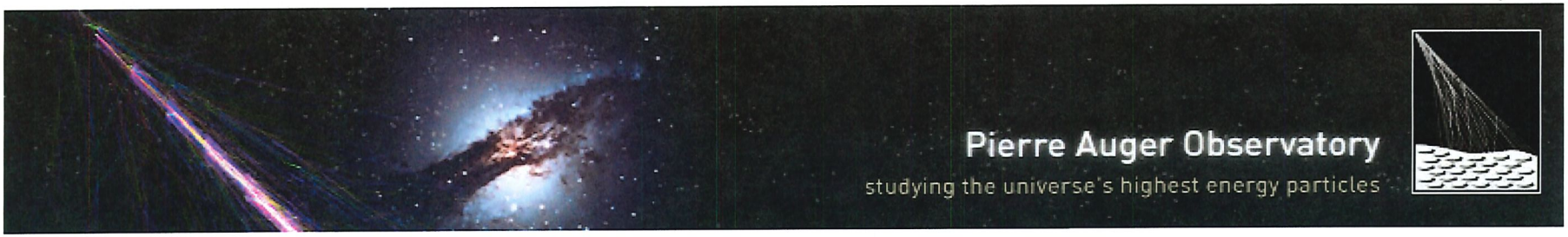
AUGER NORTH
One possible "Colorado - Kansas" layout
(details to be driven by the science)

Lamar

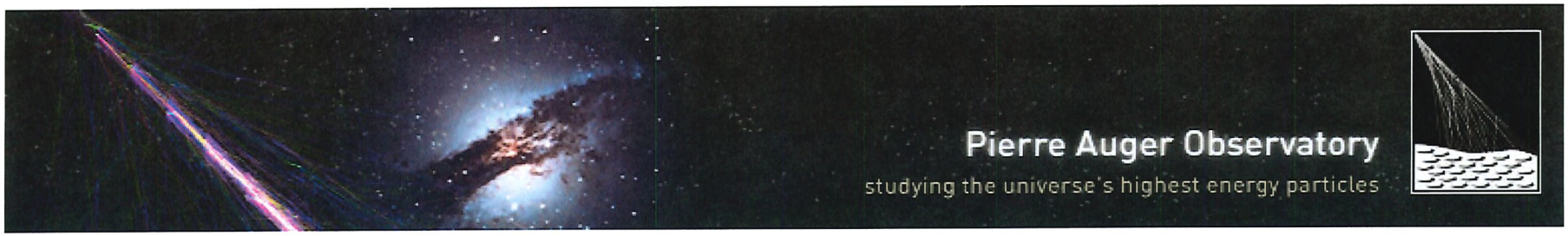
Colorado

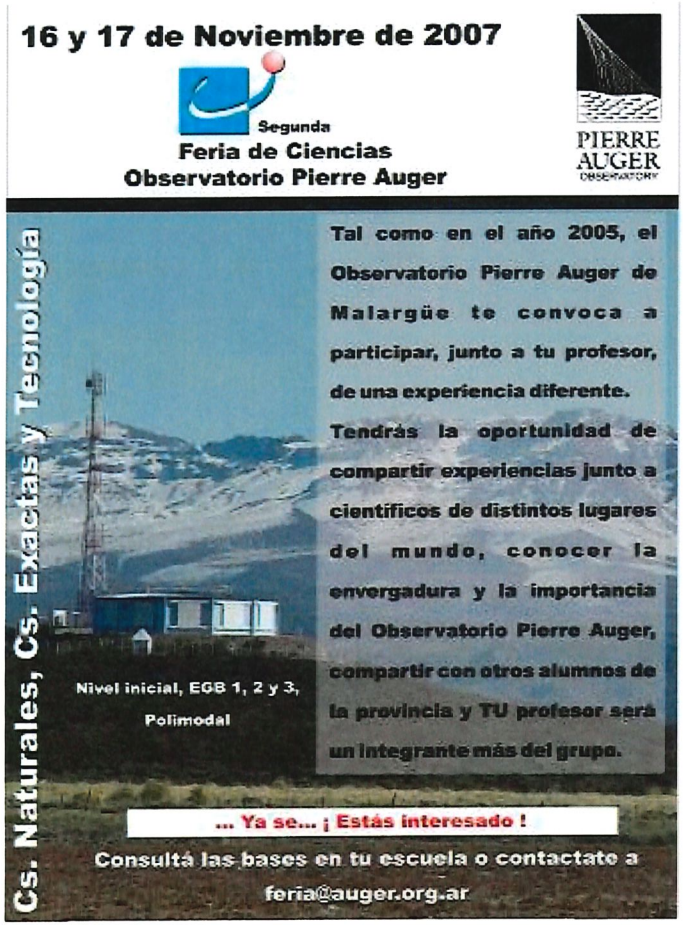
Kansas

3-10



The Auger collaboration participates in Malargüe Day parades
A tradition!

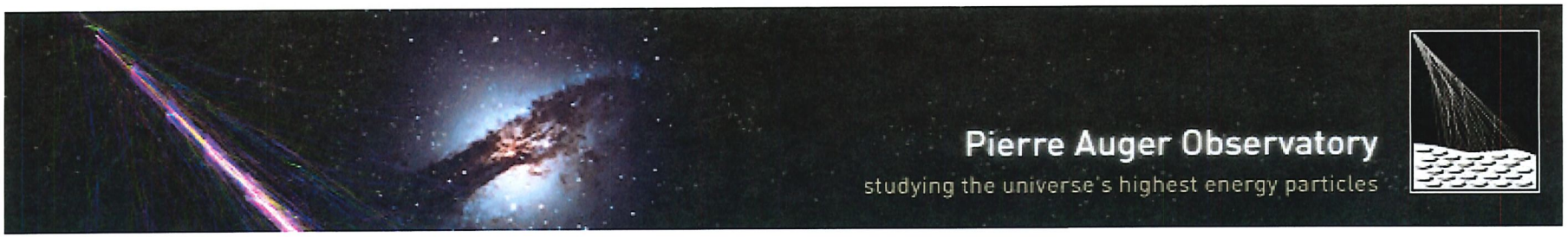




Poster for advertising

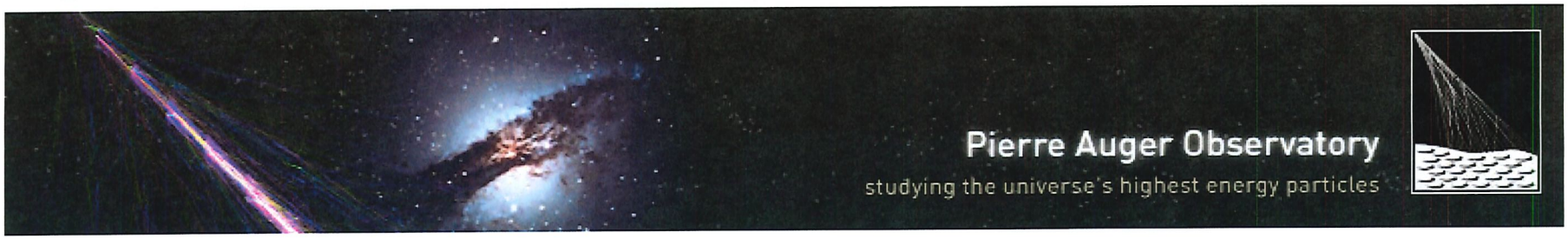
25 student-teachers teams from all over Mendoza Province

