Geometry,
Integrability
and
Quantization

IS THE LIGHT TOO LIGHT?[*]

SILVIA VILASI, ROSANGELA CANONICO[†], GIOVANNI SPARANO[‡]
and GAETANO VILASI[†]

*Dipartimento di Scienze Farmaceutiche, Università degli Studi di Salerno
and INFN, Sezione di Napoli, Compl. Universitario di Monte Sant'Angelo
Via Cintia, 80126 Napoli, Italy*

[†]*Dipartimento di Fisica "E.R. Caianiello", Università degli Studi di Salerno,
and INFN, Gruppo Collegato di Salerno, Salerno, Italy*

[‡]*Dipartimento di Matematica e Informatica, Università degli Studi di Salerno,
and INFN, Gruppo Collegato di Salerno, Salerno, Italy*

Abstract. The gravitational interaction of light is analyzed considering its dual characteristic nature, i.e., as an (electromagnetic) wave or as a particle (photon). Considered as an electromagnetic wave, the light can be source of gravitational waves belonging to the larger class of exact solutions of Einstein field equations which are invariant for a non-Abelian two-dimensional Lie algebra of Killing fields. It is shown that in the would be quantum theory of gravity they correspond to spin-1 massless particles.

1. Introduction

As described in **Quantum Electrodynamics** (QED), photon-photon scattering can occur through the creation and annihilation of virtual electron-positron pairs and may even lead to collective photon phenomena. Photons also interact gravitationally but the gravitational scattering of light by light has been much less studied. Purely general relativistic treatments of electromagnetic wave interactions have been made resulting in exact solutions [12, 13], but these calculations are different from pure scattering processes and do not address the interaction at single photon level. It is not clear to what extent, calculations of the gravitational cross-section using **Quantum Filed Theory** (QFT) methods are consistent with classical **General Relativity** (GR). First studies go back to Tolman, Ehrenfest and Podolsky

---

[*]Reprinted from JGSP **19** (2010) 87–98.