“Sensing of the whole”: Morphodynamics of early embryo development

Being an extremely complex dynamical system, embryo has broad regulation capacities. They appear in embryo ability to develop after blastomere biopsy (in IVF-PGT practice), chimere formation and experimental embryo splitting (in animal science). In fundamental embryology this is called Driesche’s regulations, and is obviously associated with a kind of “sensing of the whole” inherent to the embryo cells.

A lot of models have been offered to explain the “sensing-of the-whole” phenomenon in embryo development. However, the most natural, effective and proven of them are models of mechanically-mediated cell-flows, determining the embryo future development. A full selfconsistent model of such early morphodynamics has been offered for X.laevis [Beloussov et al., 2006], and is likely to be a good explanation of early developmental events for other species. The physical explanation of this model is also well shown by this time [Logvenkov wt al., 2018, in press].

Thus, according to the latest data, morphogenesis and cell movements in mammalian embryo are largely regulated by patterns of mechanical tension and strain in it [Beloussov, 2014; Stooke-Vaughan et al., 2017, White et al., 2017; Turlier et al., 2015].

Being associated with spontaneous decrease of symmetry in many aspects (space, dynamic and “cell-fate”), embryogenesis appears a permanent entwinement of structurally stable dynamics (deterministic aspect) and symmetry-breaking events (associated with irreducible variability and quasi-stochastic processes). Both of these aspects, being many-factor complicated processes, are to a large extent regulated by mechanical tensions acting inside the embryo.