In this project, I wish to formulate the theory of strong field MPI and ATI of a single one-electron atom irradiated by an intense beam of vortex photons. I plan to follow the steps of some work I did more than two decades ago for the same processes, albeit using linearly- and circularly polarized plane-wave laser beams. The method is based on semiclassical treatment in which the electron is treated quantum-mechanically and the radiation fields of the vortex beam are modeled classically by Laguerre-Gaussian and/or Bessel functions. The angular momentum of the vortex photons may get transferred to the emitted electrons, producing vortex electrons. My approach will employ a wavefunction time-evolved using a series introduced by M. Frasca, which is similar to the Dyson series, albeit with the roles of the non-interacting atomic Hamiltonian and the interaction reversed. The results will be transition probabilities for the multi-photon ionization and energy spectra of the emitted electrons. More specifically, the study will try to answer the following questions: (1) Can MPI and ATI, employing vortex photons, be done fully analytically?
(2) Does one get emitted electron energy spectra with peaks like in MPI and ATI with plane-wave linearly and circularly polarized photons? (3) Will the emitted electrons carry angular momentum (i.e., will they be vortex electrons)?

Start date: 06-01-2024

End date: 05-31-2025

Last modified: 10-14-2023

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Atomic Multi-Photon Ionization Using Vortex Laser Photons

Data Collection

Give a summary of the data to be collected or produced.

Output from numerical calculations will be data files (.dat)

Storage and Back-up

How will the data (digital or non-digital formats) be stored and backed up during the research?

On my network drive.

Access and Use Rights

What steps will be taken to protect privacy, confidentiality, intellectual property or other rights?

No access concerns.

Sharing Data and Controlling Access

Will data be shared during the course of the project?

Data will be shared by email, if need be.

Data Organization, Documentation and Metadata

What documentation and / or metadata (information about the data) will ensure data can be retrieved and used?

fig1.dat, ...

Data Preservation and Archiving
Should the data be considered for permanent retention / archiving?

No need for permanent retention.
**Planned Research Outputs**

**Data paper - "Atomic Multi-Photon Ionization Using Vortex Laser Photons"**

Analytic work (equations) will be derived for the ionization rates of atomic electrons. Data produced from the equations will be presented graphically.

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**Planned research output details**

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