

# 简历

**李建奇**：男，1962 年 9 月 6 日生。中国科学院物理研究所研究员，博士研究生导师。

**主要研究方向**：1、功能材料结构，结构相变和物理性能研究；包括：超导材料，强关联功能材料，功能纳米材料，多铁材料，记忆合金和新型薄膜纳米器件。

2、现代电子显微镜技术和方法研究。高分辨电子显微镜技术，Lorenz 电子显微镜技术，电子能量损失谱和电子全息技术研究；

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## 学历与研究工作经历

1986 年至 1990 年：中国科学院物理研究所，凝聚态物理专业研究生。论文题目：“高  $T_c$  超导体的结构和超导电性研究”。导师：赵忠贤教授。1990 年获得博士学位。

1991 年至 1993 年：北京大学物理系博士后。导师：尹道乐教授和甘子钊教授。研究课题：“C60 材料的超导电性和结构研究”。

1994 年至 1995 年：中国科学院物理研究所，国家超导实验室副研究员。研究课题：“新型高  $T_c$  超导体的微结构研究及缺陷分析”。

1995 年至 1996 年：德国 Max-Planck 固体物理研究所，电子显微镜实验室博士后。研究课题：“高  $T_c$  超导薄膜微结构分析”。

1996 年至 1998 年：日本无机材料研究所，超高电压高分辨电子显微镜实验室工作，客座研究员。研究课题：“巨磁 Mn-氧化物材料中的电荷有序相变”。

1999 年至 2001 年：美国 Brookhaven 国家实验室，电子显微镜研究室访问学者。研究课题：“高  $T_c$  超导材料中电子条纹的三维排布及稳定性观测”。

2002 年 5 月至今：中国科学院物理研究所，研究员，（a）强关联系统的电子相分离和电荷有序化。（b）过渡金属氧化物的电子轨道有序排列观测。

2002 年—2009 年，先进材料和结构分析研究部（北京电子显微镜重点实验室）主任。

#### 社会兼职：

2010—2014 年，Chinese Physics Letter 编委。

2002—2014 年，中国电子显微镜学会常务理事。

2010—2014 年，Global Journal of Physical Chemistry 编委。

#### 主要获奖情况

1991 年：获得中国科学院院长奖学金优秀奖。

1998 年：百人计划。

2002 年：国家杰出青年。

2002 年：国家杰出青年群体成员。

2003 年：北京科学技术二等奖（排名第一）

#### 承担重要科研项目情况

1998 年—2001 年：百人计划。综合评定结果优。

2002 年—2006 年：国家杰出青年基金。

2005 年—2010 年：973 项目“超导材料及其相关基础问题研究”，子课题负责人。

2006 年—2010 年，科学院纳米结构研究专项负责人。

2009 年—2012 年，重大研究课题培育项目。

#### 典型成果简介：

#### 关联金属氧化物中的条纹相及合作 Jahn-Teller 效应的研究

固体是自然界中存在最广泛的一种物质形态，它与我们的日常生活息息相关。固体的很多性质被其电子运动行为所决定，因此要精确描述固体的性质是一个非常复杂的多体问题。高  $T_c$  超导材料的母体是一种非常典型的 Mott 绝缘体，在超导体中存在着很强的电荷、自旋及晶格之间的相互作用，低温下发现了丰富而重要的物理现象。例如：载流子的局域化、电子相分离、条纹相（stripe phase）及合作 J-T 效应。在本项目中此，我们着重研究了条纹相问题。

在研究项目开展过程中，通过多方面的协力合作，取得了很好的新结果。

与美国 Brookhaven 国家实验室合作，对一些  $\text{La}(\text{Sr})_2\text{NiO}_4$  单晶样品进行了中子衍射和低温电子衍射分析，确定了其中的自旋反铁磁畴和电荷有序分布。合理解释了

