

## ”The Trans-Carpathian Seminar on Geometry & Physics”

(See also the [Geometry & Physics @ DFT](#) seminar homepage)

*Date:* Wednesday, April 17, 2024, 15:15 Bucharest time

*Location:* online via Zoom

*Speaker:* **Prof. Rafal Suszek** (KMMF, University of Warsaw)

*Title:* **1001 Tricks with Character(s) – A Case for Simplicial Mechanics stitched by Categorized Correspondences**

*Abstract:* The standard approach to the lagrangean modelling of dynamics is firmly internalised in the smooth category: All manifolds involved are smooth, as are tensorial data on them which we employ in the construction of lagrangean densities (such as metrics, background electromagnetic fields etc.), and, finally, also fields are chosen from among global sections of the relevant configuration bundles. Such a restrictive approach fails to account for a great many theoretically interesting and even phenomenologically relevant mechanical systems, such as, e.g., dynamics on orbispaces of non-free-&-proper group actions and Aharonov-Bohm(-type) effects, and so it calls for a generalisation.

In the talk, a particular proposal for a generalisation of this kind shall be discussed at length, in which smooth structures are replaced by (stratified) simplicial hierarchies thereof over a spacetime decomposed into ‘domains of smoothness’ which are separated by self-intersecting domain walls, or defects. It is at the latter that novel dynamical mechanisms are bound to occur which ensure a consistent gluing of the domain-wise smooth lagrangean sub-models. Thus, to begin with, it shall be argued that such structures do arise – ‘secretly’ but quite naturally, too – already within the smooth paradigm, e.g., when trying to make sense of the so-called non-linear realisations of symmetries on homogeneous spaces of Lie groups, as originally contemplated by Schwinger and Weinberg, or in the gauging of global symmetries through (pullback of) the Cartan-Borel homotopy model of the symmetry-group orbispaces. In these model cases, we witness effective descent of dynamics to a quotient of the configuration space that we work with, and that descent is attained through imposition of correspondences which generalise group actions and are divided out. This observation becomes a guiding principle in the much more general considerations of simplicial mechanics with stratified configuration spaces over spacetimes with defect networks that we plunge into next. Upon parking the discussion safely in the setting of lagrangean models of dynamics of extended charged probes in background charge fields, we encounter diverse resolutions of singular structures determining the mechanics of interest, such as: the classic Beilinson-Deligne resolution of cohomology classes of the charge fields, leading to the incorporation of distinguished Cheeger-Simons differential characters into the ( $\sigma$ -)models of the dynamics (as first proposed by Alvarez and Gawedzki); equivariantisation

of the ensuing higher geometric objects (known as bundle gerbes with connective structure) in the gauging of global symmetries of the ( $\sigma$ -)models beyond the so-called minimal-coupling scheme, in which Dirac structures on certain twisted Courant-type algebroids kick in; and more general simplicial hierarchies for quotients relative to “dualities with fusion”. As we proceed, the notion of mechanical symmetry (and the more general notion of duality) is seen to undergo a natural and conceptually rewarding categorification.