

# Figures of Lecture 3: The Schwarzschild black hole

Éric Gourgoulhon

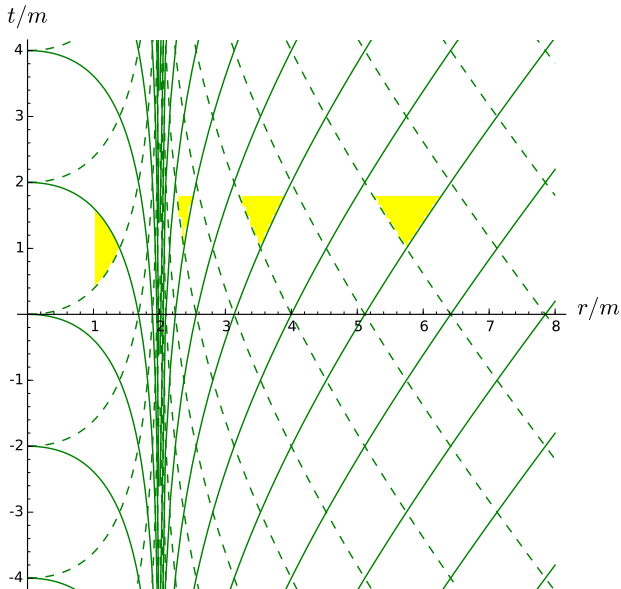
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<http://luth.obspm.fr/~luthier/gourgoulhon/>

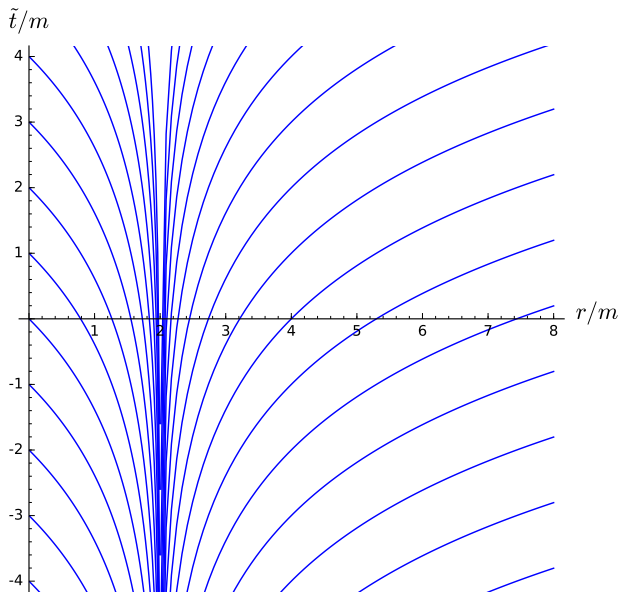
**DIAS-TH, JINR, Dubna**  
16 May 2017

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

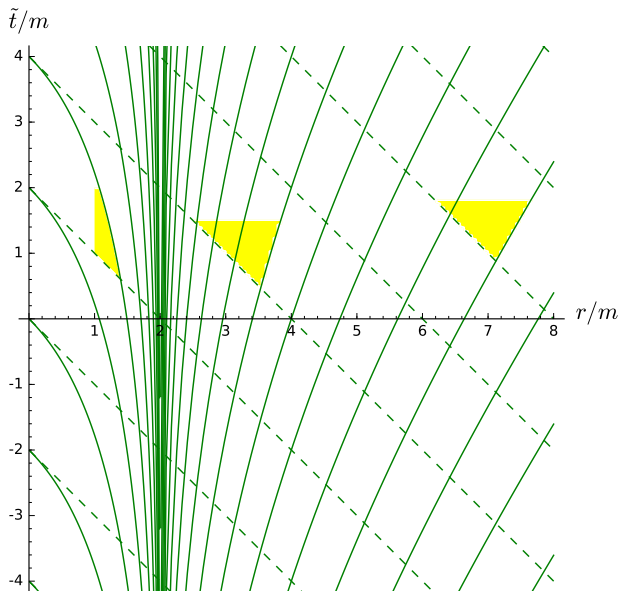
# Radial null geodesics in Schwarzschild-Droste coordinates