La(Sr)<sub>2</sub>CuO<sub>4</sub> 中的氧原子和电子有序排列现象。在我们研究过程中，澄清了结构相变和电荷条纹相之间关联问题。在 La(Ca)MnO<sub>3</sub> 的研究过程中，发现小极化子对系统的结构和物理性质影响很大，小极化子有序化状态可以产生很强的结构变化。我们首先提出了小极化子的微观结构模型，解释了一些重要的物理现象。在 Mg-Al-B 系统中发现一种新的超导相超结构相，这种新型超导相中，存在明显层状结构特点。在系统研究的基础上，提出了结构模型。认真分析了这种材料的各种物理性质。

在这一课题的研究过程中，到目前为止共发表文章 20 多篇，其中：Phys. Rev. Lett, 2 篇。Phys. Rev. B 和 Applied Phys. Lett 11 篇。其中，1998-2002 年之间发表的论文，被他人引用 178 次。国际邀请报告 3 次。（美国 1，日本 1，中国 1）。特别在近期的综述文章中我们的论文被多次引用，描述目前这一领域的发展。特别是在研究过程中，我们发现了一些新问题，提出了解决的一些可能方法。这些课题已经成为凝聚态物理研究的重要方向。

## 发表论文

目前，在国际期刊上已发表论文 200 多篇。国际邀请报告 20 次。他人引用累计超过 500 次。

## 近年主要论文题目：

Publications: 2008-2009

1. C. Ma, H. X. Yang, H. F. Tian, H. L. Shi, J. B. Lu, Z. W. Wang, L. J. Zeng, G. F. Chen, N. L. Wang, and J. Q. Li\*, Microstructure and tetragonal-to-orthorhombic phase transition of AFe<sub>2</sub>As<sub>2</sub> (A=Sr,Ca) as seen via transmission electron microscopy, Physical Review B 79, (R)(2009) 060506.
2. C Ma, H X Yang, L J Zeng, Z A Li, Y Zhang, Y B Qin, and J Q Li, Effects of layered structural features on charge/orbital ordering in (La,Sr)<sub>n+1</sub>MnO<sub>3n+1</sub> (n=1 and 2), J. Phys.: Condens. Matter 21 (2009) 045601.
3. Y. B. Qin, H. X. Yang\*, Y. Zhang, H. F. Tian, C. Ma, Y. G. Zhao, R. I. Walton, J. Q. Li, The effect of Mg doping on the structural and physical properties of LuFe<sub>2</sub>O<sub>4</sub> and Lu<sub>2</sub>Fe<sub>3</sub>O<sub>7</sub>, J. Phys.: Condens. Matter 21 (2009) 015401.
4. J.B. Lu, H.X. Yang, Z.A. Li, C. Ma, H.L. Shi, L.J. Zeng, J.Q. Li, Phase separation, cation ordering and nano-structural complexities in Nd<sub>2/3-x</sub>Li<sub>3x</sub>TiO<sub>3</sub> with x= 0.14, Journal of Solid State Chemistry, 181(2008)3194.
5. L.J. Zeng, H. X. Yang, Y. Zhang, H. F. Tian, C. Ma, Y. B. Qin, Y. G. Zhao, J. Q. Li, Nonlinear current-voltage behavior and electrically driven phase transition in charge frustrated LuFe<sub>2</sub>O<sub>4</sub>, Europhysics letters, 84 (2008) 57011
6. C. Ma, L.J. Zeng, H.X. Yang, H.L. Shi, R.C. Che, C.Y. Liang, Y.B. Qin, G.F. Chen, Z.A. Ren, and J.Q. Li\*, Structural properties, phase transition of the ROFeM (R=La, Nd; M=As, P) materials, Europhysics letters, 84 (2008) 47002
7. Y.J. Tian, H.X. Yang, Y.B. Cui, S.G. Zhan, Y.F. Chen, A multi-stage growth model leading to high-yield production of carbon nanotubes, Chem. Commun., 2008, 3299–3301.
8. C.Ma, H.X. Yang, Z.A. Li, Y. Ueda, J.Q. Li, Charge disproportionation in quasi-one-

