

**Quantum Theory of Scattering: Outline**  
Academy of Physics Teachers Kerala Workshop  
23-24 June, 2018 at Christ College, Irinjalakuda  
Govind Krishnaswami, Chennai Mathematical Institute

1. Scattering in one dimension
  - (a) Reflection and transmission coefficients
  - (b) Probability current and Wronskian
  - (c) S-matrix in 1D, unitarity, phase shifts
  - (d) Dirac delta potential, poles of S-matrix and bound states
2. Scattering in three dimensions
  - (a) Introduction, spherical polar coordinates
  - (b) Incoming and scattered waves, scattering boundary condition
  - (c) Free particle eigenfunctions in spherical coordinates
  - (d) Spherical harmonics and spherical Bessel functions
  - (e) Differential scattering cross section
  - (f) Scattering amplitude
  - (g) Total cross section
3. Partial wave expansion
  - (a) Partial wave amplitudes and phase shifts
  - (b) Semi-classical estimate of phase shifts
  - (c) S-wave scattering
  - (d) S-wave scattering length
  - (e) Optical theorem
  - (f) Infinitely hard sphere scattering
  - (g) Scattering from a finite spherical well
4. Born series and approximation
  - (a) Integral form of the Schrodinger eigenvalue problem
  - (b) Green's function for the Helmholtz operator
  - (c) Born series for the wave function
  - (d) First Born approximation
  - (e) Scattering amplitude as Fourier transform of potential
  - (f) Born approximation for spherically symmetric potential
  - (g) Screened Coulomb potential
  - (h) Rutherford cross section
  - (i) Classical approach to Coulomb scattering