Segunda
Feria de Ciencias
Observatorio Pierre Auger



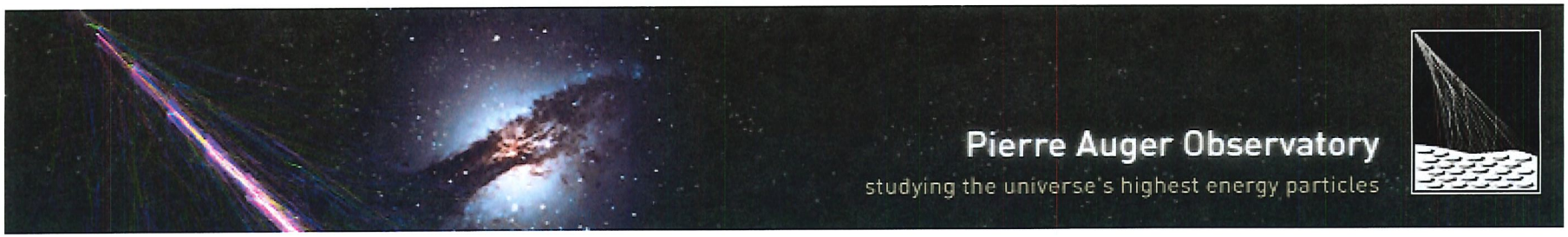
November 2007 Science Fair drew 42 participating teams

