Black Hole Physics
Schwarzschild Radius, Accretion, and Hawking Radiation

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November 24, 2025

Abstract

Computational analysis of black hole physics including Schwarzschild geometry, accretion disk properties, and Hawking radiation calculations.

1 Introduction

Black holes are regions of spacetime where gravity is so strong that nothing can escape.

2 Schwarzschild Radius

$r_s = \frac{2GM}{c^2}$

schwarzschild_radius.pdf

Figure 1: Schwarzschild radius as function of mass.

3 ISCO and Photon Sphere

effective_potential.pdf

Figure 2: Effective potential showing ISCO and photon sphere.

4 Hawking Temperature

$T_H = \frac{\hbar c^3}{8\pi G M k_B}$

hawking_temperature.pdf

Figure 3: Hawking temperature for different black hole masses.

5 Accretion Disk Temperature

$T(r) = \left(\frac{3GM\dot{M}}{8\pi\sigma r^3}\right)^{1/4}$

disk_temperature.pdf

Figure 4: Temperature profile of thin accretion disk.

6 Time Dilation

time_dilation.pdf

Figure 5: Time dilation factor near black hole.

7 Eddington Luminosity

$L_{Edd} = \frac{4\pi G M m_p c}{\sigma_T}$

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Figure 6: Eddington luminosity limit.

8 Black Hole Spin

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Figure 7: ISCO radius for Kerr black holes.

9 Results

10 Conclusions

This analysis covers key aspects of black hole physics including Schwarzschild geometry, thermal properties, and accretion processes.