Will the Standard Model of Cosmology be confirmed by Observations from the James Webb Space Telescope? If not, what then?

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Abstract: The two space missions, the James Webb Space Telescope (JWST), and the Euclid Mission launch scheduled in 2023, have been designed to investigate and confirm the Standard Model of Cosmology (SMC). It is hoped these missions will provide answers to the many aspects underpinning the SMC which remain unproven or untested. As the first deep field observations from the JWST are published we begin to find answers to questions which will lead to a deeper understanding of the origin of the Universe. In this paper we discuss the various pillars on which the SMC is built and provide the basis for an alternative class of models for the origin and evolution of the Universe. Most importantly, the space missions will be able to discriminate between the two classes of models when a survey of the most distant galaxies in made, which will lead to confirmation or rejection of the SMC.

Background: The SMC was developed over the last century as observations from more and more powerful telescopes and space missions became available, being adapted piecemeal as knowledge of the Universe increased. Its mathematical foundation is Einstein's General Theory of Relativity, and it uses the Standard Model of Particles to model the formation the first hydrogen created in the Universe from a point of intense radiation energy. There are several steps along the way, including the starting point, which cannot be proven, but which, taken together, seem to provide the most plausible explanation for the origin of the Universe.

One of the main aims of the JWST is to investigate the most distant galaxies observable from Earth. The power of the telescope and its infrared capability will enable a survey of the galaxies in all directions. Under the SMC, the most distant observable galaxies from Earth should be at the surface of a sphere at just over 13 billion light years distance.

The distance of a galaxy is calculated from a measurement called redshift, the value of which is observed accurately using a spectrograph. While the actual distance depends on the interpretation of redshift, the most distant galaxies in all directions should have the same redshift under the SMC.

The area of sky surveyed in the Hubble Deep Field Programs was a fraction of a millionth of the whole sky and was at the very limit of the Hubble telescope's range. The small areas surveyed were chosen in regions where the light pollution from the stars in the Milky Way galaxy is a minimum. This maximised the depth of field which the Hubble telescope could survey. The areas surveyed, on either side of the galactic plane, appeared to be similar and did not challenge the assumption of the isotropic nature of the Universe.

With the new space missions, for the first time it will be possible to measure the redshift of the most distant galaxies in all directions in an all-sky survey. This will provide the first sound observational test of the assumption of isotropy which underpins the SMC.

The Standard Model of Cosmology

The SMC is the culmination of nearly a century of development of the idea that the Universe evolved from a single point. Over that time, it has been continually refined from the "primeval atom" originally proposed by Georges Lemaître, a Belgian Priest and professor of physics at the Catholic University of Louvain, to explain the apparent recession of galaxies first observed by Edwin Hubble in 1929.

From the 1960's the SMC evolved from the Big Bang theory as it was commonly known then, and became the focus of research and investment into the evolution of the Universe. Over that period the only serious rival, the Steady State model, has been virtually discarded and any development of models based on the existence of infinite space left unexplored.

If the SMC was almost complete, backed by sound experimental physics, waiting to be tidied up by the $10 billion-dollar JWST then perhaps the concentration on the point origin of the Universe would be understandable, but this is not the reality. The structure of the SMC is founded on unproven concepts and although, taken as a whole, they come together to provide a plausible model, it remains a possibility that future observations will destroy this model.

Building Blocks of the Standard Model of Cosmology

1. **The Singularity**: The Universe is thought to have been in existence for a finite time, around 13.8 billion years, during which it has expanded from an infinitesimally small volume containing all the energy of the Universe in a densely compressed super-hot form. This is known using a mathematical term as a singularity. Although the mechanism by which such an infinitely dense point could have come into being is unknown, it is the fundamental assumption of the model.

2. **Inflation**: In order to explain how the Universe appears to be flat (Euclidean) and uniform it was necessary to introduce the concept of cosmic inflation under which the Universe expanded exponentially, doubling in size 100 times in the first micro-second of its existence. Although the phenomenon of inflation cannot be demonstrated experimentally and faster than light motion is impossible, it relies on the concept of expansion of space to explain this exponential expansion. This is a necessary component of the SMC.

