Gravitational Attraction within a Simplified Ring System

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Newton's Theory of Universal Gravitation has been a well known explanation of physical phenomena, since it was first presented in his work *Philosophiæ Naturalis Principia Mathematica* in the Summer of 1687. This theory provides an explanation of the attractive force between two masses that is dependent on their separation. An interesting physical application to study this theory is the gravitational force due to a planetary ring system. The most famous example of such a system would be the planet Saturn, but all gas giants in the Solar System have at least a partial ring system. In this work, these systems are studied using a simplified two-dimensional model consisting of a ring of uniform mass and a single point mass that can be placed anywhere around or within the ring. Interestingly, when the point mass is placed inside the ring, the force on it is repulsive from the center of the ring rather than being attractive toward the ring's center of mass. In other words, the point mass is attracted to the ring itself rather than the ring's center of mass. When the point mass is inside the ring, it can be viewed as a representation of a small part of the planetary atmosphere experiencing a force from the ring. Depending on the mass and asymmetry of the ring, this force could provide a partial explanation for planetary weather patterns and other phenomena. Theoretical and numerical calculations utilizing Mathematica will be presented.