Jim Cronin with first-place team in Technology

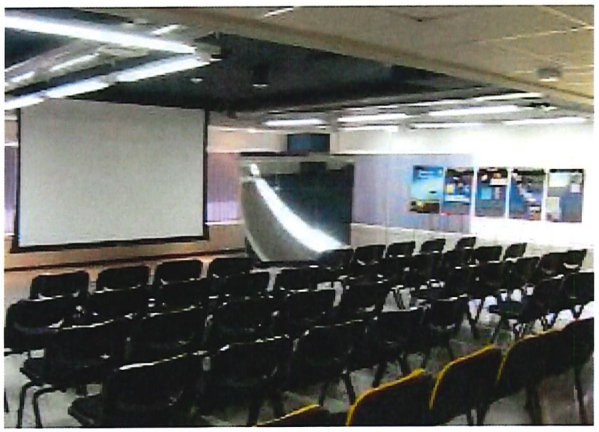


Visitor Center at Auger Office Building

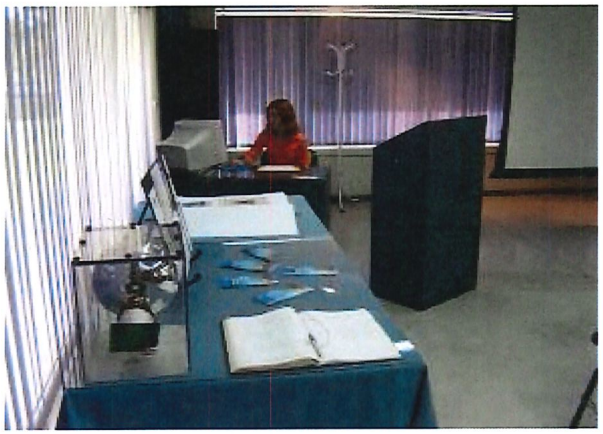
3-14



Visitor Center at Auger Office Building



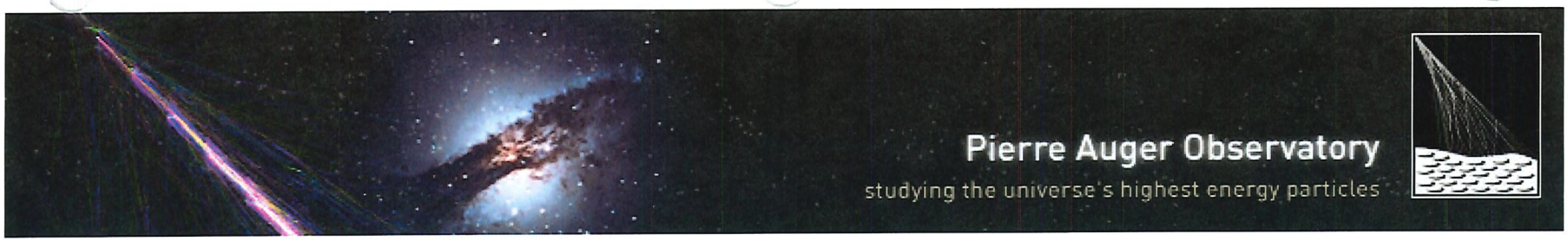
Seats 60 people



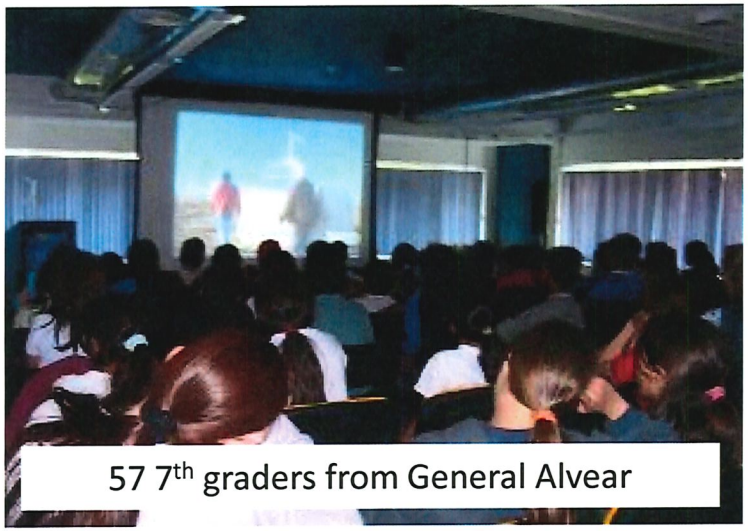
PC and multimedia projection

Glass cabinet for library and displays

Quarter-size FD mirror set-up from Karlsruhe

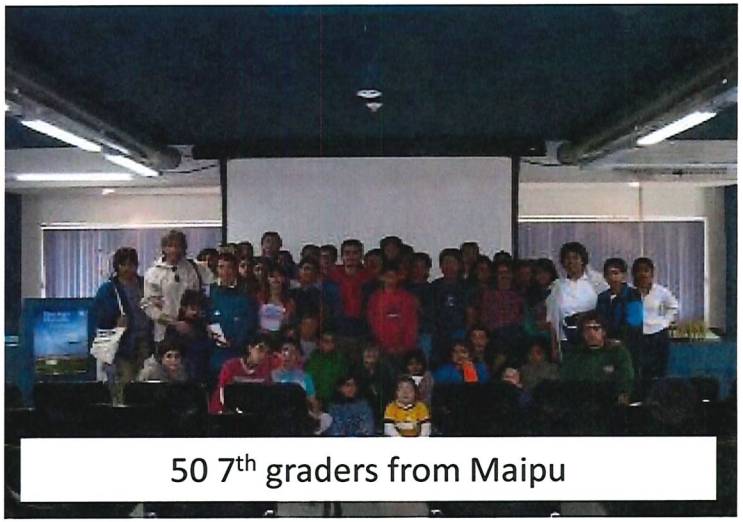


Visitor Center Hosts Many School Groups

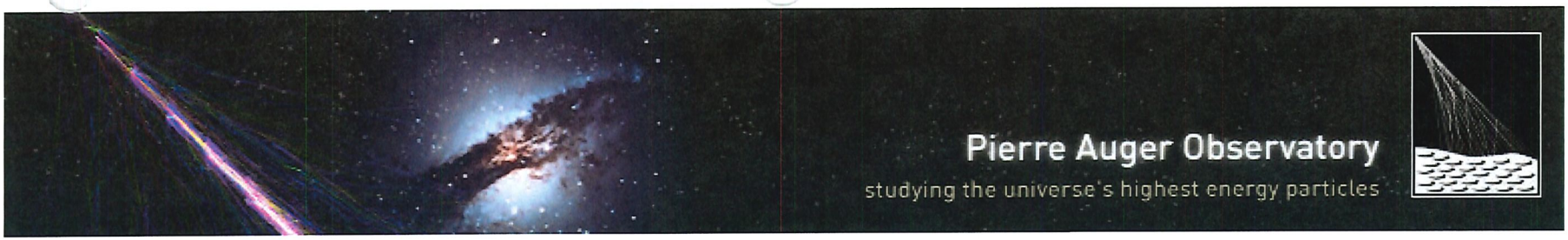


57 7th graders from General Alvear

60 elementary students from Malargüe



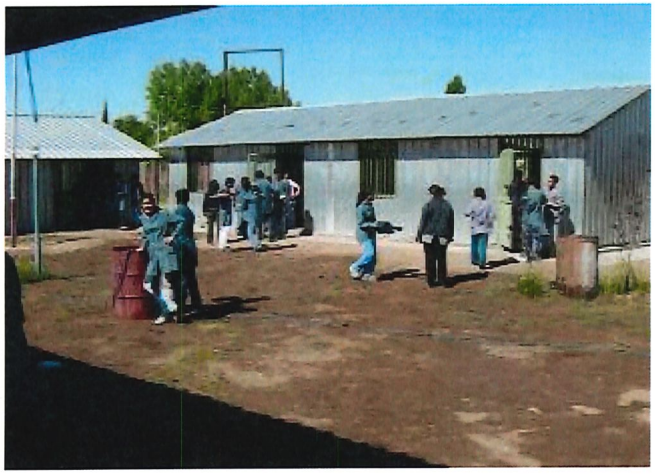
50 7th graders from Maipu



The James Cronin School of Communication, Art and Design

Naming ceremony

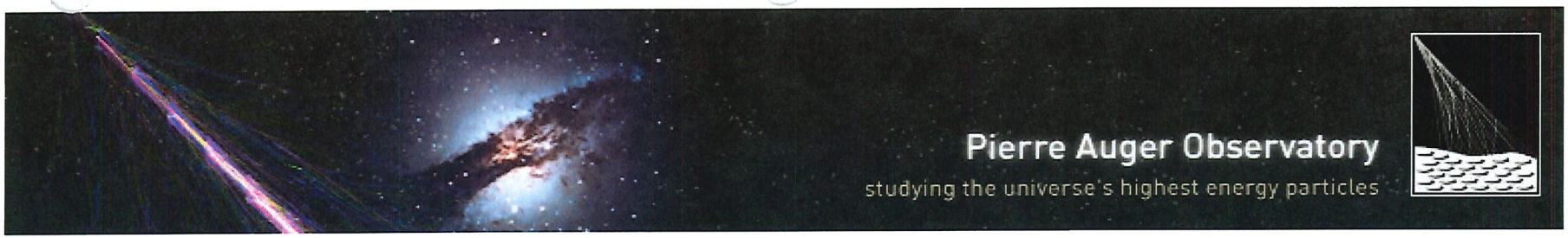
Visits with students



New building needed - Funding initiative

1st graduation festival Nov. 2003

3-17



James Cronin School Inauguration

New school opened, November 2007

Funding from Malargüe, Mendoza Province,
U.S. Grainger Foundation

3-18

Planetario Malargüe

Municipalidad de Malargüe

Collaboration instrumental in Malargüe's new planetarium, the 2nd in Argentina.

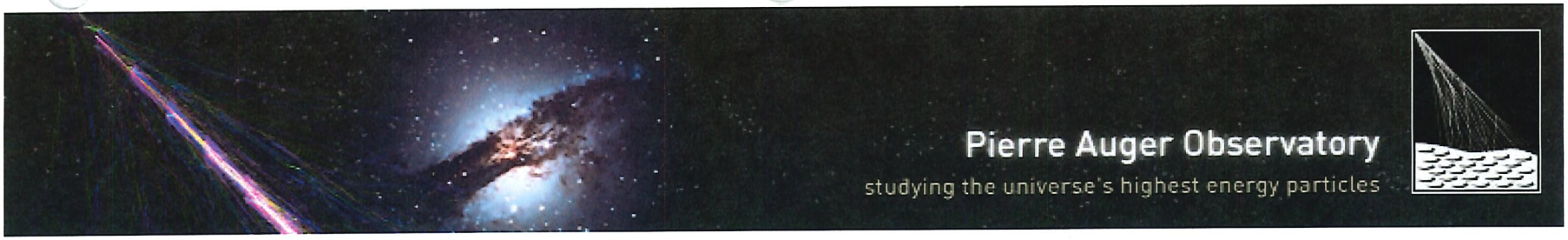
On Scientific Council

3-19

Eureka Science Park in Mendoza

EUREKA
PARQUE DE LA CIENCIA

- Two years of planning and logistics led to the public inauguration of an Auger Observatory exhibit on November 22, 2003
- Outside: 2 Mexican SD tanks outdoors with explanatory signs
- Inside: Italian FD prototype from Los Leones, posters, brochures, PC with interactive activities, small displays