3. **The Standard Model of Particles:** The formation of the first matter in the form of hydrogen from energy as the Universe expanded and cooled down, depends upon the formation of protons and electrons which make up the hydrogen atom. Under the SMP, three quarks fuse together to make a positively charged proton which captures a negatively charged electron to make the simplest hydrogen atom. Our knowledge of physics at the extreme temperatures at which proton and electrons formed under the SMC is not experimentally established.

4. **Matter/Antimatter Asymmetry:** It is an established fact that matter and antimatter particles annihilate to produce energy and under certain conditions, energy converts to matter and antimatter in equal parts. Even though under the SMC, matter and antimatter was created in equal parts, the process by which the planets, stars, and galaxies of the Universe evolved to be made up overwhelmingly of matter is not known.

5. **Dark Matter:** The concept of dark matter is required in the model because the observed motion of stars around the galaxy centre and galaxies in a galaxy cluster around the centre of the

cluster, firmly suggest that there is a significant amount of undetected mass which adds to the gravitational effect on the visible mass to produce the observed motion. Dark matter will probably be needed in any model of the Universe but what exactly makes up dark matter is not known.

6 **Dark Energy:** In the 1990's the final building block was added to the SMC in the form of dark energy. Observations of Type 1a supernova suggested that the rate of expansion of the Universe was increasing. This required a modification to the model to explain this accelerating expansion. This was provided by the concept of dark energy, which under the SMC has an anti-gravity property driving the expansion and makes up 70% of the Universe. There is no experimental evidence for the existence of an energy which has this property, and this is something that the space missions will seek to investigate.

7 **Redshift and the Concept of Expanding Space:** The increase in the wavelength of light from distant galaxies is measured by redshift and is interpreted as being the Doppler effect due to the recession of the galaxy away from the observer. The values of redshift observed for the most distant galaxies mean that the galaxies are moving away at faster than the speed of light. It is not possible for real motion to exceed the speed of light, but this phenomenon is explained under the SMC as being due to the expansion of space, which is not theoretically limited to the speed of light. The explanation is that as space expands the wavelength of light is stretched thereby increasing the redshift. This interpretation of redshift is fundamental to the SMC.

When we consider the building blocks of the SMC there are several unproven facets to the model which must all turn out to be essentially correct if the SMC is to be shown to provide a valid model for the evolution of the Universe. It is possible that some aspects of the SMC could never be proved and while future observations may provide support for the model it is also possible that one of the pillars of the SMC could be found to be invalid thereby invalidating the model.

The Standard Model of Particles

The Standard Model of Particles is inbuilt into the SMC and provides the basis whereby protons and electrons evolved from the initial pure energy as the Universe expanded and cooled. While the SMP provides a much tested and accepted model of particles, it is incomplete. Quarks and electrons are thought to be independent fundamental particles. Quarks combine to make protons and neutrons which are composite particles with the simplest hydrogen atoms forming from protons and electrons. There is no fundamental/elementary particle from which quarks and electrons are made.

The possibility that quarks and electrons are themselves made up from smaller particles in a natural fusion process from an elementary particle is not and cannot be denied. The existence of such more fundamental particles might lead to a better understanding of particle formation and a revision of the Standard Model of Particles. However, if there is an elementary particle from which all sub-atomic particles are made, it would have very significant implications regarding the formation of particles in the evolution of the Universe in the SMC.

Under the SMC the building blocks of all the hydrogen in the Universe formed during the first three minutes as the Universe expanded and cooled. The conditions during the first three minutes cannot be replicated experimentally and so the precise physics underlying the formation of protons and electrons from high energy photons under the SMC is not known. This is partly because the precise nature of a particle is not known. Is it a wave, is it a string, just what is it? How were minute quarks produced from high energy photons and how did they then combine to make protons?

These questions become harder to answer if there is an elementary particle, perhaps orders of magnitude smaller than the electron, from which quarks and electrons are made. The process becomes increasingly difficult to theorise if, as would seem necessary, the Universe must have expanded and cooled down sufficiently for elementary particles to form, before heating up again to allow them to fuse together ultimately, to form quarks and electrons. The smaller the elementary particle is, the more difficult it is to explain the formation of protons and electrons under the SMC.

