Keith M. Taddei

Curriculum Vitae

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Experienced neutron and x-ray scatterer motivated by collaboration driven exploration of novel physics in quantum materials. Passionate scientific leader and mentor with a belief in the scientist's responsibility for public and student engagement.

EDUCATION

Ph.D.: Northern Illinois University May 2016

Department of Physics, Advisor: Prof. Omar Chmaissem

- Magnetism in the iron-based superconductors: the determination of spin-nematic fluctuations as the primary order parameter and its implications for unconventional superconductivity

B.S.: Lewis University May 2010

Department of Physics

- *magna cum laude*

RESEARCH EXPERIENCE

Oak Ridge National Laboratory Oak Ridge, TN

Post-Doctoral Fellow (Summer 2016-present)

- Research quantum and strongly correlated materials with potential for quantum technologies – high temperature superconductors, multiferroics and quantum spin systems
- Lead a multi-institution collaboration studying low-dimensional superconductivity
- Manage High Flux Isotope Reactor neutron powder diffractometer (HB-2A), develop instrument capabilities and innovative extreme sample environments (local contact for 35+ experiments)
- Operate, develop and trouble-shoot cryogenic systems – including closed cycle refrigerators, cryomagnets, dynamic helium flow systems and 3He/dilution refrigerator inserts
- Manage powder diffractometer user program: recruit, train and engage users

Argonne National Laboratory Lemont, IL

Guest Researcher (Spring 2012- Spring 2016)

- Study of competing orders in iron-based superconductors using scattering techniques
- Extensive use of neutron and x-ray diffraction/scattering techniques to study structural distortions, magnetic orderings and disordered materials
- Synthesis of single crystal and powder samples
- Develop collaboration driven research between scattering group and synthesis/chemistry groups

Lewis University Romeoville, IL

Undergraduate Student Senior Project

- Construction of infrared open cavity laser and determination of build parameters' effect on final beam profile and divergence

TEACHING EXPERIENCE

Post-Doctoral

- Lecturer and proctor of guided hands-on tutorials on the technique of neutron powder diffraction, theory of magnetic structure solution and use Rietveld refinement code for nuclear and magnetic structural modeling for the 2016, 2017 and 2018 Neutron and X-ray Scattering Summer Schools
- Continuous instruction of new neutron scattering users (from undergraduate to professors) on the theory, operation and data handling of a neutron powder diffractometer
- Guest Lecturer at Evansville University Indiana for calculus-based physics (1 lecture spring 2018)

- Hosted informal sessions for Oak Ridge National Laboratory's post-graduate community on using neutrons in research

Graduate Student

- Teaching assistant for calculus-based Electricity and Magnetism laboratory: guided recitations, taught laboratory coursework, proctored lab work and graded reports (1 semester)
- Tutoring center for all undergraduate physics coursework (1 semester)
- Teaching assistant for Advanced Physics Laboratory (Senior level), helped students run experiments, learn experimental techniques (daq, labview coding, circuit troubleshooting etc), guided students in the design and implementation of senior lab projects (2 semesters)
- Volunteer at STEM Fest – community outreach teaching physics concepts to non-technical visitors

Under-graduate Student

- University tutor for Physics, Mathematics and Computer Science courses (4 semesters)
- Revised and expanded laboratory manual for algebra and calculus based 1st year physics

TECHNICAL SKILLS

- Extensive experience with data collection, reduction and analysis for time-of-flight and constant wavelength neutron scattering as applied through powder and single crystal diffractometers as well as triple-axis and chopper spectrometers
- Role of beamline scientist – evaluation of user proposals, design of experiments, user support, user scheduling and instrument/sample environment design/configuration
- Synthesis of single crystal and powder materials through self-flux, Sn-Flux, and sintering techniques, handling of highly toxic/reactive/volatile elements for synthesis
- Experience loading and pressurizing diamond anvil, gas and clamp pressure cells
- Rietveld refinements for both crystal and powder systems
- Nuclear/magnetic structure determination through group theory and representational analysis
- Development of analytical programs (structure properties calculations, peak integration)
- Pair Distribution Function analysis as implemented in PDFgui
- Reverse Monte Carlo technique as implemented in RMCProfile
- Spin-wave modeling through linearized spin-wave theory
- Transport and magnetic properties measurements
- Proficiency in Python and LaTeX, familiarity with C++ and Matlab
- Organization and execution of scientific conference

