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A3 1 Is there a hole in my pocket?

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Abstract

In this paper, we investigate the plausibility of Minecraft's inventory collapsing into a black hole. We found that a full inventory of netherite blocks would have a Schwarzschild radius of 3.6×10^{-19} m. As Minecraft inventories are invisible to the naked eye, we found the mass needed to form a black hole at a maximum size of 0.1 mm, so that it remains invisible to the human eye. A black hole this size will have a mass of 3.4×10^{22} kg, We then looked into the possibility of this much mass being available in a generated Minecraft world, and found that it is feasible but very unlikely.

Introduction

Many video games run into the same unrealistic problem: where are all the items in my inventory being kept, and how do they fit in there without forming a singularity? For this study we turned to Minecraft, a game with a very robust inventory system that can not be seen when examining the player's model. We will be examining the range of sizes for this inventory space and whether or not it would become a black hole due to the amount of mass in such a confined area.

Real-World Inventory Size

The first step in this investigation is finding real-world sizes that the inventory can be, without being visible to the human eye when studying the player model. This size was found to be at a maximum of 0.1 mm [1] and a minimum size of the Planck length 1.6×10^{-35} m.

Forming a Black Hole

The criteria for a black hole to form is an amount of mass contained in a space smaller than it's Schwarzschild radius [2]. This radius is

calculated using the equation:

$$r_c = \frac{2GM}{c^2} \tag{1}$$

In this case, M is the total mass being accounted for, and then G and c are their respective constants of gravitation and the speed of light.

Turning the Inventory into a Black Hole

In Minecraft the number of item slots available in the inventory is 35 [3], discounting the items held by the player's hands as they are visible. In order to calculate the maximum size of a potential black hole, we decided to use a full inventory of the densest material in Minecraft, known as netherite. Netherite is made up of 4 gold and 4 ancient debris [4]. As it is undefined, we took ancient debris to be a steel alloy similar to Damascus steel, which is an ancient type of steel. Gold is the densest 'real' material in the game therefore, as it's composition shows, netherite is the densest available in-game. Gold has a density of 19320 kg/m³ [5] and ancient debris has a density of 8000 kg/m³ [6]. Combining these in the way netherite is formed in-game comes to a density of 109, 280 kg/m³. This produces a 1 m³ block of netherite, 64 of which can be stored in a single item slot of an inventory. Therefore a full inventory can hold 2240 blocks of netherite. This means that in the inventory space, there is a mass of 244,787,200 kg when it is filled with netherite blocks. Putting this mass into equation (1), we get a Schwarzchild radius of 3.6×10^{-19} m, placing the Schwarzchild radius within the range of inventory sizes we initially laid out. Therefore an inventory this size or smaller would collapse into a black hole when filled with netherite blocks.

Mass of Maximum Sized Black Hole

Our range of sizes for the inventory space to not be visible when examining the player model went up to 0.1 mm. That begs the question, how much mass is needed to form a black hole with a diameter of 0.1 mm, and is there enough mass to form this black hole? To answer this we can go back to equation (1), but rearrange it to find the mass needed to form a black hole at this size. This would become:

$$M = \frac{r_c c^2}{2G} \tag{2}$$

As the black hole would have a diameter of 0.1 mm, this would mean setting the Schwarzchild radius to be 0.05 mm, we get a mass needed of 3.4×10^{22} kg. Thus, we find that the number of netherite blocks needed to achieve this mass is 3.1×10^{17} blocks. This *can* be held in an inventory using Shulker boxes [7] as they can be infinitely stacked and hold as many blocks as needed. However, a more interesting idea is to see if this number of blocks can even spawn in a generated Minecraft world. A standard Minecraft world has a size of 60,000,000 by 60,000,000 by 384 blocks [8] meaning there are 1.4×10^{18} blocks available. Filling all of this space with netherite blocks would have a total mass of 1.5×10^{23} kg, which is larger than the mass needed to form a 0.1 mm diameter black hole. This means that enough blocks of netherite *are* technically able to be generated in a Minecraft world to form this sized black hole.

Conclusion

The maximum size limit of an inventory in Minecraft was taken to be 0.1 mm, so that it is not resolvable by the human eye. With the inventory space completely filled with blocks of netherite, it was found to produce a black hole with a Schwarzschild radius of 3.6×10^{-19} m. This being significantly smaller than the maximum size of the inventory, we decided to find what mass would be needed to create a black hole with a diameter of 0.1 mm and Schwarzchild radius of 0.05 mm, producing a value of 3.4×10^{22} kg of material. A Minecraft world was found to be able to have 1.4×10^{18} blocks in it which, when turned into netherite blocks, have a total mass of 1.5×10^{23} kg. Therefore a 0.1 mm black hole is technically feasible, however it is very unlikely as a regular Minecraft world would not generate with that many netherite blocks present.

References

- [1] https://learn.genetics.utah.edu/ content/cells/scale/ [Accessed 1 October 2024]
- [2] https://www.britannica.com/science/ Schwarzschild-radius [Accessed 1 October 2024]
- [3] https://minecraft.fandom.com/wiki/ Inventory. [Accessed 1 October 2024]
- [4] https://minecraft.fandom.com/wiki/ Netherite [Accessed 16 October 2024]
- [5] https://kg-m3.com/material/gold [Accessed 1 October 2024]
- [6] Židzik, A.. TEM JOURNAL https:// doi.org/10.18421/TEM104-17[Accessed 12 November 2024]
- [7] https://minecraft.fandom.com/wiki/ Shulker_Box [Accessed 1 October 2024]
- [8] https://scaleofuniverse.com/en/ universe/minecraft-world [Accessed 1 October 2024]