The existence of an elementary particle would imply that the formation of the hydrogen making up stars when they first came into being was unlikely to have been the result of expansion and cooling from a hot state. If hydrogen did not form from a hot state cooling, then it must have formed from a cold state heating up. It would therefore be logical to suggest that if there is a single fundamental particle from which all other particles are made, then the Universe evolved from a cold state which heated up.

Interpretation of Redshift.

Redshift is the basic tool for cosmological measurement. Light emitted from a stationary source has the wavelength associated with the colours of the spectrum from red to blue, indigo, and violet which all combine to give visible white light. If the source is moving towards the observer the wavelength of the incoming light is shortened moving it towards the blue end of the spectrum, and if the source is moving away from the observer the wavelength is increased towards the red end of the spectrum. The light is said to be blue shifted or redshifted. If we look beyond our own Milky Way, we can observe galaxies far beyond our solar system and measure the redshift or blueshift of the light which has travelled from the galaxy to the telescope. Galaxies which are not gravitationally bound to the Milky Way are normally redshifted with redshift increasing the further away the galaxy is from the observer.

The Standard Model of Cosmology (SMC) is founded on the interpretation of redshift as a Doppler effect due to galaxies moving apart. The values of redshift observed for the most distant galaxies mean that the strict interpretation of the Doppler effect as velocity through space cannot apply since this would mean faster than light motion. This apparent contradiction of Einstein's principle is explained under the SMC as being due to the expansion of space itself, which is not theoretically limited to the speed of light.

There is no doubt that redshift increases with distance for distant galaxies. A pillar of the SCM is that space itself expands and if this proves not to be true then the observed value of redshift would require a different interpretation. As we have said, the observed values of redshift for distant galaxies cannot be due entirely to real motion. Hence there must be some other reason why the wavelength of incoming light increases with distance.

Light from a distant galaxy passes through the inter-galactic medium on the several billion light-years journey from the galaxy to Earth. If the light were to lose energy on that journey, then the wavelength would be increased, and the light would be redshifted. This concept was first proposed by Fritz Zwicky to explain Edwin Hubble's ground-breaking observations in 1929, although he acknowledged that collisions with intervening particles in a regular way would produce scattering of the light which would blur the images of distant galaxies observed from Earth. This is known as the Tired Light Theory

Halton Arp also challenged the purely Doppler interpretation of redshift and published supporting evidence in several books including "Seeing Red: Redshifts, Cosmology and Academic Science". His ideas gained support with other Big Bang doubters including Fred Hoyle but were not accepted by mainstream cosmology who continue to rely on the Doppler interpretation to support the SMC.

More recently a mechanism by which light could lose energy without scattering as it travels through the Universe was proposed by Lyndon Ashmore in papers on "New Tired Light Theory"[i] originally published

in 2006 concluding that redshift increases with the distance the light has travelled without scattering. If wavelength does increase with distance due to tired light, then the concept of expanding space due to dark energy is invalidated and with it the SMC.

If light loses energy with distance, then it is possible that the observed value of galaxy redshift is due to a combination of the Doppler effect due to the real motion of the galaxy and the distance the light has travelled, the combination of which might explain the non-linear nature of observations of redshift with distance.

Anomalous Real Motion of the Milky Way

Our galaxy, the Milky Way, is known to have unexplained real motion in relation to the cosmic microwave background. It is speculated that this is caused by the gravitational attraction of a galaxy supercluster in a region known aptly as the Greet Attractor, some 220 million light years away from Earth according to NASA. Observing the Great Attractor is difficult at optical wavelengths as the plane of the Milky Way both outshines and obscures (with dust) many of the objects behind it. The region behind the centre of the Milky Way where the dust is thickest remains a complete mystery to astronomers. The JWST has the capability to use infra-red wavelengths to peer through this dust and will provide much more knowledge of this important region of the sky.

