Journal of Physics Special Topics
An undergraduate physics journal

P3_8 Feats of Power

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December 13, 2018

Abstract

In this article we investigate the scene in the anime "Dragonball Z" where "Piccolo" uses an energy beam from his hand to destroy the Moon from Earth. Furthermore, grasping the feats of power of the character. We estimated that the power output of the attack is 3.1×10^{28} W. The temperature of "Piccolo's" hand while firing the beam is 2.12×10^{9} K.

Introduction

In Akira Toriama's "Dragonball Z" the character "Piccolo" has the ability to blow up the Moon with in a matter of seconds. He does this by charging his fist with energy then aiming his hand at the Moon which results in an beam of energy capable of obliterating the Moon. The aim of this article is to estimate some of the feats "Piccolo" has in terms of energy. This will include estimating the energy used to explode the Moon and estimating the temperature of the characters hand while firing the energy beam. This calculations were done by making several assumptions. The main assumptions are that the energy required to destroy the Moon is equal to its gravitational binding energy, all the energy is generated while charging, all of the charged energy is released in the form of the energy beam and finally that the characters hand is a black body emitter.

Theory

The gravitational binding energy is the minimum energy required to unbind a gravitationally bound system. In the case of the Moon if this energy is exceeded, the molecules that make up the Moon will be forced apart from each other and will not be able to reform. We will assume the Moon is a perfectly spherical body. This results to the gravitational binding energy in the form of Equation 1 [1].

$$U = \frac{3GM^2}{5r} \tag{1}$$

Where U is the gravitational binding energy, $G = 6.67\times10^{-11}$ m^3 kg^{-1} s^{-2} is the Gravitational constant, $M = 7.35\times10^{22}$ kg is the mass of the Moon and $r = 1.74\times10^{6}$ m is the radius of the Moon [2]. Substituting in these values gives $U = 1.24\times10^{29}$ J. This gives an estimate as to how much energy the character generates. In the scene, "Piccolo" charges his fist for approximately 2 s, then fires the energy beam which lasts approximately 4 s. As we have estimated the total energy needed to be generated for this attack we can estimate the power output of the beam. The power is given by Equation 2.

$$P = \frac{E}{t} \tag{2}$$

Where E is the total energy and t is the time of attack which is 4 s. This gives a power output of $P = 3.1\times10^{28}$ W Since we have the power

output of the beam, we can now estimate the energy flux output of the beam. To do this we need the area of the front of the characters hand as well as the power of the beam. The area of the characters hand can be approximated to the area of an average male hand. The energy flux of the beam is given by Equation 3.

$$F = \frac{P}{A} \tag{3}$$

Where P is the power output previously calculated and $A = 0.027$ m^2 is the area of the front of an average male hand [3]. This gives a flux of $F = 1.15\times10^{30}$ W m^{-2}. Finally, with this information assuming the characters hand is a black body emitter, we can estimate the temperature of the hand using the Stefan-Boltzmann Law defined in Equation 4 below.

$$T^4 = \frac{F}{\sigma} \tag{4}$$

Where T is the temperature, $F = 1.15\times10^{30}$ W m^{-2} is the energy flux and $\sigma = 5.67\times10^{-8}$ W m^{-2} K^{-4} is the Stefan-Boltzmann constant [4]. This gives a value of $T = 2.12\times10^{9}$ K.

Discussion

The estimate of the energy required for the attack is the same as the graviational binding energy of the moon. It is this key assumption that gives the result of our estimation. The temperature of "Piccolo's" hand assuming it is a black body emitter would be 2.12×10^{9} K. This temperature is similar to the temperature when the universe was only 100 seconds old [5]. Both of these values are what is expected as the energy to blow up the Moon is obviously very high and would require high temperatures.

Conclusion

In conclusion, it is evident that the feats of Dragonball characters far exceed anything that is physically possible in the real word. Many assumptions have been that simplify the problem but leave room for future work. One further improvement on the calculations that could be made is to consider chemical energy from the bonds between the atoms that make up the Moon . This would theoretically increase the energy needed to destroy the Moon and give a more accurate result. Another improvement would be to consider how much energy is lost as the beam travels to the Moon.

References

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