- dimensional vanadium oxides, *Solid State Communication*, 146 (2008) 30-34.
9. R.C.Che, R.J. Xiao, C.Y. Liang, H.X. Yang, C. Ma, H.L. Shi, J.Q. Li, Electron energy-loss spectroscopy and ab initio electronic structure of the LaOFeP superconductor, *Physical Review B* 77, 184518 (2008).
  10. H. R. Zhang, C. Ma, H. F. Tian, G. H. Wu, and J. Q. Li, Martensitic transformation of Ni<sub>2</sub>FeGa ferromagnetic shape-memory alloy studied via transmission electron microscopy and electron energy-loss spectroscopy, *Physical Review B* 77, 214106 (2008).
  11. C. Ma, R.J. Xiao, H.X. Geng, H.X. Yang, H.F. Tian, G.C. Che, J.Q. Li, Investigation of hole states near the Fermi level in NbMgxB<sub>2</sub> by electron energy-loss spectroscopy and first-principles calculations, *Ultramicroscopy* 108 (2008) 320–326.
  12. H.X. Yang, B.P. Zhu, L.J. Zeng, H.F. Tian, C. Ma, J. Shi, J.Q. Li, structural modulation in the orbitally induced Peierls state of MgTi<sub>2</sub>O<sub>4</sub>, *J. Phys.: Condens. Matter*, 20 (2008) 275230.
  13. L. J. Zeng, C. Ma, H. X. Yang, R. J. Xiao, and J. Q. Li\*, Structural modulation and electronic structural features in the charge ordered state of La<sub>0.5</sub>Sr<sub>1.5</sub>MnO<sub>4</sub>, *Physical Review B* 77, 024107 (2008).

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1. Y. Zhang, H. X. Yang, C. Ma, H. F. Tian & J. Q. Li \* Charge-stripe order in the electronic ferroelectric LuFe<sub>2</sub>O<sub>4</sub>, ***Phys. Rev. Lett.*** 98 (2007) 247602.
2. H.X. Yang, Y.G. Shi, Y.Q. Guo, X. Liu, R.J. Xiao, J.L. Luo and J.Q. Li, Strontium ordering, structural modulation in layered hexagonal Sr<sub>x</sub>CoO<sub>2</sub> and physical properties of Sr<sub>0.35</sub>CoO<sub>2</sub>, ***Materials Research Bulletin***, 42 (2007) 94.
3. H.X. Yang, R.J. Xiao, C. Ma, H.T. Tian, D.Wu and J.Q. Li\*, Charge and orbital ordering in Na<sub>0.5</sub>CoO<sub>2</sub>, ***Solid state communication*** 142 (2007) 718–722.
4. Z.A. Li, H.X. Yang, H.F. Tian, J.Q. Li, J.R.Cheng, J.G. Chen, Transmission electron microscopy study of multiferroic, (Bi<sub>1-x</sub>La<sub>x</sub>) FeO<sub>3</sub> --PbTiO<sub>3</sub> with x=0.1, 0.2 and 0.3, ***Appl. Phys. Lett.*** 90 (2007)182904.
5. C .Y. Liang, R. C. Che, H. X. Yang, H. F. Tian, R. J. Xiao, J. B. Lu, R. Li, J. Q. Li, Synthesis and structural characterization of LaOFeP superconductors, *Supercond. Sci. Technol.* 20 (2007) 687–690.
6. C. Ma, R. J. Xiao, H. X. Geng, H. X. Yang, H. F. Tian, G. C. Che and J. Q. Li\*, ***Ultramicroscopy***, (in press)
7. Y. Zhang, H. X. Yang, Y. Q. Guo, C. Ma, H. F. Tian, J. L. Luo, and J. Q. Li, Structure, charge ordering and physical properties of LuFe<sub>2</sub>O<sub>4</sub>, ***Phys. Rev. B.*** 76, 184105 (2007)
8. A. I. Kolesnikov, H. X. Yang, Y. G. Shi, J. Q. Li, R. I. Walton, and J. C. Li, Observation of two O-H covalent bonds of water in the Na<sub>0.3</sub>CoO<sub>2</sub> ·1.3H<sub>2</sub>O superconductor by inelastic neutron spectroscopy, ***Phys. Rev. B.*** 76, 092302 (2007)
9. Zi-an Li, Huai-xin Yang, Huan-fang Tian, Ying Zhang, Jian-qi Li, Fabrication and Characterization of Micro-Pattern Dandelion-like and Nanobelts of β -SrV<sub>2</sub>O<sub>6</sub> via Hydrothermal Process, ***Chinese Journal Of Chemical Physics***, (in press)
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1. H.X. Yang, Y.G. Shi, X. Liu, R.J. Xiao, H.F. Tian and J.Q. Li, Structural properties and cation ordering in layered hexagonal CaxCoO<sub>2</sub>, ***Phys. Rev. B*** 73 (2006) 014109.
2. H.X. Yang, Y. Xia, Y.G. Shi, H.F. Tian, R.J. Xiao, X. Liu, Y.L. Liu and J.Q. Li\*, Raman

