MICRO BLACK HOLES

EXPLORING TERRA FLUX OF HYPOTHETICAL STABLE MBH PRODUCED IN COLLIDERS RELATIVE TO NATURAL COSMIC RAY EXPOSURE

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Abstract

Although studies into the relation between the effects of hypothetical stable TeV-scale black holes produced in particle colliders relative to those which may be produced in nature due to cosmic ray (CR) collisions have already been conducted in some detail [1] this short paper re-explores the relationship between the two. Herein the same figures of CR flux and the planned number of collisions over the lifetime of the Large Hadron Collider (LHC) are used to determine a comparison between the two, though different results are concluded due to account taken to some less-considered differences between sub-Keplerian phenomena (<11.186km/s) and faster phenomena which would evade gravity capture.

The relative flux and the consequential effects of such stable MBH are considered herein due to recently published research [2] which disputes the effectiveness of Hawking Radiation (HR) in the widely anticipated (though sometimes challenged [5][6][7]) evaporation of any such phenomena.

1. Introduction

The similarity between cosmic ray collisions of equivalent centre-of-mass energies which occur all the time in nature and p-p collisions which occur under experiment in particle colliders is often cited in safety assurances of such experiments. It has been argued [1] that 3×10^(22) cosmic rays with similar energies or more have struck the Earth since its formation, which greatly dwarfs the planned 1×10^(17) p-p collisions over the duration of the planned experiments at the Large Hadron Collider at CERN (which in itself is unprecedented in industry).

However, it is argued herein that a direct comparison cannot be made between these two figures, as products of the latter can be influenced by gravity capture whereas the products of the former are not. In this context I attempt a derivation of a relative flux of hypothetical stable phenomena from nature and from the experiments.

2. Calculating the True Relative Flux

It shall be assumed for the purpose of this analysis that ∂(N) is the portion of N collisions which produce such hypothetical stable MBH, the same figure applied to cosmic ray collisions of equivalent center-of-mass energies to those collisions which occur within particle colliders. In this case, nature has produced ∂(3×10^(22)) stable MBH over the course of the lifetime of the Earth, with ∂(1×10^(17)) to be produced by the experiments.

It shall be assumed that ∝(M) is the portion of MBH produced in experiments below 11.186 km/s and subject to gravity capture, whereas it shall be assumed that none of those created by nature are sub-Keplerian – on the basis that for the centre-of-mass energy of CR-atmosphere collisions to be larger than the MBH mass, the CR momentum must be very large - and the produced BH will always be ultra-relativistic [3] prior to accretion.

It shall be assumed that the average velocity of sub-Keplerian MBH is κ(V), and so traverse one Earth diameter in approximately 12,756km/ κ(V) seconds, or every 12,756km/ κ(V) seconds as orbits through the Earth. It is also understood that MBH with velocities greater than 11.186 km/s can traverse only one Earth diameter or less – depending on the direction of traversal - with an average distance traversed as 12,756km x (1-Cos(45°)).

One can then determine the actual flux of captured MBH through the Earth introduced over the course of LHC experiments would be ∂(1×10^(17)) × (κ(V)/12,756km) – measured in MBH traversals per second. This can then be compared directly to ∂(3×10^(22)) natural traversals over 4.54 billion years since the formation of Earth.

3. A Simple Breakdown of the Relative Flux

To break down these figures, I shall first divide the flux of captured MBH traversals per second into the overall number of traversals due to natural cosmic ray exposure since the formation of Earth and from this determine the number of years it would require for this flux to equal that of the natural flux.

1. ∝(∂(1×10^(17))) × (κ(V)/12,756km) MBH traversals per second due to experiments.
2. ∂(3×10^(22)) x (1-Cos(45°) MBH traversals per 4.54 billion years due to natural cosmic ray collisions.

⇨ ∂(3×10^(22)) x (1-Cos(45°) / ∝((∂(1×10^(17))) × (κ(V)/12,756km)) seconds.

