Deficit of Mass: An Unfortunate Development in Physics

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Balance scale based measurement of mass is simply a comparison of gravity. The mass of an object, when measured using the balance scale, will be dependent on the volume of the object along with the amount of matter inside the object. Mass deficit is simply the variation in the mass of the object due to the change in volume of the object.

Deficit of mass or mass defect doesn't describe any physical phenomenon related to an object. It wouldn't even describe any physical aspect of an object. Before exploring the deficit of mass in detail, let's first look at the mass itself.

Mass can be described as the amount of matter inside an object. The standard definition for the mass is given below.

"Mass is the measure of matter in an object. The mass of an object doesn't change if that object is heated, bent, stretched, squeezed or compressed, or transported from one place to another on earth or even to a position out in space."

In summary, the definition of mass says that the mass of an object is a fixed amount and it doesn't depend on the shape and size of that object.

If mass is amount of matter, what is the matter itself? The best definition for the matter is as a thing that causes the mass in an object. Beyond this obscure definition, there is no clear description for the matter.

With mass and matter, we are using one to define the other in a circular fashion.

When we say an object contains 1 kilogram of matter, what exactly the 1 kilogram represents in regard to the object?

- Is it the color, shape or the volume of the object? Answer is a "No".
- Is it the number of basic particles inside the object? Answer is still a "No". If the mass is a number of basic particles then the mass should be represented in (x, y, z) format in which the x, y and z will be the total number of electrons, protons and neutrons respectively inside the object.
- Is it the combined mass of the basic particles? Again the answer is a "No". Combined mass of all the particles in an object will always be more than the mass of the object.

So, the measure of 1 kilogram for the amount of matter inside an object doesn't represent any physical characteristics of an object. Then, what it means when we say an object contains 1 kilogram of matter? When we measure the mass of loose cotton and an iron bar in a balance scale, we are simply comparing

the gravity of the earth to these two objects as they were being pulled down at both ends. If both these objects measure equal amount of gravity, then we say that both of these objects contains same amount of mass or matter. So, the mass, as we measure it today, is simply a comparison of gravity. If one object exerts more gravity to earth then that object can be said to have more mass and if another object exerts less gravity, then it will have less mass.

Strength of gravity an object exerts to earth certainly dependent on the total number of basic particles it contains. This number is certainly not equal in one kilogram of loose cotton and in the same mass of iron bar. Is there any other aspect of these objects influencing to make them equal in mass even though the number of particles was not same in these two objects?

Mass was defined in the works of Isaac Newton around 300 years ago as a constant value for any given object. The concept of mass deficit or mass defect came into picture in the early 20^{th} century after using the definition of mass, as provided by Newton, for about 200 years. Combined mass of all the basic particles inside an atom turned out to be more than the mass of the individual atom. The difference in mass was described as the mass deficit. With the addition of mass deficit in physics, one way, we are saying that the mass of an object is fixed and in another way we are accepting the deficit of mass with same amount of basic particles.

If we consider the matter as the number of basic particles in an object and the mass as the amount of matter, then the mass should always be a fixed amount no matter what we do with that object as long as the number of basic particles within that object remains same. Then why physics invoked the “mass deficit” into the picture? Mass deficit is simply an observation. Is there any alternative way to interpret this observation of loss of mass in the atom?

An object will have more binding energy if the particles within that object are close to each other. In similar way, binding energy within the particles will be less if the same particles are further apart. A one kilogram of iron Sphere will have more binding energy than a thin wire of 1 mm in diameter stretched from end to end made from the same one kilogram of iron sphere because the atoms in the wire are miles apart.

Binding energy will be maximum when all the particles merge into a single particle or all of them occupy the same space as a single particle. Combined gravity of the particles will increase as they merge into single particle. Mass of the object and the combined mass of all the particles within the object will be equal when all the particles occupy a space equal to a single particle. It means the deficit of mass will be equal to zero when all the particles merge to form a point size object. Mass deficit will increase as the distance between the particles increases. In other words, the object will measure less mass or gravity as the volume of the object increases.

