A Synthesis of the Cosmic Infrared and X-ray Backgrounds

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Abstract: We present a synthesis model of the cosmic X-ray and IR backgrounds, with the goal to constrain cosmic co-evolution of black-hole (BH) accretion and dusty star formation. Compared to previous models only for either IR or X-ray background, our model is unique in the ability of decomposing the energy source (BH vs. star formation) in infrared galaxies, and of improving the constraint on the evolution of Compton-thick active galactic nuclei (AGN). By assuming that individual galaxies are experiencing both star-formation and BH accretion, our model decomposes the total IR luminosity function into star-formation and BH components while taking into account the luminosity-dependent SED and its dispersion of the star-forming component, the redshift evolution of this SED, and the extinction-dependent SED of the BH component. The best-fit value of 19 free parameters are derived by fitting 449 data points from local luminosity functions, the number counts and redshift distributions at X-ray including both 0.5-2 and 2-10 keV bands, and in the mid-IR to submm bands of IRAS, Spitzer, Herschel, SCUBA, Aztec and MAMBO. With these best-fit values, we present the model's predictions on five topics about cosmic co-evolution of BH accretion and dusty star formation, including cosmic evolution of infrared galaxies, cosmic evolution of X-ray AGN (type-1, type-2 & Compton-thick), AGN selection techniques in X-ray and IR, AGN activities in IR galaxies, and star formation activities in AGN host galaxies. These predictions are in general consistent with observations in parameter ranges where current observations are able to probe.