Abstractions

FIRST AUTHOR

Galactic cosmic rays — high-energy charged particles that result from hugely energetic processes — are one of the few ways to directly measure matter from outside the Solar System. In 2000, Jin Chang, now an astrophysicist at the Purple Mountain Observatory in Nanjing, China, and a group of international colleagues first detected an excess of high-energy cosmic-ray electrons using the Advanced Thin Ionization Calorimeter (ATIC). The instrument was sent on helium balloons to measure the composition and energy spectra of cosmic rays 35 kilometres above Antarctica. Potential sources of such high-energy electrons could be a pulsar, a supernova or an intermediate-mass black hole. But the existing data don't confirm or refute any of these. In fact, Chang tells *Nature*, this could be the first indirect evidence of dark matter, the theoretical matter thought to make up as much as 85% of matter in the Universe (see page 362).

Why did it take so long to publish this work?

During an ATIC flight in 2000–01, we were surprised to find an excess of high-energy (~300–800 gigaelectronvolt) electrons — observations that had to be verified to be believed. But balloon observations are very difficult to make. In fact, balloons we deployed with improved instrumentation to reduce background noise during the third flight malfunctioned. We had to wait another two years to try again. In the end, the second and fourth flights — as well as measurements from Japan's Polar Patrol Balloon — successfully verified the pattern of high-energy electrons.

Of all the possible sources, which do you think is most likely?

Our data suggest that the source could be an unknown nearby astrophysical object capable of accelerating electrons to this energy level — such as a pulsar, a rapidly spinning star that produces regular pulses of radiation, or a supernova, the explosive death of a massive star. But they also don't discount that the electrons could be produced by the annihilation of dark-matter particles. We have a long way to go to definitively determine the source.

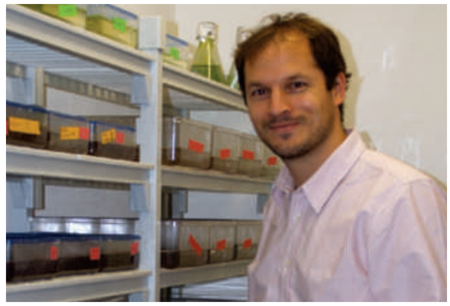
Do you think that we will understand dark matter within the next decade?

I hope so. The ATIC team plans to build a new instrument to study this source further. We are also waiting for new results from several space-based instruments. The Large Hadron Collider, the new particle accelerator at CERN near Geneva, Switzerland, may also contribute by creating and detecting predicted dark-matter particles. ■

MAKING THE PAPER

Gáspár Jékely

Precursor eyes prompt movement of marine zooplankton towards light.



Charles Darwin spent a great deal of time puzzling over how the complex machinery of the eye arose. In 1859, he proposed the theory of 'proto-eyes', or very simple light-sensing cells, as a starting point for eye evolution. Since then, surprisingly little progress has been made in understanding the neural functioning of the most rudimentary eyes. Now, researchers in Germany have established a link between light perception and locomotion in the larvae of a marine worm, *Platynereis dumerilii*, confirming that Darwin was on the right track.

Many tiny marine invertebrates such as *P. dumerilii* larvae migrate vast distances from the deep sea to light-drenched surface waters in order to disperse. Researchers suspected that simple light-sensing eyespots mediate this navigation towards the light — a phenomenon known as phototaxis — but it wasn't clear how sensory information received by the eyespots translated to locomotion. While a postdoc with Detlev Arendt at the European Molecular Biology Laboratory (EMBL) in Heidelberg, Gáspár Jékely set out to find an answer.

Jékely and his colleagues began by asking where a neural impulse generated by illumination of an eyespot might travel. *P. dumerilii* larvae are spherical, with a belt of hair-like cilia at their midpoint. Eyespots are situated on either side, just above the cilia, and consist of just two cells: a light-sensing 'photoreceptor' nerve cell and a pigmented cell that shades the photoreceptor so that it detects light from only one half of the potential field of view.

In animals with complex nervous systems, neural impulses are sent from photoreceptor cells to the brain's visual centres. When the researchers labelled a *P. dumerilii* larva's photoreceptor and traced the path of its nerve fibre, they were surprised to find that, rather than connect to the larva's simple brain, it links directly to the nearby cilia belt. These cilia serve as the swimming motor for the larvae, propelling them with a beating motion. The finding revealed a direct coupling between the light-sensing eyespots and the phototactic swimming of marine larvae (see page 395). "We expected some more complex neurobiology behind it and it was just fascinating to see that it was so simple," says Jékely, now at the Max Planck Institute for Developmental Biology in Tübingen, Germany.

The team also used fast video microscopy to detail how the eyespots mediate navigation. By stimulating one eyespot with a light beam, they observed that the cilia adjacent to the eyespot slow their beating in response to the light. The cilia on the opposite side do not slow, so propel the larvae with greater force, steering them towards the light much as differential pull on the oars of a canoe causes it to change direction.

Next, the group enlisted the help of co-author François Nédélec, a physicist at EMBL, to create a computerized model of the swimming behaviour. The resulting program showed that the larvae must continually turn on their axis so that one eyespot is shaded and the other is turned to the light. This explains why almost every type of marine plankton, from sponge and jellyfish larvae to single-celled protists, adopt a spiral motion when swimming towards light. "Basically, every simple organism that is able to follow light in open water will use this strategy," says Jékely. Some of the finer details may differ, he says, "but I suspect in most cases there will be a very simple coupling between eye and cilia". ■

See News Feature, page 304, and News & Views, page 334.

FROM THE BLOGOSPHERE

The Great Beyond, *Nature*'s News blog, provides its own perspective on the sad news of Michael Crichton's death on 4 November (http://tinyurl.com/5ton5t). Crichton was not universally popular among scientists, possibly because his favourite theme was 'science gone horribly wrong' — in genetics, nanotechnology, medicine and climate.

In 1993, the year the film came out, a reviewer of *Jurassic Park* in *Nature Biotechnology* bemoaned the lack of scientific accuracy. Crichton responded in a letter to the journal: "As Alfred Hitchcock used to say, 'It's just a movie.'"

Yet in his 2004 novel, *State of Fear*, Crichton presented climate change as a fraud perpetuated by activists and scientists. In support of this view, the author cited the Intergovernmental Panel on Climate Change (IPCC) report, asserting that his training in medicine qualified him to evaluate it. As blogger Heidi Ledford puts it: "When President George Bush invited Crichton to swing by the White House for a chat about climate change, I don't recall hearing the author protest, 'Hey, but it was just a novel'." ■

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