



2013-09-20 update

A newsletter for non-scientists (and scientists) interested in MAGIC

MAGIC is a field program funded and operated by the Atmospheric Radiation Measurement (ARM) Climate Research Facility of the U.S. Department of Energy. The ARM MAGIC webpage is <http://www.arm.gov/sites/amf/mag>.

All previous updates and other MAGIC information can be found at <http://www.bnl.gov/envsci/ARM/MAGIC/>.

The *Spirit* departed Honolulu this morning and is on its way back to Los Angeles to finish Leg19B, the last complete leg on which data will be taken during MAGIC. Peter Kalmus, a climate modeler from the Jet Propulsion Laboratory in Pasadena, CA, is riding the ship as a science observer. I talked to him briefly yesterday and he said he had a good trip over and that the scenery in Hawaii was spectacular (I agree!). I wished him a nice trip back.

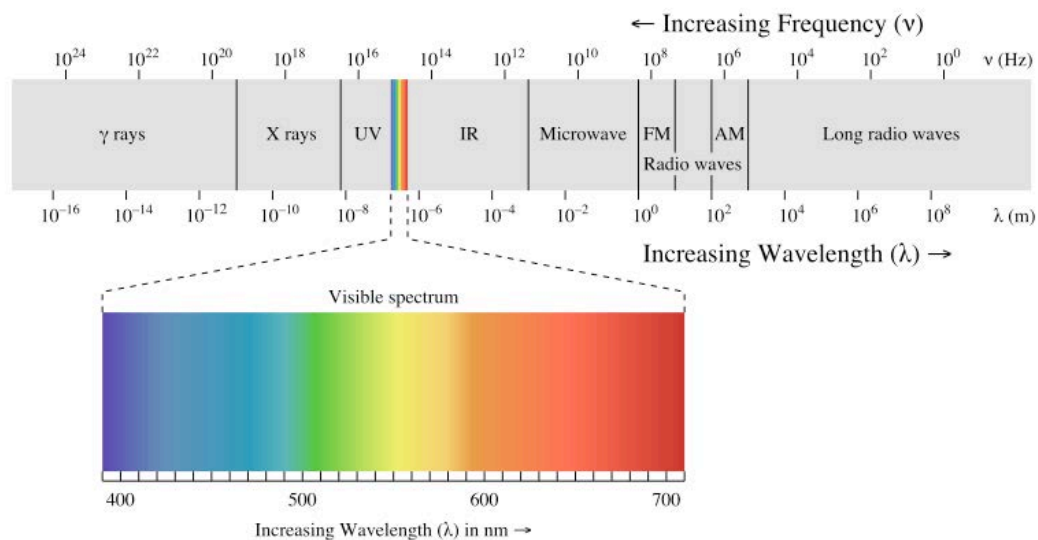
When the *Spirit* arrives in Los Angeles next Thursday some of the instruments will be removed, and then during Leg20 the remaining instruments will be turned off. Everything will be taken off the ship the next time it returns to Los Angeles on October 10, marking the end of the measurements. MAGIC has dominated my life for the last several years, and it's been quite a ride! I would like to once again thank the Captain and crew of the Horizon *Spirit*, and Horizon Lines, for their support and enthusiasm for MAGIC! They have been great hosts and become good friends, and I hope we can continue to work with them in the future.



Horizon *Spirit*

However, MAGIC is by no means over. There is nearly a year's worth of measurements from several dozen instruments, comprising an unprecedented data set on clouds, aerosols, radiation, and atmospheric structure over the ocean, and scientists will be analyzing these data for quite some time. There will be a MAGIC session at a conference in Washington, DC in November, and Joao Teixeira of the Jet Propulsion Laboratory and I are convening a session on MAGIC at a conference in San Francisco in December. During these times scientists interested in MAGIC data will meet and discuss working together, how to best use the data to attack certain questions, etc. MAGIC updates will also continue. I will try to show how the data are being used and the types of questions they address, and I have several topics I want to discuss (polarized light, layers of the atmosphere, etc.) that I haven't written about yet.

