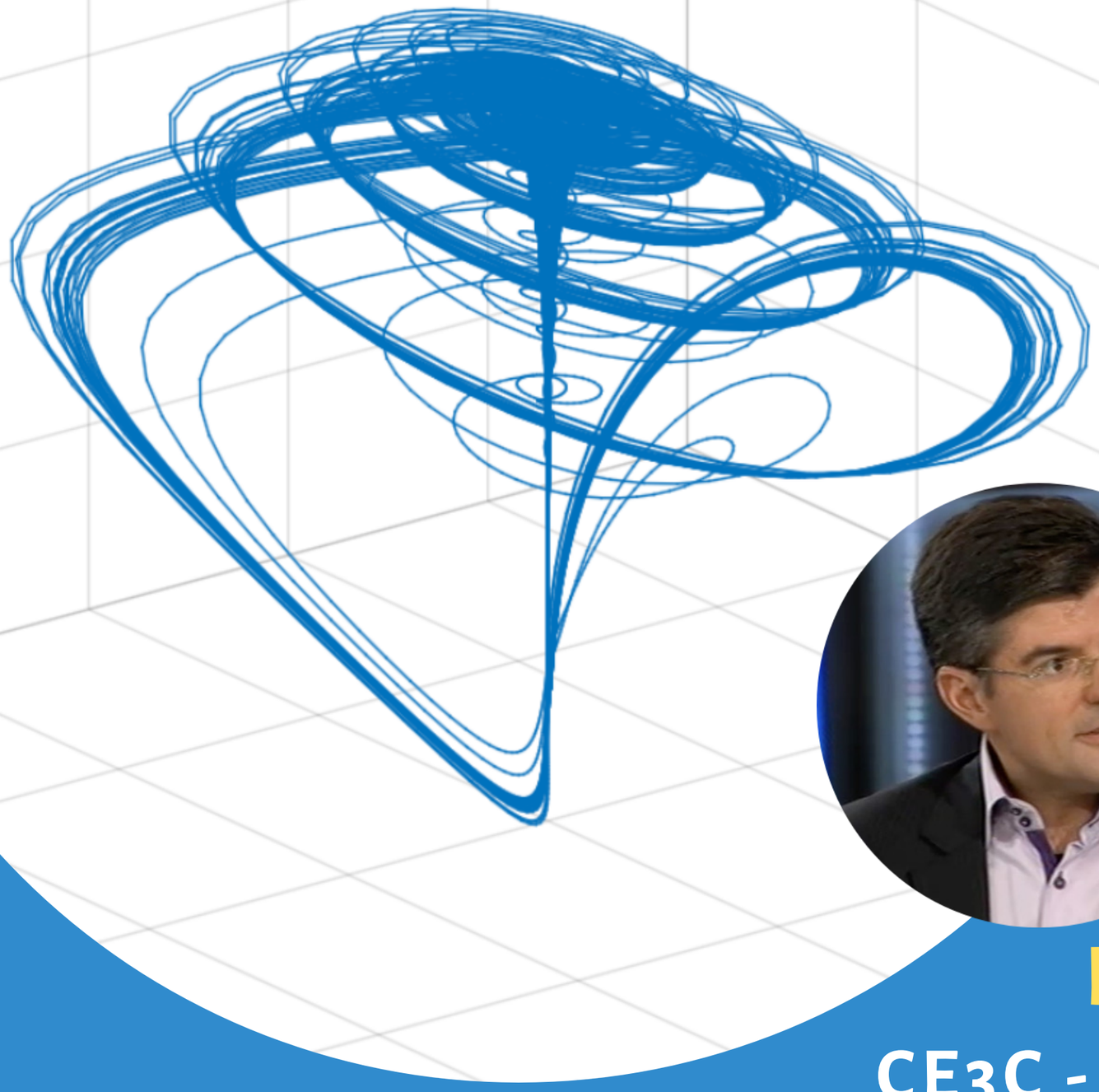

PHYSICS SEMINAR

Wednesday
December 4
14:00 - 15:00
Room 1.4.14

Dr. Rui A. P. Perdigão

CE3C - Faculdade de Ciências da Universidade de Lisboa

Black Swan Physics: Unveiling Hidden Predictability Beyond Recurrence Collapse in Complex Coevolutionary Systems

Predictability of Complex Dynamical Systems is a challenge on its own even under well-defined structural stochastic-dynamic conditions where the laws of motion and system symmetries are known. However, the edifice of complexity can be profoundly transformed by structural-functional coevolution and non-recurrent elusive mechanisms changing the very same invariants of motion that had been taken for granted. This leads to recurrence collapse and memory loss, precluding the ability of traditional stochastic-dynamic and information-theoretical metrics to provide reliable information about the system dynamics, most notably the non-recurrent emergence of fundamental new properties absent from the a priori kinematic geometric and statistical features. Unveiling predictability under such challenging conditions is not only a fundamental problem in mathematical and statistical physics, but also one of critical importance to dynamic modelling, risk assessment and decision support regarding non-recurrent criticalities and extreme events. In order to address these challenges, generalised metrics in nonlinear information physics are hereby introduced for unveiling the dynamics and elusive predictability of complex dynamical systems undergoing far-from-equilibrium structural-functional coevolution. With these methodological developments at hand, hidden predictability is hereby found and explicitly quantified even beyond post-critical recurrence collapse, long after statistical information is lost. The added predictive value is further highlighted by evaluating the new information metrics among statistically independent variables, where traditional techniques therefore find no information links. Notwithstanding the factorability of the distributions associated to the aforementioned independent variables, synergistic and redundant information are found to emerge from microphysical, event-scale codependencies in far-from-equilibrium nonlinear statistical mechanics. The findings are illustrated to elicit hidden structure in non-ergodic dynamical systems, ranging from climatic to financial, and shed light onto the dynamic predictability of non-recurrent critical phenomena, including that of extreme events in far-from-equilibrium coevolutionary dynamics.