"The first chirp from a planet through LOFAR is going to be like man walking on the moon - it is going to be an amazing moment."

Will Goodbody meets trinity astrophysicist Peter Gallagher, who talks about solar explosions, Ireland's most ambitious telescope and his dream of one day venturing into space.

Originally published in Trinity Today, a publication for Trinity alumni and friends, Autumn 2017

He's a man with a sunny disposition.

Inevitably perhaps for a scientist who has spent most of his working life studying the Sun. But Professor Peter Gallagher has plenty of reasons to be cheerful too. This year he was appointed a senior advisor at the European Space Agency (ESA) and awarded France's Chevalier des Palmes Acaderniques, one of the highest accolades the country bestows on academics and researchers. His plan to build a radio observatory in the midlands is rapidly becoming a reality. And he travelled to Wyoming in August to help NASA get the best images of the solar eclipse from one of its jets flying at 50,000 feet. Not bad for a lad from Clontarf, whose interest in science and engineering began in the garage.

His father, a service engineer, was always taking mechanical devices apart. By the age of l0, Peter knew how to disassemble and reassemble them too. His yearning for discovery was also satisfied by a homemade chemistry laboratory. "I used to take oil and all the stuff from my Dad's garage and bring them to my bedroom," he says with a wistful smile. "There were several explosions in my bedroom when I was about 11 or 12 and there were marks on the ceiling, and I remember glass in my hands."

While experimenting came naturally, school didn't. Maths and science were difficult. English almost impossible. Concentration was a struggle too. But the more he worked at it, the more the challenge of science appealed to his teen mind. And although the lure of gigs with his heavy metal band, Indestroy, proved a distraction, his grades began to slowly improve. The Leaving Cert quickly came round and while engineering and architecture were considered, he ended up studying science in University College Dublin (UCD).

The plan was to pursue chemistry, but the end of first year proved a turning point. "I did well in my exams and my parents bought me A Brief History of Time by Stephen Hawking as my reward and I loved it," he says. "I read it that summer and I became obsessed with astronomy - it was transformative for me."

After graduating, a Masters in Optoelectronics in Queen's University Belfast beckoned. A stint analysing images on a telescope in the Canary Islands solidified what he was feeling. "I was looking at the images and asking 'but how does a galaxy work, how do stars work'?

And I began thinking, I have to spend my life looking at the stars." Winning a fully-funded Ph.D. scholarship to work with NASA in the US catapulted Peter headfirst towards this aim and specifically a future in solar physics. There he worked on a satellite called the Solar and Heliospheric Observatory or SOHO - one of the "coolest missions" he had ever seen. As he became increasingly focused, an offer of a job came from the Department of Applied Maths and Theoretical Physics in Cambridge, where Professor Stephen Hawking was based.

His father likened it to being asked to play for Manchester United. But Peter had other ideas, turning it down for a position in the US in solar radio astronomy, a subject he knew nothing about. "I think there were tears shed over turning down Cambridge and Stephen Hawking's department, but it was the right decision," he said. "I always advise the students here to take the path that has the most interesting science, even if it isn't at the most prestigious university."

It was a decision that would change the trajectory of his career. He worked in California for three years at Big Bear Solar Observatory and a further three years at NASA Goddard Space light Center came next.

"It was a magical time," he remembers. "You are controlling the instruments, you are with the best people in the world. The guy in the corridor downstairs, I remember being at lunch with him and someone nudging me afterwards and saying, 'he might win the Nobel Prize'. He did - he won the Nobel Prize three years later."

But Ireland's call came and when his wife, Professor Emma Teeling, was offered a permanent job in UCD, they made the difficult but ultimately correct decision to return. Today his research and that of this team of fifteen at Trinity centres on the area of solar activity - enormous unexplained explosions known as flares and storms, focused around sunspots. "It is like looking at the clouds and saying is that cloud going to rain?" he explains. "We look at sunspots and try to figure out are they going to produce an explosion." Understanding when flares are happening is really important as the explosions can damage GPS, telecoms infrastructure and power networks.

