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Education and Outreach Activities of the Pierre Auger Observatory

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Abstract: The scale and scope of the physics studied at the Pierre Auger Observatory continue to offer significant opportunities for original outreach work. Education, outreach and public relations of the Auger Collaboration are coordinated in a separate task whose goals are to encourage and support a wide range of education and outreach efforts that link schools and the public with the Auger scientists and the science of cosmic rays, particle physics, and associated technologies. The presentation will focus on the impact of the collaboration in Mendoza Province, Argentina. The Auger Visitor Center in Malargüe has hosted over 80,000 visitors since 2001, and a fourth collaboration-sponsored science fair was held on the Observatory campus in November 2012. The Rural Schools Program, which is run by Observatory staff and which brings cosmic-ray science and infrastructure improvements to remote schools, continues to broaden its reach. Numerous online resources, video documentaries, and animations of extensive air showers have been created for wide public release. Increasingly, collaborators draw on these resources to develop Auger related displays and outreach events at their institutions and in public settings to disseminate the science and successes of the Observatory worldwide.

Keywords: Pierre Auger Observatory, ultra-high energy cosmic rays, education, outreach.

1 Introduction

Education and public outreach (EPO) have been an integral part of the Pierre Auger Observatory since its inception. The collaboration's EPO activities are organized in a separate Education and Outreach Task that was established in 1997. With the Observatory headquarters located in the remote city of Malargüe, population 23,000, early outreach activities, which included public talks, visits to schools, and courses for science teachers and students, were aimed at familiarizing the local population with the science of the Observatory and the presence of the large collaboration of international scientists in the isolated communities and countryside of Mendoza Province. As an example of the Observatory's integration into the local culture, the collaboration has a tradition of participating in the annual Malargüe Day parade since 2001 with collaborators marching behind a large Auger banner (see Fig. 1). Close contact with the community fosters a sense of ownership and being a part of our scientific mission. The Observatory's EPO efforts have been documented in previous ICRC contributions [1]. We report here highlights of recent activities.

Figure 1: Auger collaborators and Science Fair participants in the November 2012 Malargüe Day parade.

2 The Auger Visitor Center in Malargüe

The Auger Visitor Center (VC), located in the central office complex in Malargüe, continues to be a popular attraction. Through Feb. 22, 2013, the VC has hosted 79,924 visitors. Fig. 2 shows the number of visitors logged per year from Nov. 2001 through Feb. 2013. The noticeable increase of visitors since 2008 occurred after the opening of a nearby planetarium [2] in August of that year. The VC is managed by a small staff led by Observatory employee Analía Cáceres; she and other collaborators share the task of giving presentations and tours to visitors and school groups. During the Feb.-March 2013 collaboration meeting, a small group arriving at the VC included the 80,000th visitor, see Fig. 3. Auger sourvenirs were presented to the group, senior collaborators welcomed them, and local television and radio covered the visit to highlight this attendance milestone. A recent addition to the visitor experience is an AERA [3] radio detector station outside the office complex.

3 The Rural Schools Program and Education Fund

The Rural Schools Program, initiated by the Observatory staff who volunteer their time, continues to bring information about the Observatory and needed infrastructure im-

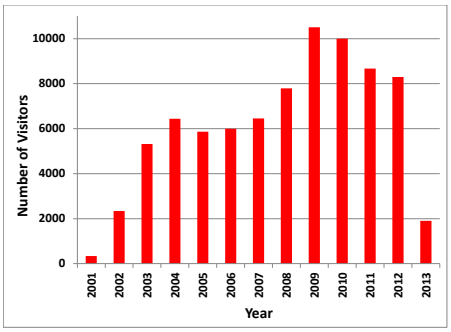

Figure 2: Number of visitors logged by year at the Auger Visitor Center from November 2001 through February 2013.

Figure 3: Auger collaborators with a visitor group which passed the 80,000 visitor milestone.

provements to remote schools that have difficulty bringing their students to the Observatory. Fig. 4 shows three technicians at the Peregrina Cantos school in Bardas Blancas, 60 km from Malargüe, working on the school's internet connectivity using hardware purchased from the Education Fund to which Auger collaborators and institutions contribute. In November 2012, several Auger collaborators met with a group of headmasters from 10 remote schools to discuss increased communication with the Observatory as well as visits to the schools by the Rural School team.

Figure 4: Auger technicians working on internet hardware at a school in Bardas Blancas.

