# Mustafa Mustafa

Specialties: Physics, Data Analysis, C++, ROOT, Linux
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## Education

2009-2013 **Ph.D. in High Energy Nuclear Physics**
Purdue University, IN.

**Thesis title**: Experimental study of electrons from heavy flavor hadrons decays in Au+Au collisions at $\sqrt{s_{NN}} = 200$, 62.4 and 39 GeV in the STAR experiment at RHIC
**Advisor**: Wei Xie

2004-2008 **B.Sc. in Physics**
University of Jordan, Amman, Jordan.

## Current Position

2013-Present **Postdoctoral Fellow**
Lawrence Berkeley National Laboratory,
Relativistic Nuclear Collisions group, Nuclear Science Division.

**Focus**:
I) Contributing to STAR Time Projection Chamber alignment and calibration R&D.
II) Measurements related to heavy quarks interactions and energy-loss in heavy-ion collisions.
**Advisor**: Jim Thomas

## Skills & Areas of Expertise

CS

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| Scientific Computing | C++ | OOP | Linux Clusters |
| Monte Carlo Simulations | ROOT | Mathematica | Linux Admin. |
| Data Analysis | Python | Vim | Open Source |

Physics

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| Heavy-Ion Physics | Quark Gluon Plasma | Heavy Flavor Physics |
| Mathematical Physics | Mathematical Modeling | |

MOOCs
Machine Learning (Andrew Ng)
Statistical Learning (Hastie &Tibshirani)

## Projects & Contributions

2014-Present **Heavy Ion Tea (HIT) seminars series (LBNL)**

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| | *Objective*: | Organization of HIT seminars which are organized by the Relativistic Nuclear Collisions group at LBNL. |
| | *Contribution*: | As a committee member I am involved in seminars program preparation and organization, speakers identification. |
| | *Skills*: | Being current in High Energy Particle and Nuclear Physics. Effective communication with committee members and speakers candidates. |
| | *Outcome*: | Fall 2014 seminars series. Spring 2015 series is in preparation. |

2014 **C++11 STAR coding guidelines committee**

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| *Objective*: | Revise STAR coding standard to provide guidance and recommendation of usage of C++11 new features. |
| *Contribution*: | As a member of the committee, my current assignment is to review: Range-based for loops/Ranged for loops. Override controls: override and final. Smart pointers. Move semantics/rvalue reference. Control of defaults: default and delete, move and copy. In-class member initializers. |
| *Skills*: | Knowledge of C++, STAR coding standards. Learning enough about C++11 standards to make informed recommendations. |
| *Outcome*: | Documents are still in the making. Link to the final product will be available soon. |

2014-Present **Measurement of non-photonic electrons in $U$+$U$ collisions (STAR experiment)**

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| *Objective*: | Measurement of non-photonic electrons production in $U$+$U$ collisions at $\sqrt{s}$=193 GeV. |
| *Contribution*: | Mentoring Masters student Katarína Gajdošová (Czech Technical University, Prague). |
| *Skills*: | Teaching and mentor-ship. |
| *Outcome*: | Preliminary results will be presented at the 53rd International Winter Meeting on Nuclear Physics, Borimo, Italy. (Jan/2015). |

2013-Present **Charm production in $p$+$p$ collision at $\sqrt{s}$ = 200 GeV (STAR experiment)**

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| *Objective*: | Measurement of charm production at mid-rapidity by direct reconstruction of $D^0 \rightarrow K\pi$ and $D^* \rightarrow D^0\pi \rightarrow K\pi\pi$ from RHIC year 2012 run. |
| *Contribution*: | Hao Qiu and I carried out the entire analysis. |
| *Technical skills*: | Large data analysis. PYTHIA. ROOT, OOP, C++, computer clusters. |
| *Outcome*: | Preliminary results were presented at Quark Matter 2014 PDF. |

2013-Present **Time Projection Chamber (TPC) alignment and calibration (STAR experiment)**

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| *Objective*: | Participate in STAR TPC alignment and calibration R&D (50% of my postdoc at LBNL). |
| *Contributions*: | TPC gas $\omega\tau$ and field distortion correction coefficients measurement and verification using Magboltz simulations. TPC alignment vetting using HFT and cosmics data. |

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| | *Skills*: | Learning about TPC operation physics and design engineering. TPC calibration and alignment techniques. Knowledge of STAR software infrastructure. |

2013-Present **Measurement of non-photonic electrons in $p$+$p$ collisions (STAR experiment)**

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| *Objective*: | Measurement of non-photonic electrons production in $p$+$p$ collisions at $\sqrt{s}$=200 GeV from RHIC year 2012 run. |
| *Contribution*: | Mentoring PhD. student Xiaozhi Bei (UIC and CCNU). |
| *Skills*: | Teaching and mentor-ship. |
| *Outcome*: | Poster at Quark Matter 2014. Paper in preparation. |

