

Figures of Lecture 1: Null hypersurfaces and event horizons

Éric Gourgoulhon

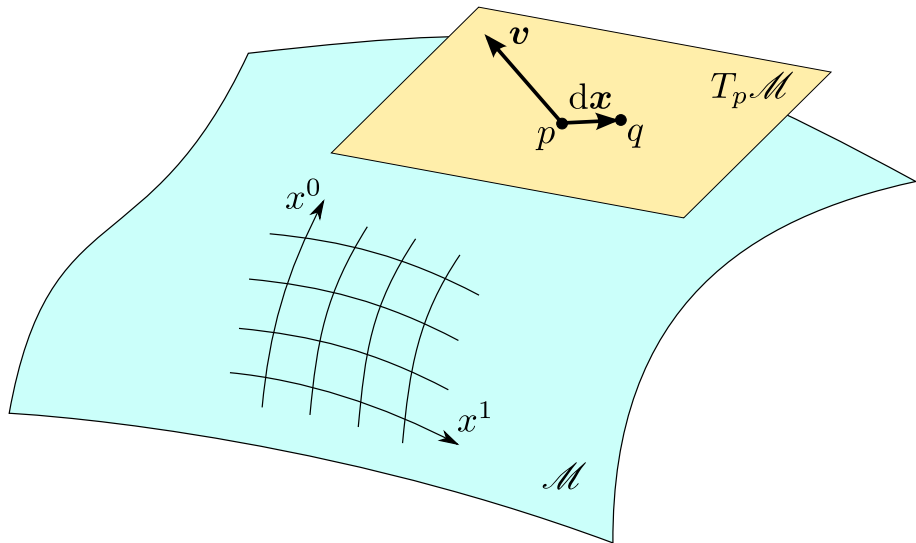
Laboratoire Univers et Théories (LUTH)
CNRS / Observatoire de Paris / Université Paris Diderot
92190 Meudon, France

<http://luth.obspm.fr/~luthier/gourgoulhon/>

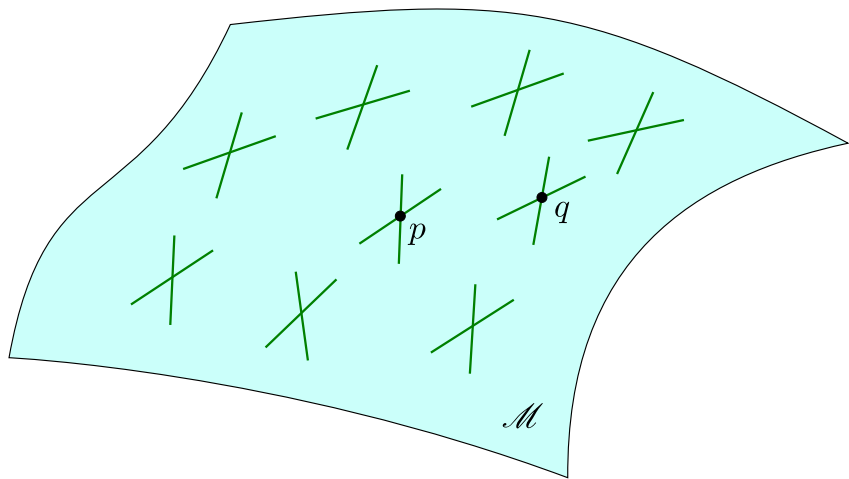
DIAS-TH, JINR, Dubna
11 May 2017

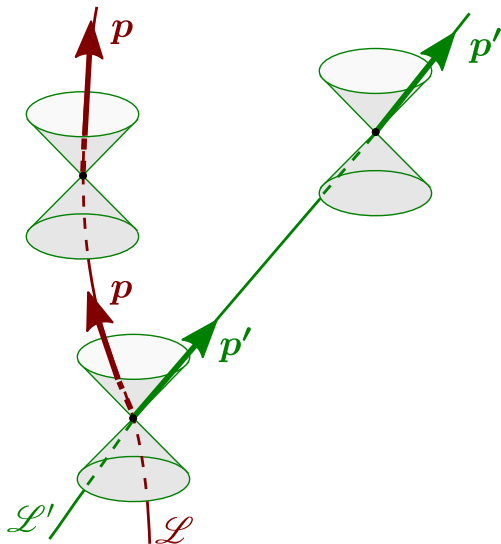
<http://luth.obspm.fr/~luthier/gourgoulhon/bh16/dubna/>

