

# Black Hole Physics

## Schwarzschild Radius, Accretion, and Hawking Radiation

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### **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

$$T_H = \frac{\hbar c^3}{8\pi GMk_B}$$

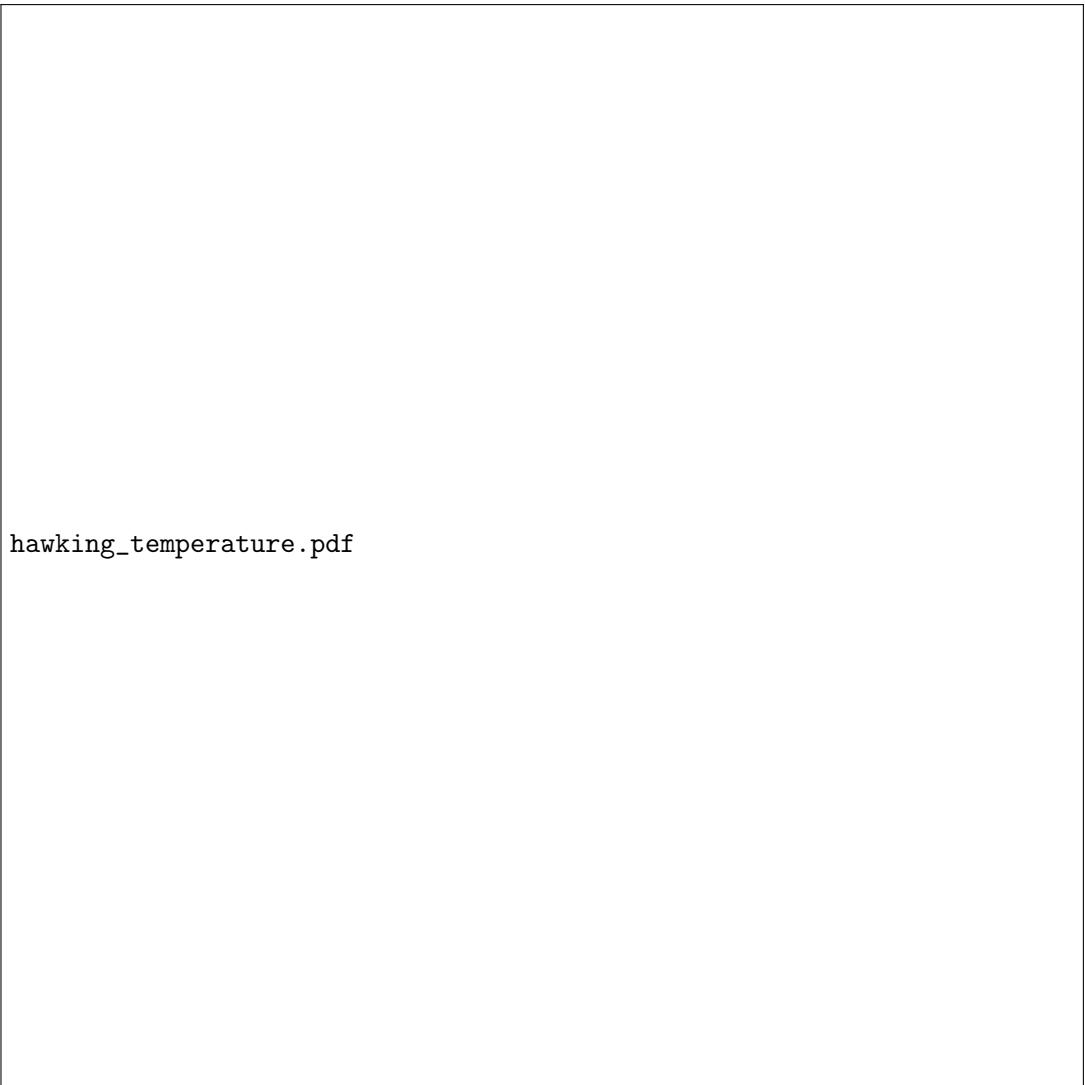


Figure 3: Hawking temperature for different black hole masses.

