Kasner, E.

The solar gravitational field completely by its light rays. (English) JFM 48.1039.05

Math. Ann. 85, 227-236 (1922).

Der Verf. hat in einer früheren Arbeit (vgl. das vorige Ref.) gezeigt, daß zwei Einsteinsche Gravitationsfelder, die nahezu euklidisch sind und dieselben Lichtwege haben, auch in den Bahnkurven des Gravitationsfeldes, den geodätischen Linien, übereinstimmen. In der vorliegenden Arbeit zeigt der Verf., wie für das Einkörperproblem auch ohne Voraussetzung des fast-euklidischen Charakters, sich die geodätischen Linien aus der Kenntnis der Bahnen der Lichtstrahlen berechnen lassen.

Reviewer: Frank, Ph., Prof. (Prag)

Full Text: DOI EuDML Link

References:

[1] Einstein's theory of gravitation: determination of the field by light signals. Am. J. of Math.43 (1921), pp. 20-28. · Zbl 48.1039.04

[2] Raum, Zeit, Materie, 4. Auflage (1921), p. 115, and footnote p. 257.

[3] The converse question, determination of the field (and hence of the light rays) from the orbits (geodesics) alone, has been discussed by the author in Science52 (1920), pp. 413-14. See also Science53 (1921), p. 238, and American Journal of Mathematics43 (1921), pp. 126-133, where it is proved that the solar field can be represented in a six-flat, but not in a five-flat.

[4] These may be regarded as special cases of Levi-Civita's general formulas for the conformal transformation of arbitrary riemannian manifolds ofn dimensions. See Nota III of his elegant series on ?ds 2 einsteiniani in campi newtoniani?, Rend. Acc. d. Lincei (1918), p. 187. The same remark applies to the formulas for the Euclidean case in {\S} 2 of the writer's article in Amer. Journ. of Math.43, p. 23.

[5] Über das Gravitationsfeld eines Massenpunktes, Sitzungsber. Akad. Berlin (1916), p. 189; or the simpler derivation in Hilbert, Grundlagen der Physik II, Göttinger Nachrichten (1917), p. 70.

[6] This form is termed pseudo-euclidean by Hilbert (?Grundlagen der Physik?, Göttinger Nachrichten 1915, 1917). Eddington uses both semi-euclidean and hyperbolic, ?the latter term, however, should not be used since there is no connection with Lobatchevsky space. The form is flat (zero riemann curvature) and is included under euclidean manifolds by Einstein.

[7] See American Journal of Mathematics43, pp. 23, 24 where it is shown directly that the curvature tensorR ij,kl vanishes. (This may also be proved from Levi-Civita's general formulas.) The letterN of the present paper is there taken asM, and the equation corresponding to (20?) is not printed, but is used in the integration, giving condition (21?). The equationN=0 thus represents a null-hypersphere in the four-flat (x 1 x 2 x 3 x 4). [Added in proof: A simple derivation of this theorem forn dimensions is given in a note by J. A. Schouten and D. J. Struik to be published in Amer. Journ. of Math. The result is stated by Ogura, Comptes Rendus, Nov. 17, 1921, apparently without knowledge of my earlier papers.]