

grad: accretion disk, Schwarzschild black hole

General Relativistic Accretion Disk model around a Schwarzschild black hole. Inner radius is fixed to be 3 Schwarzschild radii, thus the energy conversion efficiency is 0.057. See Hanawa, T., 1989, ApJ, 341, 948 and Ebisawa, K. Mitsuda, K. and Hanawa, T. 1991, ApJ, 367, 213. Several bugs were found in the old GRAD model which was included in xspec 11.0.1ae and before. Due to these bugs, it turned out that the mass obtained by fitting the old GRAD model to the observation was 1.4 times over-estimated. These bugs were fixed, and a new parameter (par6) was added to make the distinction between the old and new codes clear.

par1	distance (kpc)
par2	disk inclination angle (deg; 0 for face-on)
par3	mass of the central object (solar units)
par4	mass accretion rate 10^{18} gs^{-1}
par5	spectral hardening factor, $T_{\text{col}}/T_{\text{eff}}$. Should be greater than 1.0, and considered to be 1.5–1.9 for accretion disks around a stellar-mass black hole. See, <i>e.g.</i> , Shimura and Takahara, 1995, ApJ, 445, 780
par6	A flag to switch on/off the relativistic effects (never allowed to be free). If positive, relativistic calculation; if negative or zero, Newtonian calculation (the inner radius is still fixed at 3 Schwarzschild radii, and the efficiency is 1/12).
norm	Should be fixed to 1.