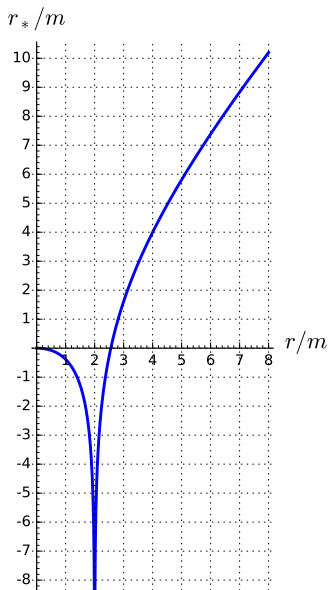
# Constant $t$ hypersurfaces in terms of IEF coordinates



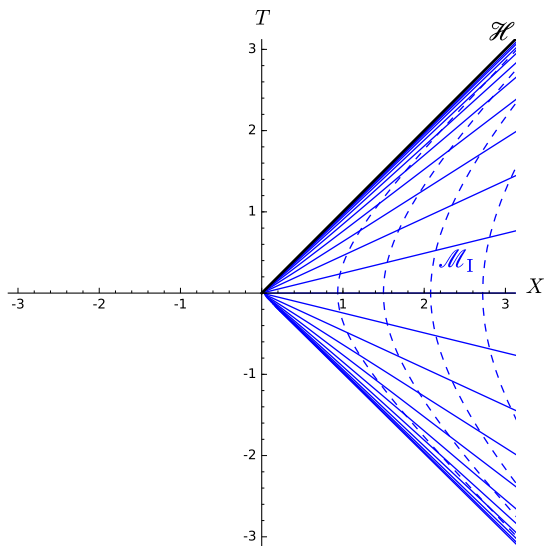
# Radial null geodesics in IEF coordinates



