Impact Exchange Between Planets of Gliese 581  
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INTRODUCTION

The discovery of meteorites from Mars and the Moon indicates that in our solar system large impacts can transfer rocky material from one planet to another. It has been suggested that living microbes can be exchanged among the planets by this mechanism [1]. An obvious extension is to ask whether this process could also operate in other solar systems.

METHODS

We used the Öpik-Arnold method to calculate the fate of 10,000 particles initially ejected from planets e-d. The initial velocity ranges (high, medium, low) were scaled from each planet's orbital velocities, which are rather high by solar system standards due to the extremely close proximity of these planets to their central star (see table below).

The actual mass of each planet is uncertain, and the literature cites only a range of acceptable values [2]. We chose the average values listed in the table for our work. We estimated the uncertainty, and the literature cites only a range of acceptable values [2]. We chose the average values listed in the table for our work. We estimated the actual mass of each planet to be [1].

RESULTS

The transfer of particles within the Gliese 581 system depends strongly on the initial ejection velocity. Several numerical simulations were analyzed in the case of high (100 km/s), medium (60 km/s), and low (20 km/s). Our standard 10,000 particles were ejected at these velocities from each planet e, b, c, and d, and their fates tabulated. Ejections from planet e were most likely to impact planet d regardless of initial velocity. Ejections from planet b were most likely to impact planet b and d. Ejections from planet c have a high percentage of impacts on b, however, an increase in initial velocity resulted in a decrease of impacts on b. Ejections from planet d have a low probability of impact on any other planet than itself with most ejected particles entering an initial hyperbolic orbit and being ejected from the planetary system.

CONCLUSION

Impact ejecta exchange in the Gliese 581 system is very different from our solar system due to the close proximity of the planets to their central star and the resulting large orbital velocities. Because of this, rather large initial velocities (20-100 km/s) are required for orbital perturbations to allow interplanetary exchanges. Planet d, which is speculated to harbor liquid or liquid water [6], would have a very small chance of transferring material to the other planets in the Gliese system and thus far more isolated, biologically, than the inner planets of our own solar system.

REFERENCES


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