His hope is that the new solar observatory in Birr, Co Offaly, will help. It has its genesis in 2009 when, during a walk in the grounds of Birr Castle, its owner Lord Rosse suggested Peter erect some small radio antennas there. The sheep sheds in the farmyard were transformed into a control room. One of Professor Gallagher's biggest discoveries subsequently followed, when he and colleagues found a connection between data on solar explosions recorded by NASA spacecraft and radio bursts they were picking up in Birr. "We were able to put the two of them together to tell us about the way these solar storms generate radiation," he says.

"And nobody knew that before so we had a big discovery only because we had these cheap low cost radio things in Birr. That ended up on the front page of Nature Physics."

But the Trinity Professor had even bigger ambitions. A European consortium was building a €150 million radio telescope network comprised of 50 individual stations called the Low Frequency Array (LOFAR). Professor Gallagher calculated that for €2 million, a station could be built here in Ireland, extending the LOFAR network across Europe to 2000krn. Birr seemed the perfect location because there was little radio signal interference. There was also

the historical connection as the castle is home to the great nineteenth century Leviathan telescope.

Fundraising began, but quickly stalled due to the economic climate. But the sun was to eventually shine on the project. Joe Hogan, founder of telecoms software firm OpenNet, introduced Peter to financier Dermot Desmond. He liked the idea that it might help develop engineering and computer science graduates, so the billionaire offered €50,000 of seed funding. Mr Desmond also made an introduction to businessman Denis O'Brien, who donated a similar amount.

But it was also a community effort. Children in Birr collected money and there was assistance from other local groups. "The wider community in Birr also went with the project and saw it as a way of bringing education, science and the universities into Offaly," he recalls.

That helped the case for state investment and in 2016 Science Foundation Ireland offered the balance of € 1.3 million. I- LOFAR was to become a reality. The first trucks arrived on 28 April and over the summer of 2017 up to 20 student interns spent 10 weeks constructing the telescope which measures the size of a football field. The data will flow via a dedicated open eir sponsored fibre optic link to a Dutch supercomputer which combines data from the 50 other stations.

While Professor Gallagher's research group will use that information to probe the causes of solar flares, others will look for extra solar planets or exoplanets. "LOFAR being a huge telescope is going to find exoplanets with large magnetic fields, and exoplanets with large magnetic fields are the best ones to live on," he says. "It will also search for extraterrestrial intelligence, for signals that we don't expect. The first chirp from a planet is going to be like man walking on the moon - it is going to be an amazing moment."

They might even "find little green men from Offaly," Professor Gallagher quips!

As if all that weren't enough, Professor Gallagher is enthusiastic about his new role advising the Director of Science at ESA. This will involve taking a 10-year forward-looking view at ESA science missions and making calls about where to invest a large chunk of a €5 billion budget.

Professor Gallagher is also directly involved with the €700 million Solar Orbiter mission. It's due to launch in February 2019 and will fly inside the orbit of Mercury very close to the Sun to acquire high resolution pictures of the star and measure solar wind.

On board will be STIX, an instrument providing imaging spectroscopy of solar thermal and non-thermal X-ray emissions. Professor Gallagher's team are the experts on data analysis and software for the STIX.

Asked whether one day he would like to go into space himself, the solar physicist doesn't hesitate. "I'd absolutely love to," he says, with yearning in his voice. He also doesn't pause when asked whether he thinks there's life elsewhere in the universe. "It could be simple or complex, but there are 100 billion stars in the galaxy and 100 billion galaxies which means there must be many stars like our own," he says.

And what would he do if he had €10 million to spend on any project? Perhaps not surprisingly Professor Gallagher says he would like to build the first Irish satellite. A predictably high altitude ambition from an Irish solar physicist, whose star is rapidly on the rise.

ABOUTTHEAUTHOR

Will Goodbody BA, (1999), Science and Technology Correspondent at RTE.