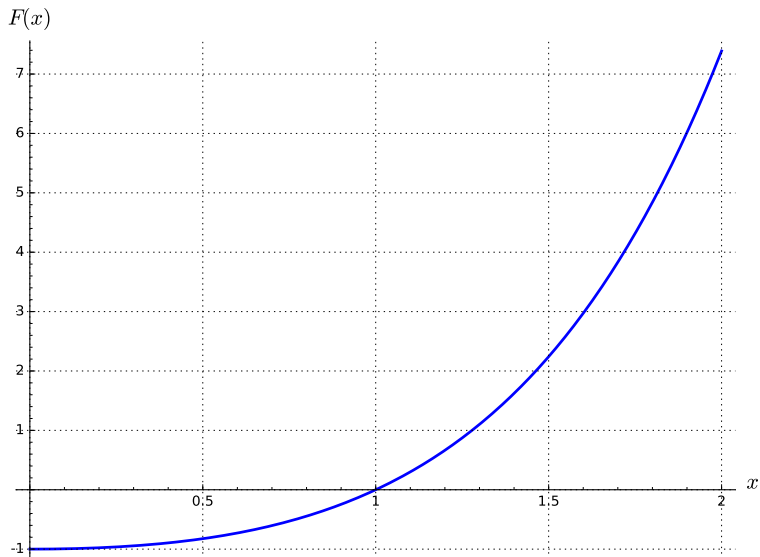
# Tortoise coordinate



# $\mathcal{M}_I$ in terms of KS coordinates

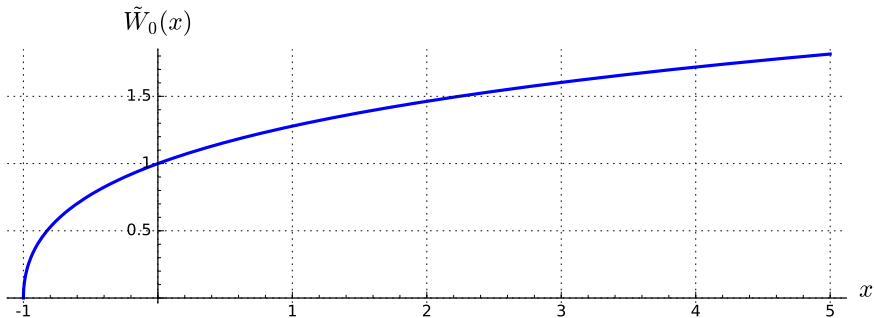


# Function $F : x \mapsto e^x(x - 1)$

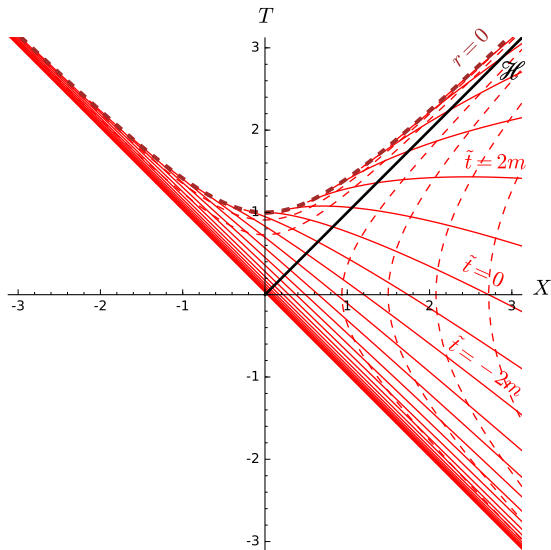




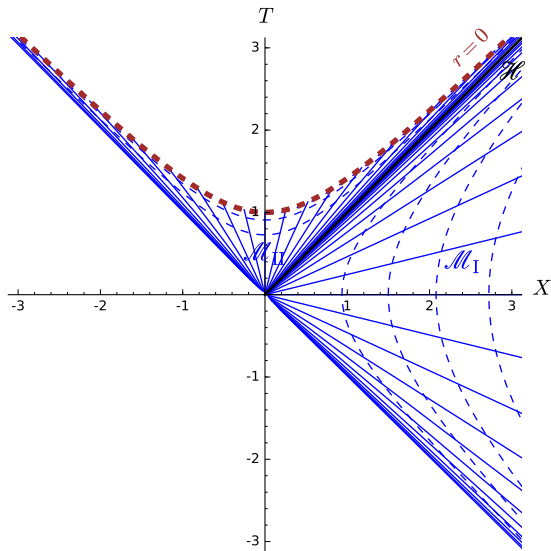
# Rescaled Lambert function



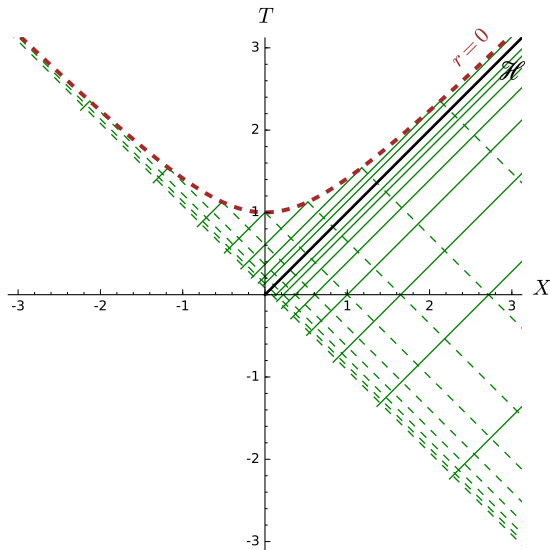
# IEF coordinates in terms of KS coordinates