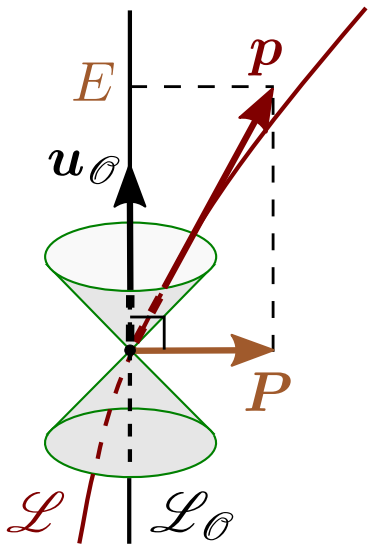
Smooth manifold



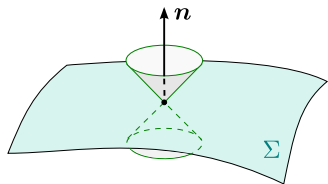
Lorentzian manifold



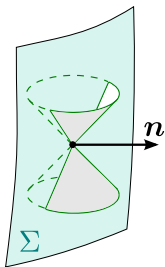




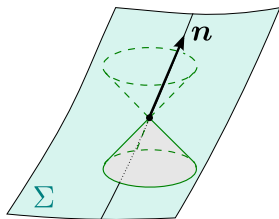
Classification of hypersurfaces



spacelike

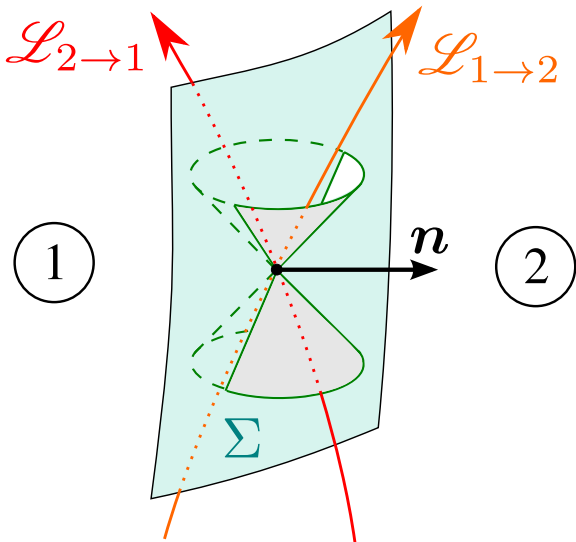


timelike

