



Giovedì 22 Giugno 2017

Aula Magna del Dipartimento
di Fisica ed Astronomia

Ore 15.30

Transformation Optics

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Abstract: Optical materials such as glass or water appear to light as if they change the geometry of space. One sees this directly in optical illusions where inhomogeneous optical materials affect the perception of space. One sees this theoretically from Fermat's principle of the shortest path: light travels along geodesics measured with respect to the refractive index of the material. One sees this in full detail from Maxwell's equations in Einstein's general relativity that appear as Maxwell's equations in media. This connection between general relativity and optics in media has given rise to a new research area: transformation optics. Here the optical implementation of coordinate transformations has inspired devices that might do the (almost) impossible such as invisibility cloaking and perfect imaging. In this lecture I will introduce transformation optics and discuss some of its exciting applications.