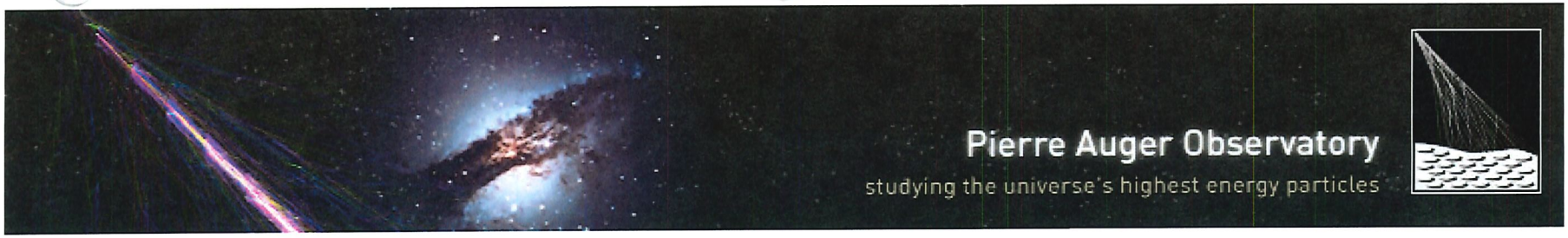


Eureka Science Museum

Former Los Leones prototype mirrors donated to Eureka by Torino group/INFN

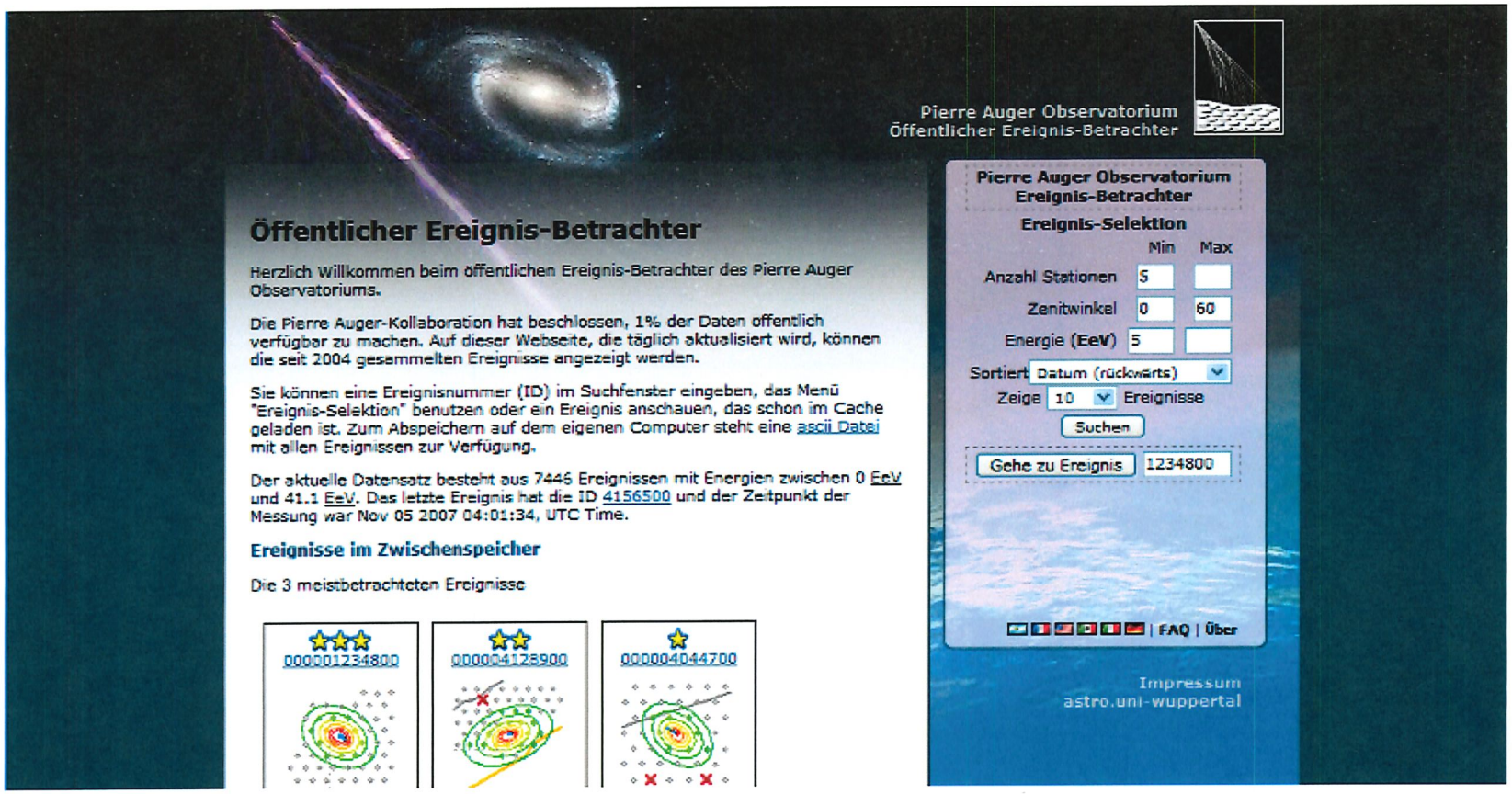
Children are fascinated by it!

EUREKA PARQUE DE LA CIENCIA



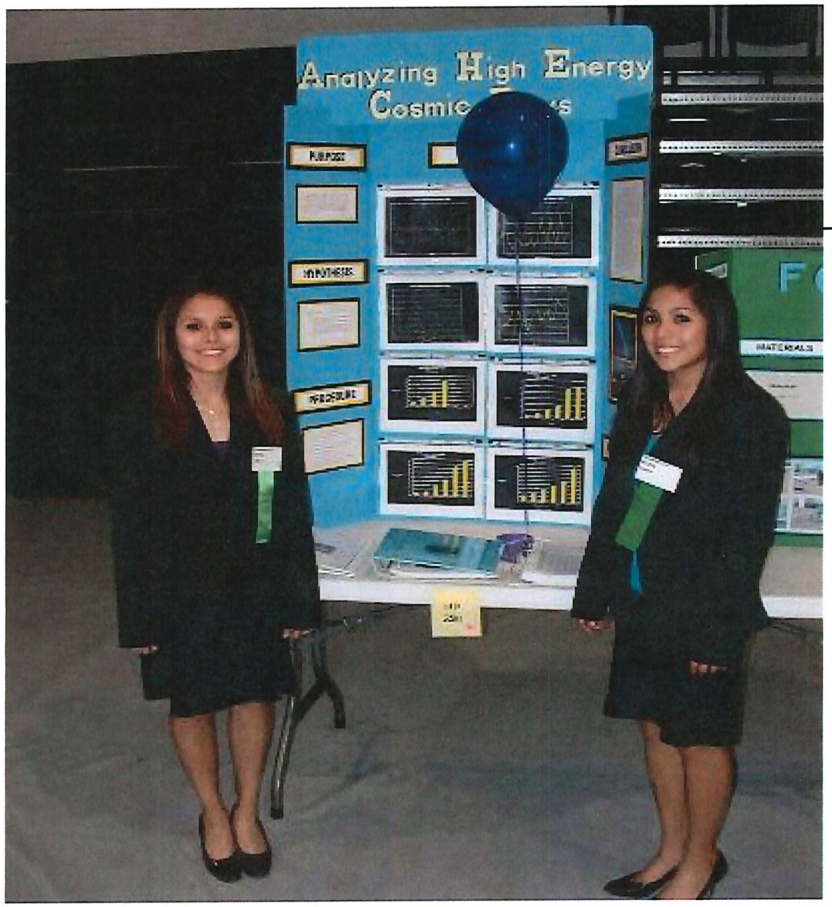
Release of cosmic ray event information to public

Five languages / Wikipedia links



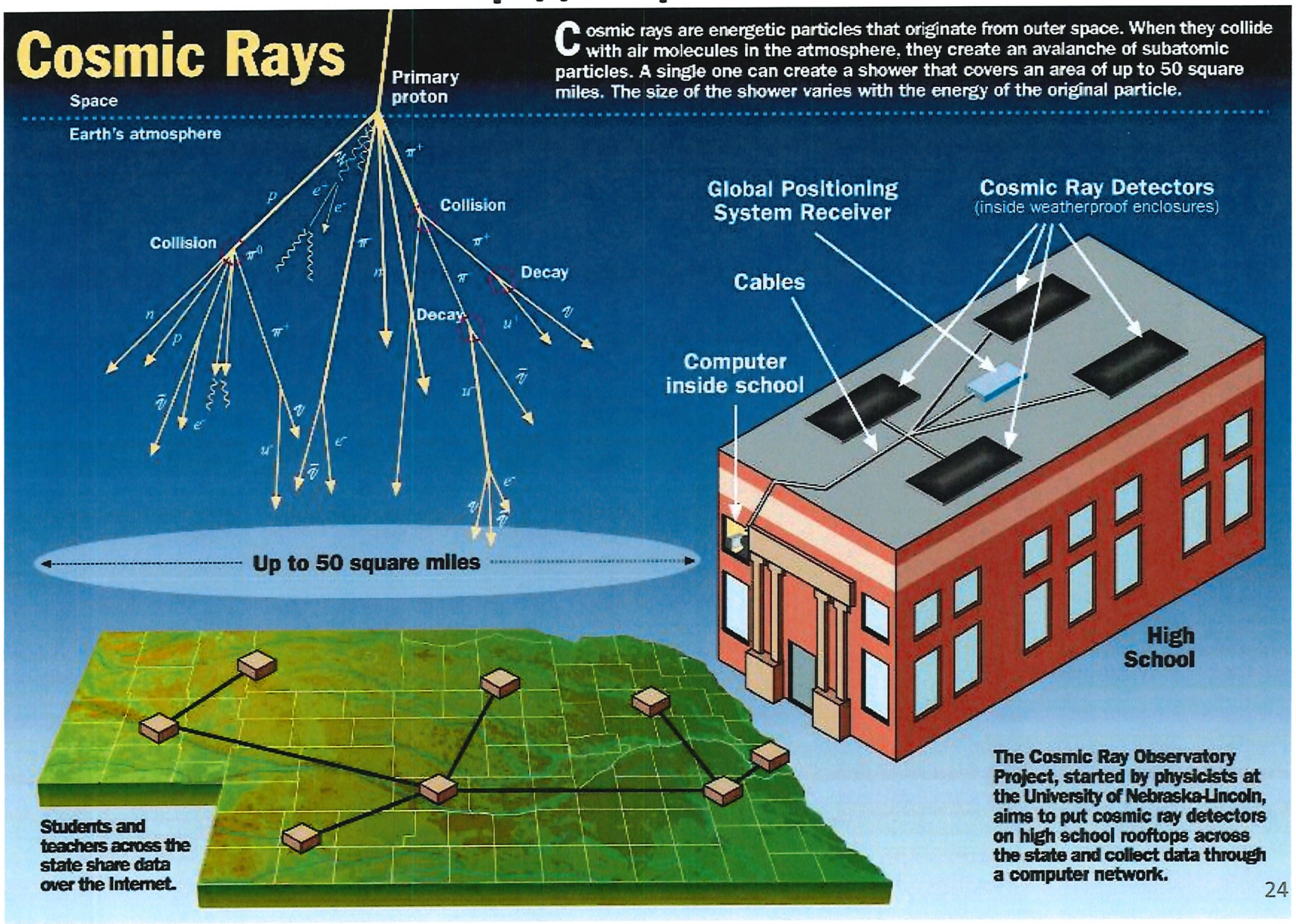
Xavier Bertou et al.
S. Coutu, C. Lachaud, P.L. Ghia, P. Mantsch, M. Mostafa, J. Rautenberg, M. Risse, P. Sommers

