Preface

The purpose of the present book is to use the phase-integral approximation of arbitrary order generated from an unspecified base function, which is described in Chapter 4, in a systematic treatment of the Stark effect for a hydrogenic atom or ion in a homogeneous electric field. Previously the Carlini[1] (JWKB) approximation has often been used to treat this problem, and there have many times appeared discrepancies between results obtained by the use of that approximation and accurate numerical results. As has been pointed out in particular by Farrelly and Reinhardt (1983) the reason for this is in general not that the approximation method is inadequate, but that it has often been used incorrectly. When it is used in an appropriate way, the discrepancies disappear, and one often obtains highly accurate energies for the Stark problem already in the first-order approximation. This conclusion applies, even to a larger extent, to the approach based on the still more efficient phase-integral approximation of arbitrary order generated from an unspecified base function, which for the Stark effect in hydrogenic atoms or ions yields analytical formulas expressed in terms of complete elliptic integrals, which can be evaluated efficiently by means of standard computer programs.

In Chapter 8 a large number of phase-integral results are compared to results obtained by other methods. Of the 198 different states discussed there, which correspond either to different quantum numbers or to the same quantum numbers but different electric field

[1] As regards the motivation for the name Carlini approximation we refer to Fröman and Fröman (1985) or to Chapter 1 in Fröman and Fröman (2002).

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strengths, the phase-integral energy values are judged to be at least as accurate as the results obtained by other methods in more than half of the cases. It may also be mentioned that, compared to the results obtained by other methods, the phase-integral energy values can contain up to six more digits.

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