

# Figures of Lecture 4: The Kerr black hole

Éric Gourgoulhon

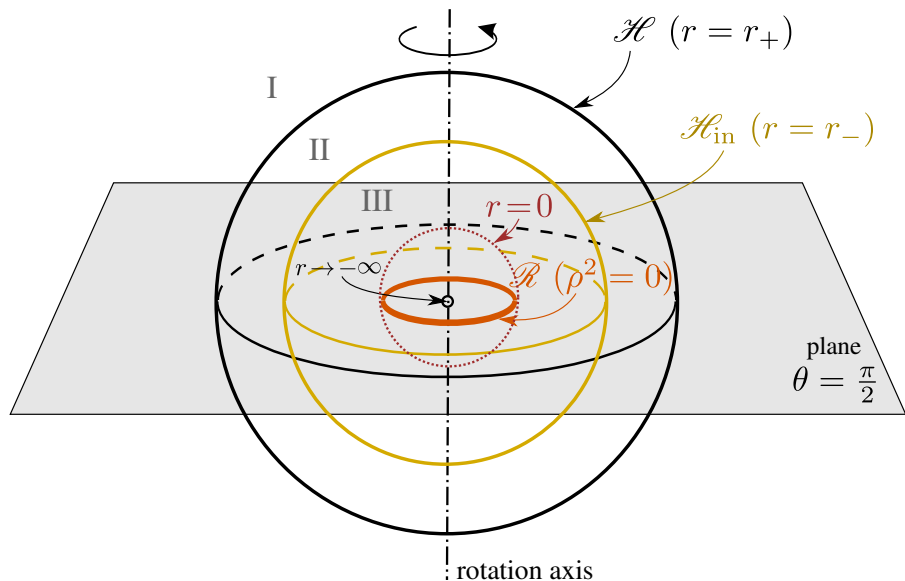
Laboratoire Univers et Théories (LUTH)  
CNRS / Observatoire de Paris / Université Paris Diderot  
Paris Sciences et Lettres Research University  
92190 Meudon, France

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

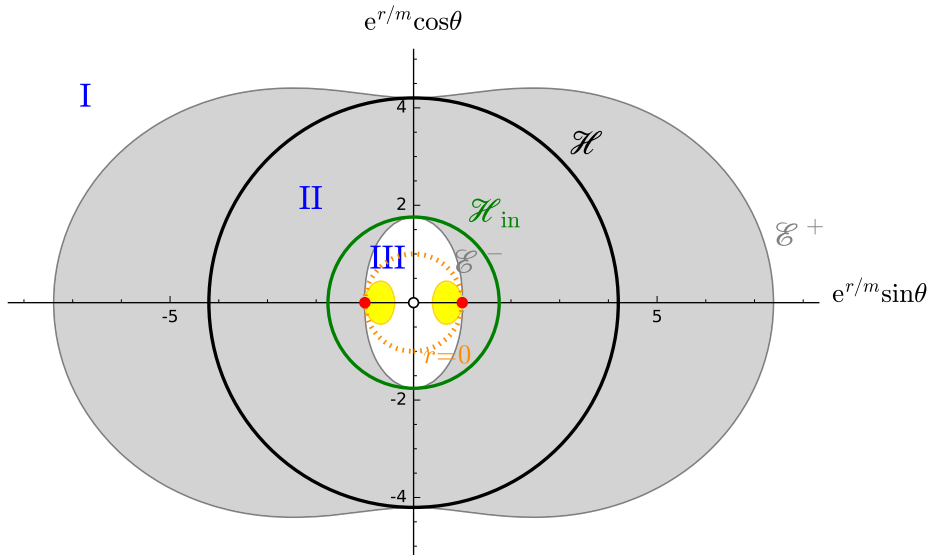
**DIAS-TH, JINR, Dubna**  
17 May 2017

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

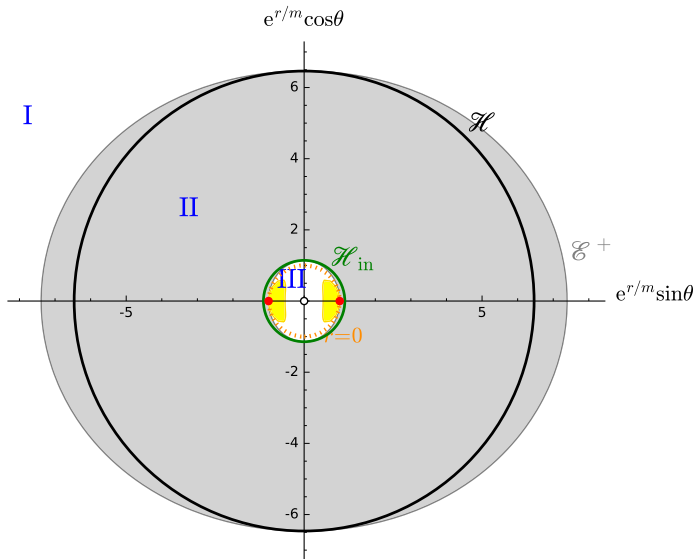
# Section of constant Boyer-Lindquist time coordinate



