Relativistically broadened line

emission from rings at two different radii

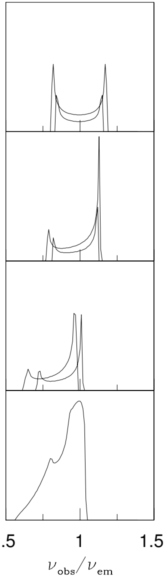
emission from a disc

Newtonian

Special relativity

General relativity

Line profile



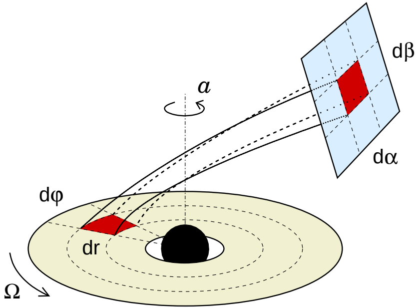
Transverse Doppler shift

Beaming

Gravitational redshift

Fabian et al. (2000) PASP, 112, 775

Transfer function — concept



$$\Delta I = \int_{\Sigma_{\alpha,\beta}} \mathrm{d}\alpha\,\mathrm{d}\beta \; \underbrace{g^{\gamma}} \; I_{\mathrm{loc}}(\alpha,\beta)$$

$$\Delta I = \int_{\Sigma_{r,\varphi}} r\,\mathrm{d}r\,\mathrm{d}\varphi \; \underbrace{g^{\gamma-1}\mu_{\mathrm{e}}\,\ell}_{\text{transfer function } G} \; I_{\mathrm{loc}}(r,\varphi)$$

$$g = \frac{E}{E_{\mathrm{loc}}}$$

$$\mu_{\mathrm{e}} = \cos\theta_{\mathrm{e}}$$

$$\ell = \frac{\mathrm{d}S_{\mathrm{o}}}{\mathrm{d}S^{\perp}_{\mathrm{loc}}}$$

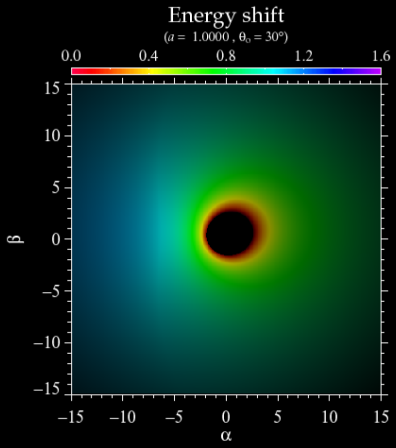
$\gamma = 4$ for $\Delta I = \frac{\mathrm{d}E}{\mathrm{d}t\,\mathrm{d}\Omega\,\mathrm{d}S}$

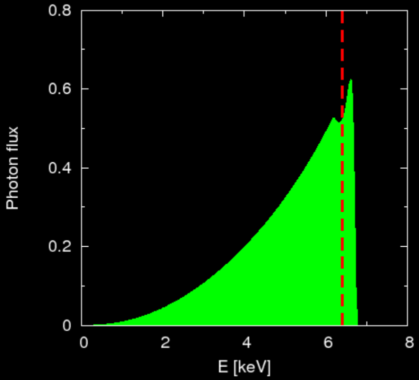
$\gamma = 3$ for $\Delta I = \frac{\mathrm{d}E}{\mathrm{d}t\,\mathrm{d}\Omega\,\mathrm{d}S\,\mathrm{d}\nu}$ or $\Delta I = \frac{\mathrm{d}N}{\mathrm{d}t\,\mathrm{d}\Omega\,\mathrm{d}S}$

$\gamma = 2$ for $\Delta I = \frac{\mathrm{d}N}{\mathrm{d}t\,\mathrm{d}\Omega\,\mathrm{d}S\,\mathrm{d}\nu}$

$$\frac{\mathrm{d}\alpha\,\mathrm{d}\beta}{r\,\mathrm{d}r\,\mathrm{d}\varphi} = \frac{\mathrm{d}S_{\mathrm{o}}}{\mathrm{d}S^{\perp}_{\mathrm{loc}}} \times \frac{\mathrm{d}S^{\perp}_{\mathrm{loc}}}{\mathrm{d}S_{\mathrm{loc}}} \times \frac{\mathrm{d}S_{\mathrm{loc}}}{\mathrm{d}S} = \frac{\ell\,\mu_{\mathrm{e}}}{g}$$

Spectrum at infinity — dependence on spin





Spectrum at infinity — dependence on inclination