Appendix B

Hawking temperature of a general black brane metric

Here we calculate the Hawking temperature for a general class of black brane metrics of the form

$$ds^2 = g(r)\Big[-f(r)dt^2 + d\vec{x}^2\Big] + \frac{1}{h(r)}dr^2\,, \tag{B.1}$$

where we assume that $f(r)$ and $h(r)$ have a first order zero at the horizon $r = r_0$, whereas $g(r)$ is non-vanishing there. We follow the standard method [376] and demand that the Euclidean continuation of the metric (B.1),

$$ds^2 = g(r)\Big[f(r)dt_{\mathrm{E}}^2 + d\vec{x}^2\Big] + \frac{1}{h(r)}dr^2\,, \tag{B.2}$$

obtained by the replacement $t \to -it_{\mathrm{E}}$, be regular at the horizon. Expanding (B.2) near $r = r_0$ one finds

$$ds^2 \approx \rho^2 d\theta^2 + d\rho^2 + g(r_0)\,d\vec{x}^2\,, \tag{B.3}$$

where we have introduced new variables ρ, θ defined as

$$\rho = 2\sqrt{\frac{r - r_0}{h'(r_0)}}\,, \qquad \theta = \frac{t_{\mathrm{E}}}{2}\sqrt{g(r_0)f'(r_0)h'(r_0)}\,. \tag{B.4}$$

The first two terms in the metric (B.3) describe a plane in polar coordinates, so in order to avoid a conical singularity at $\rho = 0$ we must require θ to have period 2π. From (B.4) we then see that the period $\beta = 1/T$ of the Euclidean time must be

$$\beta = \frac{1}{T} = \frac{4\pi}{\sqrt{g(r_0)f'(r_0)h'(r_0)}}\,. \tag{B.5}$$

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