The Heliophysics Summer School: 10 years and Counting

By Dr. Tony Phillips

Some institutions of cutting-edge learning are very old. Harvard: 380 years. Princeton: 270 years. Caltech: 125 years.

Others are a little younger.

This year, academicians around the world are celebrating the 10th anniversary of the "Heliophysics Summer School," a fresh-faced academy that introduces the next generation of scientists to a field of study that, arguably, didn't even exist when the new millennium began.

"Heliophysics is something new and exciting," says Lika Guhathakurta of NASA Headquarters.

"It's a leap across scientific boundaries," says Karel Schrijver, formerly of the Lockheed Martin Solar & Astrophysics Laboratory.

"It is a blueprint for the Universe," says Amitava Bhattacharjee, Professor of Astrophysical Sciences at Princeton University.

It begins with Helios, our sun. Of all the objects in the cosmos, the sun affects our planet most. It is the 900lb gorilla of the Solar System, shaping climate, weather, even life itself.

Earth and the sun are deeply and intricately connected, not only by simple rays of light and heat, but also by a complex web of electricity, magnetism, solar wind and extreme ultraviolet radiation. Lines of electrical current and magnetic force can sometimes be traced, without interruption, all the way from the ground beneath our feet to the base of seething sunspots 93 million miles away. Our planet and our star are, in a sense, one.

"Back in the early 2000s, NASA had a division called the 'Sun-Earth connection,' which recognized this link," recalls Guhathakurta. "When Mike Griffin became the NASA administrator in April of 2005, he asked us to come up with a one-word description of our division that captured both the holistic simplicity and the vast scope of the sun-Earth system. Ultimately it is Sun-Earth connection division director Dick Fisher who is credited with inventing the word 'heliophysics'."

Re-naming the "Sun-Earth connection" wasn't just a marketing ploy, it signaled an authentic shift in thinking about stars and their relationships to planets, moons, asteroids and comets.

"Heliophysics is a unique science," says George Siscoe of Boston University. "You can see this by realizing that all matter in the universe is organized macroscopically by two long-range forces: gravity and magnetism. As the saying goes, gravity sucks, hence the origin of dense objects like planets, stars, galaxies, etc. But magnetism repels, hence magnetospheres, solar storms, geomagnetic storms, and all large-scale magnetically organized structures in the universe. A very important part of heliophysics is made up of the structures that result when the pull of gravity and the push of magnetism compete."

Once upon a time, the study of gravity and magnetism were separated by high academic walls. They had their own textbooks, their own course numbers, and their own professors who rarely talked shop together. Heliophysics breaks down these barriers—and many others.

"In a sense," says Shrijver, "heliophysics is the equivalent of what ecology is to the life sciences: a discipline that brings awareness of the processes that couple a vast network of conditions into the whole. In order to make heliophysics work as the equivalent of ecology, a sense of community needs to exist: heliophysics is thus also the activity of teaching across traditional discipline boundaries to stimulate the curiosity of one discipline to reach out to the expertise of another."

Heliophysics plays out on scales ranging from the fusion of subatomic particles taking place in the heart of the sun to the grand sweep of magnetic storms that can engulf entire planets. It stitches together aspects of weather, climate, plasma physics, Earth science, astronomy, and even biology. A true heliophysicist is at home discussing all topics, all scales.

Enter the Heliophysics Summer School:

"A new science needs new scientists," says Guhathakurta, "and 10 years ago we set out to create them. The Heliophysics Summer School was established for this purpose."

Funded by NASA and managed by UCAR, the first Heliophysics Summer School was convened in July 2007. The Deans were George Siscoe and Karel Schrijver. During an intense, immersive two-week session, 35 young scientists were instructed by 23 experts in topics ranging from practical techniques in supercomputer modeling to the fundamental physics of magnetic explosions. Lab sections tested the exhausted but excited students' mastery of concepts that, heretofore, were rarely discussed in the same room, much less the same lab activity.

Since then hundreds of students from dozens of countries have attended the summer school. Graduates with extraordinary promise compete for and receive Jack Eddy Fellowships, named after John A "Jack" Eddy, a pioneering researcher in solar physics who shaped thinking about the Sun-Earth connection in the 20th century. These fellowships provide the support they need to continue their studies as heliophysics post-docs at leading Universities. Later, some Jack Eddy Fellows return to the Heliophysics Summer School as instructors.

"We've created a whole heliophysics life cycle," says Guhathakurta. "Caterpillars enter the cocoon of the Summer School and emerge as beautiful Heliophysics butterflies. Jack Eddy Fellows are the Monarchs."

Not bad for a school that's only 10 years old…

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