URL: http://cxc.harvard.edu/ciao3.4/why/filter_energy.html
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# Choosing an Energy Filter

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## Introduction

In many cases, the threads recommend that you filter ACIS event files on energy before beginning the analysis. See the Filtering Data and Using the ACIS "Blank−Sky" Background Files threads for examples. Be aware that the energy column in the event file only represents the nominal energy of the incoming photon. This is fine for global energy filtering, as shown here, but any more detailed analysis involves the use of an RMF; see the CIAO Threads for more information.

## Determining the Filter

There are several things to consider when choosing an energy filter for your data. Four major concerns are outlined below ***with sample filters for illustrative purposes. Depending on your analysis needs, it may be necessary to combine several of the following examples into one energy filter***.

- ***Calibration***
  ***[energy=300:10000]***

  The energy scale of the ACIS CCDs is only calibrated over the range 0.277−9.886 keV.

  The detectors were calibrated on the ground using various energies between 0.277 keV (the carbon K line) and 9.886 keV (the germanium K line). In flight, there are fewer energies and a narrower energy range with which to calibrate the detectors: 1.5−5.9 keV for an onboard radioactive calibration source, plus the oxygen lines from E0102 at ~0.6 keV. Therefore, it is not possible to extend the calibration beyond this range.
- ***ACIS Background***
  ***[energy=300:7000]***

  The high energy particle background is fairly flat in the 2−7 keV range. However, it both rises sharply below the 0.3 keV mark and climbs by a factor of 8 between 7−10 keV. For more details, see this memo (PS, 17 pp) on characterizing the ACIS background, specifically Figures 1 and 2.

  If you are looking at the faint extended structure of a source, the high background rate matters. Reducing the amount of background in your image will help make the structure more prominent.
- ***Degradation of ACIS QE***
  ***[energy=500:7000]***

  There has been a continuous degradation in the ACIS QE since launch. This is most likely due to molecular contamination building up on the cold optical blocking filter and/or the CCD chips. This degradation is the most severe at low energies; above 1 keV, the degradation is less than 10% to date. Based on the scientific analysis, the user must decide where to set the lower limit of the energy filter (e.g. 0.5 keV vs 1.0 keV). Full details are available from the ACIS QE Degradation why topic.

- ***Pileup***
  ***[energy=300:10000]***
  ***[energy=300:]***

  For unpiled sources, no source photons above 10 keV are expected. This is due to the fact that the effective area of the telescope is zero beyond that point. In this case, a cut at 10 keV is fine: ***[energy=300:10000]***. If a source is piled, however, two 6 keV photons could be detected as a single 12 keV photon. If you are intending to fit a model to the piled spectrum, do not provide an upper energy level for the filter: ***[energy=300:]***. The current pileup model (`jdpileup`) assumes that all the high energies are present in the input data.

  It is also possible to filter energy channels in *Sherpa* (i.e. with `NOTICE FILTER` and/or `IGNORE FILTER`) before applying the jdpileup model. Although the pileup correction includes the entire available energy information regardless of the specified filter, the fit statistics are calculated only on the specified bins. The use of this model is illustrated in the Using A Pileup Model thread.

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