ELSEVIER

1 November 1999

Physics Letters A 262 (1999) 257–260

PHYSICS LETTERS A

www.elsevier.nl/locate/physleta

Comment on "The speed of gravity"

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Received 18 March 1999; accepted 22 September 1999
Communicated by P.R. Holland

Abstract

Comment on a recent article by Van Flandern [Phys. Lett. A 250 (1998) 1].

In a provocative paper, Van Flandern [1] argues that the speed of propagation of the inverse-square gravitational force must be, if not infinite, at least greater than 2×10^{10} c. The core of the argument is the statement that "the consequences of introducing a delay into gravitational interactions ... is usually disastrous because conservation of angular momentum is destroyed". Thus, Van Flandern argues that if the speed of propagation for gravitational fields is limited to the velocity of light, two gravitating masses would experience a torque which accelerates the two masses so as to add angular momentum to the system. Since the effects of such a torque have not been observed, Van Flandern concludes that the speed of gravitational interactions must be far greater than that of light to minimize retardation effects.

Van Flandern quotes Sir Arthur Eddington's description of the argument and goes on to note that "the speed of gravity in Newtonian Universal Law is necessarily infinite. But [general relativity] reduces to Newtonian gravity in the low velocity, weak-field limit, which raises the obvious question of how that can be true if the propagation speed in one model is the speed of light, and in the other model it is infinite". Eddington's version of the argument, with reference to Fig. 1, is:

"If the Sun attracts Jupiter towards its present position S, and Jupiter attracts the Sun towards its present position J, the two forces are in the same line and balance. But if the Sun attracts Jupiter towards its previous position S', and Jupiter attracts the Sun towards its previous position J', when the force of attraction started out to cross the gulf, then the two forces give a couple. This couple will tend to increase the angular momentum of the system, and, acting cumulatively, will soon cause an appreciable change of period, disagreeing with observation if the speed is at all comparable with that of light".

Note that Eddington chooses a non-rotating frame of reference with origin at the center of mass. If one were to choose a frame of reference centered on one of the masses, say S, the force on J due to S is always directed radially toward S. The force on S due to J is also always radial and directed towards J. But since J is moving in the non-rotating refer-

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0375-9601/99/$ - see front matter
PII: S0375-9601(99)00675-1