- Spectroscopy Study of  $\alpha$ -,  $\beta$ -,  $\gamma$ - $\text{Na}_x\text{CoO}_2$  and  $\gamma$ -(Ca,Sr) $_x\text{CoO}_2$  **Phys. Rev. B** 74, (2006) 094301.
3. Y. G. Shi, H. X. Yang, H. Huang, X. Liu, and J.Q. Li\*, Superconductivity, charge ordering and structural properties of  $\alpha$ , $\beta$ - and  $\gamma$ - $\text{Na}_x\text{CoO}_2 \cdot y(\text{H}_2\text{O}, \text{D}_2\text{O})$ , **Phys. Rev. B** 73 (2006) 094505
  4. R. J. Xiao, H. X. Yang and J. Q. Li\*, Influence of water intercalation on the electronic structure of the hydrated  $\text{Na}_{0.3}\text{CoO}_2 \cdot y\text{H}_2\text{O}$  using a local spin density approximation, **Phys. Rev. B** 73 (2006) 092517.
  5. C. Ma, R. J. Xiao, H. X. Yang, Z. A. Li, H. R. Zhang, C. Y. Liang, and J. Q. Li\*, Electronic structure of the quasi-one-dimensional  $\beta$ - $\text{Na}_{0.33}\text{V}_2\text{O}_5$ , **Solid state communication**, 138 (2006) 563.
  6. R. J. Xiao, K.Q. Li, H. X. Yang, G.C. Che, H.R. Zhang, C. Ma, Z.X. Zhao, and J.Q. Li\*, Correlations among superconductivity, structural instability, and band filling in  $\text{Nb}_{1-x}\text{B}_2$  at the critical point  $x \approx 0.2$ , **Phys. Rev. B** 73 (2006), 224516.
  7. C.J. Nie, H.X. Yang, Y.G. Shi J.Q. Li, High temperature phase transitions in  $\text{Na}_x\text{CoO}_2$  materials **Chinese Journal Of Structural Chemistry** 25 (8): 997-1003 2006.
  8. H.R. Zhang, H.C. Yu, C.M. Shen, H.X. Yang, J.Q. Li, TEM study on hollow and porous  $\text{Cu}_2\text{O}$  nanoparticles prepared from solution phase. **Chinese Physics**, 15 (2006) 1290.
  9. H. F. Tian, H. X. Yang, H. R. Zhang, Y. Li, H. B. Lu, J. Q. Li\*, The interface of epitaxial  $\text{SrTiO}_3$  on silicon characterized by transmission electron microscopy, electron energy loss spectroscopy and electron holography, **Phys. Rev. B** 73 (2006) 075325
  10. S. Antonijevic, S.E. Ashbrook, S. Biedasek, R.I. Walton, S. Wimperise, H.X. Yang, Dynamics on the microsecond timescale in microporous aluminophosphate  $\text{AlPO}_4$ -14 as evidenced by 27-Al MQMAS and STMAS NMR spectroscopy, **J. Am. Chem. Soc.** 128 (2006) 8054-8062.
  11. Y. Zhang, C.X. Cui, J.B. Sun, H.X. Yang, H.F. Tian, H.R. Zhang, J.Q. Li, Magnetic properties and microstructure of the dual-phases nanocomposite magnet  $\text{Sm}_3(\text{Fe,Ti})_{29}\text{N}_x/\alpha\text{-Fe}$ , **Materials Science and Engineering A** 433 (2006) 90–93.

