Setting up a Bicron scintillator detector

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MHATT-CAT has several bicron standard detectors for single photon counting. We have at least two 1.75" diameter one, and one 0.75" diameter one in the cage. A bicron is a standard X-ray detector based on amplification of visible fluorescence from a NaI scintillator with a photomultiplier. Its energy resolution is typically poor (50%), its count rate modest (up to 100 kcps with a fast amplifier). It is a standard single photon counting detector, ideal for a bending magnet beamline. This document is written as notes for users as to how to set one up properly.

1   Connection

- It is critical to bias a Bicron with a POSITIVE High Voltage.

- Bias the bicron with a HV power supply with about +800 to 900V. MHATT-CAT has single width NIM module with a SHV connector at the back that are well suited for these detectors (Canberra model 3102D). If the polarity of these modules is set to NEGATIVE, one will have to remove the cover panel and switch the polarity connector. See the manual for details.

- Bring in a spectroscopy amplifier, a Canberra 2022 or 2025 and connect the preamplifier connector at the back of the amplifier to the Bicron preamplifier connector (DB-9). Connect the bicron signal BNC to the input BNC of the amplifier. The settings of the amplifier are shown in table 1. It is highly advisable to T off the amplifier output to an analog oscilloscope. A bicron can be easily damaged if overdriven by more than 150 kcps. Its output is non-linear above 50 kcps as shown in Figure 1.

- Connect the Unipolar output BNC of the amplifier to a Ortec 850 Quad SCA input BNC. Connect the SCA output to a Jorger EPICS channel lemo connector. For 18 keV, the SCA levels are shown in Table 1 as an indication of the signal amplitude.

Table 1: MHATT-CAT Canberra 2022 Amplifier settings for the bicron detector. These settings are for 17.8 keV X-rays.

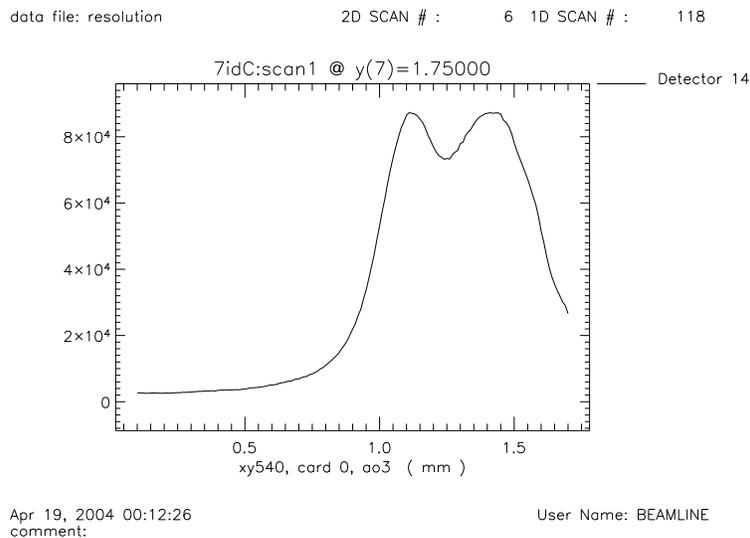| HV bias	+810V
coarse gain	10
fine gain	0.7
shapping time	0.5 μs
Input polarity	Pos.
SCA lower level LL	5.33 V
SCA upper level UL	7.51 V

Figure 1: Saturation of a bicron in high count rate situation. The data should be corrected for non-linearities well below the dip in intensity.