However, this explanation of the real motion of our galaxy cluster raises the question of how exactly the anti-gravity property of dark energy manifests itself if it does not act between galaxy clusters which are nearly a quarter of a billion light years apart. Could there be another explanation for the real motion of the Milky Way?

Alternative Models for the Origin of the Universe

We have seen that if there is an elementary particle from which quarks, electrons and the whole particle zoo is made, then the Universe is likely to have evolved from a cold state which heated up. Any model of the Universe from an infinite cold space would have to explains where the heat would have come from to generate the hydrogen for the first stars.

Consider the following statement attributed to one James C. Baker (unknown).

"It is more logical to assume all space was full of something that converted to the matter (and energy) in the universe than to assume that everything came from a single point"

Models based on the Conversion of Infinite Space into the Universe

The Steady State model assumed an infinite Universe which had always existed. It did not explain how stars and galaxies formed in the first place, even though it was known that all stars form mainly from hydrogen. Little consideration has been given to alternative models where the stars in galaxies formed from some form of energy which pre-existed the Universe in infinite space. The rejection of the Steady State model would not mean that this class of models of the Universe should be rejected.

Both the SMC and the alternative class of models share the same problem of explaining why anything should exist in the first place. In both cases we must accept an assumed starting point from which the theory can explain the subsequent development of the Universe. With the SMC the starting point is the minute point/singularity containing all the energy which fills the Universe which we now observe. With the proposed alternative the starting point is infinite space filled with a form of basic energy which is capable of being converted to hydrogen to form the Universe.

We wish to consider essential features of any alternative model leading to observations which would discriminate it from those expected from the SMC. Clearly, a Universe which develops from a single point containing all the energy of the Universe will have different characteristics from a Universe which evelved from infinite space filled with a basic energy field which converted into the Universe.

Under the SMC all the protons and electrons which make up the hydrogen atoms in the Universe formed in the first three minutes of expansion whereas under any conversion process the protons and electrons making up the hydrogen of the Universe would have formed and would still be forming over time, since it is inconceivable that the conversion of an infinite basic energy field into all the hydrogen in the Universe could have happened at the same time.

It follows that whatever model of the Universe from an energy field is developed., in all such models there would be a breakdown in the equilibrium of the basic energy field at some location in space, creating heat and releasing a chain reaction spreading out in a sphere of conversion from this location. The location of the breakdown in equilibrium of the basic energy field would become the centre of the embryo Universe. See appendix for a discussion of possible properties of a basic energy field.

What should the James Webb Telescope see under the Various Models?

Under the SMC the observable Universe is isotropic and so we should expect that the furthest observable galaxies would be the same in all directions. Beyond the sphere of most distant galaxies, we would be looking at the darkness which, under the model, would have cloaked the early Universe before the formation of the first stars.

Under the Steady State model there is no limit to the Universe and so when we look deeper into space, in any direction, we should continue to see galaxies like the galaxies closer to us. There would be no point at which light from galaxies ceased to exist. Observations of galaxies in all directions would be limited only by the power of the telescope making the observations. Under this model there is no reason to expect that observations of distant galaxies in one direction should be essentially different from observations in any other direction.

Models based on the conversion of a pre-existing basic energy field in infinite space have a centre to the Universe, which is the location of the break down in equilibrium and hence the formation of the first hydrogen, from which the oldest galaxies in the Universe would have formed. The position of the Milky Way in relation to the centre would be along a radial at an unknown distance from the centre. Further along that radial away from the centre would be younger galaxies which formed later than the Milky Way as the sphere of conversion expanded outwards. Any evidence which suggested the Universe was anisotropic would support the conversion model. A survey of the most distant galaxies in all directions could establish the direction of the centre.

Without going more deeply into possible models based on the conversion of a pre-existing basic energy field, an all-sky survey of the redshift of the most distant galaxies in all directions will be fundamental in testing the SMC. Confirmation that the Universe is isotropic in relation to the most distant galaxies will favour the SMC and make the conversion model untenable. On the other hand, hard evidence that the Universe is directional and that the most distant galaxies in one direction have a greater redshift than those in the opposite direction will support the conversion model.

