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Truncation of Continuum Ambiguities in Phase-Shift Analysis

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Abstract. The continuum ambiguity in the determination of phase shifts from scattering data consists of a family of amplitudes which have in general an infinite number of partial waves. In practical computations, however, the partial wave series is necessarily truncated. We discuss the relation of the resulting (truncated) amplitudes to those representing the true continuum ambiguity. In particular, we show that each of the latter is approximated increasingly well, as the cut-off tends to infinity, uniformly inside an ellipse in the $\cos\theta$ plane.

1. Introduction

It is well known that the determination of an elastic scattering amplitude from data on elastic scattering (differential cross-sections, polarizations, etc.), at a fixed energy over the whole angular range, generally suffers from a continuum ambiguity when the energy is such that inelastic channels are open. The family of amplitudes making up this continuum ambiguity can be explored by means of a generalization to function spaces of the implicit function theorem [1, 2]. However, in the practical implementation of this method for the determination of ambiguities [3], the partial wave series is necessarily truncated, whereas the true continuum ambiguity contains amplitudes with an infinite number of partial waves. In earlier work [3], it was generally assumed that the truncation error was unimportant: in this paper we discuss in a precise manner the relation between the truncated amplitudes produced by the computer and those belonging to the continuum ambiguity. There are two facets of this problem: i) on the one hand, one must show that, for any member of the continuum ambiguity, one can generate a sequence of increasingly better approximants by letting the truncation point recede to infinity; ii) if the finite algorithm of the computer generates a solution,

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