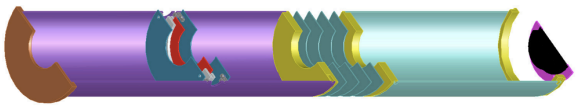
Postdoctoral Fellowship Highlight

Eddie C. Red, Ph.D., Physics

Years of Fellowship: 2007-2010
Collaborating Institution: Lawrence Berkeley National Laboratory
Currently: Assistant Professor, Morehouse College, Atlanta

Project: **Helped develop a low energy photoelectron velocity map imaging spectrometer to measure near-zero kinetic energy photoelectron angular resolved distributions from atoms and molecules**

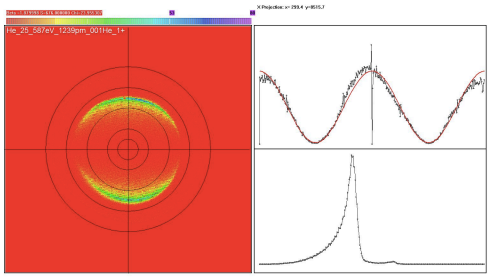
As a Lawrence Postdoctoral Fellow and ALS Postdoctoral Fellow, Eddie Red helped develop a low energy photoelectron velocity map imaging spectrometer to measure near-zero kinetic energy photoelectron angular resolved distributions from atoms and molecules.

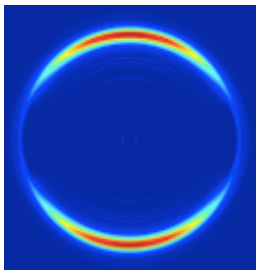


The research pursued during his stint as postdoc at LBNL was essential to perform proof of principle experiments to detect photoelectrons with energies slightly above the ionization threshold (less than 100 meV). This was accomplished by designing a modified velocity map imaging (VMI) spectrometer, which minimized external effects associated with stray magnetic fields that can alter the trajectories and time-of-flights for these near-zero kinetic-energy photoelectrons. A major objective of the experiments performed was to measure the angular distributions for these slowly moving photoelectrons. Such measurements are essential to understanding the dynamics governing electron correlations. Several experiments were undertaken in which the β-asymmetry parameter was successfully measured to a high degree of accuracy for helium and neon and were compared to previous theoretical and experimental data. These experiments validated the use of a modified VMI spectrometer designed to measure angular distributions of photoelectrons with kinetic energies 5 meV – 1 eV above the ionization threshold. In addition, the limitations of the VMI apparatus were explored and compared with similar techniques (such as COLTRIMS, CIEL, etc.) in the energy regime of interest.

This research experience was coupled with Eddie's extensive theoretical background in AMO physics and plays an important part in his current aspirations to pursue research that marries

theoretical calculations with experiment. As a result of his postdoctoral experience, Eddie has moved forward with the development of his own research laboratory, which offers students various research options.





Eddie obtained a tenure-track assistant professor position at Morehouse College in Atlanta Georgia. In addition to teaching and advising, Eddie is in the process of setting up an interdisciplinary undergraduate research laboratory. Currently, there are 10 undergraduate research students working in the R.E.D. Laboratory. Within his research lab, students have the opportunity to explore various research projects in the areas of Atomic & Molecular Physics, Materials Science Physics & Nanotechnology, Electrochemistry, and Nuclear Sciences. These projects cover a range of topics in which nano-engineered materials are used and have applications in the design of nuclear fuel cladding, fuel cells, solar panels, batteries, and sensors to name a few. He also continues his research efforts with projects involving electron/ion collisions and the quantum control of molecular reactions.

[1] Red, E.C., A.M. Juarez, D. Rolles, and A. Aguilar, "Exploring the limitations of the velocity map imaging technique for low kinetic energy photoelectrons". [Proceedings of 2008 Pan American Advanced Studies Institute (PASI) - "Ultrafast and Ultrasmall: New Frontiers in Atomic, Molecular and Optical Science", **56**(2), 100-102 (2010).

[2] M. Hoener, D. Rolles, A. Aguilar, R. C. Bilodeau, D. Esteves, P. Olalde Velasco, Z. D. Pešić, E. Red, and N. Berrah. "Site-selective Ionization and Relaxation Dynamics in Heterogeneous Nanosystems." *Physical Review* A **81**, 021201 (2010).

[3] Esteves, D.A., R.C. Bilodeau, N.C. Sterling, R.A. Phaneuf, A.L D. Kilcoyne, **E.C. Red**, and A. Aguilar, "Absolute high-resolution Se^+ photoionization cross-section measurements with Rydberg-series analysis," *Physical Review A: Atomic, Molecular, and Optical Physics* **84**(1), 013406-1 (2011).

[4] Sterling, N.C., D.A. Esteves, R.C. Bilodeau, A.L D. Kilcoyne, E.C. Red, R.A. Phaneuf, and A. Aguilar, "Experimental photoionization cross-section measurements in the ground and metastable state threshold region of Se^+," *Journal of Physics B: Atomic, Molecular and Optical Physics* **44**(2), 025701, (2011).

[5] Sterling, N.C., M.C. Witthoeft, D.A. Esteves, R.C. Bilodeau, A.L. Kilcoyne, E.C. Red, R.A. Phaneuf, G. Alna-Washi, and A. Aguilar, "New atomic data for trans-iron elements and their application to abundance determinations in planetary nebulae," *Canadian Journal of Physics* **89**(4), 379-385 (2011).

[6] Esteves, D.A., A. Aguilar, A.L. Kilcoyne, R.C. Bilodeau**, E.C. Red**, and N.C. Sterling, "Absolute single photoionization cross-section measurements of Se^{3+} and Se^{5+}," *Journal of Physics B: Atomic, Molecular and Optical Physics* **45**(11), 115201 (2012).