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1. H.X. Yang, J.Q. Li\*, R.J. Xiao, Y.G. Shi and H.R. Zhang, Electron energy loss spectra of  $\text{Na}_{0.33}\text{CoO}_2 \cdot y\text{H}_2\text{O}$  ( $y = 0, 0.6$  and  $1.3$ ), **Phys. Rev. B**, 72 (2005), 075106.
2. H.X. Yang, C.J. Nie, Y.G. Shi, H.C. Yu, S. Ding, Y.L. Liu, D. Wu, N.L. Wang, J.Q. Li, Structural phase transitions and sodium ordering in  $\text{Na}_{0.5}\text{CoO}_2$ : combined electron diffraction and Raman spectroscopy study, **Solid state communication**, 134 (2005) 403.
3. H.X. Yang, Y.G. Shi, C.J. Nie, D. Wu, L.X. Yang, C. Dong, H.C. Yu, H.R. Zhang, C.Q. Jin, J.Q. Li, Phase separation, effects of magnetic field and high pressure on charge ordering in  $\text{Na}_{0.5}\text{CoO}_2$ , **Material Chemistry and Physics**, 94 (2005) 119-124.
4. H.X. Yang, Y.G. Shi, R.J. Xiao, X. Liu, C.J. Nie, H.F. Tian and J.Q. Li\*, Superconductivity, Structural Features and Charge Ordering in  $\text{Na}_x\text{CoO}_2 \cdot y\text{H}_2\text{O}$  ( $0 \leq y \leq 1.8$ ) System, **Science and Technology Adv. Mat. Special Issue**, 6 (2005) 740–745.
5. R.J. Xiao, H.X. Yang, L.F. Xu, H.R. Zhang, Y.G. Shi and J.Q. Li\*, Electronic structure and electron energy-loss spectra of  $\text{Sr}_{0.35}\text{CoO}_2$ , **Solid state communication**, 135 (2005) 687
6. Y.G. Shi, H.X. Yang, X. Liu, W.J. Ma, C.J. Nie, W.W. Huang and J.Q. Li, Effects of Mn and Ti doping on superconductivity in  $\text{Na}_{0.3}\text{CoO}_2 \cdot 1.3\text{H}_2\text{O}$  and charge ordering in  $\text{Na}_{0.5}\text{CoO}_2$ , **Physica C** 432 (2005) 299–305.
7. H.Y. Chen, J.X. Wang, H.C. Yu, H.X. Yang, S.S. Xie, J.Q. Li, Transmission electron microscopy study of pseudoperiodically twinned  $\text{Zn}_2\text{SnO}_4$  nanowires, **J. Phys. Chem. B**,

109 (2005) 2573.

8. H.F. Tian, H.C. Yu, X.H. Zhu, Y.G. Wang, D.N. Zheng, H.X. Yang, J.Q. Li, Off-axis electron holography and microstructure of Ba<sub>0.5</sub>Sr<sub>0.5</sub>TiO<sub>3</sub> thin films on LaAlO<sub>3</sub>, **Phys. Rev. B**, 71 (2005) 115419.
9. H.F. Tian, J.R. Sun, H.B. Lü, K.J. Jin, H.X. Yang, H.C. Yu and J.Q. Li Electrostatic potential in manganite-based heterojunctions by electron holography **Appl. Phys. Lett.** 87, (2005) 164102.
10. L.B. Liu, S.Y. Fu et al, Transmission electron microscopy study on the microstructure of Fe<sub>85</sub>Ga<sub>15</sub> alloy, *Physica B-Condensed Matter* 365 (2005) 102.
11. H.R. Zhang, C.M. Shen, S.T. Chen, Z.C. Xu, F.S. Liu, J.Q. Li, H.J. Gao, Morphologies and micro structures of nano-sized Cu<sub>2</sub>O particles using a cetyltrimethylammonium template, **Nanotechnology** 16 (2005) 267.
12. F.H. Li, A method of studying dislocation core structures by high-resolution electron microscopy, *Science and Technology of Advanced Materials*, 6 (2005) 721.

