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Modelling the Destructive Force of the Black Bolt's Voice – "A Vocal Nuke"

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Abstract
This paper aims to model the destructive force of the Black Bolt's Quasi-Sonic scream via comparison of the energy and decibels required for his reported feats. The model shows that if his whisper (20 dB) produces $3.35x10^{17}$ J and his scream (129 dB) produces $2.24x10^{32}$ J, that the scaling within just one decibel induces a power increase large enough destroy buildings in a surface area roughly $4.5x10^{12}$ times greater than that of New York.

Introduction
With the ongoing success of the Marvel cinematic universe, more and more obscure superheroes are getting their chance to grace the big screen. One such upcoming group, the Inhumans, is under the command of perhaps the most destructive of Marvel's creations. Alongside the usual arsenal of powers such as super strength, speed and stamina associated with this super group Blackagar Boltagon, better known as the Black Bolt (see figure 1), is in possession of a vocal nuke.


Figure 1 – Black Bolt unleashing his Quasi-sonic scream [1].

The so called quasi-sonic scream, has the ability to interact with ambient electrons, exciting them for truly devastating effects. The quietest whisper has been said to be able to level cities, whilst a full blown scream could annihilate a planet. This study aims to model the suggested destructive force of his voice based on these data points.

Model
In order to model sound for this experiment, the decibels (dB) associated to the sounds produced were used for scaling. A whisper has been measured at 20 dB whilst the world's loudest recorded scream was set in 2000 at 129 dB [2]. This provides values for the model's vocal scaling.

To scale these values against energy, the energies required for the proposed feats had to be calculated. Due to the nuclear comparisons of this heroes' power the energy levels were measured in Joules (J) and Megatons (MT), which is the destructive force of 1,000,000 tons of TNT. The conversion rate for this is set at $1MT = 4.184x10^{15}$ J.

When looking at the destructive force required to level a city the model focuses on the MT requirement to cause heavy structure damage during a nuclear blast. Due to its common use within Marvel comics, New York was used to represent the surface area that must be covered. With a known surface area of 1,214 km^2 the city was modelled as a

circle with a radius of approximately 19.7 km. For information on the destructive range of a nuclear bomb, NUKEmap was consulted. The NUKEmap model, released in 2013 and produced by Alex Wellerstein, simulates the radii for multiple nuclear effects [3,4]. In this model, anything within a 5-20 psi overpressure range is considered to take heavy or complete structural damage as well incorporating an almost 100% fatality rate. This model produces such a blast zone for 19.7 km at a value of 80 MT.

$$80 \times 4.185 \times 10^{15} = 3.3472 \times 10^{17} J$$

To model the destructive force required to annihilate a planet in the simplest manner possible, the energy required to overcome the gravitational binding of a uniformly dense, spherical planet roughly the size of Earth has been chosen. The gravitational binding energy equation for such a sphere is stated below:

$$U = \frac{3GM^2}{5R} \qquad (1)$$

Where G is a gravitational constant of 6.673×10^{-11} $m^3 kg^{-1} s^{-1}$, M is the mass of the planet body and R is the radius from the core centre [5]. By substituting values known for Earth into this equation and converting into megatons the result is:

$$U = \frac{3 \times (6.673 \times 10^{-11}) \times (5.972 \times 10^{24})^2}{5 \times (6.371 \times 10^6)}$$

$$U = 2.242 \times 10^{32} J$$

$$\frac{2.242 \times 10^{32}}{4.184 \times 10^{15}} = 5.36 \times 10^{16}\ MT$$

Results

With energy values determined for both feats, a decibel to energy output plot could then be used to produce the energy scaling for the unrestrained quasi-sonic scream (see figure 2).

Energy values were extracted at every 20dB interval. The results are presented in table 1.

The results show that even before 60dB has been reached, the volume which is considered standard for general conversation, the scaling has already rocketed up in energy levels. In fact, at 40 dB, the energy output is already 1.237×10^{14} times greater than that at 20 dB. This equates to a surface area of 1.502×10^{17} km^2, greatly exceeding the surface area of Earth at 5.1×10^8 km^2 by almost 300 million times the value. For reference, 40 dB is considered equal to average quiet background noise or a mosquito buzzing. Even increasing a single decibel produces an energy value of 1.5×10^{30} J which, after calculation, results in coverage of 5.441×10^{15} km^2, 10.67 million times greater than the Earth's surface.

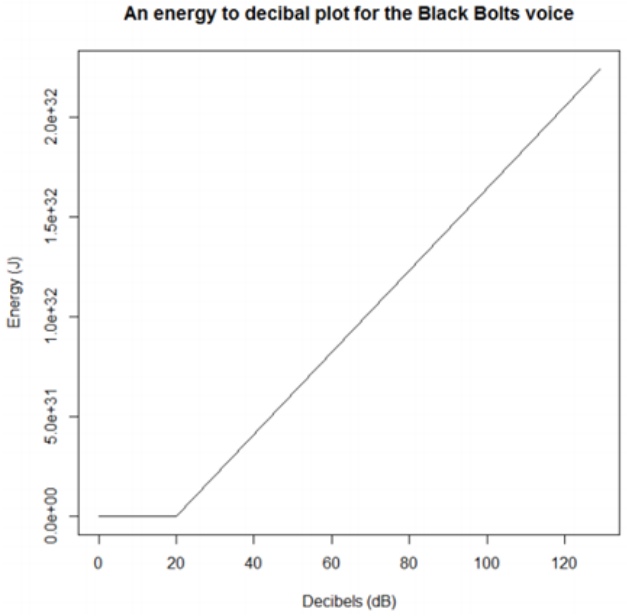

Figure 2 – Graph displaying the energy production of the quasi-sonic scream at increasing decibels.

Decibels (dB)	Energy (J)
0	0
20	3.347×10^{17}
40	4.141×10^{31}
60	8.254×10^{31}
80	1.230×10^{32}
100	1.659×10^{32}
120	2.059×10^{32}
129	2.242×10^{32}

Table 1 – Table showing energy values at every 20dB interval.

Conclusion

The results from the model show a massive scaling in destructive power over the range of even one decibel alone. The energy output between 20-21 dB alone increases to 4.5×10^{12} times that of which was required to level the surface area of New York. It can be noted that, due to the limited amount of data points available for the Black Bolt's feats, that this

model is rather simplistic in nature. However, from calculation of the well-known feats provided, it is clear from the above results that even the smallest of utterances could bring total annihilation of the planet's surface.

References

[1] Granov, A (2009) *War of Kings #5, variant cover*. (Illustration) Images taken from: Available: http://www.comicvine.com/images/1300-1363322 [Accessed 12/03/2015]

[2] Janela, M. (2014). *Happy Halloween with these 13 spooky world records. Guinness World Records*. Available: http://www.guinnessworldrecords.com/news/2014/10/happy-halloween-with-these-13-spooky-world-records-61460 [Accessed 12/03/2015].

[3] Wellerstein, A. (2014) *NUKEmap 2.42*. Available: http://nuclearsecrecy.com/nukemap/ [Accessed 12/03/2015]

[4] Glasstone, S. & Dolan, P. (1977). *The Effects of Nuclear Weapons, 3rd Ed*. U.S. Dept. of Defense.

[5] Lang, K.R. (1980). Astrophysical formulae. Berlin: Springer-Verlag. Eq 3-194