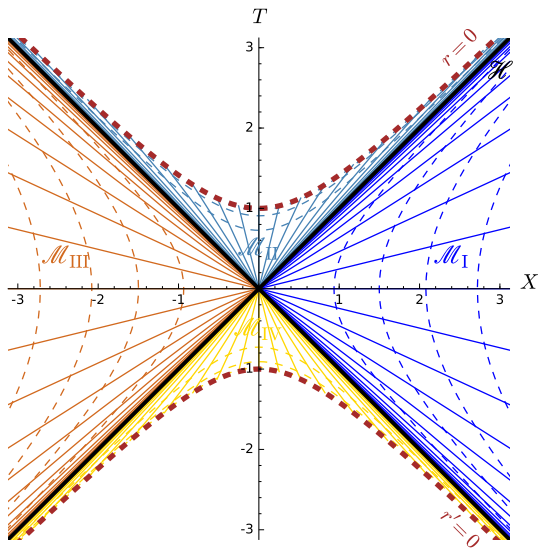
# SD coordinates in terms of KS coordinates



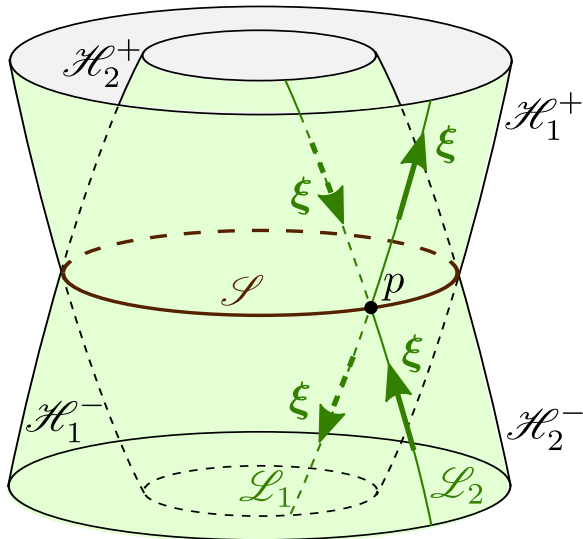
# Radial null geodesics in the IEF domain