Using Auger data released to public

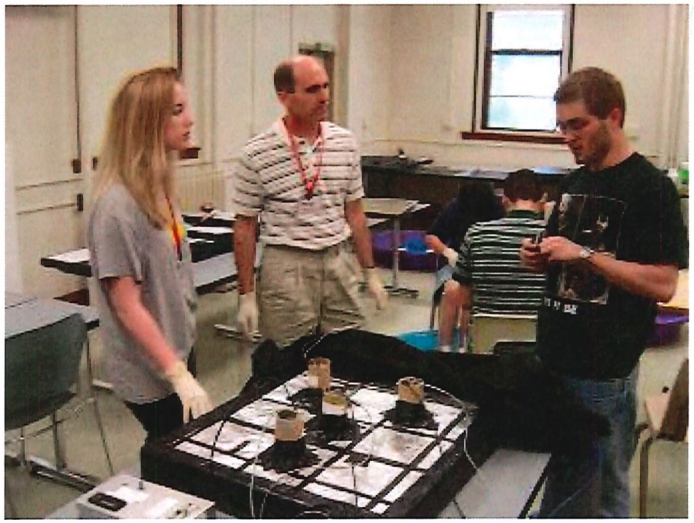


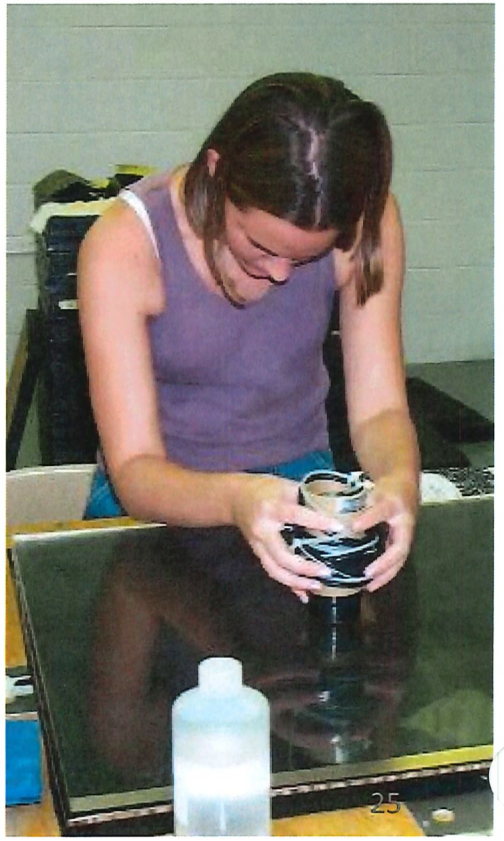
Lamar, Colorado
High school students win regional science fair

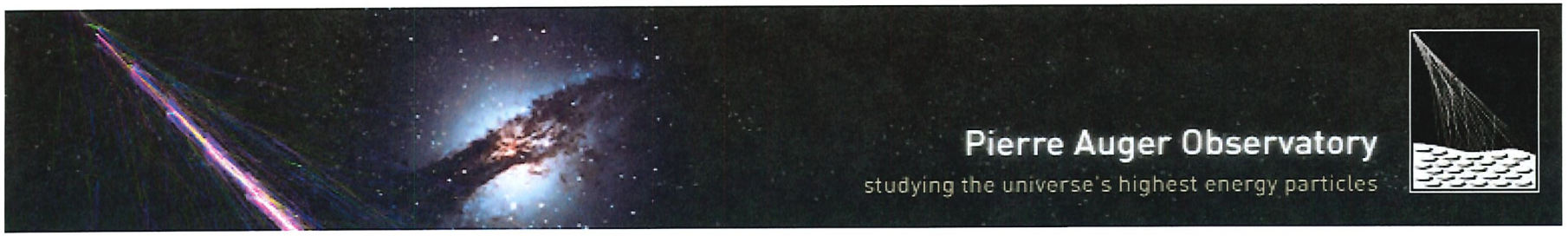
The Cosmic Ray Observatory Project in Nebraska
http://crop.unl.edu



Summer Workshop Activities
Detector assembly and testing

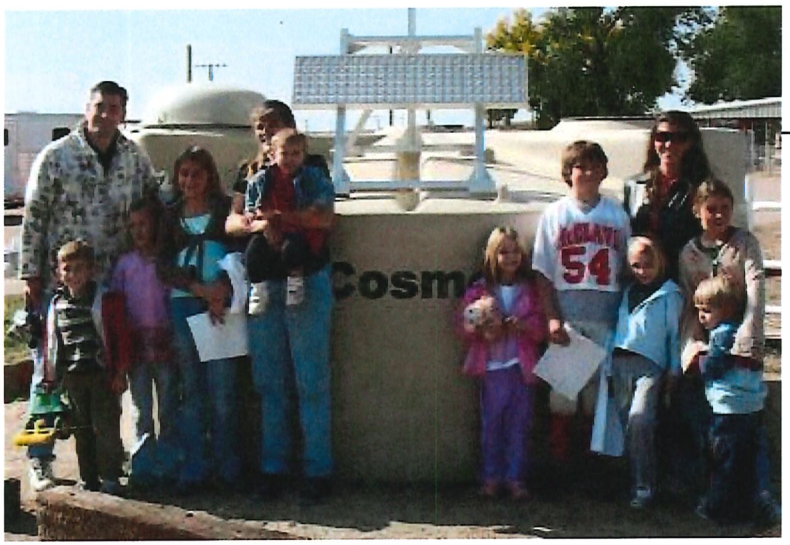






Outreach in SE Colorado

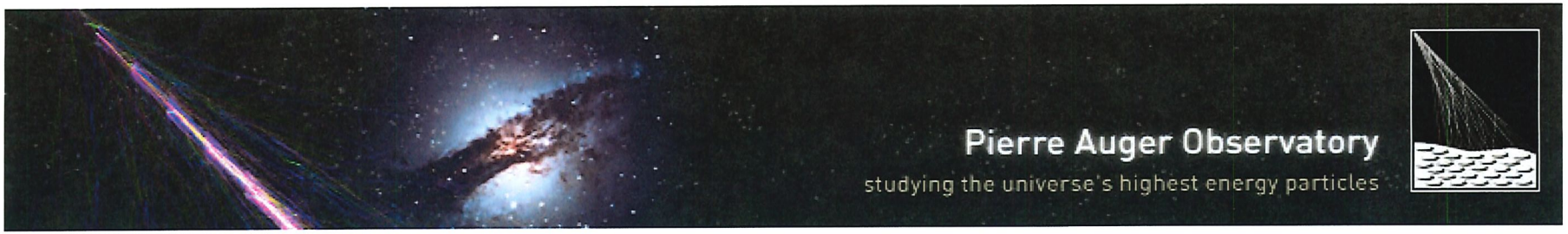
Town meetings
Seminars / colloquia
Cosmic-ray demo equipments
Demonstration tanks in Lamar and Las Animas, including naming contest in schools



