University of Crete
Department of Physics

Physics Colloquium

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Quantum oscillations in solids: past, present and future

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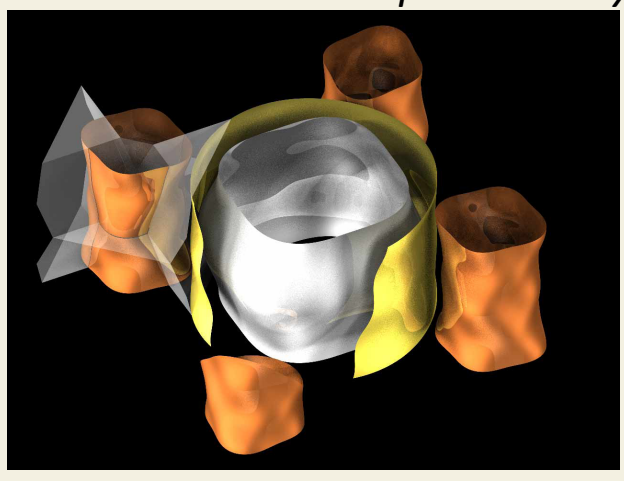
ABSTRACT

The de Haas – van Alphen effect is one of the most profound and pronounced manifestations of quantum mechanics in solids. Discovered in Leiden fully ninety years ago as a signal in the magnetic torque of bismuth, the effect is now observed in a huge range of physical properties, and often given the general name of 'quantum oscillations'. The quest from discovery to full understanding required seminal contributions from some of the most celebrated names of twentieth century physics, such as Landau, Onsager and Lifshitz. The true hero of the technique, perhaps less well known than the above friends and colleagues with whom he collaborated, was the Cambridge-based Russian experimental physicist David Shoenberg. I had the privilege of knowing David for the last ten years of his life, and of learning about quantum oscillations from him and from his protégé Gil Lonzarich. In this talk I will review the historical development of the field, and try to show how important it has been, as a driver for the development of low temperature-low noise experimental techniques, for the growth of high purity single crystals, and for the introduction of key concepts in the theory of solids. I will close by stressing that the party is far from over. New physics associated with the de Haas – van Alphen effect still at the forefront of condensed matter science to this day, and there is an ongoing search for even more exotic relatives that are predicted to exist in certain special many-body systems.



*The de Haas-van Alphen derived Fermi surface of the unconventional superconductor Sr_2RuO_4 [Bergemann et al., Adv. Phys. **52**, 639 (2003)].*