Expansion Rate of the Universe

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In 1998 strong evidence was introduced by two independent groups that the expansion rate of the universe was accelerating. This finding resulted in a scramble to identify and model explanations which reversed the general understanding that – up to that time – had been that the expansion rate was slowing due to the effects of gravitation. The IWPD Research Center has modeled the development of the universe by applying IWPD Scale Metrics with results that suggest z values in agreement with the observations from Type Ia Supernova. This theoretical agreement with observation provides support for IWPD Scale Metrics while providing a physical explanation for the observed phenomenon interpreted as the acceleration in the expansion rate of the universe.

IWPD Scale Metrics is built on a two-dimensional coordinate system (grid) with time existing as a dimensional "timeline" that defines the third dimension of space. The expansion of space can be attributed to a metric expansion by applying a scaling factor to the coordinate system. However, Scale Metrics suggests that as the distance between two points on a coordinate system increases due to the application of a scaler, that both time and mass are equally impacted by the same metric scaler. As distance increases, time slows and mass decreases by the same scale factor. In fact, IWPD Scale Metrics suggests that time, mass and distance are different manifestations of the same fundamental entity, dubbed as the "energime." To the local observer, these entities are invariant under translation and are defined by the Planck values for distance, time and mass.

In IWPD Scale Metrics, gravity has no universal influence and results in a completely flat coordinate grid. Initially, at T = 0, mass is evenly distributed on the coordinate grid. The cosmic scale factor at this time is 0 and therefore no distance exists between the masses placed on the grid. Under this condition, a singularity exists. As the scale factor increases, distance is created between the masses and a metric expansion occurs from the initial singularity.

In current theory, the expansion rate of the universe is determined from the brightness of Type Ia Supernova in comparison with the cosmological redshift of the light. The redshift is related to the change in the time dependent cosmic scale factor and is determined by:

$$1+z=\frac{a_{t_i}}{a_{t_0}}$$

Where a is the time dependent cosmic scale factor and t_i and t_o represent different points in cosmological time.

The simplest case of an expanding universe with minimal mass density provides a z value as determined by:

$$1+z=\frac{a_{t_i}}{a_{t_0}}\approx\sqrt{\frac{c+v}{c-v}}-1$$

Light seen from half way across the visible universe (approximately 7 billion light years) would have a z value of 0.73 and would be consistent with a universe experiencing a constant rate of expansion.

When applying IWPD Scale Metrics, both time and distance (along with mass) are effected by the Scaling Factor. Light seen from half way across the visible universe was emitted when the universe was half its current age and when the scale metric was 0.5 its current value. As such, time ran at a rate that was twice its current rate. An individual that experienced the evolution of the universe from half its age to its current time would experience a total time lapse of 1.5 times more than we anticipate. This observer would also see light traveling at a speed of c in the local frame of reference and therefore a light pulse emitted at half the age of the universe (as determined by us at 14 billion light years) would travel 1.5 times further than we anticipate or a total distance of 10.5 billion light years (as determined by the individual observing the evolution of the universe). During this time the Scale Metric "stretched" by 7 billion light years.

The z value determined by IWPD Scale Metrics is determined by:

$$1+z=\frac{Distance\,Traveled+Stretch}{Distance\,Traveled}=\frac{10.5+7}{10.5}=1.667\quad or\quad z=0.667$$

The Scale Metrics z value of 0.667 is approximately 9% less than that determined by a universe undergoing a constant rate of expansion with a z value of 0.73.

In fact, a Type Ia Supernova would need to be approximately 18% dimmer (9% further away) than anticipated in order to have a z value of 0.73 when applying IWPD Scale Metrics.

Note: when using IWPD Scale Metrics the intensity of the emitted light from the Type Ia Supernova is the same as for the constantly expanding universe. In the constantly expanding universe the light was emitted at 3.5 billion light years (half the distance of the universe at ½ of its current age). The light traveled a distance of 3.5 billion light years and was "stretched" an additional 3.5 billion light years to a total of 7 billion light years. In the IWPD Scale Metrics model the "stretch" was 7 billion light years (twice as much) which should impact the intensity of the light observed. Since intensity is a function of the distance squared, by stretching the light by an additional factor of 2 suggests that the intensity of the emitted light would need to be 4 times greater. In IWPD Scale Metrics, both mass and time change with the scale suggesting twice the energy emitted at twice the rate resulting in four times more intensity. Therefore, the effective distance when applying IWPD Scale Metrics is exactly in agreement with the 7 billion light years as determined by the light emitted by the Type Ia Supernova for the constantly expanding universe.