Astronomy from 4 Perspectives: the Dark Universe

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Questions: Dark matter and the virial theorem

1. Theory behind the virial theorem

(a) What's the idea of the virial theorem?

(b) What's the difference to energy conservation?

(c) For what kind of system can you use the virial theorem?

2. Mechanical similarity

(a) Why is mechanical similarity restricted to potentials of the shape $\Phi \propto r^{\alpha}$?

(b) Does α have to be integer?

(c) What's the generalisation of the Kepler-law for a potential of the form $\Phi \propto r^{\alpha}$?

3. Harmonic oscillator

(a) What can you say about different energy types in the harmonic oscillator on average?

4. Kepler problem and planetary motion

(a) Can you show that Kepler's third law implies that potential and kinetic energy are proportional to each other?

(b) Is this true in general?

5. Virial theorem in galaxies

(a) Could one explain the rotation curves by assuming a different gravitational law?