TGD inspired cosmology

1. relies on

   (a) sub-manifold gravity: cosmologies imbeddable in $H = M^4_+ \times CP_2$ implying extremely powerful constraints on cosmology as analogs of constraint forces.

   (b) many-sheeted space-time concept implying fractal Russian doll like cosmology.

   (c) zero energy ontology allowing to avoid conflict with Poincare invariance.

   (d) Cosmic strings dominating in primordial cosmology before emergence of spacetime sheets and later evolving to magnetic tic flux tubes serving as templates for the formation of various astrophysical objecs.

   (e) Dark matter realias $h_{eff} = n \times h$ phases and dark energy identified as Kahler magnetic energy of flux tubes.

2. has primordial phase

   (a) Gas of cosmic strings in M^4_+ behaving in good appro ximation as 1-D objects.

   (b) Space-time sheets have not yet emerged so that one cannot speak of cosmology in ordinary sense.

   (c) Since horizon radius for M^4_+ is infinite the string gas is in ther- mal eqiulibrium and isotropy and homogenuity hold true and is very natural since this guarantees Lorentz invariance at imbedding space level.

   (d) String gas transforms later to gas of flux tubes in M^4_+ but preserves its long range correlations due to Lorentz invariance.

   (e) String gas is in Hagedorn temperature $T_H = \hbar/R(CP_2)$: pumped energy goes to vibrational rather than translational degrees of freedom.

   (f) Density of strings behaves as $1/a^2$, where a is M^+ proper time and defines the Lorentz invariant cosmic scale factor. Mass per comoving volume is proportional to a and goes to zero.

3. critical period

   (a) A phase transition generating space-time sheetes containing topologically condensed cosmic strings.

   (b) Quantum criticality requires that mass density for space-time sheets is critical and 3-D curvature scalar vanishes since all local dimensional parameters must vanish by scale invariance.

   (c) The imbeddability of critical cosmology fixes it uniquely apart from its duration (same applies in over-critical case). Time evolution of Hubble constant is same in critical and over-critical situation.

   (d) In the beginning Hubble constant behaves like $1/a$ and g_{aa} is in good approximation equal to 1. Silent whisper amplified to Big Bang.

   (e) At some time a_1 the induced metric would become Euclidian and mass density would diverge. A phase transition to radiation dominated cosmology must take place before this.

   (f) Below a_1 expansion becomes very fast and accelerating. This is the TGD counterpart for inflationary expansion and generates ordinary and dark matter as the magnetic energy of cosmic strings decays to particles.

   (g) The expansion smooths out inhomogenities of mass density but also gene- rates large density fluctuations near a_1. Since the time $a_f < a_1$ for the transition to radiation dominated cosmology must have distribu- tion, also the final mass density has distribution. This gives rise to the fluctuations of CMB temperature.

   (h) Also gravitonic background is generated near the end period and one can understand why B-modes reflecting the interactions of CMB with gravitons are unexpectedly large.

  (i) The web formed by cosmic strings provides a microscopic description for the generation of density fluctuations and formation of galaxies (pearls in necklace) identifiable as nodes at which two cosmic strings meet.

4. Has also a transition to asymptotic phase

   (a) Since TGD cosmology is fractal critical periods are expected to appear in all scales. The acceleration of expansion assigned with later cosmology could also reflect the presence of phase transition.

   (b) The asymptotic cosmology implied by the condition that the energy momentum tensor defined by Einstein tensor defines conserved quantities is also string dominated. The interpretation is that dark energy as- sociated with topologically condensed cosmic strings begins to dominate.