Further Discussion

The purpose of this paper is primarily to raise awareness of the neglected class of models of the Universe which has been generally overlooked and would have to be considered if observation from the space

missions JWST and Euclid lead to serious questioning or even rejection of the SMC. Observations which point to a non-isotropic directional Universe would be a serious challenge to the SMC and should give rise to alternative models based on the conversion of a pre-existing energy field into the Universe.

Several of the pillars of the SCM are yet unproven, the singularity, inflation, and dark energy and even though there is more tangible evidence for the existence of dark matter its exact form remains unknown. Hopefully the space missions will provide a much deeper understanding of these assumptions underpinning the SCM.

The other pillars on which the SMC relies are the interpretation of redshift and the Standard Model of Particles. The SMC is heavily dependent on the perceived knowledge regarding these two basics of physics, but it is possible that a deeper knowledge of either or both would undermine the SMC.

In the conversion process, while the sphere of conversion may be expanding at up to the speed of light, the initial velocity of forming galaxies would be zero. The subsequent motion of galaxies after they form would be dependent on the gravitational attraction acting upon them. While there would inevitably be motion in some direction, the speed of a galaxy starting from rest and moving under gravity would most probably be only a small fraction of the speed of light, even after billions of years.

The real motion of the Milky Way observed relative to the Cosmic Background Radiation could be evidence of a gravitational attraction which acts on all galaxies drawing them outward towards the surface of the expanding sphere of conversion. The values of redshift observed in Hubble Motion could be a combination of the Doppler effect due to real motion and the effect on redshift caused by the distance the light has travelled.

Conclusions

The SMC has become the only model given serious investment over the last fifty years, meaning that any alternative model has had little or no chance of being tested against the Standard Model. This is not good physics but now, with the new generation of space telescope designed specifically with the SMC in mind, it will be possible to establish the validity or otherwise of the Standard Model. There is a real possibility that future observations of the most distant galaxies might prove to be shown to be inconsistent with the SMC. Only then would alternative models be given the attention that sound scientific principles should have required from the start.

It is frightening to think that as the next generation space telescopes arrives, we may be faced with the realisation that the last century of investment both financial, and more importantly human effort, in developing a model for the origin and evolution of the Universe, may have been misdirected and, in part at least, wasted.

In this paper we have discussed the many weaknesses and unproven assumptions in the SMC and proposed a whole class of models which have been ignored. While it is arguable that the new space missions are necessary to investigate basic pillars of dark energy, dark matter and inflation, the interpretation of redshift could have received much more attention from the scientific community than it has done to date in order to verify this basic assumption of the SMC.

One of the stated aims of the JWST mission is to investigate the nature of the most distant observable galaxies. The telescope will be capable of surveying much greater areas of sky than the Hubble telescope and because of its infra-red capability be able to reach areas which were inaccessible to Hubble. If there is evidence that the redshift of the most distant galaxies in one direction is greater than that in the opposite direction, the possibility that the Universe evolved from pre-existing existing space filled with a basic

energy must be given serious consideration. This would have implications on the Standard Model of Particles and provide evidence to suggest the existence of a fundamental particle.

Already, with only a minute area of the sky investigated, early observations of the JWST have revealed galaxies with redshift z>13 which under the SMC translates to more than 13.5 billion light years. The gap between the beginning of the Universe and the first known galaxies is shrinking and is likely to shrink much more as more of the sky is surveyed. As more distant galaxies are observed the time for the formation of stars and the grouping of stars into galaxies shrinks. Current models for the formation of the first stars and galaxies from the first hydrogen will have to be revised if the observations are to be consistent with the SMC or the model might be changed yet again. As more galaxies in different directions are investigated the record is almost certain to be broken making the problem of modelling the first galaxies within the SMC even more challenging.

Appendix:

In the above paper we have considered the possibility that forthcoming observations from the JWST could indicate that the Universe is anisotropic. Observations of the redshift of the most distant galaxies might be shown to be direction dependant. If this proves to be the case the possibility that the Universe developed from an infinite basic energy field filling all of space must be considered.

