北京大学量子材料科学中心
International Center for Quantum Materials, PKU

Weekly Seminar

Discovery of high-T_c superconductivity in a nickelate under pressure

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Time: 3:00 pm, Sept. 20, 2023 (Wednesday)

时间：2023年9月20日 （周三）下午3:00

Venue: Room w563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

摘要

High-transition-temperature (high-T_c) superconductivity in cuprates has been discovered for more than three decades, but the underlying mechanism remains a mystery. Cuprates are the only unconventional superconducting family that host bulk superconductivity with T_cs above the liquid nitrogen boiling temperature at 77 Kelvin. We found superconductivity in single crystals of $La_3Ni_2O_7$ grown by the high-pressure floating zone method with a maximum T_c of 80 K at pressures between 14.0-43.5 gigapascals [1,2]. Our collaborators have confirmed the high T_c superconductivity on our samples independently [3,4]. The superconducting phase under high pressure exhibits an orthorhombic structure of *Fmmm* space group with the $3d_{x2-y2}$ and $3d_{z2}$ orbitals of Ni cations strongly mixing with oxygen *2p* orbitals. Density functional theory calculations suggest the superconductivity emerges coincidently with the metallization of the σ-bonding bands under the Fermi level, consisting of the $3d_{z2}$ orbitals with the apical oxygens connecting Ni-O bilayers. Thus, the discoveries not only reveal important clues for the high-T_c superconductivity in this Ruddlesden-Popper double-layered perovskite nickelates but also provide a new family of compounds to investigate the high-T_c superconductivity mechanism.

[1] Z. Liu, H. L. Sun, M. W. Huo, et al., Sci. China-Phys. Mech. Astron. 66, 217411(2023).
[2] H. L. Sun, M. W. Huo, X. W. Hu et al., Nature (2023), https://www.nature.com/articles/s41586-023-06408-7.
[3] Y. N. Zhang, M. Wang, H. Q. Yuan et al., arXiv:2307.14819(2023)
[4] J. Hou, M. Wang, J. G. Cheng et al., arXiv:2307.09865(2023)

报告人简介

王猛，中山大学物理学院教授、博士生导师，现任中山大学物理学院副院长、广东省磁电物性分析与器件重点实验室副主任、物理学院中子科学与技术中心主任。王猛教授本科毕业于吉林大学物理学院，博士毕业于中国科学院物理研究所超导国家重点实验室，曾在加州大学伯克利分校物理系开展博士后研究工作。王猛教授已发表学术论文70余篇，包括Nature、Nature Physics、Nature Communications、Physical Review Letters、Physical Review B等杂志，是Science China-PMA杂志青年编委，长期担任Nature、Nature Physics、Physical Review Letters等杂志审稿人。
王猛教授研究兴趣包括非常规超导材料和量子磁性材料的物性及机理研究，研究方法包括材料生长、中子散射、高压技术等，推动并参与中国首台高能非弹性中子散射飞行时间谱仪建设。