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News

Xavier Noblin wins *The Journal of Experimental Biology*'s Outstanding Paper Prize 2009

The Editors of *The Journal of Experimental Biology* are pleased to announce that Dr Xavier Noblin from the Centre National de la Recherche Scientifique (CNRS) in the Université de Nice-Sophia-Antipolis, France is the winner of this year's JEB Outstanding Paper Prize. 'The prize is awarded in recognition of an outstanding achievement and is intended to encourage young scientists,' says Hans Hoppleler, Editor-in-Chief of *The Journal of Experimental Biology*, and adds that 'we truly appreciate when authors submit their very best work to the JEB'. Explaining how the prize is awarded, Hoppeler says 'over the year, we note all the truly outstanding contributions, and the selection is then made by a vote of all of the Editors.'

Noblin was the first author on the paper 'Surface tension propulsion of fungal spores' (Noblin et al., 2009), and admits that he was 'very surprised but very happy and honoured' when he received the news. Reflecting on the qualities that made the paper stand out, Hoppeler says 'this paper gives a sound physical description of an exciting novel process and is an outstanding example of the type of paper that we like to see most at JEB, even though we are not a "botanical" journal.'

Xavier Noblin, winner of *The Journal of Experimental Biology*'s Outstanding Paper Prize 2009.

Noblin's route into biology has been rather unorthodox. Gaining a degree in Physics from the Ecole Normale Supérieure in Lyon in 1998, Noblin moved north to Paris, where he joined the Institut Curie to work on the physics of surface wetting. 'I was looking at the statics and dynamics of wetting phenomena,' explains Noblin, 'in particular, the vibration of droplets.' Noblin explains that the physics of droplet movement has intrigued physicists for decades, and that vibrations can move droplets that have stuck to surfaces.

While at the Institut Curie, Noblin mixed with biologists and at the end of his PhD, decided to apply his understanding of fluid mechanics to biological systems. Knowing that Jacques Dumais' lab at Harvard University was doing some interesting work in biomechanics, Noblin moved to Massachusetts to begin his postdoc.

Dumais remembers that the idea of looking at fungal spore ejection came from his technician Sylvia Yang who had an interest in mycology. 'She proposed the problem and Xavier had the right background,' remembers Dumais. When the team set out to solve the problem, they knew that a tiny droplet formed at the base of the spore and that the droplet's surface tension was sufficient to send the spore flying. But, the team did not believe the evidence that had already been collected about the mechanics of fungal spore ejection. 'It was difficult to accept that water would be enough to eject spores,' Dumais explains. 'And it was hard to come to terms with how the momentum is transferred,' he adds.

The team realised that they would have to find out what happened to the water droplet at the instant of take-off. Filming the spores with conventional high-speed cameras, the team realised that they would have to get their hands on the highest-speed camera available on the market. Borrowing an ultra-fast camera for one night and working around the clock, Noblin was finally able to capture the moment of ejection. 'It is that camera which gave us the best images. It gave us enough time resolution to really see the droplet and we got really excited. We thought it was amazing,' remembers Dumais. After enhancing the contrast of the low-resolution images, Dumais and Noblin could finally see the condensing droplet's fate as it touched the spore, fused to a depression on the spore's surface and then sent the spore tumbling off into the air at speeds of up to $2.3\,m\,s^{-1}$.

Next the duo had to measure the force required to rupture the contact between a spore and its sterigma (the spore's supporting structure), 'but it was not obvious that we could measure these forces because they are really small,' remembers Dumais. The duo used an old trick; they pulled a glass pipette to a very thin gauge and calibrated the amount that the pipette deflected as they pushed it against a precise balance so that they could use the pipette as a force gauge. 'We brought those pipettes to the tip of the spore and pulled on them, and if the spore came off the sterigma, we knew how much the pipette was bent and how much force was applied,' explains Dumais. Measuring the rupture force, the team found that a ripe spore required forces ranging from $0.08\,\mu N$ to $0.3\,\mu N$ to break the hilum (which attached the spore to the sterigma). But was there enough energy stored in the surface of the tiny droplet to rupture the hilium and send the spore flying?

Calculating the surface tension energy released as the droplet fused to the spore's surface, Noblin concluded that there was enough energy to despatch the spore at speeds of up to $3.4\,m\,s^{-1}$. There was enough energy in the droplet but how exactly is the energy converted from surface tension energy into ballistics?

This is where Noblin's physics know-how came in. Puzzling over the problem, Noblin realised that the physics of fungal spore ejection was essentially the same as the physics of jumping. He explains that as we crouch down at the beginning of a jump, the ground pushes back against us. But as we unfold our crouched legs, moments at the knees are resisted by the ground, and it is this upward-directed resistance force that gives us the push to lift-off. In the case of the fungal spore, the lift force is generated by the sterigma supporting the spore.

So fungi have evolved an elegant and inexpensive way to launch spores that is powered simply by the energy stored in the surface of a microscopic droplet of water. 'When I used to speak to colleagues and physicists, sometimes they did not believe me and they were really surprised and amazed that nature could invent this kind of mechanism,' says Noblin.

Describing the time that Noblin spent in his lab, Dumais says 'Xavier is a wonderful person to work with, he is very meticulous. Physicists come with a tool kit that is amazingly broad. They can do math, they can do experimental work, they can work with computers, they can program devices to do work for them. You can let them free, they hit the ground running.'

Noblin remembers that he was excited at the prospect of joining a biology lab. 'There is a need for people from different disciplines to work together to solve problems that mix these different sciences.' He suspects that his interdisciplinary training was a strength when the time came for him to apply for jobs at the end of his postdoc at Harvard University.

Dumais says 'We are delighted by this award and that the long-term investment has paid off'. Since leaving Dumais' lab in 2006, Noblin has taken a permanent research post at the CNRS in the LPMC lab at the Université de Nice-Sophia-Antipolis. Despite their locations being on opposite sides of the Atlantic the duo is currently enjoying figuring out how ferns eject their spores. 'It is a nice collaboration,' says Dumais.

Kathryn Knight

References

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