Journal of Physics Special Topics
An undergraduate physics journal

P5_2 Cannibalism in Space?

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November 3, 2021

Abstract

Within this paper it is investigated if the Axiom, the main passenger cruise ship in WALL-E, would have the substantial power requirements to support its passengers and how long they would survive on the ship with a limited food source in a geostationary orbit around the Earth. It was found that the last couple would last approximately 521 days with the ships power being sustained.

Introduction

The cinematic masterpiece 'WALL-E' is a movie where Earth is rendered uninhabitable [1]. This results in a cruise ship being sent out into space until the Earth's conditions are proved stable for humanity return to. During this mission several generations of humans were noted to have survived implying that the ship and crew are self-sufficient. This paper discusses the plausibility of such a ship existing by looking at both the minimum power requirements needed and the survival time, in days, of these passengers.

Method

600,000 passengers are stated to be in the Axiom [2] with the primary objective to prevent humanity's extinction. Power consumption was minimised by assuming the ship would be in a geostationary orbit and would only need 300,000 rooms for each couple, with power required for each room being compared with the average power needed to run a hotel room [3][4]. A self-sufficient source of energy for a ship in the Earths solar system (solar energy) was then considered to power the ship. SunPower solar panels were chosen which had an efficiency of 22% [5].

The Axiom	Size/m
Total length, incl. stern beam	4540
Total height, stem to mast	2330
Hull length	3910
Hull height, core	1030

Table 1 which shows the dimensions of the ship [2]

The hull was assumed rectangular and to be completely fitted in panels. Each figure in table 1 was found to have an error of 10% [2] meaning that for Eqn.1 which uses the hulls surface area, the result (power) would have an error of ± 20%.

$$P_h = A_S \times (E_{Sun}) \times (E_f), \tag{1}$$

Where P_h is the power output per hour, A_S is the surface area of the Axiom, E_{Sun} is the energy output of the Sun [6] and E_f is the efficiency of the solar panels.

By assuming the hull will face the sun for periods of longer than an hour in a geostationary orbit [7] (as this is all that is needed for survival) and with the use of batteries for storing energy, a self-sufficient solar powered was found plausible. 2,000 calories was taken as the average number a human would need to sustain a healthy lifestyle. with the average cooked human body [8] providing 81500 calories. Assuming that no energy is

lost, iteration was used in order to determine the number of passengers that would need to be consumed on the first day, this value was then used to determine b in Eqn.2. The number of living passengers can then be found using:

$$A = A_o(1 - b)^t, \tag{2}$$

Where A is the number of remaining passengers on board, A_o is the initial number of passengers, b is the decay constant and t is the time in days.

A graph of this decay was then plotted with all results noted below.

Results

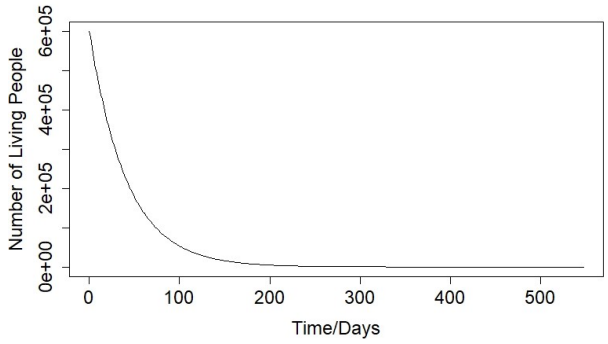

Figure 1: Population decay in the Axiom

Daily power for ship	322000 kW
Solar panel power output	1200000 kW/h
Constant b in Eqn.2	0.023400
One couple left	521.0 days
Last human	548.0 days

Table 2 showing the results of the experiment

Therefore, by assuming that the bodies are preserved and do not decay, the last theoretical chance for the human race would end after 521 days and the last human would run out of food after 548 days.

Discussion

The power needed was recorded to be 322000 kW per day with an error margin of 20%, when considering the error margin the ship generates between 960000-1440000 kW/hour, which is more than sufficient to power the ship. The surplus of excess energy that could be generated could be used to increase the quality of life or the populations life expectancy. The calorific surplus for the population at the end of the ships life cycle was assumed to be preserved for consumption through multiple days, as seen by the 27 day period, for the last human. However at the start these values, when spread out across a large population, were deemed negligible for simplicity. This surplus when accounted for could also potentially extend the amount of time the ship could remain populated in space.

Conclusion

The results of the theoretical experiment show that in the conditions set, the Axiom would be able to function on an energy basis, however when attributed with its lack of food supply would only last until 548 days plus the time taken for the last person to starve unlike the hundreds of years the ship existed in the film.

References

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