"Cosmo" in Las Animas (Bent County, CO)

"Pierre's Dream" in Lamar (Prowers County, CO)

3-26



Benefits to State of Colorado and Kansas and to local communities

Economic:
$120M project
Creation of permanent and temporary jobs
Manufacturing jobs
Visitor center
Opportunities for new/expanded businesses
Service sector

Cultural:
Possible teacher/student exchange with Argentina
Partnership with Malargüe, Argentina
Develop closer ties to local/international Hispanic and Latino communities
Interaction with visiting international scientists

Educational:
World-class astrophysics site:
Possible special science program at Community Colleges
Increased collaboration with state universities
Connections with scientists at other educational institutions
Exposure to/training in high-tech scientific research
Outreach:
Courses/seminars offered by project scientists
Recruit/encourage participation of underrepresented groups in science
Local school science program enhancement / extracurricular activities

+ Tourism…

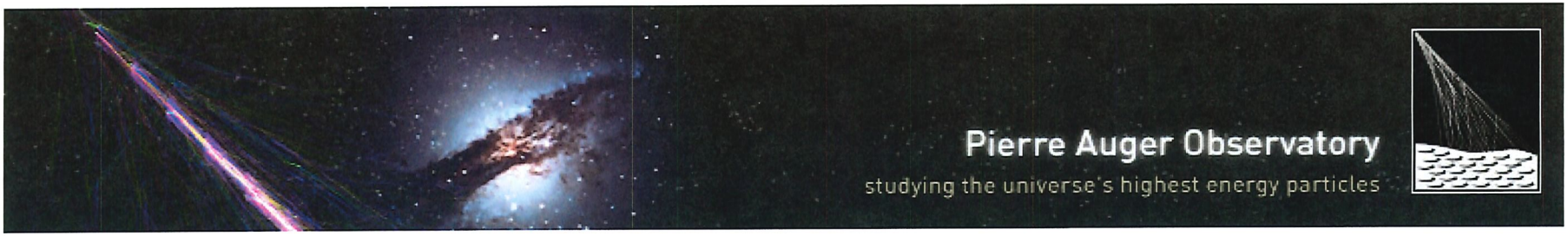
3-24

The Pierre Auger collaboration in the United States

21 institutions represented

Fermi National Laboratory, Batavia IL
New York University, New York NY
University of Wisconsin, Milwaukee WI
University of California, Los Angeles CA
University of Chicago, Enrico Fermi Inst., Chicago IL
Ohio State University, Columbus OH
Colorado State University, Fort Collins CO
University of New Mexico, Albuquerque NM
University of Wisconsin, Madison WI
Colorado State University, Pueblo CO
Case Western Reserve University, Cleveland OH
Pennsylvania State University, University Park PA
Michigan Technological University, Houghton MI
University of Hawaii, Honolulu HI
Louisiana State University, Baton Rouge LA
Southern University, Baton Rouge LA
Northeastern University, Boston MA
California Institute of Technology, Pasadena CA
University of Nebraska, Lincoln NE
Colorado School of Mines, Golden CO
Argonne National Laboratory, Argonne IL

3-28

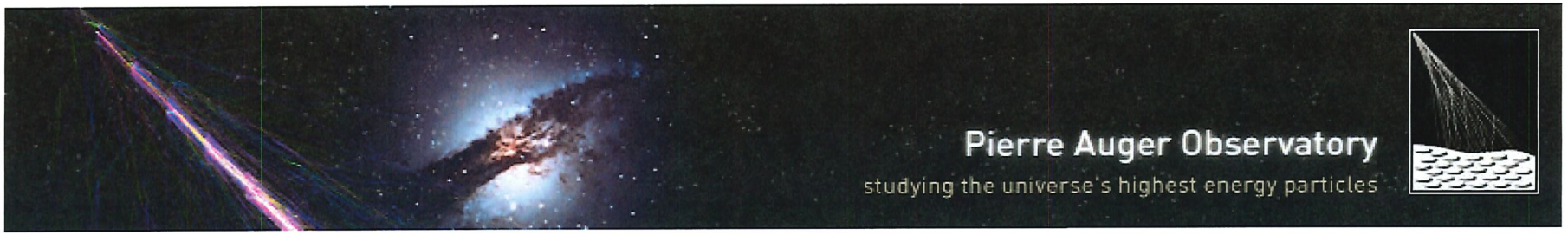


Colorado Coalition for Cosmic-Ray Research

"To promote the establishment of the northern hemisphere detector of the Pierre Auger observatory in southeastern Colorado"

Colorado State University - Fort Collins
Colorado State University - Pueblo
Colorado School of Mines
Lamar Community College
South East Colorado Economic Development

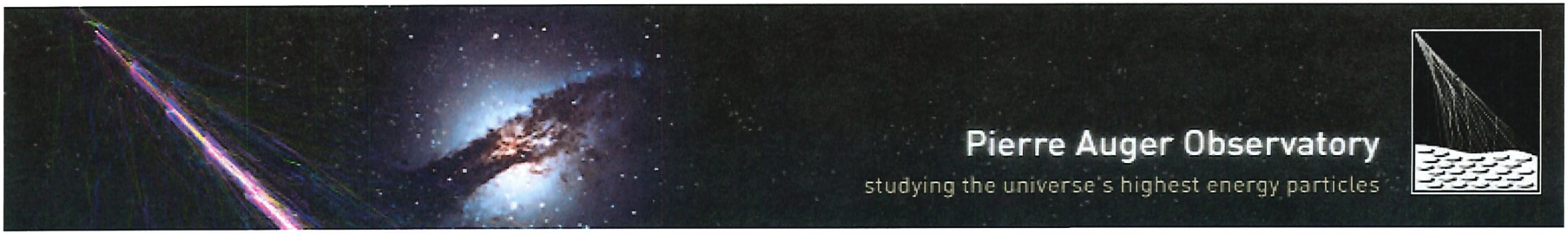
3-29



A similar coalition in Kansas?

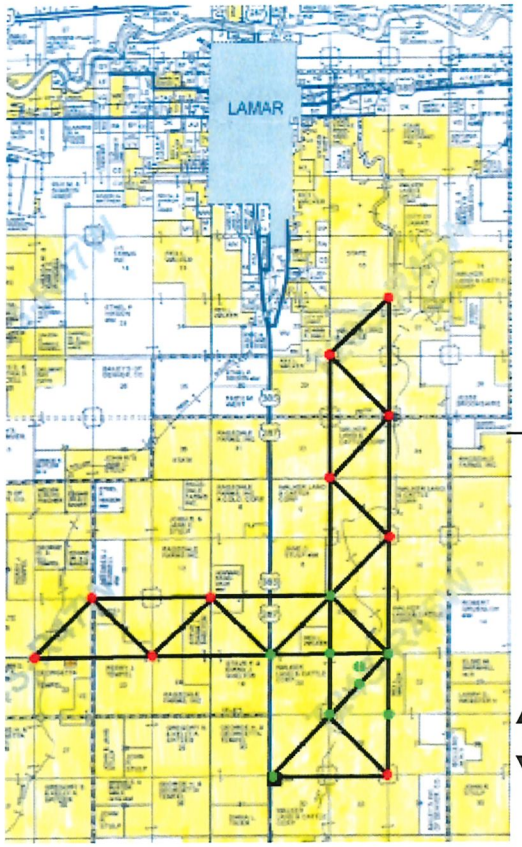
- Fort Hays University
- Kansas State University
- Kansas University
- Pittsburg State University
- Wichita State University

