

1 Abstract

Along these lectures, we introduce a new series of solvable models in quantum mechanics, focusing on the one dimensional models either relativistic or non-relativistic. In the one dimensional models with contact potentials (or potential supported on a dot, such as Dirac delta interactions), we use different type of constructions as listed below. We analyze several aspects of the problem giving some relevance to scattering. We also study one another model that we may classify as *singular*, for which the potential is the one dimensional Coulomb. Models are intended to be treated with due mathematical rigor and include:

- Contact potentials defined through self adjoint extension of symmetric operators.
- Same with a distributional method.
- The Salpeter Hamiltonian decorated with N deltas and Heat Kernel regularization.
- The Schrödinger equation with N delta potentials.
- One dimensional Dirac equation with two centers and given symmetry.
- The Birman-Schwinger method applied to the one dimensional Coulomb potential.