Alternative Reflections on the Creation of Hypervelocity Stars

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Abstract

Hypervelocity stars (HVS) are stars which move with such high velocities that they can escape the gravitational field of our galaxy. What forces produce the acceleration to such high velocities? Classical Theories, Newtonian Mechanics and General Relativity, describe gravity by attractive forces, which on a first glance are not very suited to explain these high accelerations. The most common explanation, however, assumes a complicated scenario where a partner of a binary star system is disrupted and accelerated by the huge black hole at the center of the milky way.The Alternative Reflections on Gravitation (ARG), however, let expect a much simpler scenario: The primary gravitational effects are not attractive, but repulsive forces, produced by gravitons, converted from ALPS, which are emitted, e.g. from the hot interior of luminous stars. A supernova with its enormous luminosity and a close companion in a binary star system inevitably leads to extreme accelerations of this companion and its formation into an HVS.

1. Introduction

Beginning with the year 2005 more and more reports about hypervelocity stars (HVS) appear, i.e. stars moving with such high velocity that they can escape the gravitational field of the Milky Way [1]. Of course, this raises the question: From where do the necessary forces come that generate these high velocities?

2. Explanations on the Basis of Classical Theories.

Classical gravitational theories, i.e., Newton's law of Gravitation and the General Theory of Relativity, (ATR), describe only attractive gravitational forces, which at first sight do not seem to be very suitable to explain this acceleration. The most often mentioned explanation on this basis is the disruption of a binary star system by the black hole in the center of the Milky Way (Hill's Mechanisms) [1]. Doubts on this explanation, e.g. in [2], shall not be discussed here, also not further possible explanations and alternative hypotheses in [2]. But it should be mentioned here that there are HVS, e.g. US 708 [3], whose existence cannot be explained by the perturbation by the black hole in the center of the Milky Way. It can also be noted that in connection with explanations of the formation of HVS, the term "supernova" appears more and more frequently [1], [4]. In [5] it is even claimed that e.g. during the explosion of a supernova Ia in a binary star system HVS with velocities up to 1280 km/s can be formed.

3. Expectations due to the ARG

Due to the ARG, gravitational effects are created by the following process [6]: Sources of luminosity, like the hot interiors of stars, emit ALPs which after their conversion to gravitons, especially due to the interaction with magnetic fields, produce repulsive forces when a part of them are absorbed by baryonic matter. In this paper we will consider observations of gravitational effects emanating from particularly intense sources of luminosity: The explosions of supernovae Ia. Two different types of observations are considered. First, the registration of gravitational effects by gravimeters on Earth, and second, findings detected specifically by optical methods of objects in distant space. Concerning the first possibility it may be referred to considerations in an earlier paper about the gravitational effects of the supernova SN 1987 Ia, [6]. With respect to the second type of observations, this paper is concerned with the birth of High Velocity Stars (HVS).

4. ARG, CAST, KWISP and Solar Eclipses

The ARG themselves do not provide a theoretical basis for the explanation of classically hardly explainable effects, but they draw conclusions from the observation of such effects on the basis of well known physical laws. However, also the statements of newer theories are very well considered. As an example the agreement between the ARG and the projects of CAST and KWISP at CERN shall be mentioned.

CAST (CERN Axion Solar Telescope) has been searching for photons produced from axions by conversion in the magnetic field of a superconducting magnet for several years since 2003. Since about 2015, KWISP (KWISP: an ultra-sensitive force sensor) has been searching for forces produced by chameleons from the Sun under the action of the same magnetic system. No convincing results have been reported from either project until now (2022). Could it be that the theoretical basis is very well correct despite these negative results? A proof for it seems to exist already.

According to the opinion of the author this proof seems to have existed for a long time:

By the observation of gravitational effects during the solar eclipse in May 1997 in the form of "two valleys anomaly" [7]. Why should this observation be so much more successful? If one assumes the same source of axions, ALPs or chameleons, (the Sun), and sensors with similar sensitivity, then the product of volume and magnitude of the magnetic field determines the amount of the measurable effect.

In the case of solar eclipses, the ALPs move straight line from the interiour of the Sun towards the pointlike sensor on earth and transverse a volume of about 100 km in all three directions on the surface of the moon with a magnetic field of the order of 100 nT. The effective product therefore is about 10^8 Tm^3. In the case of KWISP a volume of about .1 m^3 and a field of 10 Tesla produce a product of just 1 Tm^3. Thus it seems quite possible that the theoretical basis is very well correct, despite of the so far unsuccessful results of KWISP.

5. ARG, Supernova Ia, and Hypervelocity Stars

As already mentioned above in chapter 3, according to the ARG, gravitational effects are due to the emission of special radiation, Axions or ALPs, from all the luminous stars in the universe. In an earlier paper [8], estimates were made concerning their contribution due to their luminosity L or mass m, and their distance R in Units L_{Sun} or M_{Sun} of the Sun and pc. The sum m_i/R_i^2 of all stars in the universe results towards a value 1875 L_{Sun} /pc^2. This value represents the gravitational effects on Earth and the Newtonian gravitational constant G= 9,81 m/s^2.

What effects, especially concerning the binary companion, must on this basis be expected from a supernova Ia with a luminosity of 100 million times M_{Sun} ?. Of course this depends directly on the distance towards the binary companion.

As described in [6], (chapter23), at a distance of about .15 pc all ALPs are converted towards gravitons and thus the supernova produces a radiation at this distance of 4 $*10^9$ L_{Sun}/pc^2, which is more than 2 million times higher than the above mentioned value of 1875 L_{Sun}/pc^2.

In binary star systems, however, the distances between the partners are typically of the order of 10 AU [9], thus far smaller than .15 pc by a factor 2000. Just by this factor the repulsive forces there are higher than the above values at .15 pc, due to the fact that the conversion increases proportional to R, but the intensity changes proportional to $1/R^2$.Thus it must be expected on the basis of the ARG that enormous values of repulsive gravitational forces lead to huge values of acceleration and speed of the companion, even though the highest values of the luminosity of supernovae already decrease after several months [10] (Figs. 2. to 4.). Precise quantitative calculations must be deliberately omitted here, since too many parameters are not sufficiently well known for this.

On the other hand, with respect to explanations on the basis of the classical gravitation theories, perhaps controversial statements should be pointed out here: In the paper about the gravitational measurements for the supernova SN 1987A the authors write that the effects were 4 to 6 orders of magnitude higher than they could be expected classically [11]. On the other hand, based on the same theories, HVS with the above mentioned high values of 1280 km/s are considered possible.

6. Conclusions

Hypervelocity Stars are known since 2005. However, with the registration of their huge velocities they provide highly interesting information, on whose reasonable explanation every theory of gravitation has to prove itself.

The alternative reflections on gravitation (ARG) expect as primary gravitational effect not attracting but repulsive forces, which are caused in particular by the emission of ALPs from luminous sources and their transformation to gravitons. The universe seems to provide a particularly suitable scenario for exploration: The explosion of supernovae Ia with their tremendous luminosities in narrow binary star systems. Based on the ARG, there are two ways to detect the existence of these repulsive gravitational forces. The first is the registration of such forces with gravimeters on Earth. Such an observation seems to have really taken place in the case of SN 1987A. Second: The optical observation of processes in the universe, which were caused by these repulsive forces. And for this the HVS deliver probably the best basis. Their repulsive motion seems to be the simplest and clearest proof for the existence of the primary repulsive gravitational forces on the basis of the ARG.

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