

Theory of the Michelson-Morley Experiment in a Gravitational Field (*).

M. A. F. ROSA

*Instituto de Física e Gleb Wataghin, UNICAMP
Caixa Postal 1170, 13.100, Campinas, SP, Brasil*

W. A. RODRIGUES jr.

*Instituto de matemática, Estatística e Ciência de Computação, UNICAMP
Caixa Postal 6166, 13.100 Campinas, SP, Brasil*

(ricevuto il 3 Luglio 1985)

PACS. 04.20. - General relativity.

Summary. - We give a rigorous derivation of the expected results for a Michelson-Morley like experiment with one of the arms in the vertical direction, by taking explicit account of the gravitational effects. We prove that in the Schwarzschild field the experiment will give a null result in the first order of $GM_{\oplus}/R_{\oplus}c^2$. We also clear some misconceptions having to do with the problem.

In 1924 REICHENBACH⁽¹⁾ proposed a Michelson-Morley like experiment with one of the arms in the vertical direction of the Earth gravitational field (MMEGF) as a way to verify the validity of the General Theory of Relativity (see fig. 1). He predicted a positive result, i.e. a fringe-shift when the interferometer is rotated through 90° and the gravitational field is the Schwarzschild field. The experiment has been analysed also by IVES⁽²⁾. He showed that the Schwarzschild metric could be derived using arguments based on the Lorentz Aether Theory with the condition that the MMEGF gives a null result, i.e. no fringe shift when the interferometer is rotated through 90° degrees.

In a recent analysis of the experiment Zhong^(3,4) concludes that the prediction of the result of the experiment according to general relativity depends on the definition of physical three-dimensional length. He also concludes that the realization of the

(*) This work is supported in part by CNPq (Brasil).

(1) H. REICHENBACH: *Axiomatization of the Theory of Relativity* (University of California Press, Berkeley, Cal., 1969).(2) H. E. IVES: *J. Opt. Soc. Am.*, 29, 183 (1939).(3) Z. YUAN-ZHONG: *Acta Phys. Sin.*, 31, 1440 (1983).(4) Z. YUAN-ZHONG: *More on the possibility of a fourth test of general relativity in earth's gravitational field*, Academia Sinica, preprint AS-ITP-82-003 and in publication in *Acta Phys. Sin.*