2012-Present **Heavy Flavor Tracker - PXL simulators (STAR experiment)**

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| *Objective*: | Development and deployment of STAR Heavy Flavor Tracker (HFT) new silicon secondary vertex tracker (PXL) simulators. |
| *Contributions*: | Designed and implemented: 1) Simulation data containers 2) Simulators interface 3) Fast simulator 4) Pile up hits adder 5) STAR wrapper for DIGMAPS MAPS sensors simulation tool. Maintaining the software package. |
| *Technical skills*: | Simulation. Software architecture. Knowledge of STAR software architecture. OOP, C++. |
| *Outcome*: | STAR PXL simulation software. github, STAR documentation. |

2014 **MTD simulation software code review (STAR experiment)**

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| *Objective*: | Verify compliance of StMtdSimMaker code with the STAR coding guidelines and C++ standards. |
| *Technical skills*: | Knowledge of C++ and STAR coding standards. |

2013 **FGT point maker code review (STAR experiment)**

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| *Objective*: | Verify compliance of StFgPointMaker code with the STAR coding guidelines and C++ standards. |
| *Technical skills*: | Knowledge of C++ and STAR coding standards. |

2011-2013 **Measurement of non-photonic electrons production and azimuthal anisotropy (STAR experiment)**

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| *Objective*: | Measurement of non-photonic electrons production and azimuthal anisotropy in $Au$+$Au$ collisions at $\sqrt{s_{NN}}$=200, 62.4 and 39 GeV. |
| *Contribution*: | PicoDst production. Data quality assurance. Electrons identification. Data analysis for spectra part. Embedding and efficiency studies. |
| *Technical skills*: | Large data analysis. Statistical methods. Simulation. PYTHIA. OOP, C++, ROOT, scripting. |
| *Outcome*: | PhD. thesis. arXiv:1210.5199. arXiv:1405.6348. Two more papers in the pipeline. |

2012-2013 **Embedding Deputy (STAR experiment)**

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| *Objective*: | Train and follow-up with Embedding Helpers on embedding productions. Quality assurance of production physics and detector performance in simulation vs. data. Follow-up on issues and bugs with the core Software and Computation team. |
| *Skills*: | Effective communication. Team management. Knowledge of STAR data simulation and reconstruction code base. C++, scripting. |
| *Outcome*: | Identified and helped in solving several software bugs. Helped in restructuring the embedding work-flow and thus refactoring submission and production management scripts. |

2010-2012 **Embedding Helper (STAR experiment)**

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| *Objective*: | Organize, prepare and submit Heavy Flavor (HF) embedding productions. Quality assurance of the production. Communicate the needs of the HF working group to the embedding team. |
| *Skills*: | Effective communication. Computational resources management and planning. C++, scripting. |
| *Achievement Highlight*: | The embedding team and I finished more than 25 HF embedding requests (17m events) for Quark Matter 2012 within sixth months. This required 6500 CPU weeks and 30TB of disk space. |

2011 **$D^*$ reconstruction with HFT (STAR experiment)**

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| *Objective*: | Study topological reconstruction of $D^*$ using STAR Heavy Flavor Tracker in full GEANT simulations. |
| *Contribution*: | Carried out the entire study. |
| *Technical skills*: | Simulations. Data analysis. PYTHIA. ROOT, C++, computer clusters. |
| *Outcome*: | Optimized topological cuts and signal significance estimates for RHIC projected luminosities for year 2014 run. PDF. |

2010-2011 **$D^0$ production in $p$+$p$ collision at $\sqrt{s}$ = 200 GeV (STAR experiment)**

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| *Objective*: | Measurement of charm cross-section at mid-rapidity by direct reconstruction of $D^0 \rightarrow K\pi$. |
| *Contribution*: | Studying event-mixing techniques in $p$+$p$ collisions. Cross-checking signal reconstruction. STAR documents. |
| *Technical skills*: | Large data analysis. PYTHIA. ROOT, C++, computer clusters. |
| *Outcome*: | Phys. Rev. D 86, 072013 (2012). arXiv:1204.4244. |

2008 **Theoretical Physics Lab. Linux Cluster (University of Jordan)**

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| *Objective*: | Constructing the first Linux Cluster in the University of Jordan for computation physics research. |
| *Contribution*: | Organized and lead a group of physicists and engineers to carry the task. |
| *Skills*: | Leadership. Linux administration, networking, cluster infrastructure. |
| *Outcome*: | We completed the construction of two clusters. |

## Talks

**Conference talks:**

2013/11 **Measurement of non-photonic electrons in STAR experiment**,
*EMMI workshop on Heavy Flavor & QCD Phase Structure in High Energy Collisions.*
LBL, Berkeley, CA. PDF.