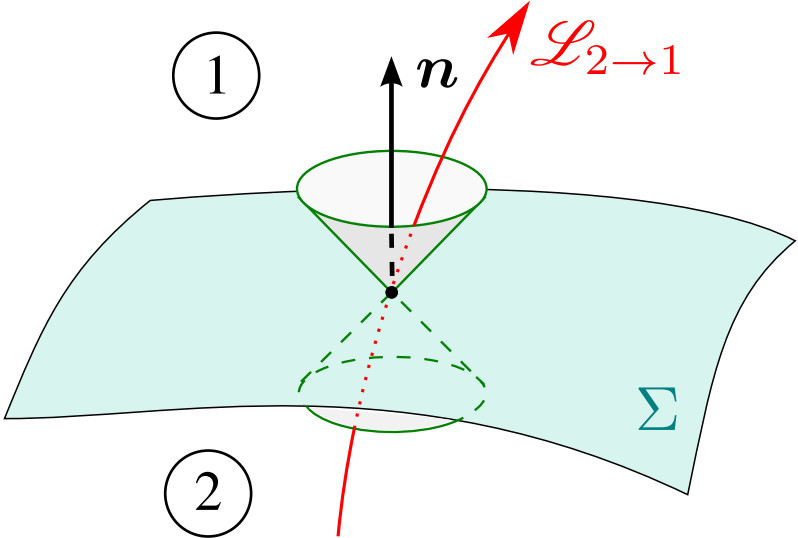


null

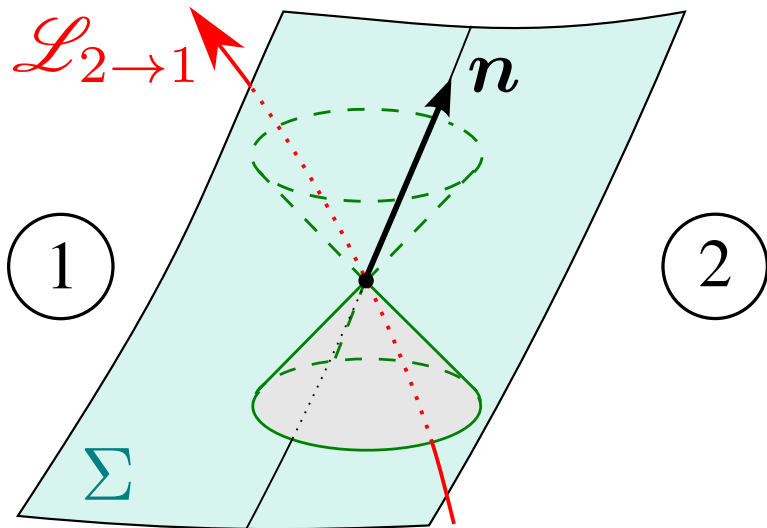
Timelike hypersurface : 2-way membrane



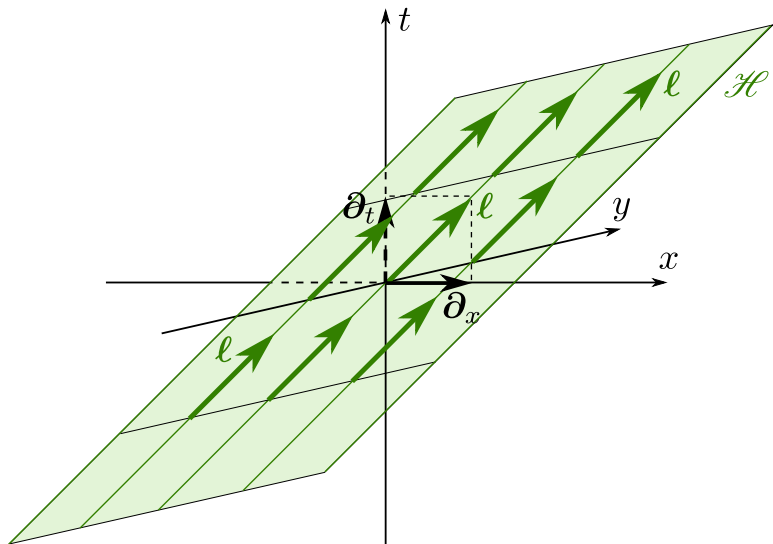
Spacelike hypersurface : 1-way membrane



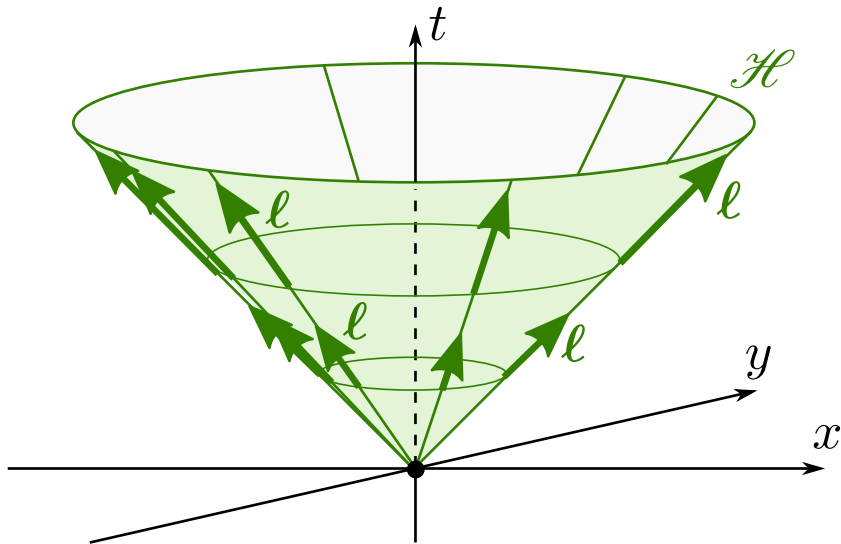
Null hypersurface : 1-way membrane



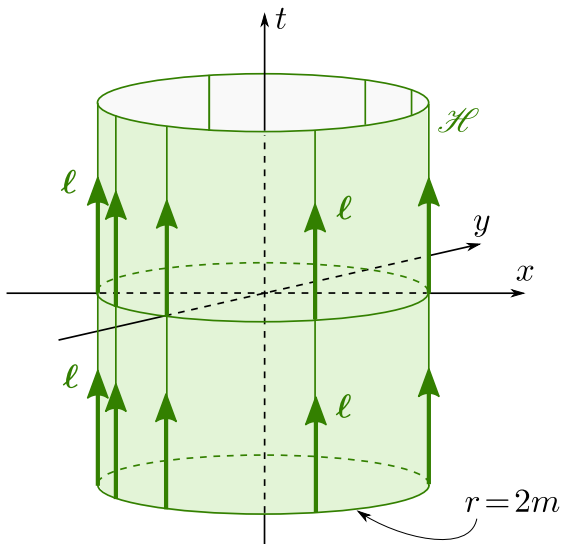
