MAGIC

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

I visited Argonne National Laboratory (near Chicago) earlier this week, where the MAGIC instrumentation is being staged before it will be shipped to Los Angeles and loaded on the Horizon *Spirit*, the container ship that will host MAGIC. Most of the instruments were there and were being secured in the vans for shipment. It was great to talk to Mike and Nicki, who are in charge of all the logistics of the deployment, and to meet others there who are the experts on weather balloons, computer systems, and various items pertinent to MAGIC.

The last update introduced some "phun" physics and discussed how radio waves, microwaves, infrared light, visible light, ultraviolet light, x-rays, and gamma rays are different manifestations of the same phenomenon, electromagnetic radiation, and that what distinguishes these different types is their frequencies (or equivalently, their wavelengths). In essence, each of these terms refers to light of a different color, although most of these colors are outside of the range that our eyes can detect.

The radio waves used for radars are grouped into so-called bands, each band covering a range of frequencies. Most of the bands consist of frequencies greater than those used for FM radio, which in turn are greater than those frequencies used for AM radio. Some of the main radar bands have rather cryptic designations, like L, S, C, X, K, Ka, and W. "L" stands for "long," as the wavelengths are longer than those used in S-band radars, where "S" stands for "short". L-band radars are used (among other purposes) for long-range air traffic control, whereas S-band radars are used for air traffic control at airports. The X-band was so named because the frequency was a secret during WW2. "K" stands for "kurz," which is German for "short" (different viewpoints on what is short, I suppose). Ka-band radars have frequencies just above K-band radars, hence the "a." Among other uses, Ka-band radars are employed by police to detect speeding motorists.

The two main radars that will be used during MAGIC are a Ka-band radar and a W-band radar. Ka-band and W-band radars have traditionally been thought of as cloud radars, meaning they are used to detect primarily cloud drops, whereas C- and S-band (and more recently X-band) radars have traditionally been thought of as precipitation radars (NEXRAD radars that are discussed on

your local weather channel are S-band radars), as they readily detect raindrops. This distinction isn't strictly valid, however, as Ka-band radars can also provide some information on precipitation.

The interaction between electromagnetic radiation such as radio waves and an object such as a cloud drop or a raindrop depends mainly on the frequency of the radiation and the size of the object. Thus, radars of different bands will yield different results when aimed at a cloud or at a rainstorm, and radars of different bands can be used together to provide information about the numbers and sizes of the cloud drops or raindrops.

Besides the frequency of the wave and the size of the object, the interaction of radio waves with an object also depends on the shape of the object and its composition. Thus radars can determine whether objects being detected are cloud drops or ice crystals, for instance, or whether objects are birds, insects, or water drops. For many years the scattering from birds and insects was considered a hindrance by radar meteorologists, but biologists are increasingly using radars as a means to study bird migration. When cleverly employed, radars can determine how fast raindrops are falling, from which they can infer the sizes of the drops. I find this last example particularly fascinating, and will discuss it and other topics in future updates.

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Please address any questions or comments to elewis@bnl.gov.
All updates and other MAGIC information can be found at http://www.ecd.bnl.gov/MAGIC.html.