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The analytic properties of the triangle and box diagram amplitudes

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An investigation is made of the analytic properties of two Feynman amplitudes, the triangle diagram amplitude and the box diagram amplitude, by using two different methods. After the first two introductory chapters, the scalar triangle diagram amplitude is studied in Chapter 3. The Feynman parametrisation of this amplitude is transformed directly into a single spectral representation in the Mandelstam variable t. In this way, the different forms of the spectral representation, the weight functions and the thresholds are obtained directly for all possible mass configurations involving stable external particles. Then, by starting with a particular normal threshold spectral representation obtained by the method of direct transformation (or by a heuristic method which is also discussed in this chapter), the different forms of the spectral representation, including cases for which the threshold is anomalous, are obtained by continuing in the external masses squared.

In Chapter 4, the method of direct transformation is extended to apply to the scalar box diagram amplitude. In this way, a double spectral representation in the Mandelstam variables s and t is established, and necessary and sufficient conditions for its validity are found. Further, by the same method, a number of different spectral representations for the box diagram amplitude are obtained for cases when the double spectral representation is no longer valid. The method of analytic continuation is then used in Chapter 5 to establish spectral representations for the box diagram amplitude for both real and complex s and t. In particular, for cases when the external particles are stable, spectral representations

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are obtained for all s in the upper half complex plane and for almost all $-\infty < t < +\infty$. These spectral representations are established by starting with a particular normal threshold spectral representation, obtained in Chapter 4 by the method of direct transformation (or by a heuristic method which is also discussed in Chapter 4), and continuing in the external masses, and then in s and t.

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