Null hyperplane in Minkowski spacetime



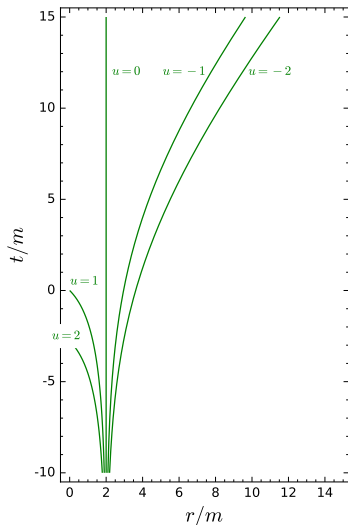
Future null cone in Minkowski spacetime



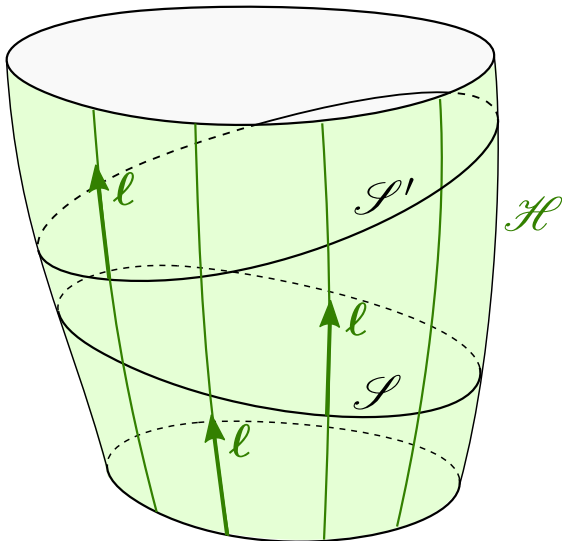
Schwarzschild horizon (in Eddington-Finkelstein coordinates)



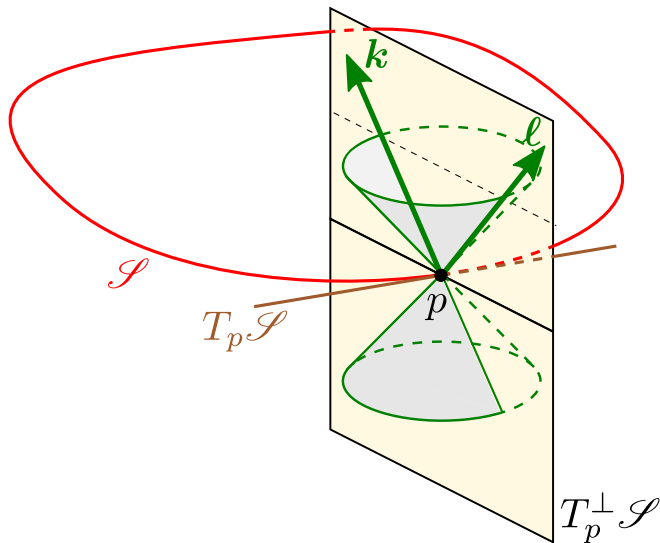
Constant u hypersurfaces around the Schwarzschild horizon



