

# Photoelectron Angular Distributions Seminar Series Outline

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This series aims to provide some insight into photoelectron angular distributions (PADs) in the perturbative or weak field limit. I will spend some time discussing background material - scattering theory and angular momentum theory - before bringing this material together to describe PADs, essentially the angular interference patterns of photoelectron partial waves. The theory part will not be rigorous, relying on examples and illustrations to try and offer a more intuitive picture of the physics. Depending on the outcome of the three talks outlined below there may be a follow-up talk/talks on some aspects of the material and possibly extension to cover PADs in the non-perturbative/strong-field case.

## Part I - Very Brief Introduction to Scattering Theory

- Scattering theory overview (stationary-state picture).
- Partial wave expansion.
- Radial continuum wavefunctions for Coulombic and non-Coulombic potentials.
- The importance of the scattering phase shift.

## Part II - Very Brief Introduction to Angular Momentum

- Angular momentum overview - what is angular momentum?
- Angular momentum wavefunctions - the spherical harmonics.
- Angular momentum coupling - Clebsch-Gordan coefficients and Wigner 3j symbols.
- Transformation under rotation - rotation matrix elements.
- Angular part of the scattering problem.

## Part III - Very Brief Introduction to Photoionization & Photoelectron Angular Distributions

- Dipole approximation, dipole matrix elements, explicit formulation of matrix elements from bound and continuum wavefunctions.
- Integrated and differential cross-sections, including exact result for 1-electron system (Cooper & Zare).
- Examples of PADs from atomic systems, in particular case of  $O^-$  photodetachment and s-d wave interference.
- Examples of PADs from molecular systems - case of many partial wave components due to non-central potentials, l-mixing/scattering etc.
- Molecular frame versus lab frame PADs.