



AMHERST CENTER FOR FUNDAMENTAL INTERACTIONS

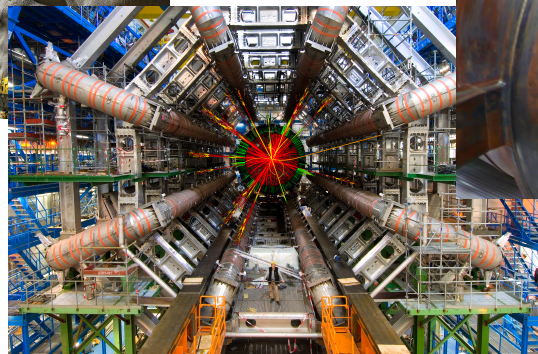
Physics at the interface: Energy, Intensity, and Cosmic frontiers

University of Massachusetts Amherst

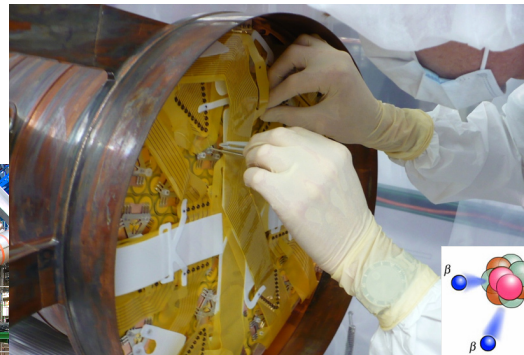
Welcome to the ACFI !



**LUX/LZ &
DarkSide**

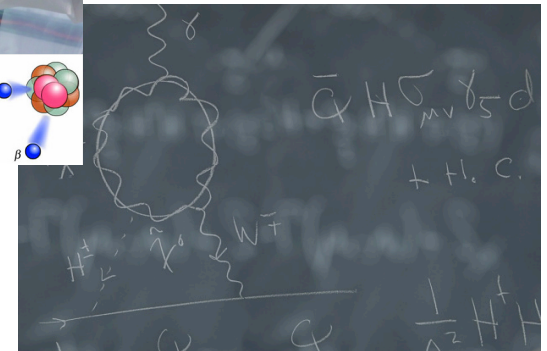


ATLAS



EXO

Theory





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We seek answers to key open questions about nature's fundamental interactions, such as:

Why is there more matter than anti-matter in the Universe?

What additional forces were active during the first moments after the Big Bang?

How are protons and neutrons put together?

Our mission:

Advancing research in theoretical and experimental physics at the interface of the Energy, Intensity, and Cosmic frontiers.

<http://www.physics.umass.edu/acfi/>



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Activities

- **Core Research (in house):** *ATLAS, EXO, LUX/LZ, DarkSide, J Lab parity & chiral, RHIC Spin, Borexino, Theory*
- **Targeted Workshops:** *Hadronic Probes, Lambda & Quasi Lambda, Higgs Portal,...*
- **Visiting Researchers:** *Ph.D. students (Australia, China), post-docs, faculty & senior researchers*



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Past Workshops

- *Hadronic Probes of Fundamental Symmetries*
- *Lambda and Quasi-Lambda*
- *Unlocking the Higgs Portal*
- *Measuring the Neutron Lifetime*
- *Fundamental Symmetry Tests w/ Rare Isotopes*
- *Time-Reversal Tests in Nuclear & Hadronic Processes*
- *Hadronic Matrix Elements for Probes of CP-Violation*
- *The CP Nature of the Higgs Boson*
- *LHC Searches for Long-Live BSM Particles*
- *Probing the EW Phase Transition at a Next Gen PP Collider*
- *Neutrino Mass: From the Terrestrial Laboratory to the Cosmos*
- *Recent Developments in Semiclassical Probes of QFT's*
- *Northeast Gravity Workshop*
- *Making the EWPT (Theoretically) Strong*
- *Neutrinos at the High Energy Frontier*
- *The Electroweak Box*
- *Testing CP-Violation for Baryogenesis*
- *Beta Decay as a Probe of New Physics*