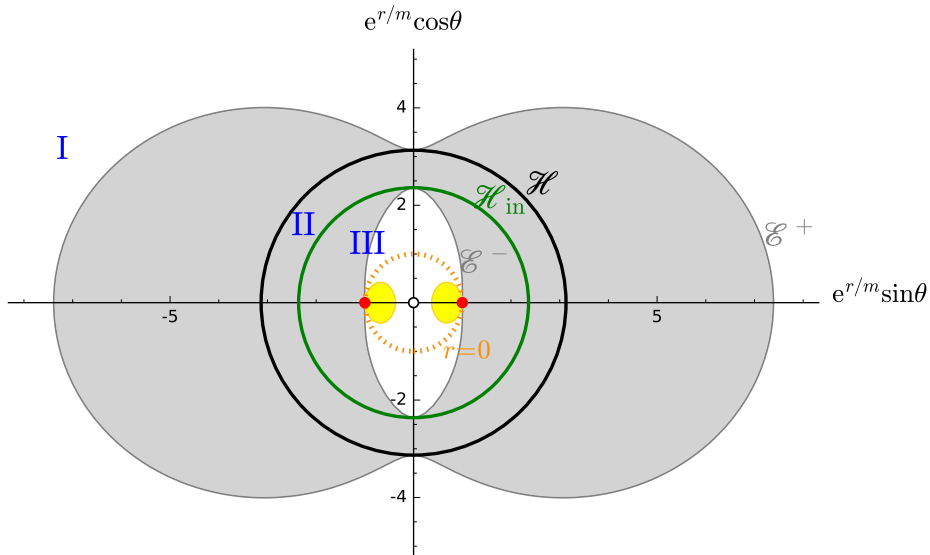
# Meridional view of a $t = \text{const}$ slice ( $a/m = 0.9$ )



