The Colorado Atmospheric Monitoring Telescope as a detector for Elves?

Lawrence Wiencke Colorado School of Mines Oct 1st 2013 HiLITE workshop, Torino





Interdisciplinary Science @ The Pierre Auger Observatory Cambridge (2011)

Atmospherics Transient Luminous Events (Elves) Geophysics

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Guest Editors Antonio Bueno and Lawrence Wiencke

Editorial: Introductory Remarks by A. Watson

The Pierre Auger Observatory and Interdisciplinary Science by L. Wiencke for the Pierre Auger Collaboration Malargue seismic array- Design and Deployment of the Temporary Array by E. Ruigrok et al. (to appear soon) Description of Atmospheric Conditions at the Pierre Auger Observatory Using Meteorological Measurements and Models by B. Keilhauer and M. Will for the Pierre Auger Collaboration Atmospheric Aerosols at the Pierre Auger Observatory and Environmental Implications Discussion Around a

Collaborative Project by K. Louedec for the Pierre Auger Collaboration and R. Losno Atmospheric monitoring with LIDARs at the Pierre Auger Observatory by V. Rizi and A. Tonachini for the Pierre Auger Collaboration, M. Iarlori and G. Visconti

Ground-truthing a satellite-based night-time cloud identification technique at the Pierre Auger Observatory by J. Chirinos for the Pierre Auger Collaboration

Observation of Elves in Auger by *R. Mussa for the Pierre Auger Collaboration and G. Ciaccio* A beginning investigation into the possible role of cosmic rays in the initiation of lightning discharges at the Pierre Auger Observatory by *W.C. Brown et al.*

http://epjplus.epj.org/index.php?option=com_toc&url=/articles/epjplus/abs/2012/08/contents/contents.html





The group photo of the participants of the ASPERA days of the ATMON'08 conference in Prague:



Atmospheric Monitoring for Astroparticle Physics, Prague, June 26 - July 4, 2008

ATMON'10: Madison, Wisconsin

Second Workshop on Atmospheric Monitoring in Astroparticle Physics and Astronomy



 Dates:
 from 13 September 2010 08:30 to 14 September 2010 18:00

 Timezone:
 US/Central

 Location:
 UNIVERSITY OF WISCONSIN MEMORIAL UNION 800 Langdon Street Madison, WI USA



2013

2008

Colorado School of Mines Astroparticle Group Pierre Auger, JEM-EUSO, ...





AMT: Atmospheric Monitoring Telescope



Motivation for speed-dependent analysis Application to CLF laser shots Application to CR showers Conclusions & perspectives

Shower Speed Using Stereo Events



- Use the cross product of the two different SDPs to locate shower axis and shower core
- Project pixel directions into the SDP
- Within the SDP find the geometry parameters R_p and χ_0 to use in timing fit





Keri Kuhn (MSc), Eric Mayotte (MSc) & Fred Sarazin Physics Department, Colorado School of Mines

Auger collaboration analysis meeting, June 2011

MultiEye timing fit for velocity (Laser Data)



Clear Weather Cuts, Long tracks

Laser – Air Shower Equivalence







High Resolution Fly's Eye 1999-2004





Location of AMT

Colorado School of Mines

Elastic Side-Scatter vs Raman LIDAR techniques

Aerosol Optical Depth @ 4.5 KM





L. Valore

ARCADE

LIDAR (elastic + Raman) and telescope for side-scattering measurements (Atmospheric Monitoring Telescope). The laser source is common.

LIDAR will Tilt Toward The AMT



AMT Atmospheric Monitoring Telescope

Weather Station

COLORADOSCHOOLOFMINES

PMT Camera

Spherical Mirror



Power, Internet and Data Acquisition Napoli

High Resolution Fly's Eye Optics - Mirrors

Spherical Mirrors

Glass slumped over a mold in an oven Sputter deposit aluminum over front surface Anodized

Radius of curvature ~480 cm

Each detector mirror has 4 segments

Made enough mirrors for 3 2pi sites.

Spot size ~1cm modified by spherical abberation Effective Spot size about degree equivalent









Figure 7. The AMT's camera has 1 degree pixels in a 16x16 arrangement. It includes 128 PMT assemblies. Only 2-3 vertical rows will be required to measure tracks from vertical laser beam.



Figure 8. Detail of camera backplane. Each D connectors carries differential signal pairs for 8 channels.



Figure 9. A PMT assembly including base and preamp. The PMT is the same model used in the Auger FDs.



An example shower:







Filter Closed (In Place)



Filter Open (Not in Place)







TEMPERATURE CONTROLLED UV LED (CSU J. Brack)







A plot with a familiar features?



Cosmic Ray Flux x E²





The Incredible Shrinking Cost of Hard Drive storage

Write more sky Very loose Trigger (No Trigger eventually)

Chart: honesthypocrite.blogspot.com Data: http://ns1758.ca/winch/winchest.html

Outlook:

AMT disadvantages

too fast digitization – need a slower readout and deeper buffer Importing instruments into Argentina is challenging FOV may be a bit narrow

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AMT advantages

it exists very sensitive 3.5 m² optical collecting area fast digitization (Currently 20 Mhz) could look at different wavelengths absolute photometric calibration

Interested in collaborative efforts