Northumbria University NEWCASTLE

From l-r: Dr Bethan Ford, Sophia Long, Dr Juna Sathian

Jul 09, 2025 12:22 BST

Major breakthrough in Maser research for Northumbria scientists

Scientists at Northumbria University have made a breakthrough in developing a new type of 'microwave amplification by stimulated emission of radiation' device, known as a maser.

With the ability to detect and amplify extremely weak electromagnetic signals without adding additional noise, masers have many potential uses, including the production of more sensitive magnetic resonance body scanners, such as those used in airports.

Despite being first discovered in the 1950s, there has been little development of the technology since then due to the complex and expensive conditions required to make them – with masers only able to be produced in very cold conditions, while also within a vacuum, and a high magnetic field.

Northumbria's Dr Juna Sathian is one of the UK's leading experts in maser technology and has previously worked with colleagues at Imperial College London and University College London to develop a room-temperature maser which works using laser light. However, this method is expensive and difficult to replicate in everyday applications.

Two years ago, she was awarded a New Investigator Award from the government's Engineering & Physical Sciences Research Council (EPSRC) to develop a new type of maser using LED-pumping.

Through this grant, Dr Sathian has led an all-women team of researchers to explore the use of LEDs to create an affordable, energy efficient alternative, which could be used in quantum technologies, deep-space communications, and portable sensing devices.

An academic paper detailing their breakthrough, entitled LED-pumped room-temperature solid-state maser, has now been published in Communications Engineering, part of the prestigious *Nature* portfolio.

Carrying out the research alongside Dr Sathian is Dr Bethan Ford – a Senior Technician within Northumbria's Faculty of Energy and Environment, and the first researcher to join the project at Northumbria. Her foundational postdoctoral work was critical to establishing the maser platform.

Final-year PhD student Sophia Long is the first author of the paper, with her meticulous and sustained experimental efforts integral to achieving the LED-pumped maser's successful operation.

Dr Sathian is committed to encouraging more young people, especially young women, into STEM subjects, and is a committee member of the Institute of Physics' Women in Physics Group, as well as Head of Physics at Northumbria.

Speaking about the research, she said: "This pioneering work represents a significant advancement towards affordable, energy-efficient maser

technology and highlights the exceptional contributions of our team of women scientists leading this research.

“By replacing complex laser systems with low-cost LEDs, we have opened the door to practical masers that can operate at room temperature, unlocking exciting potential in quantum technologies, secure communications, deep-space exploration, and portable sensing.

“Realising this breakthrough required persistence, creativity, and precision across many disciplines, from materials design to photonic engineering, and I’m incredibly proud of the collaborative spirit and scientific rigour our team has shown. Having the right people, with the right mix of skills and a shared vision, was absolutely critical to achieving what has eluded the field for decades.

“This is just the beginning. The future of maser research lies in developing compact, scalable systems that can be integrated into next-generation quantum and photonic platforms. We are now working to extend this technology into new materials, broader frequency ranges, and real-world applications, bringing masers from lab curiosity to everyday utility.”

The Northumbria research team worked in close partnership with leading international collaborators, including Dr Lisa Lopez and Professor François Balembois, of the Institut d’Optique Graduate School, Université Paris-Saclay, France; Dr Riccardo Montis, of the University of Urbino, Italy; Dr Daan Arroo, Dr Wern Ng and Professor Neil Alford, of Imperial College London; and Northumbria’s Dr Hamdi Torun.

Professor Alford said: “I’m delighted to see this work published – it’s the result of a really productive collaboration between Imperial and Northumbria and I look forward to the next challenge for the team.”

Professor Balembois added: “LED-pumped luminescent concentrators promise a bright future as new sources combining power and brightness. We are proud to contribute to the emergence of LED-pumped MASER.”

Find out more about the EPSRC-funded research project being carried out by Dr Sathian, Sophia Long and Bethan Ford.

Read the research paper in full here.

Find out more about studying Physics at Northumbria University.

FURTHER INFORMATION:

Visit the Northumbria University Research Portal to find out more about Dr Juna Sathian's work.

The paper *LED-pumped room-temperature solid-state maser*was published in *Communications Engineering* on 9 July 2025.

DOI: https://doi.org/10.1038/s44172-025-00455-w

UNIVERSITY OF THE YEAR 2022 (Times Higher Education Awards)

Northumbria is a research-intensive university that unlocks potential for all, changing lives regionally, nationally and internationally.

Two thirds of Northumbria's undergraduate students come from the North East region and go into employment in the region when they graduate, demonstrating Northumbria's significant contribution to social mobility and levelling up in the North East of England.

Find out more about us at www.northumbria.ac.uk

--- Please contact media.communications@northumbria.ac.uk with any media enquiries or interview requests ---

Contacts

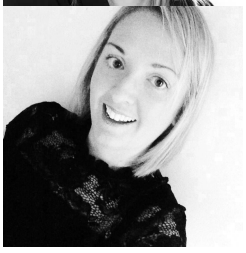
Rik Kendall
Press Contact
PR and Media Manager
Business and Law / Arts, Design & Social Sciences
rik.kendall@northumbria.ac.uk
07923 382339

Andrea Slowey
Press Contact
PR and Media Manager
Engineering and Environment / Health and Life Sciences
andrea.slowey@northumbria.ac.uk
07708 509436

Rachael Barwick
Press Contact
PR and Media Manager
rachael.barwick@northumbria.ac.uk
07377422415

James Fox
Press Contact
Student Communications Manager
james2.fox@northumbria.ac.uk

Kelly Elliott
Press Contact
PR and Media Officer
kelly2.elliott@northumbria.ac.uk



Gemma Brown
Press Contact
PR and Media Officer
gemma6.brown@northumbria.ac.uk