2012/08 **Measurements of non-photonic electrons at STAR experiment**,
parallel talk at *Quark Matter 2012 International Conference*,
Washington D.C. PDF.

**Invited talks:**

2014/06 **Recent open heavy flavor results from STAR experiment**,
*RHIC & AGS Annual Users' Meeting*,
BNL, NY. PDF.

2013/06 **Recent open heavy flavor results at RHIC**,
*RHIC & AGS Annual Users' Meeting*,
BNL, NY. PDF.

2012/10 **Measurements of non-photonic electron in STAR experiment**,
*International Workshop on Heavy Quark Production in Heavy-Ion Collisions*,
Utrecht, Netherlands. PDF.

2012/08 **Measurements of non-photonic electron in STAR experiment**,
*Workshop on Heavy Flavor Production in High-Energy Nuclear Collisions*,
UIC, Chicago, IL. PDF.

**Seminars:**

2014/08 **Measurements of electrons from heavy-flavor hadrons decays in STAR experiment**,
*University of Illinois at Chicago*,
Chicago, IL. PDF.

## Publications

+50 publications. Full list available at Google Scholar or INSPIRE.

**Selected experimental physics publications:**

2013 *Measurements of non-photonic electron production and azimuthal anisotropy in* $\sqrt{s_{NN}} = 39$, $62.4$, *and* $200$ *GeV* $Au$+$Au$ *collisions from STAR at RHIC*.
Mustafa Mustafa (for the STAR Collaboration). Nuclear Physics A 904-905, 665 (2013). arXiv:1210.5199.

2012 *Measurements of* $D^0$ *and* $D^*$ *production in* $p$ + $p$ *Collisions at* $\sqrt{s}$ = *200 GeV*.
L. Adamczyk et al. (STAR Collaboration). Phys. Rev. D 86, 072013 (2012). arXiv:1204.4244.

**Mathematical physics publications:**

2011 *Supersymmetry identifies molecular Stark states whose eigenproperties can be obtained analytically*.

M. Lemeshko, M. Mustafa, S. Kais, B. Friedrich. New J. Phys. 13, 063036 (2011). arXiv:1106.4402.

2011 *Supersymmetric factorization yields exact solutions to the molecular Stark effect problem for "stretched" state*.
M. Lemeshko, M. Mustafa, S.Kais, B. Friedrich. Phys. Rev. A. 83, 043415 (2011). arXiv:1105.5262.

2009 *A Venn diagram for supersymmetric, exactly solvable, shape invariant, and Infeld-Hull factorizable potential*.
M. Mustafa, S. Kais. arXiv:0911.4206.

2009 *Effective polar potential in the central force Schrödinger equation*
M. S. Shikakhwa and M. Mustafa. Eur. J. Phys. 31, 151 (2010). arXiv:1001.3693.

**Book chapters:**

2009 *General Physics, Electromagnetism Laboratory Manual, 3rd Edition*.
M. S. Shikakhwa, M. Mustafa, R. Al-Rfou', A. Ecevit, M. Ozbakan.
Middle East Technical University, North Cyprus Campus.

## Work History:

**Research:**

2010-2013 **Graduate research assistant. High-Energy Nuclear Physics Group.**
*Purdue University, IN.*
The primary focus of my research was heavy quarks interaction with the strongly interacting partonic medium created in heavy-ion collisions so-called Quark Gluon Plasma.

2008-2009 **Research assistant. Remote collaboration with Prof. Sabre Kais.**
*Purdue University, IN.*
Applications of Supersymmetric Quantum Mechanics techniques to problems in Atomic and Molecular Physics. This work has been initiated during my Dec. 2008 research visit to Max Planck Institute for Physics of Complex Systems, Dresden, Germany.

2008 **Research Assistant. Prof. Jameel Khalifeh's group.**
*University of Jordan, Amman, Jordan.*
Worked on analytical evaluations of lattice Green's functions for isotropic and anisotropic FCC, BCC and SC lattices, where these are applied to evaluate resistance of networks of resistors.

2007 **DAAD Intern.**
*Ilmenau Technical University, Ilmenau, Germany.*
Developed a Mathematica™ visualization package to be used with an Ada implementation of a Kinetic Monte Carlo simulation of thin film growth package.

**Teaching:**

2009-2010 **Astronomy laboratory teaching assistant.**
*Purdue University, IN*.

2008-2009 **Introductory physics laboratory instructor.**
*Middle East Technical University, North Cyprus Campus*.

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