+ an economic development partner in western Kansas



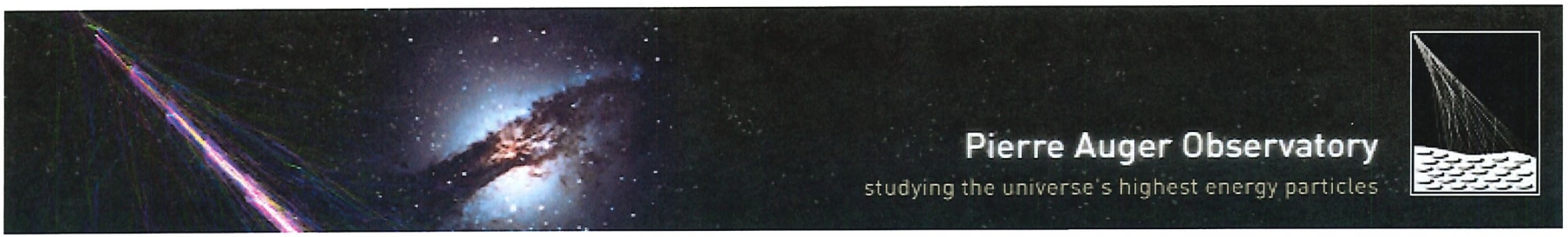
R&D for Auger North (2010 - 2011):

US [Federal Earmark]:	$1.1M
Other countries:	$780k in Colorado / $2.4M total



Location of the R&D array near Lamar, CO
Test of new designs / components / communication system

Study of the atmosphere over the Auger North site

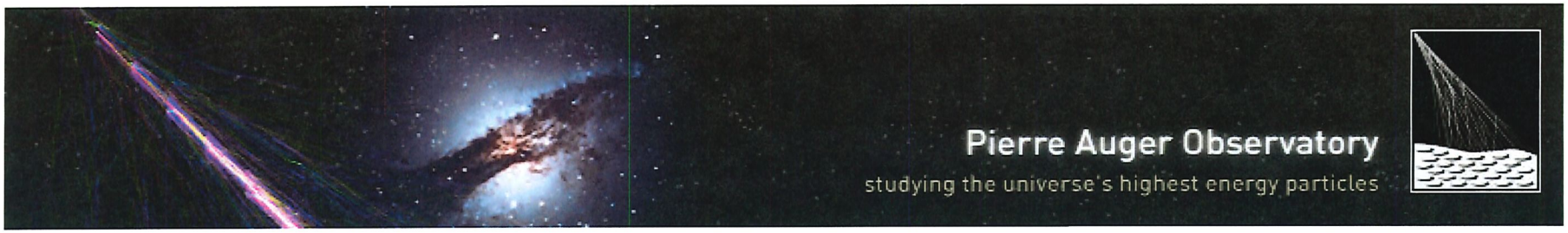


Training of highly-skilled personnel

The Colorado School of Mines
Auger group (2010)

Faculty
Technician
Undergraduates
MSc students
PhD students
International visitors

By the Fall of 2010, the same undergraduate students will enroll in:
MSc in Physics, Mechanical Engineering, Electrical Engineering

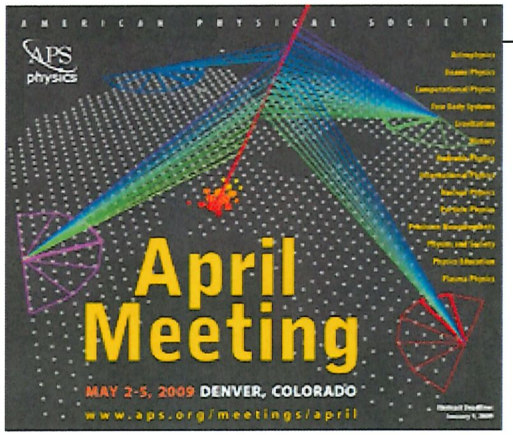


Increased visibility for educational institutions

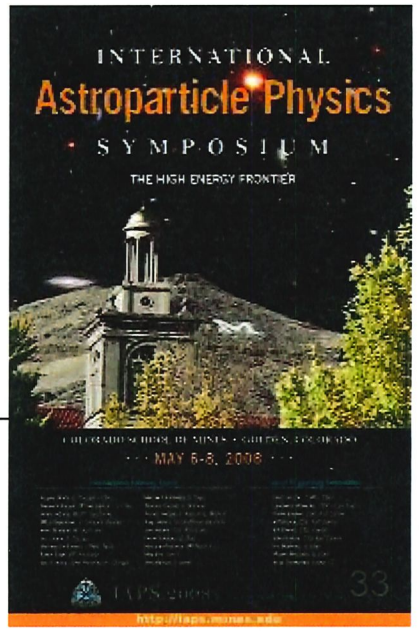
Physics Faculty Recently Hired in Colorado on Auger
1 hired by Colorado School of Mines 8/2007
1 hired by Colorado State University 5/2008

Auger North Collaboration Meeting
Colorado State University
February 17-19, 2009
~80 participants

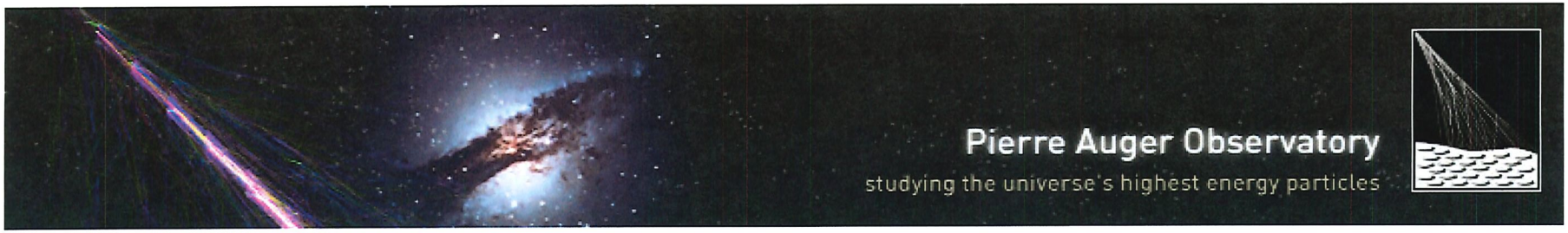
Pierre Auger Collaboration Meeting
Lamar Community College
May 10-16, 2008
~150 participants



APS April Meeting
Denver
May 2-5, 2009



International Astroparticle Physics Symposium
Colorado School of Mines, May 6-8, 2008
120 participants
14 countries
>15 science collaborations represented



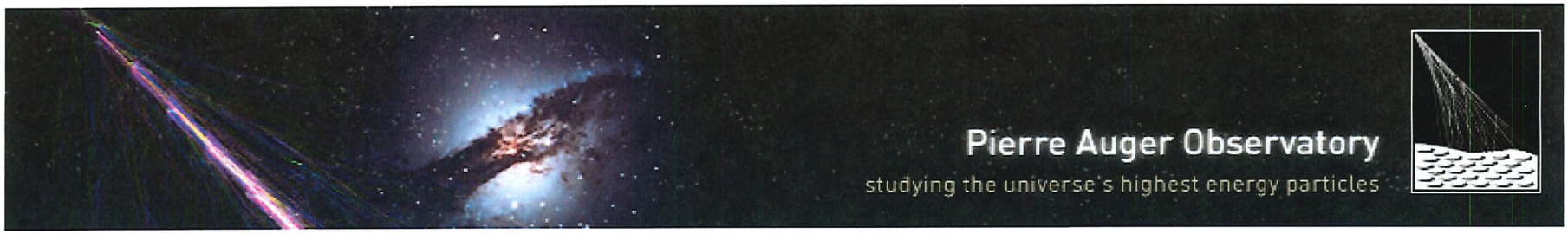
The Renewable Energy Initiative

Building the greenest particle physics experiment in the World

Goals: Power the entire northern observatory with renewable energy
Make Auger North also a renewable energy center in the Plains

Partnerships:

Xcel Energy
Colorado Energy Research Institute (CERI)
National Renewable Energy Laboratory (NREL)
Karlsruhe Institute of Technology (KIT - Germany)
Other partners?