In the following we offer suggestions for the possible nature of this basic energy field and how the Universe could have developed from basic energy.

Properties of the Basic Energy Field

1. It is generally accepted that the Universe is flat and that its geometry is Euclidean. This implies a critical value for the mass/energy density of the Universe. If the origin of the Universe is the conversion of the basic energy field in a region of infinite space, then space itself must be flat with the same critical density value.
2. As we have said above if the quarks and electrons were not formed from energy as the Universe expanded and cooled down then it is reasonable to suppose that they formed as the basic energy field heated up. The logical consequence of that would be that the basic energy field, filling all of space is cold and the Universe formed from the heating up of basic energy starting at one location and spreading outwards from that location.
3. The lowest possible temperature for the basic energy field is absolute zero. A basic energy field at this temperature would imply no motion whatsoever, which is impossible under Heisenberg's uncertainty principle. The mean temperature of the basic energy field would have to be just above absolute zero (0° K).
4. With the Big Bang, quarks and electrons formed as the Universe expanded and cooled. If the Universe formed from a cold beginning, it must have heated up to allow quarks and electrons to form and produce hydrogen. Since there is no possible outside agent to cause this, the heat must have been generated within the basic energy field itself.
5. We know that matter and antimatter were created in equal quantities under the Big Bang model, and so it is reasonable to assume that matter and antimatter existed in equal parts in the basic energy field. Particles of matter and antimatter annihilate, but at or near absolute zero they would not be free to do so.
6. A basic energy field consisting of a balance of matter and antimatter would suggest that elementary particles of matter and antimatter would be bound together in pairs at a temperature which prevented annihilation. They would be in a dormant or "frozen" form.

7. The temperature of the basic energy field would fluctuate at just above absolute zero at which the particle pairs would have remained dormant almost unchanging through the eons. At some instant and location this timeless equilibrium must have been broken by an excessive fluctuation in the basic energy field.
8. Once released from the dormant state at some location in space, matter and antimatter particles would annihilate releasing energy in the form of photons which would then free adjacent dormant particle pairs to annihilate in a chain reaction spreading out from that location in an ever-expanding sphere.

In order to understand what would happen next it is necessary to know the exact nature to the elementary particles which make up the basic energy field. If quarks and electrons are not themselves fundamental particles, as is assumed in the SMP, then they will have been formed in a fusion process starting with the elementary particle. Elementary particles will either annihilate or form higher order composite particles, both matter and antimatter. As composite particles form from the fusion of elementary particles and energy is released in the annihilation process the balance of matter and antimatter would be broken with one or other becoming predominant.

The above argument is presented as a possible explanation of how our Universe is made of predominately matter. The idea that the first hydrogen formed in a fusion process from an elementary particle is not possible under the Standard Models of both Particles and Cosmology.

The exact way in which quarks and electrons form from the elementary particle would depend on the extended model of particles but the principle would be the same. Once freed from the dormant state the elementary particles would be free to annihilate with other elementary particles (matter with antimatter) or form higher order composite particles by fusing (matter with matter and antimatter with antimatter). with other elementary particles to form composite particles.

This process would be repeated in a chain reaction creating increasingly energetic composite particles, eventually producing quarks and electrons and the heat required to form protons and ultimately the simplest hydrogen atoms. There would be a natural process of fusion from elementary particles at near absolute zero, through increasingly massive composite particles and increasing temperature, until reaching the stage where composite particles (quarks and electrons) combine to form hydrogen. This process of hydrogen formation would be consistent with nature's way of forming heavier elements which are created by fusion in the crucible of stars.

For the authors alternative model read "The Effect of an Elementary Particle on the Standard Model of Cosmology"[ii] and "Hubble Motion without Dark Energy giving an Alternative Model of the Universe"[iii]

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[i] Lyndon Ashmore,2016-21, www.researchgate.net/project/new-tired-light

[ii] Olley and Yee 2021 https://www.vixra.org/pdf/2102.0085v1.pdf

[iii] Olley 2021 https://www.vixra.org/pdf/2104.0106v2.pdf