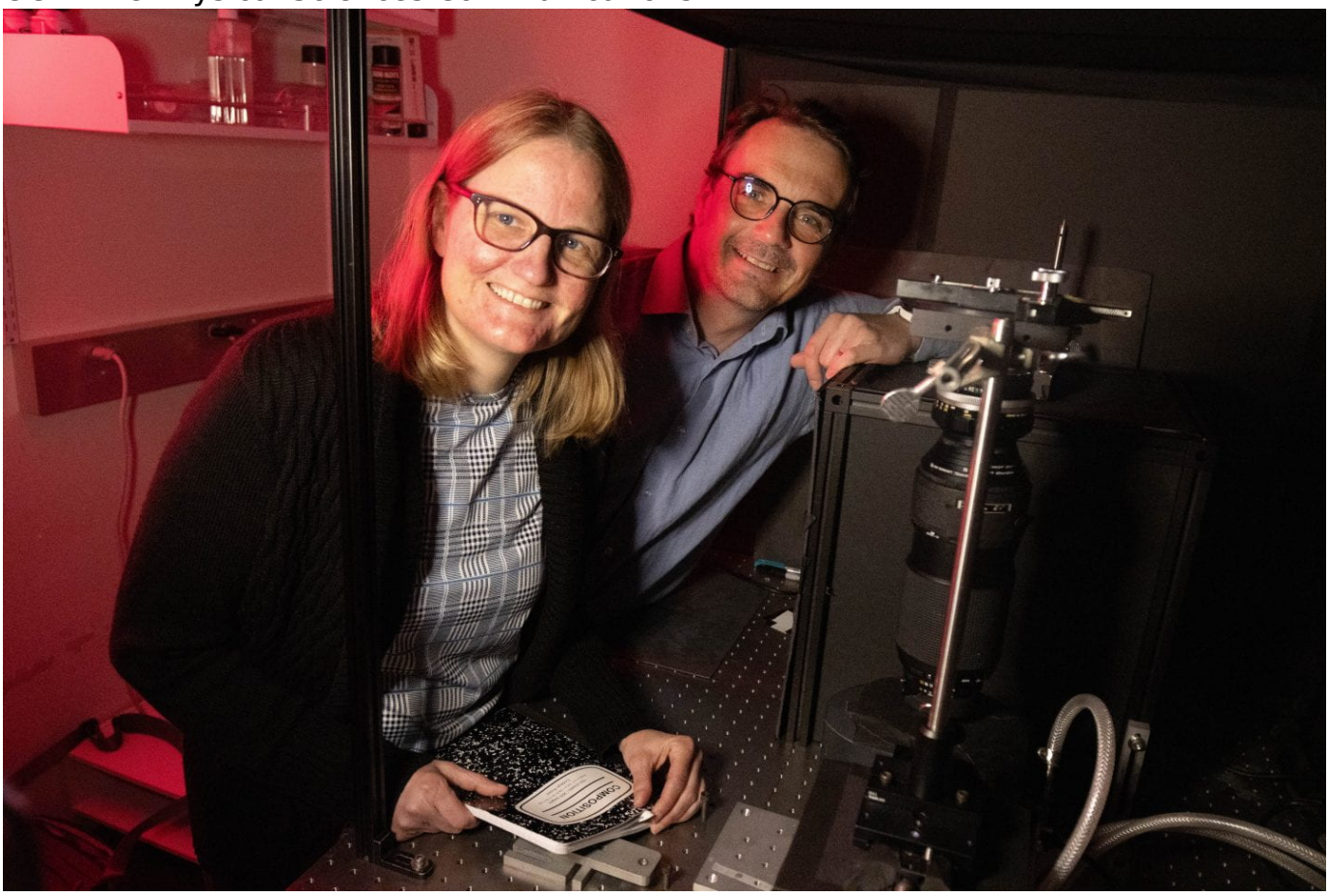
UC Irvine scientists design bioluminescent RNA

The “RNA lanterns” promise to reveal sec.rets of viruses and human memory.
Thursday, January 09, 2025
Lucas Van Wyk Joel
UC Irvine Physical Sciences Communications



Jennifer Prescher (left) and Andrej Lupták collaborated on developing a new technique for attaching bioluminescent molecules to RNA which enables it to be tracked in real time as it moves throughout the body. The breakthrough promises to be beneficial in a wide range of health applications such as detecting viruses to mapping memories in the brain.

Picture Credit:
Lucas Van Wyk Joel / UC Irvine

Irvine, Calif., Jan. 9, 2025 — RNA is the molecule that reads the genetic information stored in DNA. It's critical for the proper functioning of cells, and in a new study published in *Nature Communications*, University of California, Irvine scientists have discovered a way of tagging RNA with a glowing bioluminescent molecule that allows them to track RNA in real time as it moves throughout the body. The work promises to help scientists better understand everything from the way viruses propagate to how memories form in the brain.