4 The 2012 Auger Science Fair

The Observatory hosted its fourth biannual Science Fair in the Assembly Building November 15-17, 2012, this Fair dedicated to the 100^{th} anniversary of Victor Hess's balloon flights which are often referred to as the discovery of cosmic rays. See Figs. 5 and 6. Thirty-six student teams from all over Mendoza Province, with ages ranging from primary school through high school, presented research projects in the areas of natural science, exact science, and technology. Auger collaborators and a few invitees served as judges for the student projects, and prizes were awarded to the top teams in several categories in the closing ceremony on November 17. On the 16^{th}, the Science Fair participants had the opportunity to walk in the Malargüe Day parade along with Auger collaborators, everyone attended a presentation about the Observatory in the Visitor Center, and a pizza party and *asado* were held in the evening. The November 2012 Science Fair owes its success to the Observatory staff, the collaborators who served as judges, the Municipality of Malargüe, the participating teachers and students, and special mention goes to the lead local organizers: Miguel Herrera, Fabian Amaya, and Alicia Piastrellini.

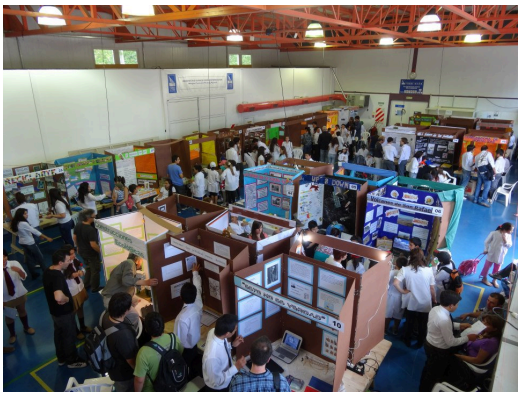

Figure 5: November 2012 Science Fair in progress in the Assembly Building.

Figure 6: Science Fair organizers and participants.

5 Selected Outreach Activities in Member Countries

La Brújula in Mendoza

The Observatory is currently being featured at the first exhibition of science and technology, *La Brújula* ("The Compass") [4], which highlights scientific research projects

based in Mendoza Province, Argentina, and runs from May 15 to June 16, 2013, in the Cultural Center Julio Le Parc in the provincial capital. Figs. 7 and 8 show a Fluorescence Detector prototype mirror and a Surface Detector station at the exhibition, which are accompanied by signage explaining cosmic ray research and the hybrid detection techniques employed by the Auger Observatory. During its first four days, over 200,000 people attended *La Brújula*. The exhibition is sponsored by Mendoza Province, the federal Ministry of Science and Technology (MINCyT), and the National Atomic Energy Commision (CNEA). The Auger exhibit is similar to the successful presence of the Observatory at the Technopolis exhibition in Buenos Aires last year.

Figure 7: Prototype Fluorescence Detector mirror installed at *La Brújula* in Mendoza.

Figure 8: Surface Detector station being prepared for CNEA's Auger exhibit at *La Brújula*.

Auger Observatory public data set

The online release of extensive air shower data [5] continues to draw attention from around the world. Betwen May 1, 2012, and April 30, 2013, the web site which currently offers Surface Detector (SD) information from 30,000 air showers had 3776 visits among which 70% were new to the site. Auger collaborators in several countries have employed the public data in exercises for students and teachers in educational settings and workshops. As an example, Auger collaborators and physics education reseachers at the University of São Paulo developed a hands-on exercise to construct a 3-D model of a single air shower using simple, inexpensive materials and SD data (station positions and recorded signal strengths and times) provided in the data set [6]. Fig. 9 shows two high-school physics teachers working on their model during a School of Modern Physics in 2011, and Fig. 10 shows the finished model.

Figure 9: High school teachers constructing a 3-D model of an extensive air shower.

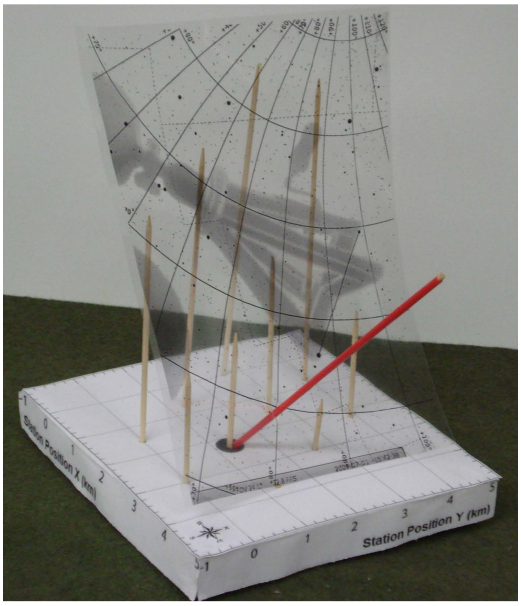

Figure 10: Completed 3-D model of an air shower front (plastic sheet), with wooden stick lengths representing the arrival times for SD stations included in the event. The red stick indicates the shower arrival direction pointing to the shower core.