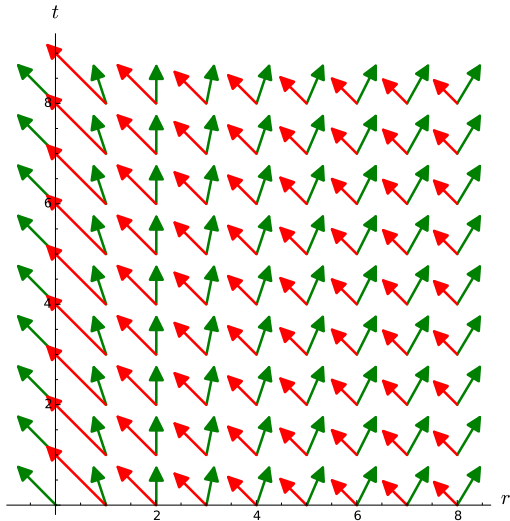
Cross-sections of a null hypersurface



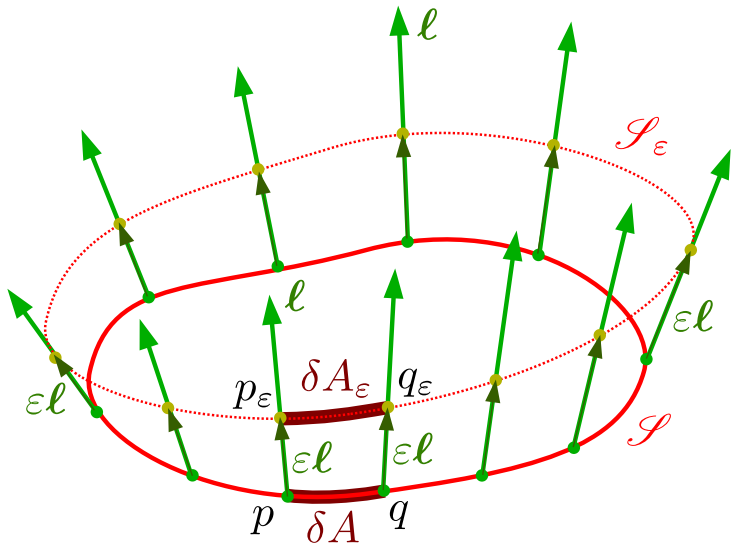
Null normals to a spacelike surface



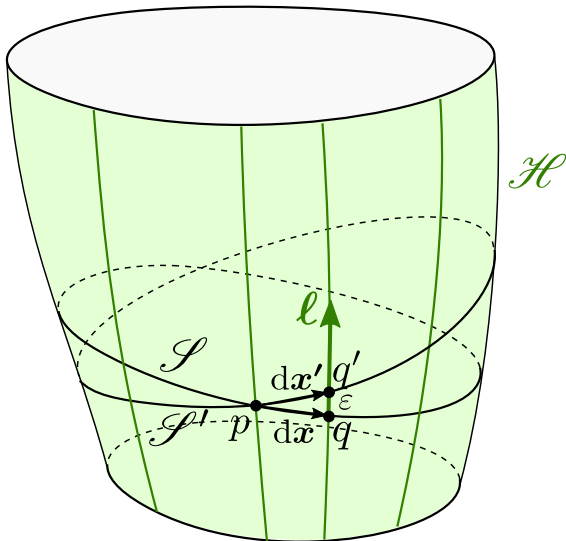
Null normals around the Schwarzschild horizon



