Weak form of electric-magnetic duality

1. Background for WFED:

   (a) Montonen-Olive: Electric-magnetic duality for N=4 SUSY. States essentially that one obtains a theory physically equivalent with the original one when one replaces gauge coupling g with 1/g.

   (b) Applies in 4-D N=4 supersymmetric gauge theory. There actually exists larger SL(2,Z) symmetry where g and theta angle trasnform non-trivially.

   (c) One can introduce complex coupling $\tau = \theta/2\pi + i4\pi i/g^2$ transforming as $\tau(a\tau+b)/(c\tau+d)$ under SL(2,Z).

2. Motivations for weak form of e-m duality.

   (a) Self-duality for CP_2 Kähler form. Kähler form defines self-dual monopole field with identical Kähler electric and magnetic charges (dyon).

   (b) One should fix boundary conditions at wormhole throats at which induced metric changes signature and has vanishing determinant.

   (c) WFED requiring that the values of Kähler electric field and Kähler magnetic field at partonic 2-surfaces could allow to achieve this.

   (d) The condition can be generalized that it is also true at space-like 3-surfaces at the ends of CD and at light-like wormhole throats.

3. Consequences of WFED:

   (a) If $j \cdot A$ term in Kähler action vanishes, Kähler action reduces to 3-D boundary terms at the ends of CD and at wormhole throats. If WFED holds true, Kähler action reduces to Chern-Simons terms.

   Comment: The vanishing of $j \cdot A$ leads to proposal that Minkowskian preferred extremals consist of regions representing massless states moving with light velocity along curvilinear orbits.

   (b) Effective 2-dimensionality and almost topological QFT results in accordance with strong form of holography.

   (c) Good hopes about calculability of TGD: no need to know the details of the preferred extremal in its interior.

4. WFED inspires some conjectures in elementary particle physics.

   (a) Elementary particles correspond to string like objects. Kähler magnetic flux tubes carrying monopole fluxes at parallel spacetime sheets with wormhole contacts connecting their ends. These are accompanied by string world sheets carrying spinor modes.

   (b) Hadrons would involve similar color magnetic flux tubes in hadronic scale and connecting valence quarks. They carry most of the energy of baryons: quarks give only a small contribution.