The following note describes an evaluation of the possible advantages for coherent small angle x-ray scattering of changing from 7.76 keV to 5 keV. The various factors that come into play are listed below.

1. Flux, absorption and efficiency issues.
    a. We should gain a factor of **1.2** in the undulator brilliance at 5 keV as compared to 7.66. This is based on figure 3 of APS technical bulletin 17.
    b. We have two Be windows upstream of the sample. One sits just in-front of the filter in the FOE enclosure and the other sits just after the Ge mono in the I hutch. There is an APS requirement for 2 Be windows between air and the undulator ring, so unless we run our samples in UHV we cannot avoid these two windows. At 7.665 keV the window absorption is .89 while at 5 keV it is .67. Hence the net absorption loss is **0.75**
    c. Peter presently plans to use a vacuum integrated CCD camera, so any absorption in the camera window or the flight path exit window can be neglected. However with either the PI camera or Peters present camera this would give an additional attenuation factor.
    d. The detector improves its efficiency with energy. Based on Peters numbers we have an efficiency of 0.45 at 5 keV and 0.14 at 7.665 keV. This gives a net gain of a factor of **3.2**.
    e. For a channel cut mono with no miscut the relative bandpass is roughly independent of energy. For Matt's monochromator the figures are: $\Delta E / E = 1.1\times10^{-3}$ at 7.66 keV and $\Delta E / E = 5.6\times10^{-4}$. At 5 keV. This would imply a loss of a factor of 0.51. However, since it is not clear if we will use Matt's mono we will ignore this factor.
2. Sample scattering and beam coherence.
    a. The absorption length of a typical sample goes as E^{-3}, and since the sample thickness should generally be chosen to be one absorption length, then the sample scattering will decline by the same amount.
    b. The differential scattering cross section is independent of energy. If one integrates all the scattering over a full ring then $I(q) \approx \left(\frac{d\sigma}{d\Omega}\right)\frac{\lambda^2 q^2}{2\pi}\frac{\Delta q}{q}$. Consequently for a fixed fractional resolution the integrated intensity increases as λ^2.
    c. The coherence lengths of the beam in the vertical and horizontal directions are both proportional to λ. One would expect that this should imply an improvement of λ^2 in the coherent scattering intensity. However the effective vertical coherence length is already limited by the detector pixel size, and further improvement of the vertical coherence is unusable. Consequently we only gain as λ . If we put this factor together with the factors in parts 2a and 2b, the overall energy dependence cancels out. This dependence was checked by a direct comparison. Using the web coherence calculator assuming a 2.00 m detector distance with 12.7 micron pixels, 50X50 micron slits at 1.62 angstroms (7.6 keV) give a beta of 0.08. Changing to 2.48 angstroms (5 keV) and moving the detector in to 1.3 m (too keep the same q-range) gives a beta of 0.1. The ratio of the

two beta's is 1.25, which is equivilent to an increase in flux of (1.25)^2 = 1.56, almost identical to the ratio of the energies (1.53).

Putting all the factors together gives a net gain of **2.9**. This is on the assumption that we do not use Matt's mono and run in vacuum. Using Matt's mono and running the CCD in air would almost certainly lead to a decrease in signal to noise rather than an increase.