⇨ 3×10^(22) x (1-Cos(45°) / ∝((1×10^(17)) x (κ(V)/12,756km)) seconds.

⇨ 3x10^(5) x 0.293 / ∝(κ(V)/12,756km) seconds.

⇨ 1.1x10^(9) / ∝(κ(V)) seconds (where κ(V) is in units of km/s).

Consider a sub-Keplerian MBH with an initial velocity v km/s - this would fall freely under acceleration due to gravity g_0 - initially at approx. 35.30394 km/h/s. This would accelerate/decelerate as it orbits towards and away from the Earth's center of gravity, and for the purposes of this analysis it will be assumed that such will remain within the sub-Keplerian limit - and so herein I apply 11.185 km/s as an upper-bound for such MBH velocities.

⇨ 1.1x10^(9) /(∝(11.185)) seconds.
⇨ 9.8x10^(7) /(∝) seconds, or 3.1/(∝) years.

Therefore the increase in flux of such hypothetical stable MBH through the Earth can be calculated:

⇨ 4.54 billion / (3.1/(∝)).
⇨ ∝(1.46 x10^(9)) where ∝ is the sub-Keplerian ratio.

The sub-Keplerian ratio has been derived in previous research [1] to be 5.7x10^(-4) where M = 4 TeV, when applying worst case scenarios to the analysis. This sets an upper bound at:

⇨ FR < 5.7x10^(-4) x 1.46x10^(9) where FR is the relative flux ratio.
⇨ FR < 8.32x10^(5).

Therefore the relative flux of sub-Keplerian MBH through the Earth due to the complete run of LHC collisions over its lifetime could be as great as 8.32 x 10^(5) higher than the flux of MBH through the Earth caused by natural cosmic ray collisions with the Earth's atmosphere. To express this in different terms: It has derived herein based on CR estimates that hypothetical stable sub-Keplerian MBH produced over the lifetime of LHC operation could require as little as 5,438 years to accumulate similar traversal distance that has been caused by cosmic rays in collision with the upper atmosphere of the Earth over its 4.54 billion years to date.

4. Conclusions

It has been demonstrated herein that the consequences of p-p collisions could have a lasting imprint on the flux of hypothetical stable micro black holes through the Earth if such could be produced. This was calculated to be an increase of 8.32x10^(5):1 km/km based on planned number of LHC collisions and their sub-Keplerian ratio.

This equates to a lower bound of 5,438 years over which a similar traversal distance could accumulate due to the sub-Keplerian MBH produced at the LHC as has already occurred naturally over the lifetime of the Earth.

Although it has been argued [1] the Earth's density does not provide enough material to stop a highly relativistic black hole from cosmic ray collisions, one should consider the effect of such an MBH making a direct strike on multiple atomic nuclei as it traverses the Earth – and whether such MBH would become sufficiently slow to reduce to sub-Keplerian speed. However, as MBHs are orders of magnitude more energetic, this is a rare event.

If one defines a success ratio of relativistic MBH being reduced to a sub-Keplerian speed by such collisions to be φ(M), one could extend this analysis to determine an equivalent quantity of MBH captures at φ(5,438) years to those which may have occurred due to natural cosmic ray collisions with the Earth over the lifetime of the Earth to date. It is beyond the scope of a paper on MBH flux to determine such a value for φ(M), though if assumed to be < 1 x 10^(-5), this would result in equivalence on a monthly basis post-experiments, which places safety assurance solely in consideration of neutron stars and white dwarfs in the existing G&M report [1].

One could also argue that the elevated flux caused by sub-Keplerian MBH could have a heating effect on Earth if the recent theorem of Rossler [2] is incorrect and such MBH do emit Hawking Radiation as widely anticipated - a concept explored in earlier work by Plaga [4]. However, to sustain the flux derived herein one would require the accretion rates to balance or exceed the rate of evaporation or such MBH would not sustain their mass - a scenario which could only materialize if either rate was vastly different to those explored in detail by G&M [1].

REFERENCES:

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