

# MARK S. NEUBAUER

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## EDUCATION

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- PhD** University of Pennsylvania, Physics June 2001  
Dissertation: *Evidence for Electron Neutrino Flavor Change through  
Measurement of the  $^8\text{B}$  Solar Neutrino Flux at SNO*  
Advisor: Dr. Eugene Beier
- BS** Kutztown University, Physics May 1994  
Graduated *Summa Cum Laude*  
Minored in Mathematics

## PROFESSIONAL APPOINTMENTS

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|----------------------------|---|-------------|
| <b>Professor</b>           | University of Illinois at Urbana-Champaign      | 2018 –      |
| <b>Faculty Affiliate</b>   | National Center for Supercomputing Applications | 2018 –      |
| <b>Associate Professor</b> | University of Illinois at Urbana-Champaign      | 2013 – 2018 |
| <b>Assistant Professor</b> | University of Illinois at Urbana-Champaign      | 2007 – 2013 |
| <b>Postdoctoral Fellow</b> | University of California at San Diego           | 2003 – 2007 |
|                            | Massachusetts Institute of Technology           | 2001 – 2003 |

## HONORS AND AWARDS

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|---|-------------|
| <b>Breakthrough Prize in Fundamental Physics</b>                | 2016        |
| <b>Dean's Award for Excellence in Research</b> (U. Illinois)    | 2013        |
| <b>Fellow, Center for Advanced Study</b> (U. Illinois)          | 2012 – 2013 |
| <b>NSF Career Award</b>   | 2011        |
| <b>Fellow, National Center for Supercomputing Applications</b>  | 2008 – 2009 |
| <b>Arnold O. Beckman Research Award</b> (U. Illinois)           | 2007        |
| <b>Member, Sigma Xi</b> (Massachusetts Institute of Technology) | 2002        |
| <b>Chairman's Teaching Award</b> (University of Pennsylvania)   | 1995        |

## PROFESSIONAL SERVICE

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- Committees / Co-Organizer**
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| <i>Building Collaborations for Machine Learning in HEP</i> Workshop, MIT               | 2017 |
| <i>Practice &amp; Experience in Advanced Research Computing (PEARC17)</i> Workshop     | 2017 |
| Fermilab Operational Readiness Review Committee  | 2017 |
| Chair, <i>Fostering HEP &amp; Computer Science Collaboration</i> Workshop, U. Illinois | 2016 |
| Open Science Grid Campus Infrastructures Community Committee                           | 2016 |

**Diboson Production as a Sensitive Probe of New Physics**

2007 – 2018

The search for diboson resonances is a sensitive probe of new physics. My group has been at the forefront of studying diboson production at colliders, producing:

- Stringent limits on the production of new heavy particles decaying to heavy boson pairs ( $WW$ ,  $WZ$ ,  $ZZ$ ,  $hW$ ,  $hZ$ ) and constraints on new physics models predicting these signatures at the LHC [[PRD 98 \(2018\)](#), [JHEP 1803 \(2018\)](#), [PLB 765 \(2017\)](#), [JHEP 1609 \(2016\)](#), [PLB 755 \(2016\)](#), [JHEP 1601 \(2016\)](#), [EPJC 76 \(2015\)](#), [EPJC 75 \(2015\)](#), [JHEP 1501 \(2015\)](#), [PLB 737 \(2014\)](#), [PLB 718 \(2012\)](#), [PRL 107 \(2011\)](#)]
- First measurement of  $ZZ$  production at a hadron collider [[PRL 100 \(2008\) 201801](#)]
- First observation of  $WZ$  production [[PRL 98 \(2007\) 161801](#)]

I have also authored two review articles on tests of electroweak physics

[[RMP 84 \(2012\) 1477](#)] and diboson physics at colliders [[ARNPS 61 \(2011\) 223](#)]

**Higgs Boson Discovery!**

2012

The ATLAS and CMS experiments announced the discovery of a Higgs boson  $h$ . This discovery led to the [2013 Nobel Prize in Physics](#) for its theoretical prediction

- My group contributed to this discovery ( $5.9\sigma$ ) [[PLB 716 \(2012\) 1](#)] through analysis of the  $h \rightarrow WW^* \rightarrow e\nu\mu\nu$  channel
- My group contributed to the  $h \rightarrow WW^*$  observation ( $6.1\sigma$ ) [[PRD 92 \(2015\) 012006](#)], providing the most precise single-channel measurement of  $h$  couplings. My graduate student Philip Chang received the 2014 US ATLAS Graduate Student Achievement Award for his work on the  $h \rightarrow WW^*$  observation and the  $h$  couplings measurement

**Constraints on Charged Higgs Bosons**

2012

Charged Higgs bosons ( $H^\pm$ ) often arise in new physics models. Through the work of Allison McCarn ([Ph.D. thesis](#)) and Anna Sfyrlla, my group lead searches for  $H^\pm \rightarrow \tau\nu$  in top pair events using a direct mass reconstruction method [[JHEP 1206 \(2012\) 039](#)] and via an apparent violation of lepton universality [[JHEP 1303 \(2013\) 076](#)].

