

Controlling matter with ultrafast light: Dr. Igor Tyulnev wins a 2026 Pioneer Award

Tyulnev's ICFO PhD thesis, which uses tailored laser pulses to switch the behavior of electrons inside materials, has won the CERCA award for its market potential.

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Imagine changing how a material behaves with a flash of light lasting less than a trillionth of a second. That is the idea at the heart of Dr. Igor Tyulnev's PhD thesis, which has recently earned him a 2026 Pioneer Award from the CERCA Institution.

The CERCA awards recognize recently defended doctoral theses from member centers with the greatest potential to reach the market and have an impact on society. Tyulnev carried out his doctoral studies in the Attoscience and Ultrafast Optics group at ICFO, supervised by ICREA Prof. Dr. Jens Biegert, and defended his thesis, "Investigation and Control of Phase Transitions by Ultrafast Strong-field Techniques", in February 2026.

His doctoral research focused on the idea that in many materials, electrons can sit in one of

two energy "valleys", a property that could one day be used like the 0 and 1 of a bit. Tyulnev and his colleagues showed that a specially shaped laser pulse, whose electric field traces a three-leaf pattern, can push electrons into one valley or the other. Rotating the pulse by just 60 degrees flips the choice. Until then, this kind of control was thought to require layers that were only one atom thick; but the team achieved it in ordinary bulk molybdenum disulfide (MoS2). This significant result which has been coined i¿½Valleytronicsi¿½ was published in Nature in 2024.

This result is relevant because light is capable of this choice flipping at optical speeds, much faster than today's electronics switch, and thus, the approach points towards ultrafast, energy-efficient ways of storing and processing information, including quantum information. It also offers new optical tools to characterize materials. As the CERCA Institution has stated, Tyulnev's work brings the quantum control of matter with ultrafast lasers closer to the next generation of optical technologies.

The award ceremony took place on Thursday, October 8th. This year's call drew 21 applications from 10 CERCA centres, and six of these were recognized and selected as finalists. Tyulnev's was the only winning project in quantum technologies, in an edition that was otherwise dominated by health applications, from graphene-based brain and retinal implants to new approaches to breast cancer, liver thrombosis and colorectal cancer metastasis. A jury of experts from FCRI, Mobile World Capital Barcelona, the Department of Research and Universities and Biocat assessed both the scientific excellence of each thesis and its potential for social and economic impact.

Congratulations Igor!

