Kerr Black holes

Boyer–Lindquist coordinates

ボイヤー・リンキスト（Boyer-Lindquist）座標による表現

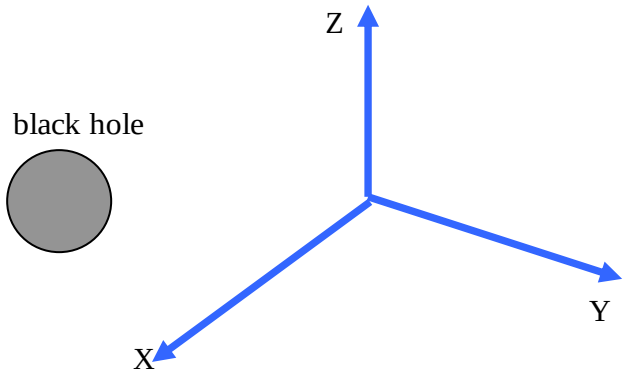
事象の地平線半径（radius of black hole's event horizon）

膠着円盤（accretion disc）

Kerr metric (G=c=M=1)

Null 測地線の微分方程式

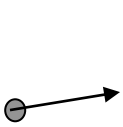
Initial Conditions



Coordinate transformation

$RayDir = (r_s, \theta_s, \varphi_s)$

Spherical coordinates



$RayPosition = (r, \theta, \varphi)$

Boyer - Lindquist coordinates

Wormhole 3-parameters(W, a, ρ)

Direction of the light ray( )

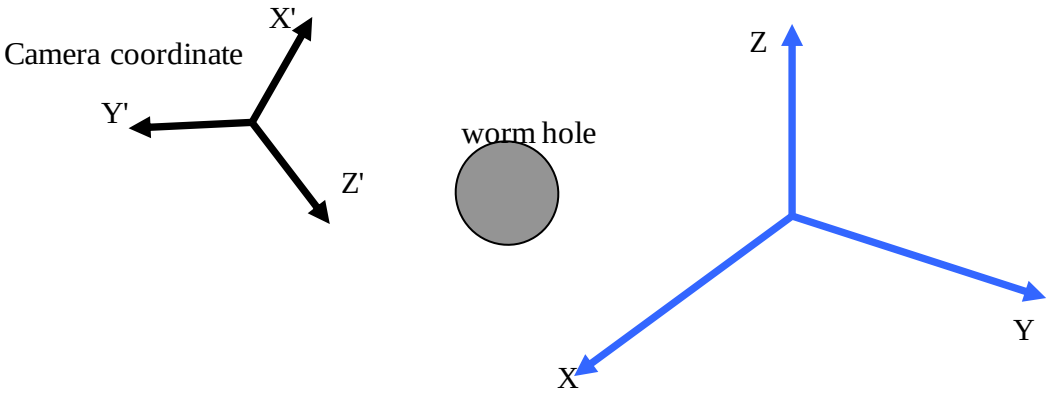
Initial camera position( )

光線運動量

(A9d)

Null 測地線の微分方程式 A7a～A7e

Initial Conditions



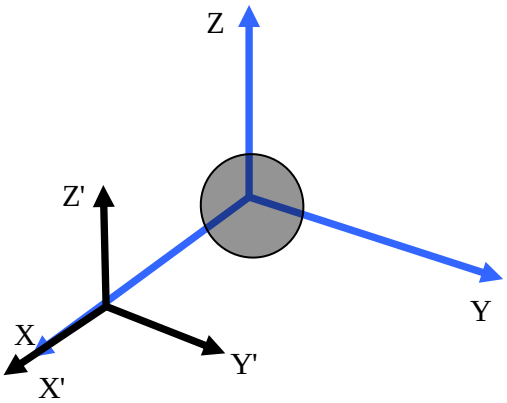
Coordinate transformation

$RayDir = (r_s, \theta_s, \varphi_s)$

Spherical coordinates

$RayPosition = (r, \theta, \varphi)$

Spherical coordinates



の逆関数の計算にはニュートンラプソン法を使う。

で　求めて　　であるので

として計算される（符号±はこの計算では決まらない)。

Gravitational Lensing by Spinning Black Holes in Astrophysics, and in the Movie Interstellar

Oliver James, Eug_enie von Tunzelmann, Paul Franklin1 and Kip S Thorne

A PUBLIC GPU-BASED CODE FOR GENERAL-RELATIVISTIC RADIATIVE TRANSFER IN KERR SPACETIME

HUNG-YI PU , KIYUN YUN , ZIRI YOUNSI , AND SUK-JIN YOON

Visualizing Interstellar's Wormhole

Oliver James, Eugénie von Tunzelmann, Paul Franklin, and Kip S. Thorne