число). Тогда условие $\theta_0 = \theta_d$ эквивалентно $R_d = \frac{a}{2}\sqrt{\frac{n_0}{n_2|A|^2}} = R_{nl}$, где R_{nl} называется нелинейной дифракционной длиной, или длиной самофокусировки. В случае большой мощности ($P \gg P_c$) поведение пучка может быть описано в приближении геометрической оптики. В случае $\varepsilon_2' < 0$ (уменьшение показателя преломления в поле пучка) имеет место самодефокусировка электромагнитной волны.

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NONLINEARITIES IN ENERGY

I.S. Nurgaliev

The problem of effective energy transfer is considered. A few approaches are proposed for solving this task.

Keywords: nonlinearities, energy transfer, energy saving.

UDC 5530.12+531.51

EFFECT OF SELF-ACTION IN THE WORMHOLE SPACETIMES

A.A. Popov[1]

We consider the problem of computing the self-force on a scalar or electric charge at rest in the wormhole spacetimes.

Keywords: effect of self-action, wormhole spacetime.

The motion of a charged point-like object in a fixed background spacetime, is affected by the coupling between the object’s own charge, and the field that this charge induces. This coupling results in a self-force acting on the object. At leading order, the object’s acceleration due to this self-force (in the absence of non-gravitational external interactions) is proportional to q^2/M, where q and M denotes the object’s charge and mass, respectively. This leading order is obtained by treating the particle’s field as a linear perturbation over a fixed curved background spacetime.

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[1] *apopov@kpfu.ru*; Kazan Federal University

In flat spacetime this effect is produced by a local distortion of the field lines associated with the particle's acceleration. For electrically charged particles in flat spacetime, the self-force is given by the Abraham-Lorentz-Dirac formula. In the gravitational field the self-energy problem becomes more complicated. The reason is that contribution to the self-energy in this case is non-local. The self-force problem for an electric charge in a curved space background was first investigated by DeWitt and Brehme and later by Hobbs[1]. The gravitational self-force was first calculated almost simultaneously by Mino, Sasaki and Tanaka[2] and by Quinn and Wald[3]. Later, Quinn derived the equivalent formula for a charge coupled to a minimally-coupled massless scalar field[4].

Analysis of the self-force in curved spacetime also has a practical motivation: one possible source for LISA - the planned spacebased gravitational wave detector, is a binary system with an extreme mass ratio, which inspirals toward coalescence. Here, the self-force is required for the calculation of the accurate orbital evolution of such systems. These orbits are needed in order to design templates for the gravitational waveforms of the emitted gravitational radiation.

A number of simple static configurations has been analyzed, including the self-force acting on scalar or electric charges held static in the spacetime of a Schwarzschild black hole[5], electric or magnetic dipoles which are static outside a Schwarzschild black hole[6], a static electric charge outside a Kerr black hole[7] or a Kerr-Newman black hole[8], a static electric charge in a spherically-symmetric Brans-Dicke field[9]. The self-force can be nonzero for a static particle in flat spacetimes of the topological defects[10]. In curved spacetimes with nontrivial topological structure the investigations of this type have the additional interesting features[11].

Unfortunately, the authors do not know the results of calculation of the self-force of the charge, which is the source of a massive field. In this paper we consider the problem of computing the self-force on a scalar charge at rest in the spacetimes of long throats, allowing for the arbitrary values of the mass of field and coupling constant. It gives the possibility to compare the explicit calculation of the self-force in the limit of large mass of the field with the corresponding result of paper[12].

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ЭФФЕКТ САМОДЕЙСТВИЯ В ПРОСТРАНСТВАХ КРОТОВЫХ НОР

А.А. Попов

Рассмотрен эффект самодействия зарядов, являющихся источниками неминимально связанного с кривизной скалярного поля или электромагнитного поля в пространствах кротовых нор.

Ключевые слова: эффект самодействия, кротовая нора.