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P5_8 They Call It... "The Almighty"

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Abstract

In this paper, we investigate a theory regarding the Cabal super-weapon from Destiny 2, which involves injecting a star with a small planet's worth of electrons. We found that the resulting outward electrostatic repulsion would be over 20 orders of magnitude greater than the pull of gravity, likely resulting in the star's destruction.

Introduction

In the video game Destiny 2, the solar system is invaded by a faction of the Cabal known as the 'Red Legion', whose greatest weapon is a huge spacecraft known as the Almighty, used to annihilate the stars of every planetary system the Red Legion visits. The Almighty operates by consuming the inner-most planet of a system and using this material as fuel for a beam weapon that is continuously fired into the star. After some time, the Red Legion will depart the system, and leave the star to undergo a catastrophic explosion.

Numerous theories exist for how this weapon operates, however one article [1] observed that during a mission to disable it, the player's assistant says "We have to disrupt the electron reservoir!", and hypothesised that the weapon may be an electron beam which increases the electron degeneracy pressure in the star's outer layers, causing increased pressure on the core, and resulting in its collapse followed by a supernova. While this may be possible, we feel the article has missed a simpler, and much more powerful consequence of injecting a star with a planet's worth of electrons: electrostatic repulsion.

Theory

For this analysis, we will consider our own solar system, with the target star being the Sun, and the planetary fuel source being Mercury. Mercury has a complex, but highly metallic composition [2], so for simplicity we will make the crude approximation that Mercury consists entirely of iron. We will also assume that the Sun is neutral to begin with, and that the Almighty is capable of fully ionising iron to extract all 26 electrons per atom, and injecting them into the Sun in a uniform distribution with no losses. This gives the Sun a charge of:

$$Q_\odot = qZ_{\mathrm{Fe}}\frac{M_☿}{m_{\mathrm{Fe}}} \tag{1}$$

where q is the elementary charge, $Z_{\mathrm{Fe}} = 26$ is the atomic number of iron [3], $M_☿$ is the mass of Mercury, and m_{Fe} is the mass of an iron atom.

We can then determine whether this would be sufficient to destroy the sun by comparing the forces on a small element of volume $dA\,dr$, assuming the Sun is a non-conducting sphere with both uniform charge and mass density and that the Almighty's process is instantaneous. The electrostatic force acting on the volume element

can then be derived from the Lorentz force:

$$F_e = Eq = E(r)\rho_c \, dA \, dr \tag{2}$$

where ρ_c is the charge density in the Sun, $dA\,dr$ is the volume element, and $E(r)$ is the electric field strength at a given radius r inside a uniformly charged sphere. This is given by:

$$E(r) = \frac{Q}{4\pi\varepsilon_0 R^3} r \tag{3}$$

where Q is the total charge of the sphere, ε_0 is the permittivity of free space and R is the radius of the sphere [4].

The gravitational force on an element at radius r inside a sphere of uniform mass density is given by:

$$F_g = -\frac{GM}{R^3} r \rho_m dA \, dr \tag{4}$$

where G is the universal constant of gravitation, M is the sphere's total mass, R is the radius of the sphere, and ρ_m is the mass density.

Taking the ratio of the magnitudes of equations 2 and 4 and simplifying gives the ratio of the two forces:

$$\frac{|F_e|}{|F_g|} = \frac{1}{4\pi\varepsilon_0 G} \left(\frac{Q_\odot}{M_\odot} \right)^2 \tag{5}$$

where $Q_\odot$ is the Sun's charge from equation 1, and $M_\odot$ is the mass of the Sun.

Results and Discussion

Using a value of 3.3011×10^{23} kg for the mass of Mercury [5] and 55.845 u for the mass of an iron atom [3], we found the total charge in the Sun would be -1.5×10^{31} C. From this, and using a value of 1.9885×10^{30} kg for the mass of the sun [6], we found the ratio given in equation 5 to be 7.5×10^{21}. This is far greater than 1, suggesting that in this case, electrostatic repulsion would be overwhelmingly stronger than gravitational attraction, and the Sun would likely be torn apart.

Conclusion

While it's possible that electron degeneracy pressure may contribute to a stars destruction, we have shown that the simple electrostatic repulsion between electrons is capable of overwhelming gravity by a significant amount, and that through this method, the Almighty would indeed be able to destroy stars. There are however a number of significant issues with these theories, such as the apparent length of time the process takes being far from instantaneous, the ability of electrons to permeate the Sun over a relatively short time period, and most importantly, the apparent violation of the conservation of charge. Further research is required to thoroughly understand the Almighty's devastating weapon, and the advanced Cabal technology it is built upon, so that humanity may better defend its home in the Cosmos.

References

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