**Resolution of a b-baryon Lifetime Puzzle**

2007

On CDF, I lead an analysis of  $\tau(\Lambda_b)$  in exclusive decay  $\Lambda_b \rightarrow J/\psi \Lambda$ . At the time of publication [[PRL 98 \(2007\) 122001](#)], this was the single most precise measurement of  $\tau(\Lambda_b)$  and higher than the previous world average by  $3.2\sigma$ . Our measurement resolved the “ $\Lambda_b$  Lifetime Puzzle” in favor of earlier theory calculations of  $\tau(\Lambda_b)$ .

**Resolution of the Solar Neutrino Problem**

2001

On the SNO experiment, my analysis of  $^8\text{B}$  solar neutrino data provided first direct evidence for  $\nu_e$  flavor change, resolving the decades-long “Solar Neutrino Problem”. The first SNO paper [[PRL 87 \(2001\) 71301](#)] was based on my thesis work and led to the [2016 Breakthrough Prize in Fundamental Physics](#) and the [2015 Nobel Prize in Physics](#) (A. McDonald and T. Kajita) for observation of  $\nu_e$  flavor change at SNO.

## SELECTED PUBLICATIONS

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A complete list of my publications can be found [here](#).

- M. Aaboud *et al.* [ATLAS Collaboration], “Search for  $WW/WZ$  resonance production in  $lvqq$  final states in  $pp$  collisions at  $\sqrt{s} = 13$  TeV with the ATLAS detector,” *JHEP* **1803** (2018) 042.
- M. Aaboud *et al.* (ATLAS Collaboration), “Search for new resonances decaying to a  $W$  or  $Z$  boson and a Higgs boson in the  $llbb$ ,  $lvbb$  and  $\nu bbb$  channels with  $pp$  collisions at  $\sqrt{s} = 13$  TeV with the ATLAS detector,” *Phys. Lett.* **B765** (2017) 32.
- M. Aaboud *et al.* (ATLAS Collaboration), “Searches for Heavy Diboson Resonances in  $pp$  Collisions at  $\sqrt{s} = 13$  TeV,” *JHEP* **1609** (2016) 173.
- G. Aad *et al.* (ATLAS Collaboration), “Observation and Measurement of Higgs Boson Decays to  $WW^*$  with the ATLAS Detector,” *Phys. Rev.* **D92** (2015) 012006.
- G. Aad *et al.* [ATLAS Collaboration], “Search for  $H^\pm$  through the Apparent Violation of Lepton Universality in top-pair events using  $pp$  collisions at  $\sqrt{s}=7$  TeV with the ATLAS detector,” *JHEP* **03**, 76 (2013)
- G. Aad *et al.* [ATLAS Collaboration], “Search for charged Higgs bosons decaying via  $H^\pm \rightarrow \tau \nu$  in top quark pair events using  $pp$  collisions at  $\sqrt{s}=7$  TeV with the ATLAS detector,” *JHEP* **1206**, 039 (2012)
- G. Aad *et al.* [ATLAS Collaboration], “Observation of a New Particle in the Search for the Higgs Boson with the ATLAS detector,” *Phys. Lett.* **B716** (2012) 1.
- A. Andreani, *et al.*, “The FastTracKer Real Time Processor and Its Impact on Muon Isolation, Tau,  $b$ -Jet Online Selections at ATLAS,” *IEEE Trans. Nucl. Sci.* **59** (2012) 348.
- J. Hobbs, M.S. Neubauer, and S. Willenbrock, “Tests of the Standard Electroweak Model at the Energy Frontier,” *Rev. Mod. Phys.* **84** (2012) 1477.
- M.S. Neubauer, “Diboson Production at Colliders,” *Ann. Rev. Nucl. Part. Sci.* **61** (2011) 223.
- T. Aaltonen *et al.* (CDF Collaboration), “First Measurement of  $ZZ$  Production in  $p$  anti- $p$  collisions at  $\sqrt{s} = 1.96$  TeV,” *Phys. Rev. Lett.* **100** (2008) 201801.
- A. Abulencia *et al.* (CDF Collaboration), “Observation of  $WZ$  Production,” *Phys. Rev. Lett.* **98** (2007) 161801.
- Q. R. Ahmad *et al.* (SNO Collaboration), “Measurement of the Rate of  $\nu_e + d \rightarrow p + p + e^-$  Interactions Produced by  $^8B$  Solar Neutrinos at SNO,” *Phys. Rev. Lett.* **87** (2001) 071301.