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1. Y.G. Shi, Y.L. Liu, H.X. Yang, C.J. Nie, R. Jin and J.Q. Li, Raman spectroscopy study of Na<sub>x</sub>CoO<sub>2</sub> and superconducting Na<sub>x</sub>CoO<sub>2</sub>·yH<sub>2</sub>O, **Phys. Rev. B**, 70 (2004) 052502.
2. Y.G. Shi, C. Dong, J.Q. Li, Structure and superconductivity in Na<sub>x</sub>CoO<sub>2</sub>·yH<sub>2</sub>O, **Supercond. Sci. Technol.** 17 (2004) 42.
3. H.C. Yu, Y.G. Shi, G.C. Che, L.B. Liu, Y.H. Liu, J.Q. Li, Z.X. Zhao, Superconductivity and microstructure of YBaSrCu<sub>3-x</sub>Fe<sub>x</sub>O<sub>y</sub> system, **Physica C-Superconductivity and Its Applications** 411 (2004) 94.
4. H.Y. Chen, Y. Gao, H.R. Zhang, L.B. Liu, H.C. Yu, H.F. Tian, S.S. Xie, J.Q. Li, Transmission-electron-microscopy study on fivefold twinned silver nanorods, **Journal of Physical Chemistry B** 108 (2004) 12038.
5. H.Y. Chen, Y. Gao, H.C. Yu, H.R. Zhang, L.B. Liu, Y.G. Shi, H.F. Tian, S.S. Xie, J.Q. Li, Structural properties of silver nanorods with fivefold symmetry, **Micron** 35 (2004) 469.
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8. G.D. Liu, L.B. Liu, Z.H. Liu, M. Zhang, J.L. Chen, J.Q. Li, G.H. Wu, Y.X. Li, J.P. Qu, Chin TS Giant magnetostriction on Fe<sub>85</sub>Ga<sub>15</sub> stacked ribbon samples **Applied Physics Letters** 84 (2004) 2124.
9. J.Q. Li, Z.H. Liu, H.C. Yu, M. Zhang, Y.Q. Zhou and G.H. Wu, Martensitic transition and structural modulations in the Heusler alloy Ni<sub>2</sub>FeGa, **Solid State Communications** 126 (2003) 323–327.
10. Y.G. Shi, J.Q. Li, H.C. Yu, Y.Q. Zhou, H.R. Zhang and C. Dong, Structural and physical properties of the Na<sub>x</sub>CoO<sub>2</sub>·yH<sub>2</sub>O superconducting system, **Supercond. Sci. Technol.** 17 (2004) 42–46.
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2. C Ma, H X Yang, L J Zeng, Z A Li, Y Zhang, Y B Qin, and J Q Li, J. Phys.: Condens. Matter 21 (2009) 045601.
3. Y. B. Qin, H. X. Yang\*, Y. Zhang, H. F. Tian, C. Ma, Y. G. Zhao, R. I. Walton, J. Q. Li, J. Phys.: Condens. Matter 21 (2009) 015401.
4. L.J. Zeng, H. X. Yang, Y. Zhang, H. F. Tian, C. Ma, Y. B. Qin, Y. G. Zhao, J. Q. Li, Nonlinear current-voltage behavior and electrically driven phase transition in charge frustrated  $\text{LuFe}_2\text{O}_4$ , Europhysics letters, 84 (2008) 57011
5. Y.J. Tian, H.X. Yang, Y.B. Cui, S.G. Zhan, Y.F. Chen, Chem. Commun., 2008, 3299–3301.
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