

# The 11<sup>th</sup> Dvořák Lecture

by Professor **Ramamoorthy Ramesh**

Department of Physics and Department of Materials Science and Engineering, University of California, Berkeley, USA

## Electric Field Control of Magnetism: From Global Markets to Spin Orbit Coupling

Friday, June 21, 2019 at 14:00

Institute of Physics of the Czech Academy of Sciences, Na Slovance 2, 182 21 Praha 8, Czech Republic

*The lecture and the discussion will be in English only, the translation to Czech will not be provided.*

*The admission to the lecture is free, however it is necessary to reserve a seat using the registration form at: [rezervace.fzu.cz](http://rezervace.fzu.cz)*

### Annotation

The emergence of the “Internet of Things” and the explosion of Artificial Intelligence/Machine Learning applications are likely to push up significantly the market for microelectronics. The related energy consumption could increase by 20–25%. Thus, looking for a new generation of ultralow power memories and switches is an area of significant current research. Perovskite oxides exhibit a rich spectrum of functional responses, including magnetism, ferroelectricity, highly correlated electron behavior, superconductivity, etc. Over the past decade the oxide community has been exploring the science of such materials in the form of crystals, thin films epitaxial heterostructures and nanostructures with an eye towards low-

energy applications. There exists a small subset of materials – known as multiferroics – which exhibit multiple order parameters at a time. Particularly, the coexistence of ferroelectricity and some form of ordered magnetism (typically antiferromagnetism) has been of major interest due to the evidence that an electric field can control both antiferromagnetism and ferromagnetism at room temperature. Current work in my group is focused on ultralow energy (1 attoJoule/operation) electric field manipulation of magnetism as the backbone for the next generation of ultralow power electronics. In this talk, I will describe our progress to date on this exciting possibility and outline the directions of the future research.



### Ramamoorthy Ramesh

Professor Ramesh graduated from the University of California, Berkeley in 1987. After several outstanding appointments (APS David Adler Lectureship and Distinguished University Professor at University of Maryland, Bellcore Corporate Awards, Founding Director of the SunShot Initiative at the U.S. Department of Energy, just to name a few), he returned to Berkeley and is currently the Purnendu Chatterjee Chair Professor in Materials Science and Physics. He has opened new research avenues in ferroelectric nonvolatile memories, colossal magnetoresistive (CMR) oxides and multiferroic oxides, for example, his group in Berkeley demonstrated the large ferroelectric polarization in multiferroic BiFeO<sub>3</sub> films and the electric field control of antiferromagnetism and ferromagnetism. His publications are highly cited (over 65,000 citations, H-factor=110). He is a fellow of APS, AAAS & MRS, holder of the Humboldt Senior Scientist Prize, the James McGroddy Prize, the TMS Bardeen Prize, the 2018 IUPAP Magnetism Prize, and the Néel Medal. In 2011, Professor Ramesh was elected to the National Academy of Engineering.



### Vladimír Dvořák

(1934–2007)

Vladimír Dvořák was a solid state physicist and the most prominent Czech scientist in the theory of ferroelectricity and structural phase transitions. He was affiliated with the Institute of Physics of the Czech Academy of Sciences in Prague for the whole productive life. He served as its director in 1993–2001 and was the main protagonist of the revolutionary reforms of the Institute after 1989. He was a member of the Learned Society of the Czech

Republic since 1995. His personality has strongly influenced the scientific program and development in the Department of Dielectrics of the Institute since the late sixties up to the present. He was a brilliant lecturer and is considered as one of the most respected directors of the Institute.

To commemorate his work and personality, the Institute Physics of the Czech Academy of Sciences decided to organize an annual festive Dvořák lecture, given by prominent internationally renowned scientists in the field related to the research pursued at the Institute..



**FZU**

Institute of Physics  
of the Czech  
Academy of Sciences