

A1_14 Bounty Hunting

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Abstract

This paper investigates how a fictional alien called Metroid Prime (in the Nintendo game Metroid Prime) can make itself invisible in several spectrums at once whilst switching between these spectrums and concludes that such a creature is very highly unlikely to exist in nature as it coincides of an internal temperature change of 298 to 2.98×10^7 K.

Introduction

In the game Metroid Prime for the Nintendo Gamecube, Samus Aran is an intergalactic bounty hunter that crash lands on the planet Tallon IV. She is looking to recover the parts of her damaged space suit, destroy the space pirate settlement and to eliminate the source of the radioactive phazon (a fictitious substance that mutates and damages life forms) which is revealed to be a creature called Metroid Prime. [1]



Figure 1: An in-game shot of the final boss of the game Metroid Prime, also called Metroid Prime in the optical spectrum. Image credit: [2]

A metroid is a parasitic creature that feeds off of the life energy of other organisms. Metroid Prime is assumed to be some sort of alpha metroid being much larger and more powerful than the other metroids. One of these powers is to render herself invisible in all but one of the 3 available spectrums to Samus Aran (the optical, infrared and X-ray spectrums) [3][4][5].

Theory

If we assume that the Metroid Prime is a blackbody emitter (which means that Metroid Prime has a reflectivity of zero), we must consider 3 cases and determine whether or not that they are true. The first is that it is visible in the infrared, but not in the optical or X-ray region, the second where it would be visible in the optical but not in the infra- red or X-ray region, and the third where it would be visible in the X-ray region, but not in the optical or infrared regions.

A blackbody emitter is highly dependent on its effective temperature as can be seen from Figure 2 (below).

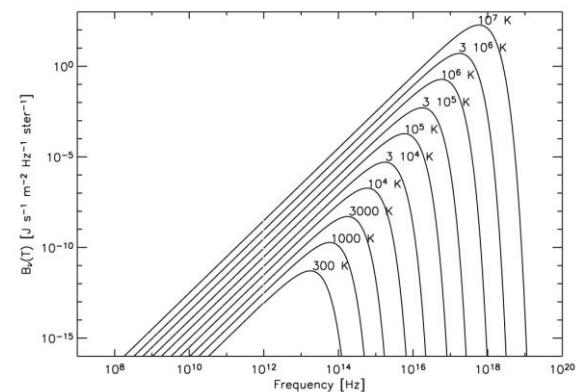


Figure 2: A graph showing how a blackbody radiates at different wavelengths and temperatures. [6]

If the emitter is only hot enough to emit in the infrared then it will be dimmer than a much hotter source at all wavelengths. This means that if something is hot enough to emit

X-rays it will still emit strongly in the optical and the infrared etc.

Infrared

As already discussed, if something emits a small amount of heat (of the order 300K) it will emit in the infrared and not the optical or X-ray wavelengths. This means that Metroid Prime could easily conform to the infrared case.

Optical

If something is a lot hotter, it will emit light in the optical region as well as the infrared region, but not in the X-ray region. The scenario in the game where Metroid Prime is invisible at all wavelengths other than the visible could only be achieved if the environment around it was also relatively hot, such as a furnace or the inside of a volcano. This means that Metroid Prime would find it difficult to conform to this case.

X-ray

If we have something hotter still, it will emit X-rays. However, it will also be very bright in other regions of the electromagnetic spectrum. This is by far the most difficult scenario to conform to. It is, however, possible to do so under very specific circumstances.

Like in the optical case, the environment around Metroid Prime would have to be relatively hot, to decrease the visibility in the infrared region. It would also have to be surrounded by thick dust; similar to the dust that impairs visibility in the optical band of the galactic centre [7].

Changing effective temperatures

If Metroid Prime could conform to all of the above scenarios it would still have to change its body temperature dramatically. The degree of this change can be calculated by Wien's displacement law [6]:

$$\lambda_{max}T = 2.98 \times 10^{-3} , \quad (1)$$

where λ_{max} is the maximum wavelength emitted by the blackbody in metres and T is the temperature of the blackbody in K. If we substitute typical wavelengths of infrared and

X-ray photons we can find the range of temperatures of which Metroid Prime would emit by rearranging (1):

$$\frac{2.98 \times 10^{-3}}{\lambda_I} \leq T \leq \frac{2.98 \times 10^{-3}}{\lambda_X} , \quad (2)$$

where λ_I and λ_X are the typical wavelengths of infrared and X-ray photons respectively. If we use $\lambda_I = 10\mu\text{m}$ and $\lambda_X = 0.1 \text{ nm}$ [8] we get that Metroid Prime would have a temperature range of: $298 \leq T \leq 2.98 \times 10^7 \text{ K}$.

Conclusion

Whilst it is possible for Metroid Prime to conform to each individual scenario discussed, it is very difficult to do so, especially for the "X-ray only" case. Metroid Prime would have to change its body temperature of the order of 10^7 K in order to accomplish the ability to switch between all 3 of these scenarios. Therefore it is deemed impossible to exist in nature, or at the least very highly unlikely.

References

- [1] Metroid Prime, Nintendo and Retro Studios 2003.
- [2]<http://www.toy-tma.com/wp-content/uploads/2010/09/Essence-of-Metroid-Prime.jpg>
- [3] <http://www.youtube.com/watch?v=V9h-OsIX1bA> (3/3/11)
- [4] http://www.youtube.com/watch?v=1sR-0c59_mA (3/3/11)
- [5]<http://www.youtube.com/watch?v=mYifeP-hiPP4&feature=related> (3/3/11)
- [6] M, Zielik., S. A. Gregory., *Introductory astronomy and Astrophysics*, (London, Saunders College Publishing, 1998) 4th Ed. p. 172.
- [7] Ibid p. 275.
- [8] Ibid p. 155.