Abstractions

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Supernovae are stellar explosions. Typically, it takes about a month for them to become visible enough to be discovered by ground-based telescopes. As a result, the neutrinos and gravitational waves generated during a supernova's early days, which might provide a better understanding of the underlying explosive mechanism, have gone unexamined. On 9 January, astronomer Alicia Soderberg at Princeton University in New Jersey caught a supernova's first moments by detecting a short-lived X-ray outburst. This was produced by photons bursting from behind the shock wave caused by the star's explosive core collapse from lack of fuel. Soderberg tells *Nature* that this shock-wave signature will soon allow astronomers to routinely witness the birth of supernovae.

Was it skill or luck that led to your finding this X-ray outburst?
Luck was definitely involved. I happened to be using the Swift X-ray Telescope to observe a different supernova that occurred in the same galaxy in December 2007. Because I was looking at data as it came off the satellite, I realized something new had just exploded in that galaxy. We could probably resolve many mysteries by examining data as they arrive.

What caught your attention?
The X-ray outburst was significantly more luminous than the outbursts typically produced by neutron stars or black holes, but was not as luminous as the gamma-ray outbursts that accompany a small fraction of this type of core-collapse supernova. Our observation ultimately confirmed the existence of an outburst of intermediate intensity. Such an outburst was predicted in the 1960s, but had never been seen.

Was it difficult to quickly convince other observatories to collect data?
Telescopes can focus on new objects quickly once the source of the signal is known. But because to begin with we didn't know what had produced the X-ray outburst, organizing the telescopic observations in the first 24 hours involved frantic phone calls, e-mails and a few favours. I didn't sleep for a good week, but because we caught the star exploding and alerted the rest of the world, this is perhaps the best-studied supernova so far.

Will this discovery change supernova research?
Yes. For so long, finding supernovae was solely an optical game. But we show that X-ray observatories will soon play just as large a part in the field. This phenomenal discovery was serendipitous, but luck favours the prepared. I hope good fortune allows more discoveries down the road. ■

MAKING THE PAPER

Julie Theriot

Mechanism for cell shapeliness decoded from fish scales.

What determines a cell's shape might not seem a particularly pressing question. But biochemist Julie Theriot explains that, for those eukaryotic cells that don't have a cell wall, shape is intrinsically connected to the inner mechanics that facilitate cell movement. By combining a large-scale study using microscopy with mathematical modelling, her group has determined that for certain cell types, shape — and thus movement — is determined by an interplay between membrane tension and the distribution of actin filaments, chief components of the cell's scaffolding.

Theriot, who is based at Stanford University School of Medicine in California, confesses to a lifelong fascination with moving cells. "I was that kid who would scoop up pond water to look at all the swimming critters under a microscope," she says. That fascination carried through to her graduate studies in the early 1990s, when she began studying actin dynamics in moving cells.

After another group showed that cultured fish keratocytes — cells found in fish scales — move in a persistent manner, with a wide leading edge and a rounded cell body bringing up the rear, Theriot trekked down to the local pet shop to buy some goldfish. Others in the field, including her graduate advisor, Tim Mitchison of Harvard Medical School in Cambridge, Massachusetts, went on to propose in the mid-1990s that keratocytes' movement was driven by 'treadmilling' of the actin network.

After spending a number of years studying actin in other cell types, Theriot recently returned to keratocytes to test the idea that the cells might be shaped by their movement. The study on page 475 reports her group's assessment of the natural variation in shape among keratocytes and in the density and location of their actin filaments. To gather a large enough dataset, four of the authors spent nine months at the microscope, between them recording and measuring about 2,000 individual cells. The group showed that 93% of shape variation can be captured by measuring just two parameters: the cell's area and whether it has a rounded 'D' shape or a more elongated 'canoe' shape. In addition, they found that the area occupied by an individual cell is essentially constant whatever its shape, limited by the cell's unstretchable membrane.

With this information to hand, the team derived a mathematical model, starting with the assumption that membrane tension limits cell shape, and incorporating the two main parameters that explain the shape. According to the model, where filament density is highest, actin grows at a rate that overcomes membrane tension, so protrusion occurs at the leading edge of the cell. At the other end, where filament density is low, the membrane tension causes collapse of the actin filaments, which draws in the rear.

Theriot embraces the applied mathematics involved in the work. "The whole reason for my existence is to make cell biology a more quantitative science," she says. Finding simple quantitative relationships between cellular components leads to much richer insight into mechanisms than studies that look only for the absence or presence of a trait, she adds.

And although understanding cell shape has important implications for work on processes such as wound healing, immune responses, development and cancer metastasis, Theriot's interest also stems from a more basic curiosity. She is intrigued that although eukaryotic and bacterial cells both contain the same basic components, only eukaryotes developed a range of wildly complicated shapes. ■

FROM THE BLOGOSPHERE

Massimo Pinto of Italy's Istituto Superiore di Sanità in Rome has discovered an unusual qualification for being a peer reviewer of research done at Italian institutions: paying your taxes. Since 2006, Italians have been allowed to donate 0.5% of their taxes to selected non-profit organizations. On his Nature Network blog, Science in the Bel Paese (http://tinyurl.com/3gxlr5), Pinto points out that individuals can elect to donate their contributions to specific research institutes.

The process could have the effect of bypassing the peer-review system for research projects, which, Pinto argues, could have dire effects on research in a country such as Italy, where science-funding levels are low. Some institutes have even taken to advertising for donations, but providing no details of the research the tax money will fund. "The particular advert that irritated me was a dialogue between two young citizens," writes Pinto. "One was asking whether the researchers in XYZ University were really going to deliver results, and the other one replied, reassuringly, that they were among the very best in Europe. Donating to them was a guarantee of success." ■

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