The Change in Gravitational Potential Energy of Objects Near Stars in Stellar Metamorphosis

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Abstract: With a few simple statements it is outlined that the gravitational potential energy of objects near stars in stellar metamorphosis changes as the stars evolve. Explanation is provided.

In stellar metamorphosis, exoplanets are evolved/evolving and dead stars. They have lost the majority of their mass, and their gravitational fields and radii have diminished considerably, as well as the rate of acceleration with free fall of objects in those gravitational fields. Therefore as a simple rule, the gravitational potential energy of objects in highly evolved stars such as Earth is much lower than younger stars such as the Sun.

For a 1kg object dropped on Earth, with an acceleration of 9.8m/s² at 1000 m, subtracting for loss due to the atmosphere causing friction, has a GPE of 9,800 J. For the same height, the GPE for 1kg object dropped on the Sun, (275m/s² acceleration of free fall) subtracting for loss due to the atmosphere causing friction and other factors, is 275,000 Joules.

What this means is that the potential energy for objects that fall on younger stars that have a lot more mass and have much higher accelerations for free fall is much higher. This means their atmospheres are probably much more energetic from the heat of friction of particles constantly falling back into the star. It should be no wonder young stars are bright and hot, the particles that fall back into the star are accelerating extremely fast, at an astounding ~28 G's. To compare familiar objects, a 50kg dumbbell dropped at 10,000 meters from the surface of the Sun would have about 137 million joules. That would be the same energy as a 60 ton aircraft at landing speed of 115 knots.

So it is clear for the reader, the GPE of objects inside or near stars diminishes at a smooth, continuous rate, given the change in height from the surface and mass do not change, and levels off as the star begins completely solidifying and has lost about 99% of its atmosphere. So to rewrite the equation, would could add Delta (change in) in front of the g. So it would look like this: $\Delta PE = m * \Delta g * h$