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Neutron Lifetime

arXiv:1410.5311

Determination of the Free Neutron Lifetime

J. David Bowman,¹ L. J. Broussard,² S. M. Clayton,² M. S. Dewey,³ N. Fomin,⁴ K. B. Grammer,⁴ G. L. Greene*,^{4,1,†}
P. R. Huffman,⁵ A. T. Holley,⁶ G. L. Jones,⁷ C.-Y. Liu,⁸ M. Makela,² M. P. Mendenhall,³ C. L. Morris,²
J. Mulholland,⁴ K. M. Nollett,^{9,10} R. W. Pattie, Jr.,² S. Penttilä,¹ M. Ramsey-Musolf,¹¹ D. J. Salvat,^{8,2}
A. Saunders,² S. J. Seestrom,² W. M. Snow,⁸ A. Steyer,¹² F. E. Wietfeldt,¹³ A. R. Young,⁵ and A. T. Yue³



Hadronic Probes



J Lab proposal & Physics Reports



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EWPT @ 100 TeV
arXiv: 1606.09408

CERN-TH-2016-11

ACFI-T16-10

Unlocking the Higgs Portal
arXiv: 1604.05324

Physics at a 100 TeV pp collider: Higgs and EW symmetry breaking studies

Editors:

R. Contino^{1,2}, D. Curtin³, A. Katz^{1,4}, M. L. Mangano¹, G. Panico⁵, M. J. Ramsey-Musolf^{6,7}, G. Zanderighi¹

The Higgs Portal and Cosmology

Ketevi Assamagan,^a Chien-Yi Chen,^{b,c} John Paul Chou,^d David Curtin,^e Michael A. Fedderke,^f Yuri Gershtein,^d Xiao-Gang He,^g Markus Klute,^h Jonathan Kozaczuk,ⁱ Ashutosh Kotwal,^j Steven Lowette,^k Jose Miguel No,^l Tilman Plehn,^m Jianming Qian,ⁿ Michael Ramsey-Musolf,^o Alexei Safonov,^p Jessie Shelton,^q Michael Spannowsky,^r Shufang Su,^s Devin G. E. Walker,^t Stephane Willocq,^o Peter Winslow^o

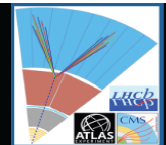


Long Lived Particles @ LHC

LHC **LLP** Community White Paper

Collecting the efforts of several workshops

- “LLP Signatures” — UMass — Nov. 2015
- “Experimental Challenges” — KITP — May 2016
- LHC LLP Mini-Workshop — CERN — May 2016 & April 2017





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Other Meetings & Events

- **International Workshop on Baryon & Lepton Number Violation: 2015**
- **School on the Physics of Electric Dipole Moments: 2016**
- **Nuclear Theory Topical Collaboration: Neutrinoless Double Beta Decay & EDMs: 2017**
- **School on the Physics of Neutrinoless Double Beta Decay: 2017**



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Upcoming Workshops & Schools

- **Theoretical issues and experimental opportunities in searches for time reversal invariance violation using neutrons (starts today!)**
- **> 5 for 2019: topics TBD**



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Support

- *Seed funding from UMass Amherst*
- *Department of Energy Office of Nuclear Physics (2018+)*
- *National Science Foundation (NLDBD School)*



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Meeting Logistics

- **Wireless Network: UMASS (usr & pw in packet) or eduroam**
- **Espresso !**
- **Lunch: on campus**
- **WS Dinner: Thursday @ Monkey Bar Bistro, 6:30 pm**
Amherst Center, Schedule: online
- **People: students, post-docs, staff (Brittany Bonenfant)**



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This Workshop: Motivation & Goals

- *Tests of time reversal invariance with neutrons and nuclei continue to push the forefront of BSM sensitivity*
- *This workshop will explore the complementarity between different neutron probes and between neutron observables and those involving other systems*
- *Experimental strategies for advancing sensitivity and open theoretical challenges will be discussed*