AWARDS, SERVICE & ORGANIZATIONS

Awards

- 2016 Graduate School Dissertation Completion Fellowship
- 2016 Outstanding Graduate Student – Physics
- 2015 ACA Annual Meeting Margaret Etter Award in the category of Neutron Scattering
- 2010 Physics Student Award (Undergrad)
- 2006-2010 Honors Connections Program (Undergrad)
- 2006-2010 Deans List (Undergrad)

Elected Leadership Roles

- Executive Committee Member ORNL Postdoctoral Association 2017-2018
- Vice-Chair Research Committee ORNL Postdoctoral Association 2017-2018
    - Organized 'Your science in a nutshell' workshop Oct. 4, 2017
    - Organized 6th Annual ORPA Research Symposium Aug. 7, 2018
    - Organized 2017-2018 'On the shoulders of Giants' Seminar Series
- Vice-President Society of Physics Students Lewis University Chapter 2009-2010
- Secretary American Chemical Society Lewis University Chapter 2007-2008

Community and Professional Service Work

- NIST Center for Neutron Research proposal reviewer
- Referee for Physical Review Letters and Physical Review B
- Volunteer – ORPA donation drive to benefit the victims of hurricanes
- Volunteer – ORPA United Way Bake Sale
- Community outreach for Neutron Scattering Society of America (Booth at 2016 and 2017 APS March Meeting)
- Volunteer - 2012 Northern Illinois University STEM fair

Organizations

- American Crystallographic Society
- American Physical Society
- Neutron Scattering Society of America
- Pittsburgh Diffraction Society
- ORNL Postdoctoral Association
- *Sigma Xi* research society
- *Sigma Pi Sigma*
- *Kappa Mu Epsilon*

PUBLICATIONS (ORNL)

In preparation

K.M. Taddei, M. Struza, M. Frontzek, C. de la Cruz, "Magnetic order and aberrant semi-conducting behavior of $CuFeTe_2$" In preparation for submission to Phys. Rev. B

O. Chmaissem, K.M. Taddei, R. Stadel, D. Bugaris, D.D. Khalyavin, P. Manuel, S. Lapidus, D.Y. Chung, M. Kanatzidis, H. Claus, R. Osborn, S. Rosenkranz, "Scaling and universality of the C_4 magnetic phase in hole-doped AFe_2As_2 (A = $Ba_{1-x-y}Sr_xNa_y$, $Sr_{1-x-y}Ca_xNa_y$)" In preparation for submission to Phys. Rev. Lett.

K.C. Santosh, K.M. Taddei, A.A. Belik, C. de la Cruz, J.H. Lee, V.R. Cooper, "First-principles and neutron diffraction investigation of unusual spin-driven polarization in tetragonal $BiCoO_3$" In preparation for submission to Phys. Rev. B

Under review

K.M. Taddei, L. Sanjeewa, J.W. Kolis, A.S. Sefat, C. de la Cruz, D.M. Pajerowski, "Evidence of local-Ising magnetic order and metamagnetism in the pyrogermanate $Er_2Ge_2O_7$" Under review for publication in Phys. Rev. Mat. arXiv:1810.00446v1

A. Virtue, X. Zhou, D. Wilfong, J.W. Lynn, K.M. Taddei, E.E. Rodriquez, "Magnetization of Mixed Mn 122-Type Sulfides, $KMMnS_2$ (M = Cu, Li)" Under review for publication in Phys. Rev. Mat.

B.A. Frandsen, K.M. Taddei, D.E. Bugaris, R. Stadel, M. Yi, A. Acharya, R. Osborn, S. Rosenkranz, O. Chmaissem, R.J. Birgeneau, "Widespread nematic fluctuations in the $(Sr,Na)Fe_2As_2$ family of superconductors" Under review for publication in Phys. Rev. B Rapid Communications arXiv:1809.01764v1

A. Klimkowicz, K. Cichy, O. Chmaissem, B. Dabrowski, B. Poudel, K. Swierczek, K.M. Taddei, A. Takasaki, "Reversible oxygen intercalation in hexagonal $Y_{0.7}Tb_{0.3}MnO_{3+\delta}$: toward oxygen production by temperature swing absorption in air" Under review for publication in Chemistry of Materials