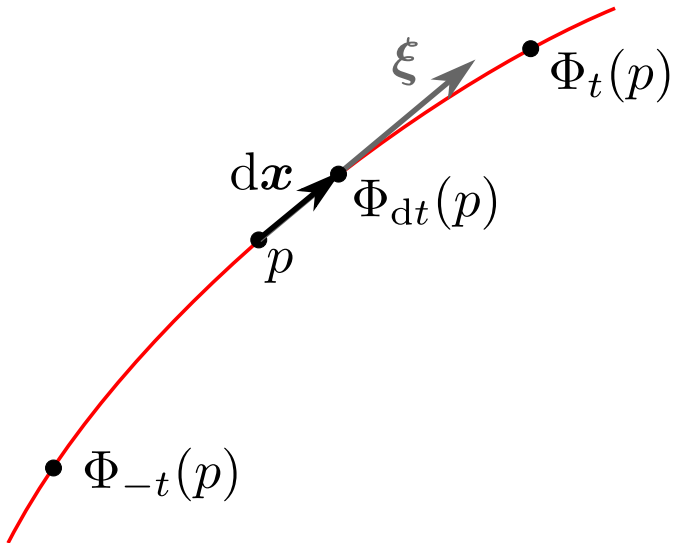
Lie dragging along a null normal



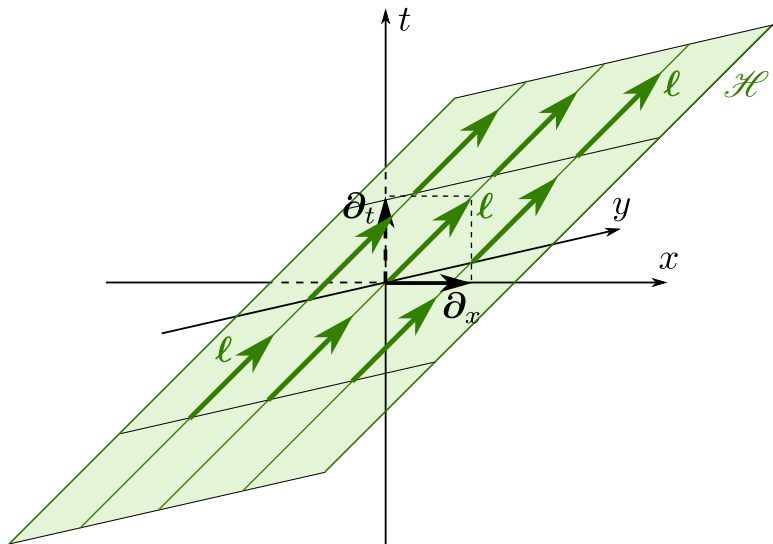
Independence of the expansion from the cross-section



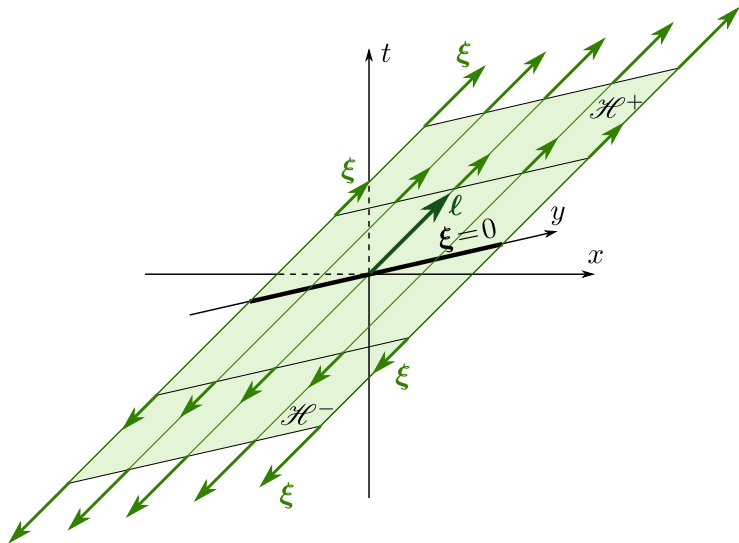
Generator of a 1-dimensional group action



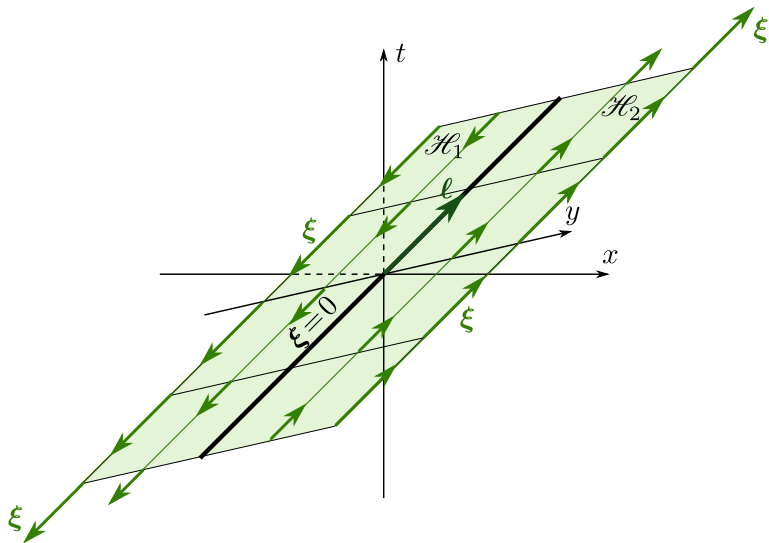
Null hyperplane as a translation-Killing horizon



Null half-hyperplanes as boost-Killing horizons



Null half-hyperplanes as null-rotation-Killing horizons



Schwarzschild horizon as a Killing horizon

