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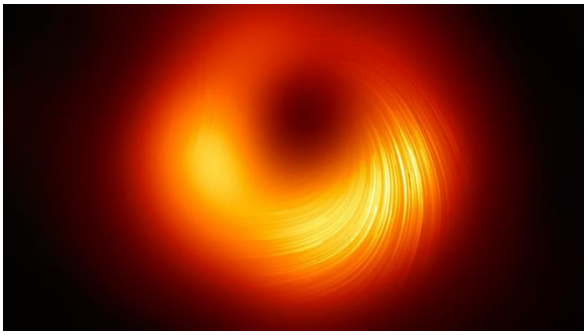
Practical 2

MATH 2134K: *Introduction to* MATLAB *Programming*

Black Holes and Cosmology



Question: In astrophysics, black holes are often surrounded by an accretion disk, a disk of matter (such as gas, dust, and other materials) that is being pulled toward the black hole due to its gravitational attraction. The matter in the accretion disk releases energy as it spirals inward toward the black hole, leading to the emission of radiation, including light and X-rays. Your task is to create a MATLAB script to estimate the temperature of the accretion disk surrounding a black hole based on its properties. Here are the parameters and assumptions:

- Black Hole Mass (M): Mass of the black hole, typically given in solar masses $(M_{\odot})$.
- Accretion Disk Radius (R): The radius of the accretion disk, typically given in kilometers (km).
- Stefan-Boltzmann Constant (σ): A fundamental physical constant representing the amount of radiation emitted by a black body, approximately $5.670374419 \times 10^{-8}\ Wm^{-2}K^{-4}$.
- Gravitational Constant (G): The gravitational constant, approximately $6.67430 \times 10^{-11}\ m^3kg\ s^{-1}$.
- Black Hole Distance (D): The distance of the black hole from Earth, typically given in light-years (ly).

Given these parameters, the temperature of the accretion disk (T) can be estimated using the following formula:

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

where

$\dot{M}$ represents the mass accretion rate, which is not directly given but can be assumed to be a fraction of the Eddington accretion rate.

Your task is to implement a MATLAB script that takes the black hole mass (M), accretion disk radius (R), and black hole distance (D) as inputs, and then estimates the temperature (T) of the accretion disk.

Considerations:

- Ensure that all units are properly handled throughout the calculations.
- Provide informative output to the user, including the estimated temperature of the accretion disk.
- Discuss the implications of distance on the observed temperature, if any.