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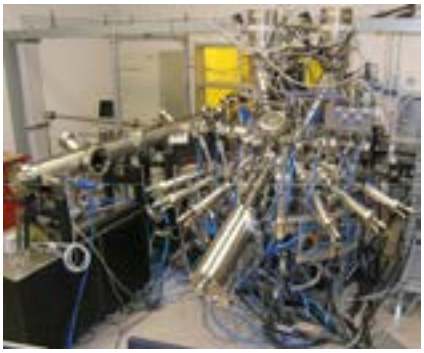
On the road to room-temperature superconductivity?

Superconductivity in cuprates has many mysterious facets, but the most important question is why the critical temperature (T_c) is so high. Our experiments target this question. We use atomic-layer-by-layer molecular beam epitaxy to synthesize atomically perfect thin films and multilayers of cuprates and other complex oxides. By atomic-layer engineering, we optimize the samples for a particular experiment.



I will present the results of a focused and comprehensive study that took twelve years and over two thousand cuprate samples, perhaps without precedence in Condensed Matter Physics. We have measured the key physical parameters of the normal and superconducting states and established their precise dependence on doping, temperature, and external fields. This large data basis contains a wealth of information and constraints tightly the theory. One striking conclusion is that superconducting state cannot be described by the standard Bardeen-Cooper-Schrieffer theory, anywhere in the phase diagram. Next, the rotational symmetry of the electron fluid in the normal metallic state above T_c is always spontaneously broken-the so-called "electronic nematicity"-unlike in standard metals that behave like Fermi Liquids. Finally, the insulating state on the underdoped side is also unusual, with mobile charge clusters formed by localized pairs. All these features are quite exceptional, paint a new picture of high-T_c superconductivity in cuprates, and point to a new direction in search of new high-T_c superconductors.

Biography

Ivan Bozovic received his PhD in Solid State Physics from Belgrade University, Yugoslavia, where he was later elected a professor and the Physics Department Head. After moving to the USA in 1985 he worked at Stanford University, the Varian Research Center, and 1999-2002 in Oxxel, Bremen, Germany. Since 2003, he is the MBE Group Leader at Brookhaven National Laboratory, and since 2014 also an Adjunct Professor of Applied Physics at Yale University. He is a Member of European Academy of Sciences, Foreign Member of the Serbian Academy of Science and Arts, Fellow of APS, and Fellow of SPIE. He received the Bernd Matthias Prize for Superconducting Materials, SPIE Technology Award, the M. Jaric Prize, the BNL Science, and Technology Prize, was Max Planck and Van der Waals Lecturer and is a Gordon and Betty Moore Foundation PI. His research interests include basic physics of condensed states of matter, novel electronic phenomena including unconventional superconductivity, innovative methods of thin film synthesis and characterization, and nanoscale physics. He has published 11 research monographs and over 280 research papers, including 25 in Science and Nature journals.

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