# Cosmic strings

Cosmic strings:

1. Basic extremals of Khler action. $M^4$ projection minimal surface as in string models. $CP_2$ projection geodesic sphere, and more generally, com- plex sub-manifold of $CP_2$.

2. String tension proportional to $\hbar/\alpha_K R^2$. In string models string tension of form $\hbar/L_P^2$ propto $1/G$. The counterpart of string tension in p-adic mass calculations assumed to be proportional to $\hbar/R^2$. If one uses the $\hbar/\alpha_K R^2$ the value of must be assumed to be larger by factor $1/\alpha_K$.

3. Emergence of strings from well-defined em charge for spinor modes. Spinor modes restricted to to 2-D string world sheets or partonic 2-surfaces with vanishing $W$ fields have well-defined em charge. Also the vanishing of classical $Z^0$ field is possible and implies vanishing of large parity breaking effects in long length scales at least.

4. Conjecture. Preferred extremals with vanishing classical $W$ and $Z^0$ fields are possible (so that spinor modes have well-defined em charge and purely vectorial couplings) and have 2-D $CP_2$ projection which is either geodesic sphere or complex sub-manifold of $CP_2$. Cosmic strings correspond to these extremals.

Topological condensation of cosmic strings and TGD counterpart of inflation.

1. Cosmic strings basic objects in primordial cosmology before ordinary cosmology in which space-time surfaces representable as graphs for maps $M^4 \to CP_2$ dominate. Gas of cosmic strings in $M^4_+$ ( uture light-cone) carrying only classical em fields.

2. The magnetic energy of cosmic strings represents energy of inflaton field. The magnetic energy of topologically condensed gradually thickening cosmic strings flux tubes - represents dark energy. The decay of cosmic strings to ordinary and dark matter corresponds to the decay of the vacuum energy energy of inflaton field to ordinary and dark matter. The conservation of monopole flux and thickening of cross section implies that the energy density per length decreases during expansion.

3. The phase transition to radiation dominated cosmology described by quantum critical cosmology for which 3-D curvature scalar vanishes. This cosmology unique apart from its duration. The period ends with accelerating expansion analogous to inflationary period in or- dinary cosmology.

4. The fluctuations of CMB temperature are due to the fluctuations in the exact time for the end of the transition period. The recently claimed local polarization of CBM temperature could be understood as having gravitational origin but also synchrotron radiation from magnetic flux tubes could contribute.

5. Cosmic string's magnetic energy would explain the origin of cosmo- logical constant. GRT space-time would be effective notion with metric defined as sum of $M^4$ metric and the deviations of various space-time sheets at which particle has topological sum contacts. This metric is not in general imbeddable to $M^4 \times CP_2$ but Poincare invariance suggests that it obeys Einstein's equations with cosmological constant at least in statis- tical sense. Cosmological constant would parametrize the presence of topologically condensed magnetic flux tubes.

6. Cosmic strings carry monopole magnetic flux through the 2-D cross section which is closed 2-D surface unlike for ordinary Maxwellian flux tubes. No current is needed to create the magnetic field. This would explain the presence magnetic fields in all length scales. In ordinary cosmology they presence is very difficult to understand since the currents would be random and would not give rise to magnetic fields in required long scales.

7. Magnetic flux tubes dominate also the asymptotic assumed to satisfy the condition that Einstein tensor defines conserved isometry currents: this implies that the space-time surface is extremal of curvature scalar for induced metric. Mass density behaves as $1/a^2$, a light-cone proper time.

Cosmic strings would be also key players in astrophysics.

1. The constant orbital velocity spectrum for distant stars rotating around galaxies inspired the hypothesis that a suitable halo of dark matter is responsible for it.

2. The simplest TGD explanation is that the visible parts of galaxies are decay predicts of cosmic strings extended to magnetic flux tubes along long magnetic flux tube and like pearls in necklace. There exists em- rical support for the arrangement of galaxies along linear structures.

3. Galaxies could be also at junctions of two cosmic strings which have collided and started to decay to ordinary matter.

4. Also stars could be arranged along thick magnetic flux tubes originating from cosmic strings.

Summary: In the fractal TGD Unverse cosmic strings and the magnetic flux tubes resulting as their $M^4$ projection expands, would be in key role of dynamics in all scales. Even elementary particles would correspond to pairs of lux tubes at parallel space-time sheets connected by wormhole contacts.