In the last update (2013-08-28) I warned everyone not to believe everything they read on the web. Unfortunately, this advice sometimes applies to my updates, but fortunately I have good friends who inform me when I make mistakes, and I try to correct them. In my discussion of the electromagnetic spectrum, I referred to several types of electromagnetic radiation and included cosmic rays, but this isn't correct. Although cosmic rays were originally thought to be electromagnetic radiation, they are instead very-high-energy particles that come from outer space, many of which are thought to be formed from supernovae. Doug, a friend from grad school who works at NASA, wrote that some of his friends would be upset that I was turning their beloved particles into waves—sorry guys. Michele, who is here at BNL, wrote that not only was I incorrect, but neither was the diagram that I included, which listed gamma rays (which ARE a type of electromagnetic radiation that I forgot to include) and cosmic rays. High energy gamma rays also come from outer space, and they are formed from radioactive decay of atoms, from collisions of cosmic rays with Earth's atmosphere, and by other mechanisms. He sent me a better diagram, which appears below. Thanks Doug and Michele!



After the last update I received a request from Veronique Perraud, a friend who is a postdoctoral researcher in atmospheric chemistry at the University of California at Irvine. She has a blog at <http://chemistryexhibit.blogspot.com/> in which she demonstrates that “Chemistry isn’t necessarily restricted to the lab and/or classroom, and that it can be really fun, and we can be creative to speak about it.” I fully agree with each of these sentiments. She asked if she could link MAGIC updates to her blog. As I support any activities that attempt to communicate science to non-scientists, naturally I agreed, and I’m honored that she asked. Thanks Vero!

Although MAGIC was primarily focused on clouds, aerosol measurements were also made. The term “aerosol” refers to a suspension of particles in the atmosphere (thus, the particles themselves are not aerosols, although they are often incorrectly called this). If you are old enough, you may recall that aerosol spray cans were blamed for interfering with the ozone layer, but it wasn’t the aerosols that were the culprit, but rather the propellant that was used to make the mist, or aerosol, of whatever was in the cans (hair spray, air freshener, etc.). Aerosol particles are important as they affect climate, health, and visibility, and they serve as the seeds on which cloud drops form. The size, shape, and chemical composition of an aerosol particle affect how readily it can form a cloud drop, how it scatters light, how easily it can be inhaled, and how it participates in various processes in the atmosphere. Scientists are interested in the lifecycles of aerosol particles: how and where they are formed, how they are transported, how they are transformed along the way by uptake of gases or combining with other particles, and how they are removed (each of these aspects would make an update by themselves). The Aerosol Observing System, or AOS, was one of the three vans on the *Spirit* during MAGIC. The AOS has a 10-foot high stack to draw in air that is fed to a number of instruments that measured aerosol properties, and these properties give insight into the compositions of aerosol particles, their sources, and the processes they undergo.



AOS with stack; other instruments are mounted on the roof railings



Inside of AOS

I leave in just over a week for Ireland, to present some early results from MAGIC at a workshop on sea spray aerosol. Sea spray aerosol refers to those particles that are formed at the sea surface, mainly by bursting bubbles that occur in whitecaps, which are the remnants of breaking waves. When bubbles burst, they eject small drops into the atmosphere, each of which then becomes an aerosol particle. As there may be other substances at the sea surface that are included in these drops besides the salt in the seawater, the term “sea spray” rather than “sea salt” is currently used for these particles. Nearly everyone is familiar with this mechanism of aerosol production; the tickling feeling on one’s nose when drinking a fizzy beverage is caused by the small drops ejected from bubbles of carbon dioxide (which is used to “carbonate” the beverage) when they burst at the surface. As scientists, we want to know many things about these sea spray aerosol particles: their production flux (i.e., how many are formed over a given area of the ocean surface every second), their size distribution (i.e., how many in each size range are produced), their size-dependent concentration (how many of each size are in a give volume of the atmosphere), their chemical composition, and how each of these quantities is affected by atmospheric conditions such as wind speed, for instance, which affects the frequency and size of breaking waves. In the next update I’ll discuss how results from MAGIC can provide insight into some of these questions on sea spray aerosol.

As a final note, I recently put together a slide show that gives an overview of MAGIC, with pictures of the instruments, the *Spirit*, living quarters, and the deployment in general. It can be found at <http://www.bnl.gov/envsci/ARM/MAGIC/docs/MAGIC%20slide%20show%202013-09-07.pdf>.

Ernie Lewis
2013-09-20

Please address any questions or comments to elewis@bnl.gov.