

Stephan von Molnár

Stephan von Molnár, a Distinguished Research Professor Emeritus at Florida State University (FSU) and a trailblazer in the fields of magnetic semiconductors and spintronics, died on 17 November 2020 in Tallahassee, Florida. Stephan was a professor of physics at FSU from 1994 until his retirement in 2013 and was director of its interdisciplinary Center for Materials Research and Technology between 1994 and 2007.

Born on 26 June 1935 in Leipzig, Germany, Stephan spent much of his childhood taking shelter in the southern German countryside during World War II. In 1947 he immigrated to the US to be reunited with his mother, who was Jewish and had left Germany in 1938. At Stuyvesant High School in New York City and later at Phillips Academy in Andover, Massachusetts, Stephan developed an interest in theater acting and science. After getting his BS in physics from Trinity College in 1957 and his MS in physics from the University of Maine in 1959, he did a brief stint with DuPont's polymer division.

In 1960 Stephan decided on physics as his lifelong pursuit and entered the graduate program at the University of Chicago. A year later he moved with his adviser, Andy Lawson, to the University of California, Riverside. His dissertation focused on magnetic resonance study of the magnetic anisotropy in europium sulfide, an ideal Heisenberg ferromagnet and a model material of concentrated magnetic semiconductors.

After receiving his PhD in 1965, Stephan joined the research staff at the IBM Thomas J. Watson Research Center; he was manager of the cooperative phenomena group there in 1970–89 and senior manager of the novel structure physics group from 1989 until he left in 1993. When Stephan started at Watson, Frederic Holtzberg was leading the synthesis and magnetic studies of the europium chalcogenides EuX and their derivatives. Starting with those substances, Stephan began more than five decades of highly influential and far-reaching research into the magnetotransport properties of magnetic semiconductors. In many ways, his studies helped launch the field and were a harbinger of the field's remarkable progress into mainstream materials science and

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condensed-matter physics. The research also presaged the emergence of the field of spintronics.

In 1967 Stephan, Leo Esaki, and Phillip Stiles made heterojunctions of metal-EuX-metal. In a clever move, they exploited the spin-splitting of the Schottky barrier height as the magnetic semiconductor entered the ferromagnetic state, and they observed greatly enhanced field emission current. That constituted a direct experimental demonstration of spin-filtered tunneling and control of the charge current through the semiconductor's magnetic state. Their work was broadly recognized as the first conceptual presentation of a semiconductor spintronic device.

That same year Stephan and his colleagues observed that a moderate magnetic field could reduce the resistance of gadolinium-doped europium selenide by orders of magnitude near the Curie temperature. He conceived the term "giant negative magnetoresistance" to describe the enormous resistance changes. Inspired by those magnetoresistance experiments, Stephan and Tadao Kasuya proposed the idea of the bound magnetic polaron. It offers a natural and physically appealing account of the giant magnetoresistance and associated magnetic and electronic phase transitions in those and many other material systems. In 1987 at IBM, Stephan and one of us (Awschalom) observed the magnetic polaron in diluted magnetic semiconductors by using novel time-resolved optical and magnetic measurements. Stephan be-

came increasingly convinced that magnetic polarons could be found in numerous magnetic materials and could be a microscopic force behind electronic phase separation and associated percolative phase transitions.

Two years later Stephan, Hiro Mune-kata, another of us (Ohno), and colleagues at IBM set out to synthesize III–V magnetic semiconductors, and they identified ferromagnetism in phase-pure indium manganese arsenide. Ohno's group followed that work by synthesizing gallium manganese arsenide with high Curie temperatures. Those breakthroughs set off worldwide research efforts on the III–V materials, which quickly became a model material system for spintronics physics and device research.

Stephan moved in 1994 to FSU, where he embraced the intellectual freedom offered by academia and took great pleasure in mentoring graduate students and postdocs. While continuing his long-standing endeavors in nanomagnetism and spintronics, he quickly ventured beyond the physics department and initiated collaborations with colleagues in biology, chemistry, and engineering. He also turned his curiosity to bionanotechnology, particularly the use of solid-state devices for biomolecular activation and sensing.

Throughout his career, Stephan steadfastly believed in, promoted, and personified open scientific exchange and collaboration across disciplinary and national boundaries. His mentees and collaborators dotted numerous countries across several continents. Stephan's passion went far beyond his science. His interests ranged from music and theater to sports; he was not only a fan but also a skilled squash player. Stephan was a warm, gracious, and greathearted colleague who made a lasting impression on numerous researchers, especially those he mentored. His wise counsel, frank critiques, timely encouragement, and unwavering support early in their careers are fondly remembered by many.

David Awschalom
University of Chicago

Chicago, Illinois

Hideo Ohno

Tohoku University

Sendai, Japan

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