

Modeling Durin's Bane

Introduction:

Works of fiction often ignore or do not appreciate physical laws and principles which could be used to justify themselves. When science is brought into fiction the experience of the narrative is improved, even for those unaware or unequipped to know of the knowledge being employed. Modeling Durin's Bane, more well known as "The Balrog," is to justify and experience these two claims in the case of one monster from *The Lord of The Rings* by J.R.R. Tolkien, popularly portrayed in the film trilogy of the same title by Peter Jackson.

Part of the excitement of The Balrog is its continual being aflame. This project is an attempt to measure the thermal properties of Durin's Bane using *Mathematica*. From this thermal analysis will be drawn conclusions about the energy consumption required to keep the monster ignited, as well as the input required for it to increase the size of its flames. These claims being satisfied, real world analogies are constructed to provide an illustration of the power of The Balrog's undying fire.

Methods:

Blackbody Radiation

$$B_{\nu}(\nu, T) = \frac{2h\nu^3}{c^2} \frac{1}{e^{\frac{h\nu}{kT}} - 1}$$

The Balrog is considered a blackbody 5 different times, with 5 different values of e . Information gathered from the books and movies will be used to provide values for parts of the blackbody radiation equation.

Basic three-dimensional shapes are constructed as blackbodies. *Mathematica* will be used to represent the range of 5 scenarios on each using a slider. Each plot is three-dimensional, color-coded, and adjustable in size, wavelength, and temperature.

Mathematica can construct a three-dimensional model of Durin's Bane using the "blocks" mentioned. The visual is used to see the temperature over the whole of the body of The Balrog. A conclusion about the average temperature and energy consumption is made.

The average temperature is converted into joules. Real world analogies are briefly modeled. Analogies for Newtonian mechanics, electrostatics, and astronomy (suns) are drawn.

Division of Tasks:

Though each task is a coordinated effort, sections of this project will weigh more heavily on one person at a time than on the other. This list details who takes the initiative for that section of the project.

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| 1. Information gathering: | Kayson Reardon |
| 2. Blackbody Temperatures: | Joshua Mills |
| 3. Balrog Parts, Head, Arms, Legs, Feet: | Joshua Mills |
| 4. Balrog Parts, Torso, Wings, Hands: | Kayson Reardon |
| 5. 3D Model, Durin's Bane: | Kayson Reardon |

Foreseen Challenges:

The information gathering to calculate blackbody temperatures is the most difficult part of this project. The objective is to minimize assumptions. Assumptions cannot be eliminated as The Balrog is a work of fiction.

Attaching the parts of The Balrog together in a single model will be a learning experience, and if it proves too difficult it may be simplified to a simple summation for average temperature.

Small difficulties arise in making real world analogies, as these test knowledge that is not used regularly. Use of a principal is different than enforcing a calculation.

Comments:

While the plan for this project is clear, at least half of it is listed here as a potential challenge. Suggestions for simplification are welcome.

This project is also seen as an enjoyable exercise. Should the finished product have a plethora of cultural references or remarks, Josh and Kayson cannot be held accountable.