# Meridional view of a $t = \text{const}$ slice ( $a/m = 0.5$ )

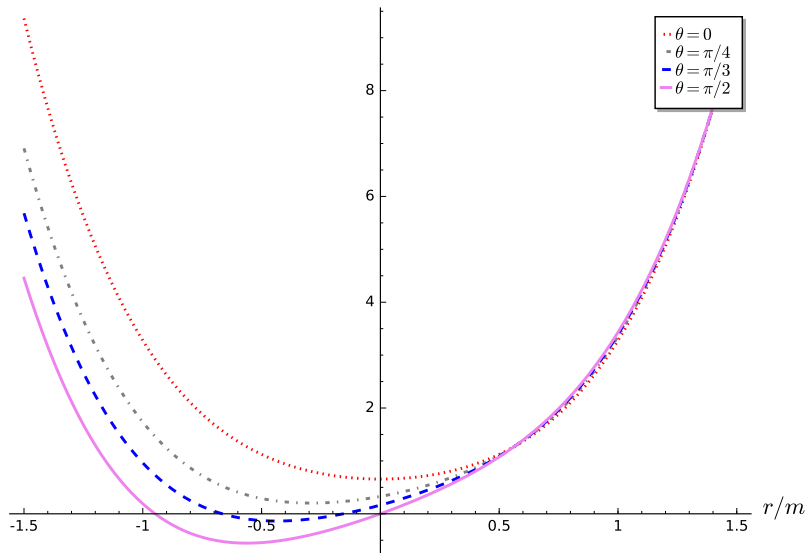


# Meridional view of a $t = \text{const}$ slice ( $a/m = 0.99$ )

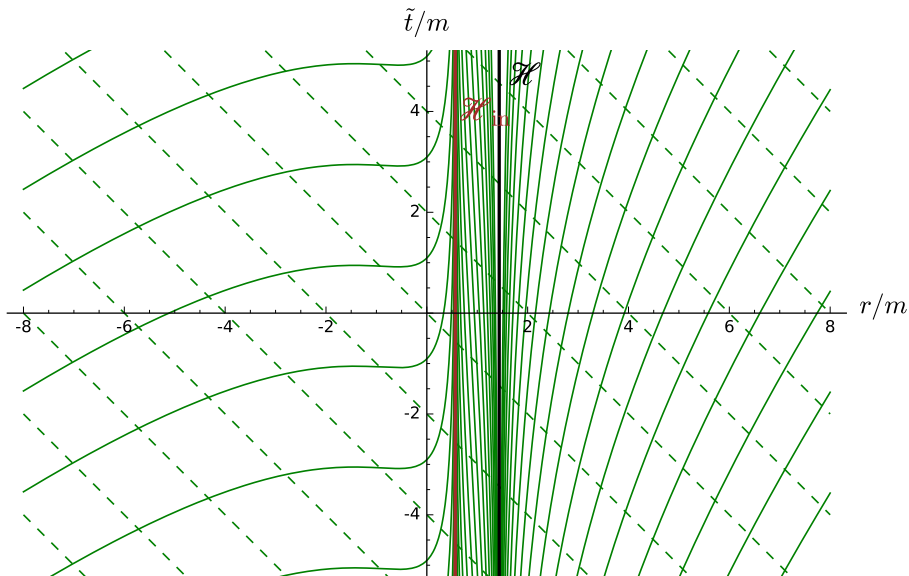


# Sign of $g_{\varphi\varphi}$ for $a = 0.9 m$

$$\rho^2(r^2 + a^2) + 2a^2mr \sin^2\theta$$

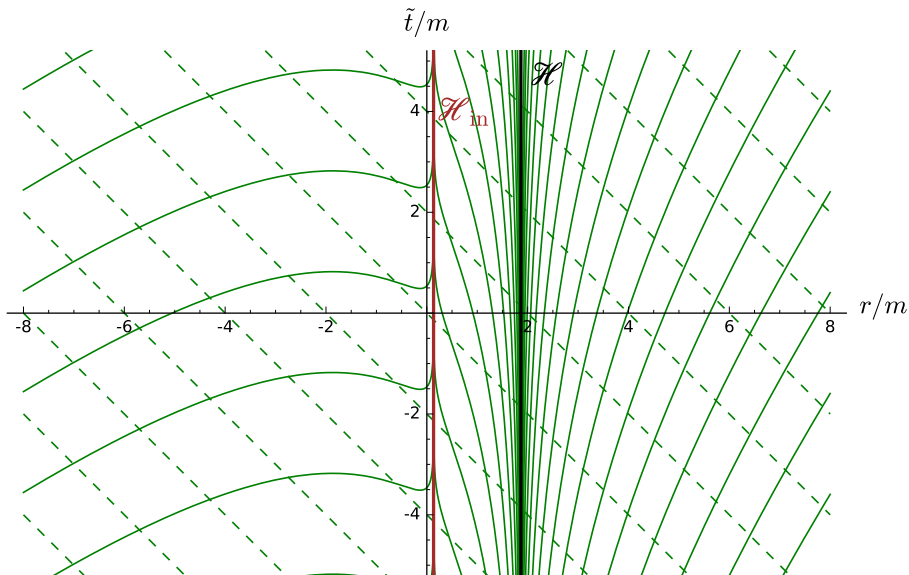


# Principal null geodesics ( $a/m = 0.9$ )

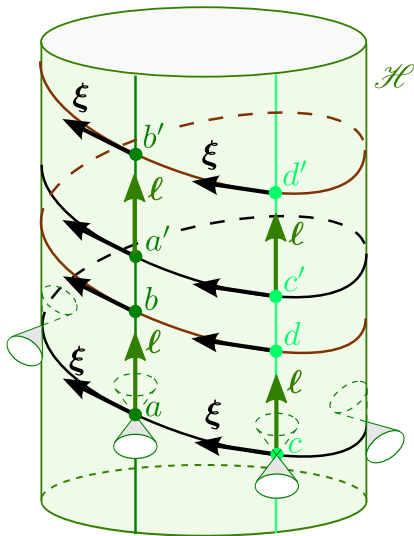




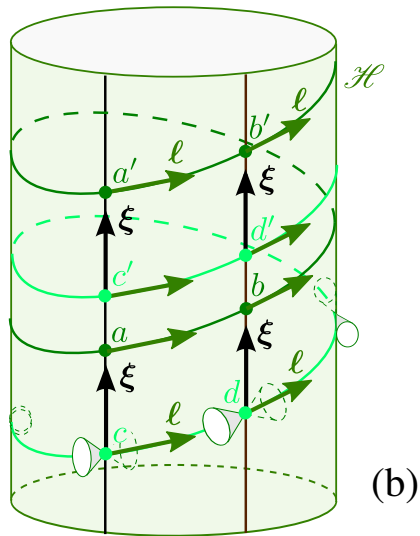
# Principal null geodesics ( $a/m = 0.5$ )