Published

K.M. Taddei, G.Z. Xing, J.Sun, Y. Fu, Y. Li, Q. Zheng, A.S. Sefat, D.K. Singh, C. de la Cruz. Frustrated structural instability in superconducting quasi-one-dimensional $K_2Cr_3As_3$" Accepted Phys. Rev. Lett. arXiv:1805.03637v2

S. Calder, K. An, R. Boehler, C. de la Cruz, M. Frontzek, M. Guthrie, B. Haberl, A. Huq, S.A.J. Kimber, J. Liu, J. Molaison, J. Neuefeind, K. Page, A. dos Santos, K.M. Taddei, C. Tulk, M. Tucker, "A Suite-level Review of the Neutron Powder Diffraction Instruments at Oak Ridge National Laboratory." Rev. Sci. Inst. **89,** 092701 (2018)

J.-J. Liu, J.Wang, J. Sheng, F. Ye, K.M. Taddei, J.A. Fernandez-Baca, W. Luo, G.-A Sun, Z.-C. Wang, H.Jiang, G.-H. Cao, W. Bao. "Neutron diffraction study on magnetic structures and transition in $Sr_2Cr_3As_2O_2$" Phys. Rev. B **98,** 134416 (2018)

N. Sangeneni, K.M. Taddei, N. Bhat, S.A. Shivashankar. "Magnetic Properties of superparamagnetic, nanocrystalline cobalt ferrite thin films deposited at low temperature." J. Mag. Magn. Mat. **465,** 590-597 (2018)

K.M. Taddei, Q. Zheng, A.S. Sefat, C. de la Cruz. "Coupling of structure to magnetic and superconducting orders in quasi-one-dimensional $K_2Cr_3As_3$" Phys. Rev. B. Rapid Comm. **96,** 180506(R) (2017)

B.A. Frandsen, K.M. Taddei, M. Yi, A. Frano, Z. Guguchia, R. Yi, Q. Si, D.E. Bugaris, R. Stadel, R. Osborn, S. Rosenkranz, O. Chmaissem, R.J. Birgeneau. "Local orthorhombicity in the magnetic C_4 phase of the hole-doped iron-arsenide superconductor $Sr_{1-x}Na_xFe_2As_2$." Phys. Rev. Lett. **119,** 187001 (2017).

K.M. Taddei, J.M. Allred, D.E. Bugaris, S.H. Lapidus, M.J. Krogstad, H. Claus, D.Y. Chung, M.G. Kanatzidis, R. Osborn, S. Rosenkranz, O. Chmaissem. "Observation of the magnetic C_4 phase in $Ca_{1-x}Na_xFe_2As_2$ and its universality in the hole-doped 122 superconductors" Phys. Rev. B **95,** 064508 (2017)

PUBLICATIONS (ANL/NIU)

J.M. Allred, K.M. Taddei, D.E. Bugaris, M.J. Krogstad, S.H. Lapidus, D.Y. Chung, H. Claus, M.G. Kanatzidis, D.E. Brown, J. Kang, R.M. Fernandes, I. Eremin, S. Rosenkranz, O. Chmaissem, R. Osborn, "Double-Q spin-density wave in iron arsenide superconductors." Nature Phys. DOI: 10.1038/NPHYS3629 (2016)

K.M. Taddei, J.M. Allred, D.E. Bugaris, M.J. Krogstad, S.H. Lapidus, D.Y. Chung, R. Stadel, M.G. Kanatzidis, D.E. Brown, S. Rosenkranz, R. Osborn, O. Chmaissem. "Detailed magnetic and structural analysis mapping a robust magnetic C_4 dome in $Sr_{1-x}Na_xFe_2As_2$" Phys. Rev. B **93,** 134510 (2016) (EDITOR'S SUGGESTION)

S. Jiang, C. Liu, H. Cao, T. Birol, J.M. Allred, W. Tian, L. Liu, K. Cho, M.J. Krogstad, J. Ma, K.M. Taddei, M.A. Tanatar, M. Hoesch, R. Prozorov, S. Rosenkranz, Y.J. Uemura, G. Kotliar, N. Ni. "The structural/magnetic phase transitions in $Ca_{0.73}La_{0.27}FeAs_2$ with electron overdoped FeAs layers" Phys. Rev. B **93,** 174413 (2016)

M.P. Smylie, M. Leroux, V. Mishra, L. Fang, K.M. Taddei, O. Chmaissem, H. Claus, A. Kayani, A. Snezhko, U. Welp, W.K. Kwok, "Effect of proton irradiation on superconductivity in optimally doped $BaFe_2(As_{1-x}P_x)_2$ single crystals." Phys. Rev. B **93,** 115119 (2016)

J.M. Allred, S. Avci, D.Y. Chung, H. Claus, D.D. Khalyavin, P. Manuel, K.M. Taddei, M.G. Kanatzidis, S. Rosenkranz, R. Osborn, O. Chmaissem. "Tetragonal magnetic phase in $Ba_{1-x}K_xFe_2As_2$ from x-ray and neutron diffraction." Phys. Rev. B **92,** 094515 (2015).

