Appendix D

Some flat metrics with Cauchy horizons.

In this Appendix we present a family of flat $n + 1$ dimensional space–times which have at least two non–isometric extensions across a smooth Cauchy horizon; this example is a generalization of Misner's model for the Taub–NUT space–times [84]. The space–times considered here do not have compact spacelike hypersurfaces, as opposed to Misner's example which, in n+1 dimensions, can be given $\mathbb{R} \times S^1 \times T^{n-1}$ topology, where T^ℓ is an ℓ dimensional torus. In view of the renewed interest in flat Lorentzian manifolds [130] [92] [83] it would be useful to understand the global structure of all flat Lorentzian manifolds, at least in 4 dimensions.

For $n \geq 2$ let (t, x, y), $y = y^1$ if $n = 2$ or $y = (y^1, \ldots, y^{n-1})$ otherwise, be coordinates in $n + 1$ dimensional Minkowski space,

$$ds^2 = -dt^2 + dx^2 + dy^2 \ , \tag{D.0.1}$$

with $dy^2 = (dy^1)^2$ if $n = 2$ and $dy^2 = d\vec{y}^{\,2} = (dy^1)^2 + \ldots + (dy^{n-1})^2$ otherwise. Let Λ_0 be a fixed Lorentz boost in the $t - x$ plane,

$$\Lambda_0 = \begin{bmatrix} \gamma_0 & \gamma_0\beta & 0 \\ \gamma_0\beta & \gamma_0 & 0 \\ 0 & 0 & id_{\mathbb{R}^{n-1}} \end{bmatrix} ,$$