Commun. math. Phys. 15, 83—132 (1969)

The Monodromy Rings of a Class of Self-Energy Graphs

G. PONZANO, T. REGGE, E. R. SPEER*, and M. J. WESTWATER*
Institute for Advanced Study, Princeton, New Jersey

Received April 18, 1969

Abstract. The monodromy rings of self-energy graphs, with two vertices and an arbitrary number of connecting lines, are determined.

§ 1. Introduction

This paper is the first of a series of publications in which we hope to elucidate in a systematic way the properties of Feynman integrals. The motivation for this work is clear: we hope to develop sufficiently the methods of investigating functions of several complex variables defined by integrals to give a basis for the determination of the analytic structure of the S-matrix itself. This is admittedly not an easy task and one whose outcome we cannot guarantee. An ideal research program should be carried out in three steps:

I) The individual contributions of each perturbation order should be separately investigated. These are functions of the Nilsson class[1] and therefore their analytic structure admits a simple qualitative description – to each function corresponds a certain group, the fundamental group of its domain, and a finite dimensional representation of this group by linear transformations of the vector space spanned by the determinations of the function in the neighbourhood of a nonsingular point. This representation may be extended to a representation of the group ring of the fundamental group which we term the monodromy ring of the function[2]. These rings are to be explicitly determined.

This point of the program is well under way and has been completed for the single loop Feynman relativistic amplitudes (FRA) and for the class of self-energy FRA considered in the present paper.

* Research sponsored by the Air Force Office of Scientific Research, Office of Aerospace Research, United States Air Force, under AFOSR Grant 68-1365.

[1] See § 3.3.

[2] These concepts are developed in detail in § 2.