



CYCLE DE CONFÉRENCES

Séminaire général du département de physique  
de l'École polytechnique

# SYMMETRIES IN GENERAL RELATIVITY AND GRAVITATIONAL RADIATION



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**Abstract :** Symmetries or the breaking thereof form an important circle of ideas, relevant not only for most areas of physics, but also religion, art, philosophy,...

In General Relativity, the concept of symmetry seems at first glance rather vacuous, because all transformations leave the action invariant. In fact, rather than considering them as symmetries, it is more appropriate to view them as an enormous redundancy describing a given system. The situation changes when one restricts attention to isolated systems, i.e. ones that resemble empty space at large distances from a localized source. Here, it is meaningful to ask for the transformations preserving „as much as possible“ the isolated character of the system. The understanding of such „asymptotic symmetries“ was essentially achieved by Bondi and collaborators in the early 1960's. An

unexpected outcome of their analysis was the existence of new symmetries beyond the standard ones familiar from Special Relativity.

Those so-called super-translations (no relation with supersymmetry) have recently attracted new interest because they can be used to extract information about gravitational radiation. In particular, they are related intimately to an effect known as the memory effect, which is the fact that a burst of gravitational radiation passing through an arrangement of freely falling test masses far from the source will cause a lasting displacement.

In this colloquium, I will explain in a non-technical way some of these ideas, and their analogues in more conventional theories such as Quantum Electrodynamics, closing with some remarks on proposed connections to the so-called information loss paradox.

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