

Prof. Lavinia Heisenberg - Ecole polytechnique fédérale de Zurich

Lavinia Heisenberg's research is driven by the following fundamental questions: What sets gravity apart from the other fundamental interactions? What are the essential and fundamental properties of gravity? How can gravity and the quantum theories be consistently combined? How can we extract fundamental knowledge from cosmological and astrophysical observations and particle physics experiments?

Her research activities following from these questions fall into four main areas: (1) Different representations of gravity allow alternative and simpler approaches to essential problems of general relativity (GR), e.g. to the calculation of energy and entropy of gravitational fields or their canonical quantization. For this reason, she is studying GR from a variety of geometrical and field-theoretical concepts. (2) Theories of gravity underly severe restrictions. She has completed the most extensive classes of such theories, and she is studying these with respect to their theoretical consistency, e.g. in view of background stability, absence of ghosts, causality, and well-posedness. (3) Gravity as we observe it is a low-energy theory of an underlying quantum or string theory. She is interested in studying the implications of quantum corrections for the low-energy sector. This includes also the renormalizability properties of classical Lagrangians, the structure of the arising counterterms, and stringy implications for cosmology. (4) The consequences of the theoretical foundations of gravity for astrophysics, cosmology, and particle physics need to be confronted with empirical evidence. She is working out the observational implications of theoretical ideas, e.g. on gravitational waves, cosmic structures, astrophysical compact objects, and particle physics processes.