In a nuclear reaction, an element with more binding energy will be converted into less binding energy elements. The difference in binding energy will be released as the energy. The final products in this reaction will have less binding energy and occupies more space than the initial object. If energy is consumed in a nuclear reaction then the final product will have more binding energy and occupies less space.

Here, we see a clear relationship between the amount of space an object occupies and the amount of gravity it exerts to earth. It means, if matter is compressed or occupies less amount of space, it measures more gravity and if the same amount of matter within the object occupies more space, then it measures less gravity to the earth. Gravity of the object, in other words, the mass of the object as we measure it today depends on the amount of matter inside an object and the amount of space that matter occupies. If an object compresses to a point size then it will have maximum amount of gravity with that particular amount of matter. This observation goes against the definition of mass, which says that the mass doesn't depend on the size of the object.

Concept of binding energy was misrepresented in nuclear physics. If an object releases energy then the final products should have less energy. Mass deficit in the final products was interpreted as the binding energy. As a result, final products were shown to have more binding energy. Point mass object will have zero mass deficit. Then can we say that all the material in a point mass was holding together without any binding energy in the object?

There is no established relation between the definition of mass and the way we measure it. To continue the imaginary relation between them, deficit of mass was introduced which in turn made the mass and its characteristics even more complex to comprehend. Scientific community got an excellent opportunity to establish the relation between the mass and its measurement when the deficit in mass was observed. Instead of correcting the definition of mass and its measurement, it was awkwardly extended to incorporate the deficit of mass. It is the most unfortunate thing to happen in modern science.

An object is a set of particles and the binding energy between those particles. Gravity can only interact with the particles, not with the binding energy between them. The number of basic particles remains same before and after a nuclear reaction. When mass is simply the strength of gravity then mass deficit in nuclear reactions can be best described as deficit of gravity due to the change in the internal arrangement of basic particles within that object. Therefore the strength of gravity an object exerts not only dependent on the number of basic particles it contains but also the amount of space those particles occupy.

If we call the matter as the number of basic particles in an object, the object exerts more gravity if all that matter occupies less space. If the volume of the same object is more, then the same amount of matter exerts less gravity. The mass, as we measure it today, is dependent on the size of the object and the number of basic particles it contains. The definition of mass and its measurement needs to be redefined to incorporate the amount of matter inside an object as well as its size. The need for the deficit of mass will be eliminated with the new definition of mass.

Mass is being used in almost every principle within the physics. If the present definition of mass and its measurement are flawed then all the principles dependent on the mass needs to be revisited. Physics is considered as the foundation of all branches of science. If the core concept within the physics is flawed then all our understanding of nature has no base.

Prevailing principles of physics can't describe beyond the big bang because we don't differentiate between the matter in the universe and the point size object where all that matter came from. Here, the point mass universe exerts tremendous amount of gravity and the same amount of matter in the present universe exerts less amount of gravity to an external object at same distance from these two forms of universe.

Gravity was assumed as a weak force based on the present definition of mass and the inverse square law of gravity. Inverse square law of gravity inherently uses the definition of mass in its derivation. An object like the sun was compressed to a point size and still mentioned as exerting same amount of gravity. If the definition of mass and the way we measure it is flawed then there is no base for the inverse square law for gravity.

Shell theorem, which was derived using the present definition of mass and the inverse square law of gravity, is also flawed. Gravity of a sphere to an external object will increase when the size of that object is decreased by keeping the same distance between the centers of two objects.

The simplest explanation for the pioneer anomaly is that the sun exerts more gravity when it looks like a point from the outskirts of solar system.

Note 1: This is a brief summary about the mass described in the book – Gravity from a new angle, which attempts at understanding the true nature of gravity. A chapter on mass from the book is available at the following link:
http://www.kmarasakatla.com/gravity/mass.html

Note 2: A brief presentation on the definition of mass is available at the following link:
http://www.scivee.tv/node/13471

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