Auger collaborators continue to develop tools and lesson plans for the use of the public data set. Collaborators at RWTH Aachen University have developed a user-friendly analysis package named Visual Physics Analysis (VISPA) [7] which has been field tested by large numbers of undergraduate students using the public data set as input. As an example, students have used VISPA to learn about the supergalactic coordinate system by plotting cosmic ray arrival directions from the public data set, as shown in Fig. 11. Collaborators at the Laboratory of Instrumentation and Experimental Particle Physics (LIP) in Portugal have also developed a detailed users guide for the public data set.

High altitude balloons

During the halftime of a University of Nebraska football game against Arkansas State University on September 15,

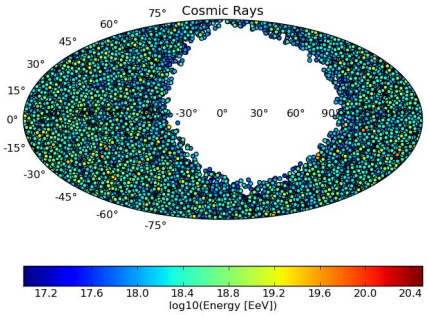

Figure 11: Cosmic ray arrival directions from the Auger public data set plotted in supergalactic coordinates using VISPA.

2012, 85,000 spectators viewed the launch of three high-altitude balloons from the football stadium. Suspended below the balloons were a number of "pods" containing experiments designed by high school students from Lincoln and Omaha and undergraduate students from the University of Nebraska-Lincoln (UNL). UNL physics students were responsible for measuring radiation vs. altitude using a small-area portable Geiger counter in one of the pods, in commemoration of the 100^{th} anniversary of the manned balloon flights taken by Victor Hess. The balloons were equipped with cameras, GPS receivers, and radio transmitters to relay data to a ground station in real time (see Fig. 12). The balloons all reached about 95,000 feet (30,000 meters) altitude before bursting, and parachutes carried the payloads to the ground, to be retrieved by chase vehicles. The balloon round-trip time was about 90 minutes. NASA astronaut Clayton Anderson, a Nebraska native who has flown on the International Space Station, attended the event, signed autographs, spoke on local radio about the importance of science education, and helped launch the balloons from the football field. A two-minute video clip of the event can be found on YouTube [8].

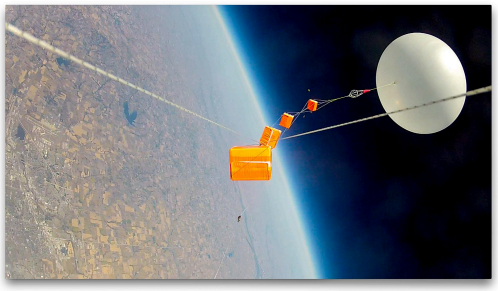

Figure 12: View looking up at one of the ballons and the suspended experimental pods. The prominent lines that extend to the edge of the photo are the strings attaching the camera pod to the orange pods above it.

Fig. 13 shows the Geiger counter counts per minute vs. altitude, showing the increase in measured radiation with altitude, as seen by Victor Hess at lower altitudes. Data points from both the ascent and descent are plotted. For altitudes above 60,000 feet, one observes more scatter in the data points and a slight decrease in the average radiation counts. This is attributed to the transition from detecting extensive air shower particles at lower altitudes to detecting primary cosmic-ray particles at higher altitudes.

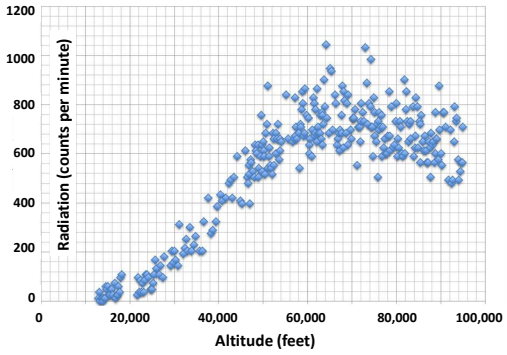

Figure 13: Measured Geiger counter counts per minute vs. altitude.

Partnership with the Helmholtz Alliance
The Auger Observatory has formed a partnership with the outreach arm of Germany's Helmholtz Alliance for Astroparticle Physics (HAP) [9] led by Astrid Chantelauze who visited the Observatory and covered the Nov. 2012 Science Fair. The Observatory profits from HAP's online resources and its extensive use of social media to communicate news and events related to several astroparticle experiments and theory.

6 Conclusions

The Auger Observatory continues to provide unique education and outreach opportunities which expose people of all ages to the excitement of astroparticle physics. Its Visitor Center, Rural Schools Program, and Science Fairs have great local impact near Malargüe, while collaborators around the world ensure that the Observatory's science and successes have international reach.

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