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### ***Fields Medals Awarded to 4 Mathematicians***

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Every four years, at an international gathering of mathematicians, the subject's youngest and brightest are honored with the Fields Medal, often described as the Nobel Prize of mathematics.

This year's recipients, announced on Wednesday at the International Congress of Mathematicians in Rio de Janeiro, include one of the youngest ever: Peter Scholze, a professor of mathematics at the University of Bonn who is 30 years old.

Two weeks ago, Peter Woit, a professor at Columbia University who blogs about mathematics and physics, was among those who anticipated that Dr. Scholze would receive the medal. Dr. Woit said Dr. Scholze was "by far the most talented arithmetic geometer of his generation."

By custom, Fields medals are bestowed to mathematicians 40 years old or younger. That means Dr. Scholze would have still been eligible for another two rounds of medals. The medal, first awarded in 1936, was conceived by John Charles Fields, a Canadian mathematician. The youngest winner, Jean-Pierre Serre in 1954, was 27.

The other Fields medalists this year are Caucher Birkar, 40, of the University of Cambridge in England; Alessio Figalli, 34, of the Swiss Federal Institute of Technology in Zurich; and Akshay Venkatesh, 36, of the Institute for Advanced Study in Princeton and Stanford University in California.

Four years ago, Maryam Mirzakhani of Stanford University became the first woman ever to receive a Fields Medal. (She died in 2017 of cancer.) All four medalists this year are men.

Dr. Scholze gained prominence when he was still in graduate school in 2010, simplifying a complicated book-length, 288-page proof to a novella-size 37-page version. In his mathematics, he works with fractal structures that he calls perfectoid spaces.

"I once heard a senior number theorist, who I will not name, say that Scholze had kind of ruined his to-do list for the next 20 years," said Jordan Ellenberg, a mathematician at the University of Wisconsin.

Dr. Birkar's field is algebraic geometry, which investigates connections between numbers and shapes. A set of solutions to a set of equations can be represented by a geometric space. He and his collaborators are looking at "minimal models," where the solutions can be replaced by a simpler set that captures the important qualities but are easier to understand.

What Do Ducks Hear? And Why Do We Care?

**By James Gorman**

It's not easy to help ducks. Ask Kate McGrew, a masters student in wildlife ecology at the University of Delaware.

Over two seasons, 2016 and 2017, she spent months raising and working with more than two dozen hatchlings from three different species, all to determine what they hear underwater.

This was no frivolous inquiry. Sea ducks, like the ones she trained, dive to catch their prey in oceans around the world and are often caught unintentionally in fish nets and killed.

Christopher Williams, a professor at the university who is Ms. McGrew's adviser, said one estimate puts the number of ducks killed at sea at 400,000 a year, although he said the numbers are hard to pin down

A similar problem plagues marine mammals, like whales, and acoustic devices have been developed to send out pings that warn them away from danger.

A similar tactic might work with diving ducks, but first, as Dr. Williams said, it would make sense to answer a question that science hasn't even asked about diving ducks: "What do they hear?"

"There actually is little to no research done on duck hearing in general," Ms. McGrew said, "and on the underwater aspect of it, there's even less."

That's the recipe for a perfect, although demanding research project. Her goal was to use three common species of sea ducks to study a good range of underwater hearing ability. But while you can lead a duck to water and it will paddle around naturally, teaching it to take a hearing test is another matter entirely.

The training involved many steps. First she had to teach the ducklings to associate a sound with a treat. Then she had to get them to peck a target when they heard that sound.

Eventually the ducks had to learn to respond to a light by diving and pecking one target, and then, if they heard a sound while they were underwater, to surface and peck another target.

The ducks varied in learning ability, both by species and individual duckling. Over two years only nine of 29 hatchlings made it to the final stages of the hearing test.

As for the differences in species, she said, "The long-tailed ducks are the smartest." But, she said, they also try to cheat. She said they "try and get the reward without doing the correct behavior."