# The event horizon and its null generators

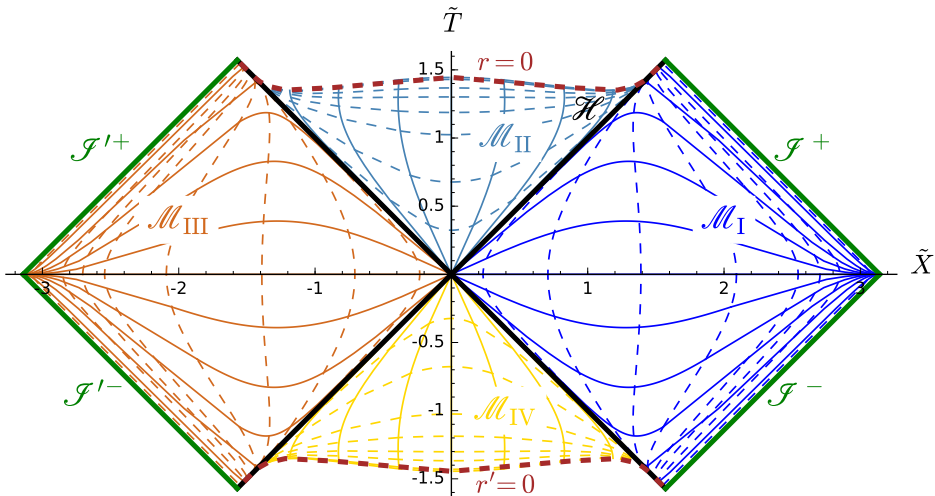


(a)



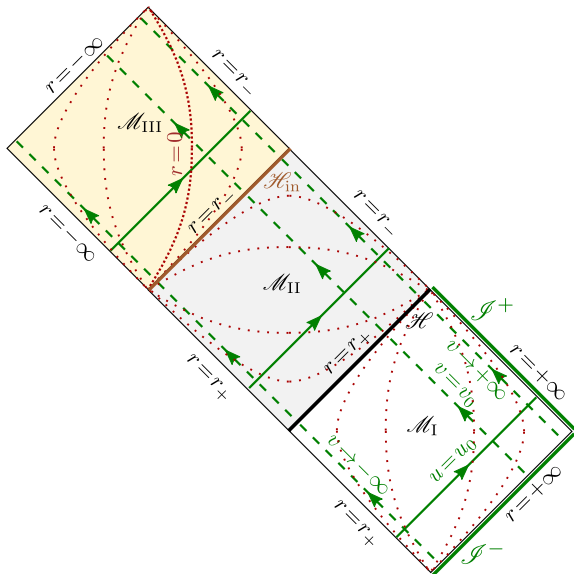
(b)

# Carter-Penrose diagram of Schwarzschild spacetime based on Frolov-Novikov coordinates



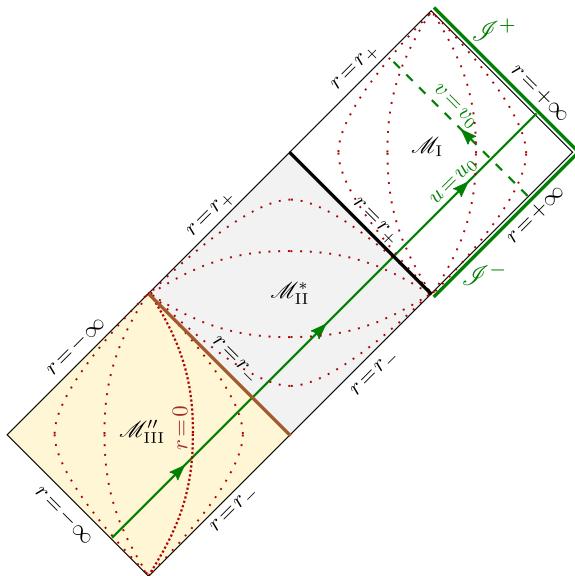
# Conformal diagram of Kerr spacetime

with  $\mathcal{M} = \mathbb{R}^2 \times \mathbb{S}^2 \setminus \mathcal{R}$

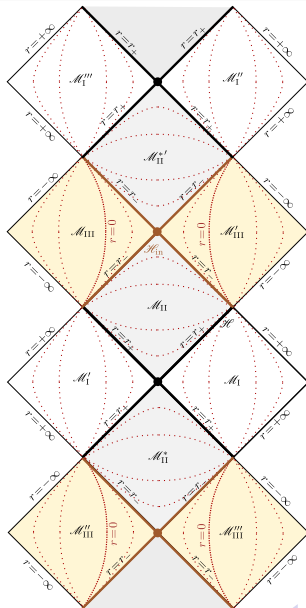


# Minimal extension of $\mathcal{M}_I$

to ensure complete outgoing principal null geodesics



# Carter-Penrose diagram of the maximal analytic extension



# Cauchy horizon