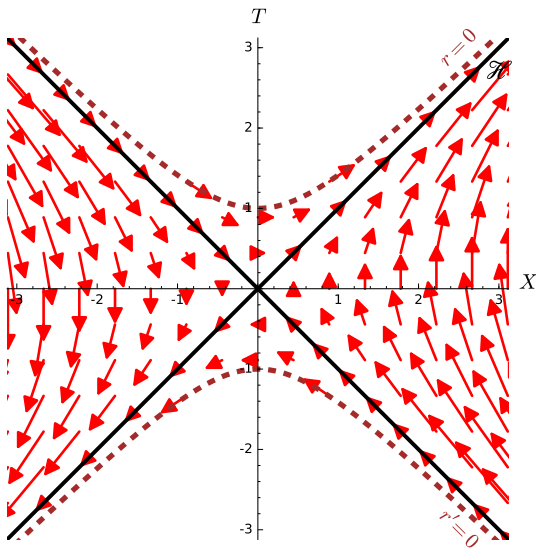
# Kruskal diagram



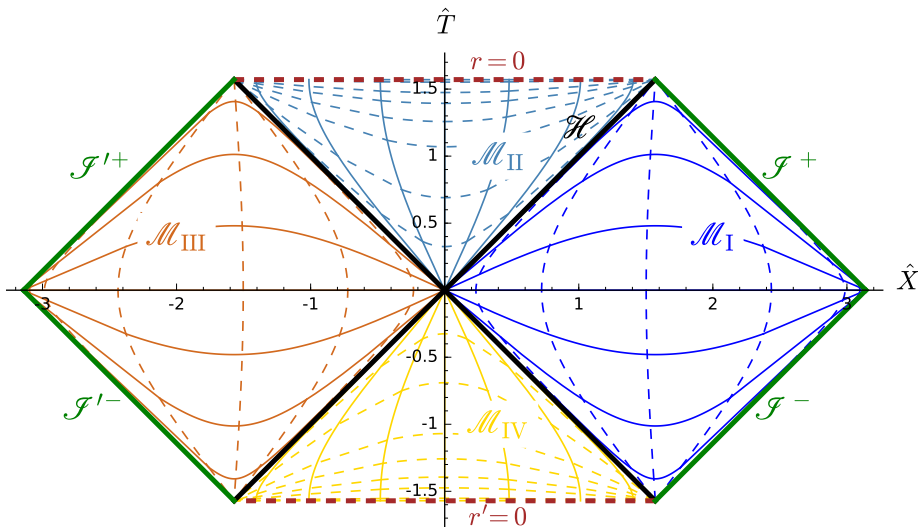
# A bifurcate Killing horizon



# Stationary Killing vector $\xi$

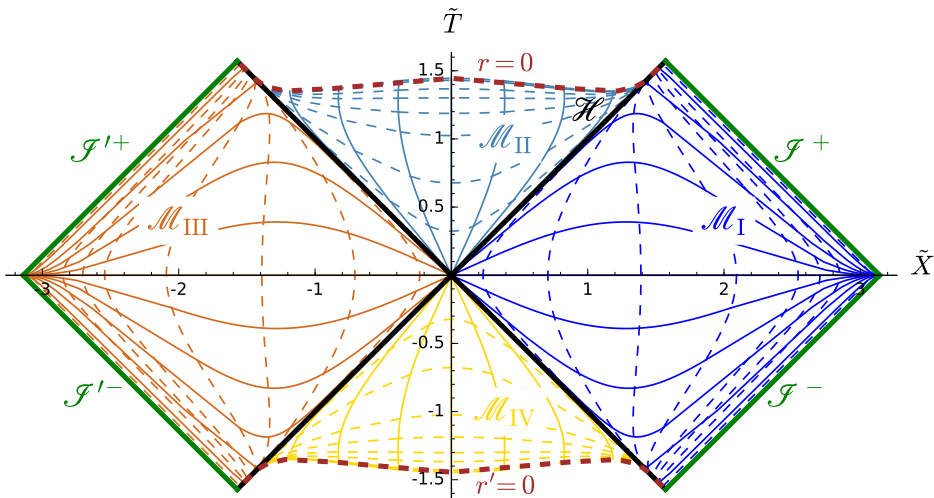


# Standard Carter-Penrose diagram (singular at $\mathcal{I}$ )

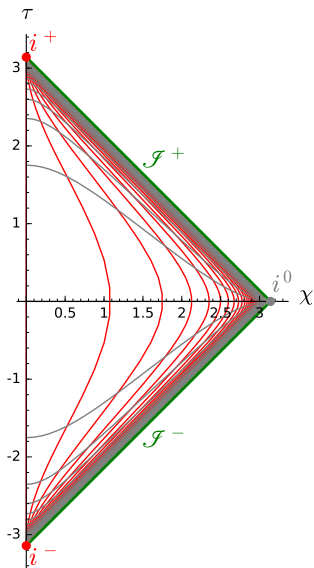




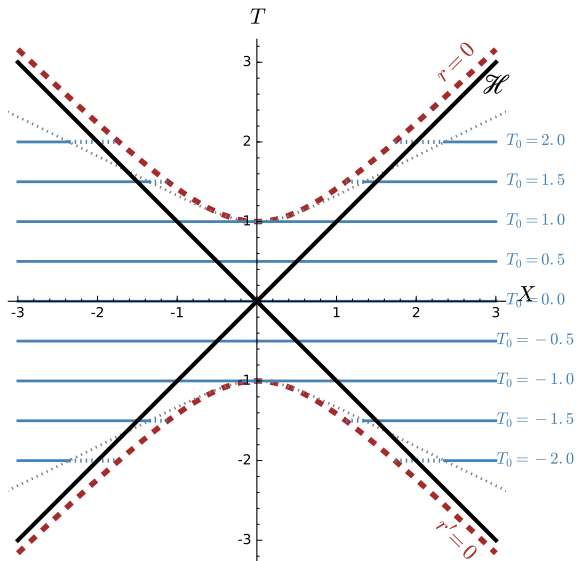
# Carter-Penrose diagram based on Frolov-Novikov coordinates