Common eiders were too group-oriented to do any tests alone. "I was actually only able to train one individual," Ms. McGrew said, of 11 hatchlings. "But she ended up being probably my most reliable duck."

Surf scoters were not the smartest, she said, but once they learned the drill, they performed it reliably.

In the end, it turned out that the ducks heard well underwater in a range from one to three kilohertz. That is unfortunately close to the hearing range of fish, which can hear up to two kilohertz. And fishing operations don't want to warn the fish away.

Marine mammals hear at much higher frequencies, which makes commercial fishing operations more likely to use warning devices for them.

This research is just a first step, though, in setting up a basic understanding of duck hearing ranges, so the practical applications for creating warning pingers for ducks are still far in the future.

Ms. McGrew has another species that she trains, although not for experimental purposes. That work has suffered because of all the time in the lab, she said. “I joke that my ducks are better trained than my dog.”

## **Bell Burnell: Physics star gives away £2.3m prize**

By Pallab Ghosh Science correspondent, BBC News - 6 September 2018

One of the UK's leading female astronomers is to donate her £2.3m winnings from a major science prize she was awarded.

The sum will go to fund women, under-represented ethnic minority and refugee students to become physics researchers.

Prof Dame Jocelyn Bell Burnell has been awarded a Breakthrough Prize for the discovery of radio pulsars.

This was also the subject of the physics Nobel in 1974, but her male collaborators received the award.

The Breakthrough award also recognises her scientific leadership.

'An inspiration'

Prof Bell Burnell believes that under-represented groups - who will benefit from the donation - will bring new ideas to the field.

"I don't want or need the money myself and it seemed to me that this was perhaps the best use I could put to it," she told BBC News.

Prof Bell Burnell's story has been both an inspiration and motivation for many female scientists. As a research student when pulsars were discovered, she was not included in the Nobel prize citation - despite having been the first to observe and analyse the astronomical objects (a type of neutron star that emits a beam of radiation).

She now says she wants to use her prize money to counter what she describes as the "unconscious bias" that she believes still occurs in physics research jobs.

Fresh perspective

The former president of the Institute of Physics (IOP) believes that it was because she was from a minority group herself that she had the fresh ideas required to make her discovery as a young student at Cambridge University more than 50 years ago.

"I found pulsars because I was a minority person and feeling a bit overawed at Cambridge. I was both female but also from the north-west of the country and I think everybody else around me was southern English," she said.

"So I have this hunch that minority folk bring a fresh angle on things and that is often a very productive thing. In general, a lot of breakthroughs come from left field."

Professor Dame Julia Higgins, president of the Institute of Physics, said: "This is an excellent and hugely appropriate acknowledgement of Jocelyn's work. Her discovery of pulsars still stands as one of the most significant discoveries in physics and inspires scientists the world over.

"Her example of using insight and tenacity to make a discovery that rings through the ages stands her alongside the greatest of scientists.

"Alongside her scientific achievement, Jocelyn has become a hugely respected leader in the scientific community. She has been instrumental in making sure the issue of access to science by people from under-represented groups is at the very top of the science community's agenda."

The fine detail of the scholarship have yet to be decided. In addition to women and under-represented ethnic minorities, refugee applicants will also be eligible for a slice of the funding.

She said of these groups: "Those are the people that tend to be discriminated against through unconscious bias so I think that's maybe one of the reasons why there aren't so many. And so if they come with some funding with them then they look much more attractive".

#### Age profile

Prof Bell Burnell has been diplomatic when asked about the Nobel Prize controversy. But she hopes that her scheme will play a part in changing the current disparity.

"There certainly has been a notable lack of women Nobel Prize winners, except maybe in areas like literature where you know there are women," she said.

"I think in part that's to do with the age profile of the women that there are in the subject at the moment. Nobel Prizes rarely go to young people; they more often go to established people and it's at that level that there are fewer women in physics."

And her message to those thinking of applying for her scholarship?

"I'd say go for it if you're at all interested. I think physics is immense fun... and if you don't want to continue in it forever you're very well equipped to do all sorts of things afterwards," she explained