Cost breakdown (Auger North proposal):

US - Federal (NSF & DOE):	$40M
US - State of Colorado and Kansas:	$12M (present CO commitment: $1.5M)
Other countries:	$68M
TOTAL:	$120M

Possible contributions from the State of Colorado and Kansas?

This Resolution

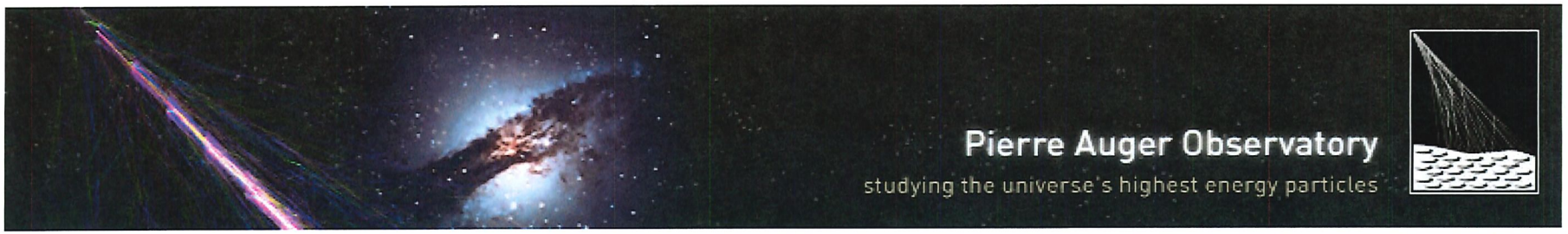
- Mirrors a similar resolution approved by the Colorado state legislature (2005)

In-kind contributions, infrastructure and incentives

- One-time Tax Credit to Landowners (CO: $250 x 4000 tanks = $1,000,000)
- Buildings (CO: $250,000 towards site HQ in Lamar)
- Infrastructure improvements: Roads / Power lines / Optical Fibers
- Tax break to companies
- Other in-kind contributions (CO: $250,000)

(...)

3-35



US Federal Funding Status

Department Of Energy / National Science Foundation (20M$ each)

Auger North proposals submitted late 2009

Science reports

2009 - Particle Astrophysics Science Assessment Group (PASAG)

Scenario A&B:	*no or little increase of the science budget*
Scenario C:	doubling of science budget in the next 10 years
Scenario D:	more optimistic than scenario C

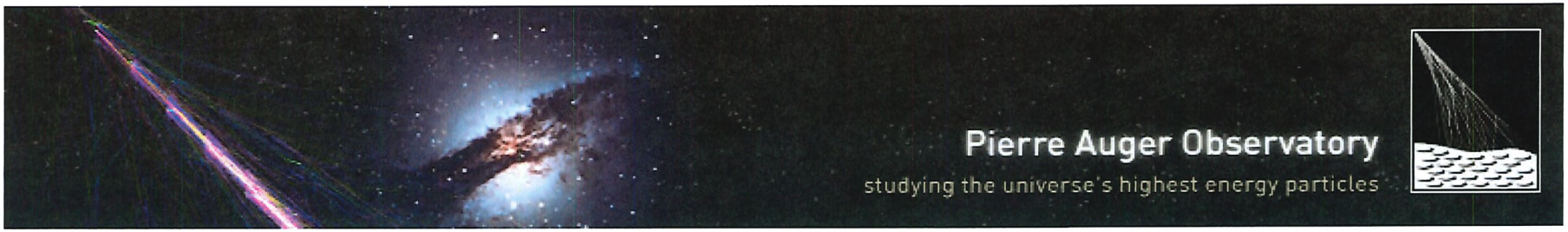
2010 - Astronomy & Astrophysics Decadal Survey (Astro 2010)

Report to be released this Fall

Europe (68M$)

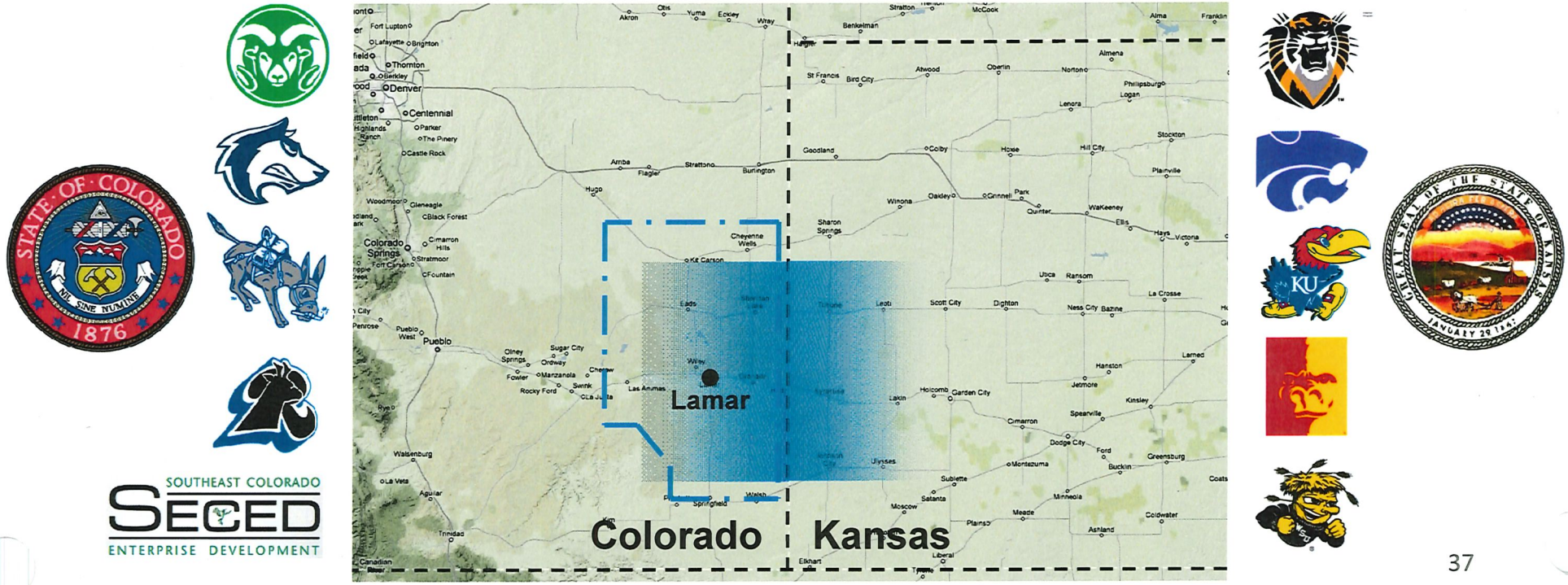
Auger North among the "Magnificent Seven" experiments in particle astrophysics

3-36



Summary

We are looking forward to welcoming the researchers of Kansas universities among the members of the Auger collaboration and the State of Kansas as a partner to make "Auger North" a reality.



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