Investigating the motion of a rocket in orbit

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INTRODUCTION AND THEORY

A satellite in orbit around a body follows an elliptical path, with the barycenter at one of the foci of the ellipse, as described by Kepler's First Law [1]. This path is defined by the changing velocity of the satellite as it orbits, being lowest when it is at the apoapsis, which is derived from Newton's laws of motion and gravitation. The force on two bodies with mass is given by the latter, being [2]

$$F_{12} = \frac{Gm_1m_2}{r_{12}^2}, \tag{1}$$

where F_{12} is the force between objects 1 and 2, G is the gravitational constant, and m_1 and m_2 are the masses of the objects. From this, the equation of motion for an orbiting satellite can be derived using Newton's second law, giving

$$m\ddot{\boldsymbol{r}} = -\frac{mMG}{\mid \boldsymbol{r} \mid^3}\boldsymbol{r}, \tag{2}$$

where m is the mass of the satellite, M is the mass of the large body, and r is the position of the satellite relative to the center of the large body.

RESULTS

DISCUSSION

CONCLUSIONS

APPENDIX

REFERENCES

[1] J. Kepler and W. H. Donahue, *New Astronomy*, Cambridge University Press, Cambridge; New York, 1992.
[2] I. Newton, A. Motte, and N. W. Chittenden, *Newton's Principia. The Mathematical Principles of Natural Philosophy*, D. Adee, New-York, 1st edition, 1848.