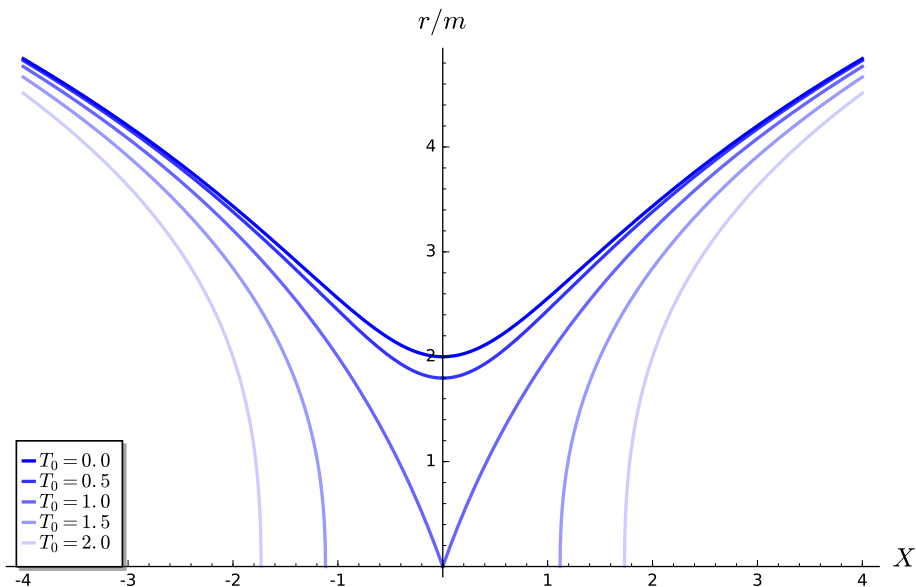
# Comparison with the conf. diagram of Minkowski spacetime



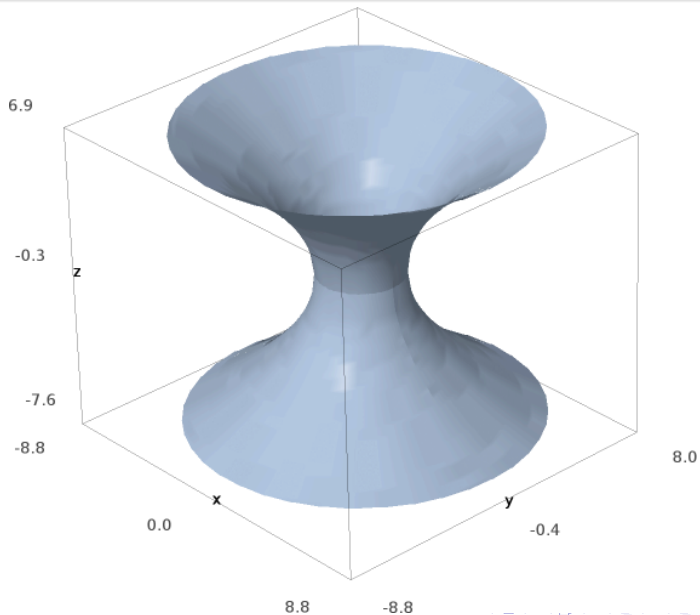
# Constant KS-time hypersurfaces $\Sigma_{T_0}$



