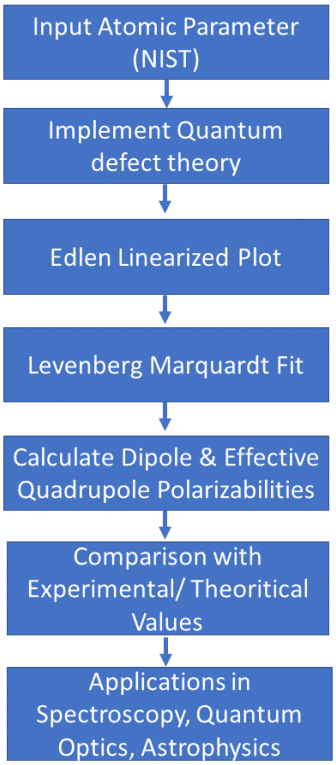
Masters Thesis Information Showcase
Spring Semester-2026
Year 2026

	Department: PHYSICS Programme: MS PHYSICS Specialization: Physics
1	**Title of the Thesis** Atomic Polarizability of H-Like Group-A elements using Semi-empirical method.
2	**Abstract** Atomic spectroscopy played a vital role in understanding not only atom but the universe. The measurement of lifetime, transition probabilities, oscillator strength, and line strengths of spectral line emitted from atoms has revealed important characteristics of atoms and the nature and history of the phenomena in the evolution of the Universe. The advent of the Laser made this field alive. Another important atomic property, the Dipole polarizability α_d, is important for understanding the behavior of atom in external fields including long range atomic interaction, shift in energy level, precision calculation. It is also important in modeling of stellar atmosphere and find broad applications in atomic physics, quantum optics, and astrophysics. In this work, Core polarizability model was used to calculate the dipole polarizability α_d of 40 hydrogen like atoms from Group A elements. Python program were developed to estimate the dipole polarizabilities. It based on the Quantum defect theory and Edlén's linearized formulation. Beside it calculated effective quadrupole polarizability α_q^{eff}. Initial energies were taken from National institute of science and technology (NIST). These results were compared with existing results and found accuracy and contribute in atomic models and applications in spectroscopy.
3	**Impact on SDG#___"** (min 500 words) (Please mention the impact of the relevant attained SDG) The present work on atomic spectroscopy and the determination of dipole and quadrupole polarizabilities using the Edlén linearization method is intrinsically aligned with several United Nations Sustainable Development Goals. Goal 9 (Industry, Innovation, and Infrastructure) is directly addressed, as this research advances fundamental atomic physics specifically, precise polarizability data for Rydberg states of alkali atoms and hydrogen-like systems, which underpins technological innovations in quantum computing, precision atomic clocks, laser systems, and optical lattice design. This contributes to building resilient infrastructure and fostering scientific innovation. Regarding Goal 4 (Quality Education), this work utilizes open-access spectroscopic data from the NIST Atomic Spectra Database and contributes new, empirically validated polarizability values to the global scientific literature, serving as an educational resource and benchmark for future students and researchers in atomic, molecular, and optical physics. Furthermore, this

	research supports Goal 17 (Partnerships for the Goals) by relying on international scientific collaboration drawing upon theoretical advances, experimental data, and computational resources from multiple institutions worldwide and by producing open, reproducible results that strengthen the global scientific community's knowledge base. Additionally, the atomic spectroscopy techniques reviewed and applied in this work are essential diagnostic tools for Goal 7 (Affordable and Clean Energy), particularly in plasma physics research for controlled nuclear fusion, a potential clean and abundant energy source.
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6	**Graphical Abstract**