Astrophysics and TGD.

1. Under what assumptions extremals of Kähler action could provide sensible models for astrophysical systems?
   (a) The original approach started with guesses for the extremals of Kähler action which might be applied to a modelling of astrophysical objects li- ke stars and galaxies.
   (b) The basic problem was was whether GRT follows from TGD or not. The general solutions of Einstein's equations are certainly not imbeddable to $M^4 \times CP_2$ and it has become clear that GRT spacetime is only effective notion. Its metric is obtained by summing gravitational effects of various space-time sheets on test test particle having topo- logical sum contacts to all these space-time sheets.
   (c) The challenge is therefore to understand whethter single preferred extremal could provide a realistic description of an astrophysical object under some circumstances.
   (d) One might guess that this could be case under highly symmetric situa- tions when the number of space-time sheets involved is smaller or their effects sum up to something very simple. Einstein's equations would of course be satisfied by the extremal.
2. Maxwell-Einstein action as a model for effective space-times.
   (a) Vacuum extremals of Kähler action are the most obvious candidates in this respect.
   (b) Einstein-Maxwell action is expected to be a natural guess for the variational principle determining effecspace-time surface.
   (c) In TGD framework Euclidian space-time regions gions represent lines of generalized Feynman diagrams and a very natural question is whether black hole interiors might be replaced by them. A deformation making the radial component of Schwartshild metric finite at horizon makes it light-like surface at which the determinant of four-metric vanishes just as it does at wormhole throats at which induced metric changes its signa- ture. This would suggest that Euclidian regions indeed provide a proper description of black-hole interiors.
   (d) Einstein-Maxwell action allows Reissner-Nordström solution as Minkowskian metric and CP_2 as an Euclidian metric with cosmological constantl, which is large and characterizes CP_2 size. S-N solution is representable as vacuum extremal and CP_2 type vacuum extremals correspond to CP_2 as gravitational instanton.
3. Attempts to model astrophysical system in terms of extremals of Kähler action.
   (a) The existing TGD based models for astrophysical systems date back to the time when the understanding of the relationship between TGD and GRT had not yet developed to the recent level. Hence the models are more like exercises in sub-manifold geometry with physical interpretation. Some of the examples considered were following.
   (b) Schwartschild and Reissner-Nordström metrics allowing imbedding as vacuum extremal.
   (c) The attempt to imbedding R-N type metric as non-vacuum extremal to $M^2 \times S^2$, S^2 geodesic sphere, suggested difficulties with EP if gravita- tional mass is calculated as the Kähler energy of the solution. Cutoff is however needed so that the result was not convincing.
   (d) Model for the final state of the star. A non-vacuum extremal was considered and an approximate solution with 2-D CP_2 projection belonging to homologically non-trivial geodesic sphere was considered. The basic prediction was the presence of dynamo like structure and the concentration of the mass density at the surface of the object.
   (e) These models suggest that GRT limit of TGD in terms of effective metric is needed at at least when the the astrophysical object does does not not allow model in terms of vacuum extremal. TGD would be "microscopic" description replacing GRT as an effective theory of gravitation.
4. Could astrophysical systems be quantum coherent?

(a) The work of Laurent Nottale raised the question whether planetary orbital radii could be understood as Bohr radii with gigantic value of Planck constant $h_{gr} = GM_1M_2/v_0$, $v_0/c \simeq 2^{-11}$: for 3 inner planets v_0 has same order of magnitude as planetary orbital velocity from Bohr rules which are same as for hydrogen atom. For outer planets the value of v_0 is 5 times smaller.

(b) The identification of h_{gr} as h_{eff} is excluded since h_{gr} has gigantic value and Compton lengths of particles with this value of Planck constant would be enormous: Schwartschild radius of Sun multiplied by the mass of planet using the mass of the particle as unit!

(c) If the notion of h_{gr} makes sense it must have some other origin and I have made a proposal to this direction. By Equivalence Principle one can apply the Bohr rules equally well to individual particles to get same spectrum of orbital radii. Now the value of h_{gr} would be much smaller and the dark Compton length would be about GM_1/v_0, roughly 1000 times the Schwartschild radius $r_S \simeq 3$ km of Sun. Solar radius is about 2.3×10^2 longer.

(d) For inner planets Compton length would be about 3000 km and roughly $.2 \times 10^{-5}$ times smaller the distance of Earth from Sun. One could interpret this in terms of ordinary dark matter residing at magnetic flux tubes emerging from Sun. What is interesting that the Compton length would be same for all particles of dark matter.

(e) This raises the question whether macroscopic quantum coherence might prevail for dark matter in astrophysical length scales. Could the M^4 projections of partonic 2-surfaces have astrophysical size and could dark matter at them as macroscopic quantum phases be responsible for Bohr rules. The ordinary matter would condense around dark matter de-localized along the Bohr orbits.