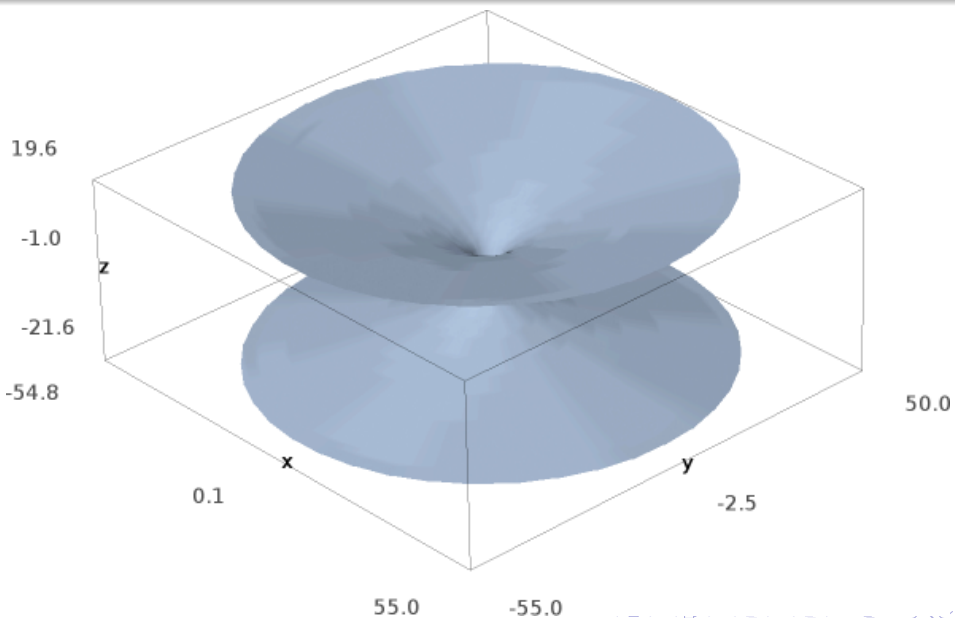
# Areal radius as a function of $X$ on $\Sigma_{T_0}$



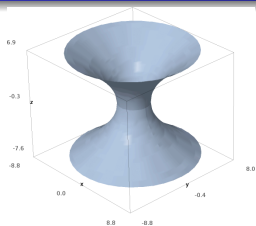
# Flamm paraboloid



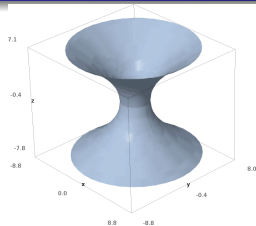
# Flamm paraboloid (zoom out)



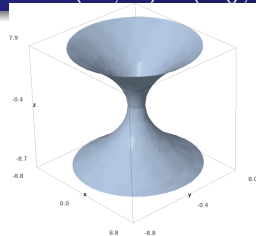
# Sequence of isometric embeddings of slices $(T, \theta) = (T_0, \frac{\pi}{2})$



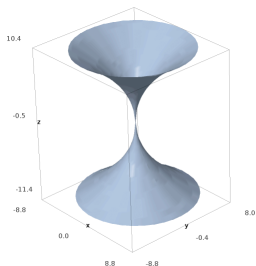
$$T_0 = 0$$



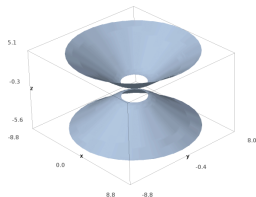
$$T_0 = 0.5$$



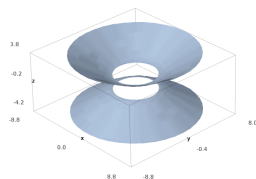
$$T_0 = 0.9$$



$$T_0 = 1$$



$$T_0 = 1.5$$



$$T_0 = 2$$

# Areal radius $r$ in terms of the isotropic coordinate $\bar{r}$

