Spectral Fitting.

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In the standard forward fitting method in X-ray spectral analysis the model predicted counts are compared to the observed counts in the detector channel space. The instrument calibration files provide the translation between the detector space and the physical units of the source. The energy dispersion $R(E', \hat{p}'; E, \hat{p}, t)$ is included in a photon redistribution matrix (RMF[1]); the instrument effective area $A(\hat{p}'; E, \hat{p}, t)$ in the ancillary calibration file (ARF[1]), and a photon spatial dispersion $P(\hat{p}'; E, \hat{p}, t)$ in the point spread function (PSF); where $\hat{p}'$ and E' are apparent photon location and energy (or the arrival detector channel), while $E, \hat{p}$ are true photon energy and location and t describes the photon arrival time.

The model $M(E', \hat{p}', t)$ that describes the expected distribution of counts arriving at the detector is then described by the following formula:

$$M(E', \hat{p}', t) = \int dE\, d\hat{p}\, R(E'; E, \hat{p}, t)\, P(\hat{p}'; E, \hat{p}, t)\, A(E, \hat{p}', t)\, S(E, \hat{p}, t) \tag{1}$$

where $S(E, \hat{p}, t)$ is the physical model of the source, e.g. energy spectrum, morphology (point, extended, diffuse etc) and variability. We follow the standard approach and ignore the arrival time and consider only the total number of photons (arriving within the observing time period) in the forward fitting process. We also take the source position and shape as known and assume that the source photons are collected from the detector area containing an entire interesting source region. This approach is valid as long as the sources are well separated (at the distances larger than the size of the PSF). In the crowded field or a complex diffuse structure the contribution from the other sources are important. In this situation the above formula reduces to:

$$M(E') = \int dE\, R(E'; E)\, A(E)\, S(E) \tag{2}$$

where the source emitted spectrum $S(E)$ depends on the source physics and is parameterized. Then the forward fitting procedure solves for the best fit model parameters assuming a fit statistic.

[1]http://heasarc.gsfc.nasa.gov/docs/heasarc/caldb/docs/memos/cal_gen_92_002a/cal_gen_92_002a.html