## 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

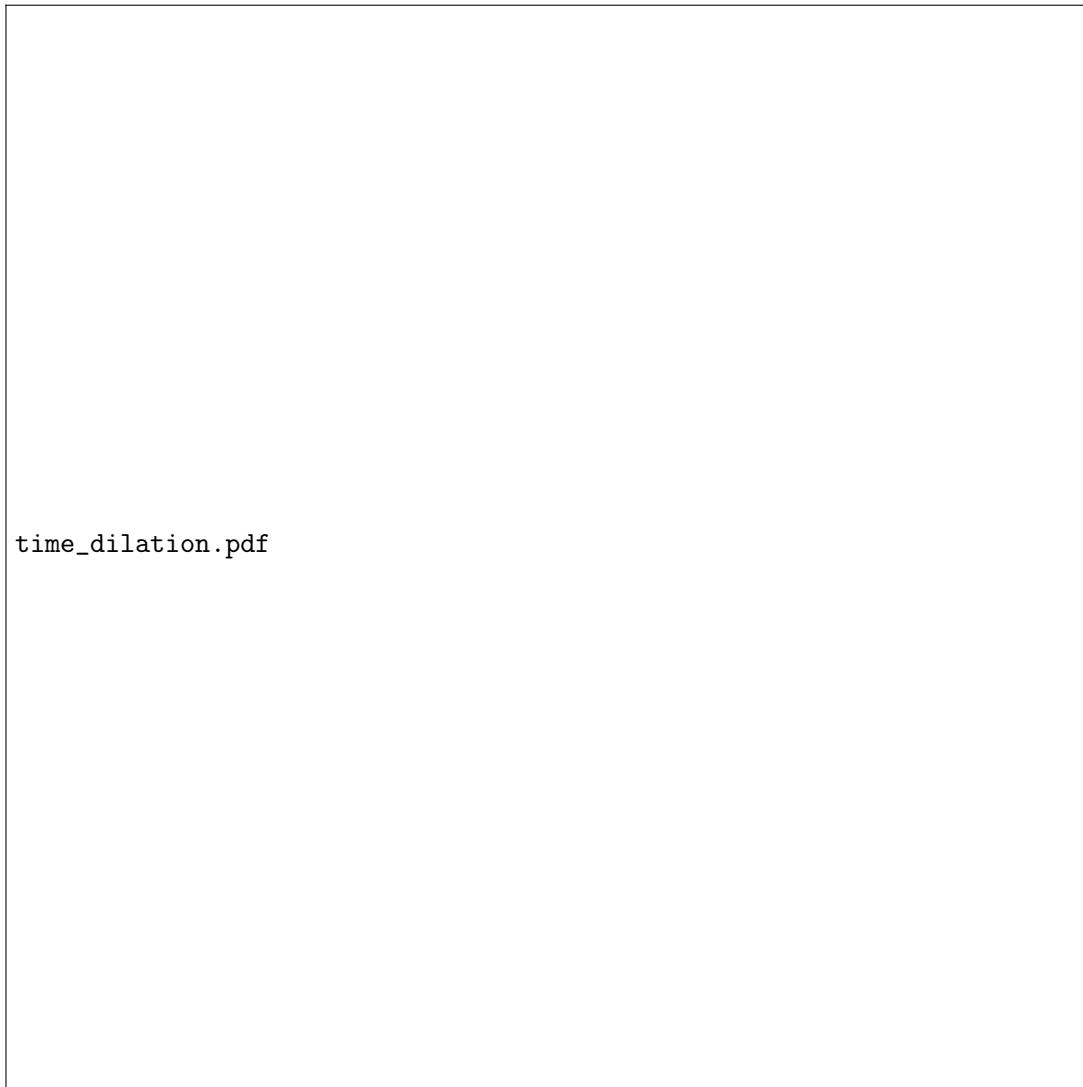


Figure 5: Time dilation factor near black hole.

## 7 Eddington Luminosity

$$L_{Edd} = \frac{4\pi GMm_p c}{\sigma_T}$$

`eddington_luminosity.pdf`

Figure 6: Eddington luminosity limit.

## 8 Black Hole Spin



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.