"The first step in saying something's going to happen in a cell – the cell is going to grow, adapt, change or anything like that – underlying all of that is RNA," said Andrej Lupták, a professor of pharmaceutical sciences at UC Irvine and one of the lead corresponding authors of the study.

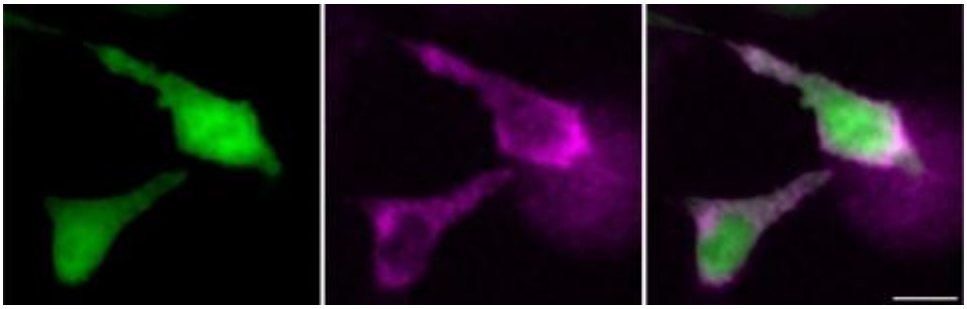
Until now, little was known about how and when RNA does what it does inside cells. "It turns out it's been really quite difficult to know in living cells, and especially in living organisms, when RNA is turned on and where it goes," said Lupták. "If you wanted to study the first 30 seconds or the first minute – nobody knows. But we provide a tool. You can now visualize it."

Viruses propagate throughout the body by infecting cells with their RNA, and if scientists can tag that viral RNA with the team's so-called "RNA lanterns," they can better understand the way a virus infiltrates the body's defenses.

The tag could also allow for real-time imaging of living brains with cells carrying bioluminescent RNA. RNA, explained co-lead corresponding author and UC Irvine professor of chemistry Jennifer Prescher, appears to play a key role in the formation of memories in the brain.

"There's a lot of interesting biology that's happening at the RNA level in neurons," said Prescher. "And being able to see early events and the transport of RNA from the cell body out to neural synapses where connections are being made to other neurons – that directly correlates with memory formation. If you have a way to watch that in real-time, that could tell you something fundamental about the brain and memory, which has been a holy grail in science for a long time."

Image



Two human cells making RNA made visible by the bioluminescent lantern in pink (middle image). On the left, the same cells making a fluorescent protein that's distributed evenly throughout the two cells. The right image is an overlay of the two, emphasizing that the RNA is distributed unevenly and is concentrated at specific locations. Bar on the lower right is 20 microns (1 micron is 1 millionth of a meter). *UC Irvine*

To tag the RNA, the team used luciferase, the same enzyme that enables insects like fireflies and glow-worms to shine the way they do. Before, scientists were unable to produce the results reported by the UC Irvine team because researchers couldn't find a way to make the luciferase molecules glow brightly enough for available camera technology to detect them.

Both Prescher and Lupták credit the cross-disciplinary, collaborative research culture at UC Irvine for helping make the research possible. "We had an absolute dream team of students that were involved in this," Prescher said, referring to fellow study authors like Lila Halbers and Kevin Ng of the Department of Pharmaceutical Sciences and Kyle Cole of the Department of Molecular Biology and Biochemistry, as well as the third collaborator, Oswald Steward, the Reeve-Irvine Professor of anatomy & neurobiology and neurobiology & behavior.

The study was supported by a grant from the W. M. Keck Foundation awarded to Lupták, Prescher and Steward.

UC Irvine's Brilliant Future campaign: Publicly launched on Oct. 4, 2019, the Brilliant Future campaign aims to raise awareness and support for the university. By engaging 75,000 alumni and garnering $2 billion in philanthropic investment, UC Irvine seeks to reach new heights of excellence in student success, health and wellness, research and more. The School of Physical Sciences plays a vital role in the campaign's success. Learn more at https://brilliantfuture.uci.edu/uci-school-of-physical-sciences/.

About the University of California, Irvine: Founded in 1965, UC Irvine is a member of the prestigious Association of American Universities and is ranked among the nation's top 10 public universities by *U.S. News & World Report*. The campus has produced five Nobel laureates and is known for its academic achievement, premier research, innovation and anteater mascot. Led by Chancellor Howard Gillman, UC Irvine has more than 36,000 students and offers 224 degree programs. It's located in one of the world's safest and most economically vibrant communities and is Orange County's second-largest employer, contributing $7 billion annually to the local economy and $8 billion statewide. For more on UC Irvine, visit www.uci.edu.

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