STACEE is a fairly small collaboration and is now observing, so it's a perfect experiment for students to get involved with. Everyone in our group is making major contributions to the experiment. Professor Doug Gingrich from the University of Alberta collaborates on STACEE with groups from McGill University, University of California – Los Angeles, Santa Cruz, Case Western Reserve University and Barnard Collage – Columbia University.

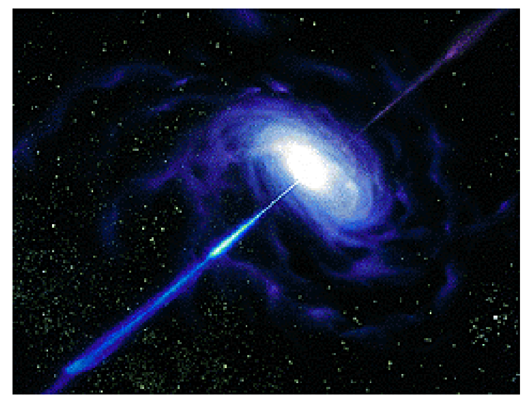
Professor Douglas M. Gingrich

Centre for Subatomic Research
Department of Physics
University of Alberta
Edmonton, Alberta
Canada T6G 2N5
Phone (780) 492-9501
Fax (780) 492-3408
Email: gingrich@ualberta.ca
http://www.phys.ualberta.ca/~gingrich/

STACEE

SOLAR TOWER ATMOSPHERIC CHERENKOV EFFECT EXPERIMENT

Gamma-Ray Astronomy



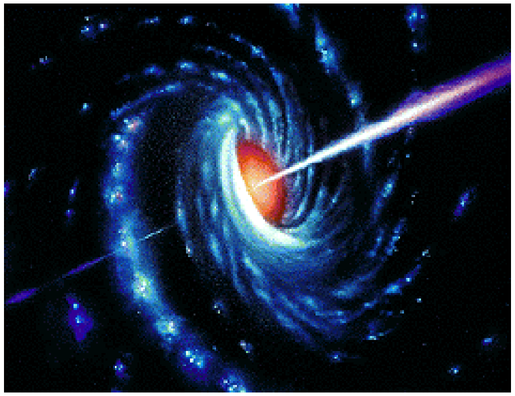
SOLAR TOWER ATMOSPHERIC CHERENKOV EFFECT EXPERIMENT

On the outskirts of Albuquerque, in the dark desert, a team of astrophysicists operates a giant array of solar collectors. For 14 nights every month, the National Solar Thermal Test Facility at Sandia National Laboratory turns into a nighttime observatory, scanning the skies for evidence of high-energy gamma-ray radiation from distant galaxies.

This gamma ray "telescope", called the Solar Tower Atmospheric Cherenkov Effect Experiment (STACEE), concentrates the faint light – known as Cherenkov radiation – that is the signature of high-energy gamma rays that hit the top of the atmosphere.

We are looking in a region of the electromagnetic spectrum that has never been explored before. Every time a new window in the spectrum is opened – for example when astronomers first began to explore the Universe in the infrared, X-ray or radio wavelengths – something new was discovered.

The energy in the gamma-ray portion of the electromagnetic spectrum is comparable to that produced in the most powerful particle accelerators here on Earth. Astronomers think they may be produced by neutron stars – dense, highly magnetized stars that give off gamma-ray radiation as they spin – or such objects as active galaxies that have massive gravity fields.



Active galaxies are amazing objects. An entire massive galaxy is compressed into a volume about the size of our solar system – something like one billion stars are in a single black hole. The enormous gravitational forces lead to particle acceleration and radiation in the form of gamma rays. Now that gamma rays have actually been seen from some of them we want to find more, and figure out how they work.

When gamma rays from space reach the top of the Earth's atmosphere, they cannot penetrate; instead they trigger a shower of particles that fly through the atmosphere faster than the speed that light normally travels through the air. Because they are traveling faster than light, they generate the visual equivalent of a sonic boom, a faint blue glow, called Cherenkov radiation.

Cherenkov radiation from a gamma ray is like a headlight beam streaming through the atmosphere – by the time it reaches the ground, it has spread out to cover an area about 200 meters across. More conventional ground-based gamma-ray telescopes can collect only a small fraction of this beam, and so only "see" the highest-energy (and therefore brightest) of the gamma-ray sources. Because the STACEE collectors are spread out over a large area, they can collect a larger fraction of the "beam" and thus see much fainter sources.