

### Offered Title: Gravity... an Enigma

He reasoned that all things attract each other and those with more mass attract with greater force. He wasn't the first to consider or test gravity, but the big idea came to Sir Isaac Newton in a moment of epiphany. Of course! Gravity acts as does light. Its affect is inversely proportional to the square of distance. Thus was born, *Newton's law of universal gravitation*. Everything seemed to fall into place and physics was on a roll. The motion of planets was now understood, and this even led to the prediction and discovery of Neptune in the 19<sup>th</sup> century. Now we're getting somewhere! Now we understand gravity, right?

Not quite.

We really don't know what gravity is. We know how it works and we can use it, but we just haven't figured out for sure if it is a force or and effect. It appears to be an effect, a natural phenomenon where mass causes the spacetime around itself to warp. Think about it, almost everything (except photons and gluons) has mass: stars, planets, people, atoms, sub-atomic particles, even neutrinos have mass. Spacetime is warped around everything, albeit in varying degrees, depending on a thing's mass. Can you visualize it? Our universe is a wiggling, sometimes seething cauldron of warped spacetime! Still, gravity is described as the weakest of the four fundamental forces, so what is it?

Einstein's theory of general relativity is about gravity and describes it as warped spacetime around mass. Not a force. However, there is a movement in the quantum mechanics community aimed at describing gravity as a force, with a particle called the graviton. The recent detection of gravitational waves has been cited as indirect evidence for the graviton's existence. We'll see.

The elephant in this room is a seeming overabundance of gravity in the universe. There is more gravity than expected for all observable matter/energy. A case in point is the Milky Way, our home galaxy, and basically all galaxies. Based on observable matter/energy measurements, there is not enough gravity to hold galaxies together. Yet they're staying together, so where is the extra gravity coming from? We don't know so we call it 'dark matter'. Maybe we should call it 'dark mass' because it doesn't appear to be matter. Whatever it is, dark matter doesn't interact with the electromagnetic spectrum, so we cannot detect it directly. Seems everything we can measure constitutes only 20% of the observable universe's mass-energy, therefore, gravity. As we get better at detecting stuff that number will change but will it ever explain all the gravity?

We really don't know what gravity is. Yet.

### What's in the Sky?

Jupiter! On May 8 Jupiter will rise as the Sun sets...its at opposition, meaning it appears opposite in the sky from the Sun. This is a similar phenomenon as with the full Moon, it rises as the Sun sets. Opposition.