K.M. Taddei, M. Struza, D.Y. Chung, H.B. Cao, H. Claus, M.G. Kanatzidis, R. Osborn, S. Rosenkranz, O. Chmaissem, "Cesium vacancy ordering in phase-separated $Cs_xFe_{2-y}Se_2$." Phys. Rev. B **92,** 094505 (2015).

J.M. Allred, K.M. Taddei, D.E. Bugaris, S. Avci, D.Y. Chung, H. Claus, C. dela Cruz, M.G. Kanatzidis, S. Rosenkranz, R. Osborn, O. Chmaissem, "Coincident structural and magnetic order in $BaFe_2(As_{1-x}P_x)_2$ revealed by high-resolution neutron diffraction." Phys. Rev. B **90,** 104513 (2014).

PRESENTATIONS

"Indications of a rich phase diagram in superconducting $K_2Cr_3As_3$" 2018 Oak Ridge Postdoctoral Association Symposium

"Neutron scattering studies of the quasi-1D superconductor: $K_2Cr_3As_3$" 2018 Gordon Research Conference AND Gordon Research Seminar for Correlated Electron Systems (Poster)

"Understanding Superconductivity in $K_2Cr_3As_3$" 2018 American Physical Society March Meeting

"When electrons misbehave: superconductivity and how we study it" INVITED University of Evansville Research Seminar 2018

"Using neutron diffraction to study competing orders in unconventional superconductors" INVITED 2017 Pittsburgh Diffraction Society Annual Meeting

"Neutron diffraction studies of multiferroic $BiCoO_3$" 2017 International Meeting on Ferroics

"Coupled structure, magnetism and superconducting order in quasi-1D $K_2Cr_3As_3$" 2017 Oak Ridge Postgraduate Association symposium.

"Neutron scattering studies of the quasi-1D superconductor: $K_2Cr_3As_3$" 2017 Gordon Research Conference for Superconductivity AND 2017 Gordon Research Seminar for Superconductivity (Poster)

"Neutron diffraction studies of the quasi-1D superconductors $K_2Cr_3As_3$" 2017 American Physical Society March Meeting

"Universality of double-Q magnetic ordering in the hole-doped 122 iron-based superconductors" 2016 American Crystallographic Association Annual Meeting AND 2016 Oak Ridge Postgraduate Association symposium.

"Structural parameters and the varied manifestations of the magnetic C_4 phase in the 122 iron-based superconductors" 2016 American Conference for Neutron Scattering

"Magnetism in the iron-based superconductors: Spin-nematic fluctuations, the primary order parameter and unconventional superconductivity" Invited talk for the 2016 Joint Institute for Neutron Sciences at Oak Ridge National Lab

"At the crossroads of superconductivity and Magnetism: The complex phase behavior of the iron based superconductors." Invited Colloquium at Northern Illinois University AND Invited talk for the 2015 Joint Institute for Neutron Sciences at Oak Ridge National Lab

"Observation of the magnetic C_4 phase and a two Q magnetic structure in hole doped $Sr_{1-x}Na_xFe_2As_2$." 2015 American Crystallographic Association Annual Meeting.

"The phase diagram of $Sr_{1-x}Na_xFe_2As_2$: evidence of magnetic C_4 phase universality." 2015 American Physical Society March Meeting.

"The structural and magnetic properties of $Cs_xFe_{2-y}Se_2$ as determined by x ray and neutron scattering of powder and single crystal samples." 2014 American Physical Society March Meeting AND 2014 American Conference on Neutron Scattering.

"Synthesis, structure and magnetic properties of $BaFe_2(As_{1-x}P_x)_2$ as determined by elastic and inelastic neutron scattering." 2013 American Physical Society March Meeting.

REFERENCES

Reference #1

Dr. Clarina de la Cruz
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Oak Ridge, Tennessee 37831
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Reference #2

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Reference #3

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