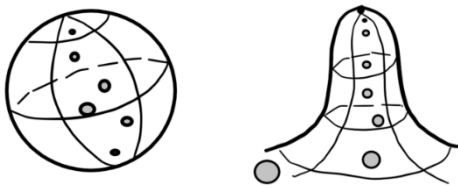


The **basic problem - the expanding universe versus base units**. The universe is filled with matter and radiation. Matter and energy have the same basis - quantum field or matter field. Both matter and particles are excitations of the quantum (matter) field. Basically, there is not that much difference between radiation particles (photons) and matter particles (quarks, protons, etc). Both are material, both carry energy and have mass, and both are wave and particle in nature. With matter, particles are always just slower than their waves, and a lot of the "motion" here is hidden in untranslated forms. Whereas with radiation, the particles (photons) are as fast as their waves - all the energy is "free". This is why matter is sometimes described as frozen or bound energy.

Go back to the expansion. See images below – there are two basic models of our universe. *Matter as particles - marked with circles with different size. The question is whether particles change or are stable during the cosmic expansion. And whether we're able to find that out. Find out using internal units.*



**There are two basic models of our universe.** The first model with a beginning and an end point, here the universe expands and then contracts. The second model with a beginning point (it may not be a point, but that's later) from which the universe expands to the big rip.

Both models have one thing in common - the base units are chosen from the universe itself. Base units are internal and not external. **The universe changes** (it may change in other ways than the above two models) **and so do the base units**. Do particles expand like radiation ? (see relict radiation versus the whole spectrum of electromagnetic radiation). Anyway, base units for time, distance and others are derived from our universe. We don't have outer base units for distance and time. No outer ruler. No outer oscillations. We have only inner rulers, inner oscillations. **We have chosen one of oscillations as the basic one for others**. See the definition of time based on the cesium atomic clock – 1 sec. is nearly 9 bil. oscillations.

*It is possible to plot a triangle on a spherical (or other) surface to determine the degree of curvature of the space. But only if the gravitational field is uniformly distributed on the spherical (or different) surface. The ruler remains the same, although curved (which we cannot detect), but the distance between the lines of the ruler is constant. If the gravitational field is inhomogeneous, then in a given part of the spherical (or different) surface there will be not only a change in the curvature of the ruler, but also a change in the distance between the lines of the ruler - which of course we cannot detect. We are inside and not outside with our rulers.*

**The basic question is - do the basic units change in accordance with the expansion of the universe?**

Or are there stable basic units like the "good old" platinum-iridium alloy that seems not to be expanding. Or is there a slippage in matter between expansion of the universe and a change of e.g. the length of a material object like the alloy meter above.

*Notice: Based on observations, we know that galaxies tend to cluster into systems we call galaxy clusters (metagalaxies). Our local galaxy system is holding together, and the spiral galaxy in the constellation Andromeda is even coming closer to us. However, all the galaxies beyond our local galaxy system are moving away from us.*