

FIRST RESULTS ON THE CRYSTAL ANALYSER SPECTROMETER, TFXA, AT THE SNS

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Presented are the first preliminary commissioning results obtained on the crystal analyser spectrometer TFXA at the SNS.

The Time Focussed Crystal Analyser TFXA is an indirect geometry inelastic scattering spectrometer using a time-focussed pyrolytic graphite analyser to give good count rates and energy transfer resolution over a wide range of energy transfers.

TFXA is located on the N8 beam at 12m from the ambient poisoned moderator at the SNS.

The spectrometer is based on the time focussing geometry described by Ikeda et al⁽¹⁾, and is shown in figure 1. In addition to the time focussing, the Marx principle is used to provide energy focussing⁽²⁾. This reduces the positional uncertainty in the analysing energy E_2 , and is a feature not previously exploited on crystal analyser spectrometers. It enables good energy transfer resolution to be maintained down to energy transfers of a few meV.

Figure 2 shows the calculated energy transfer resolution for TFXA. The improvement in resolution from the energy focussing at energies of less than 100 meV is clearly shown. Further improvements in resolution are expected by removing the uncertainty in scattered flight path due to the thickness of the BF_3 gas detectors.

The spectrometer has been installed with half the final detector solid angle, comprised of eight 1" BF_3 gas detectors. The full detector solid angle and scintillator detectors will be installed later in 1985.

The initial commissioning results have been obtained using a 30% scatterer of zirconium hydride at mean currents on the SNS of between 0.05 and 0.5 μ A. Figure 3a shows the raw time of flight data summed over the eight detectors. The suppression of the higher order reflections from the graphite analyser by the cold beryllium filter is excellent. Low levels of background are seen at both short and long times of arrival. Figure 3b shows the raw time of flight data of the individual detectors, where the importance of the variation in final energy for the different detectors at low values of energy transfer is clearly demonstrated by the variation of the position of the elastic line. An initial calibration of the important distances L_1 and L_2 and the final energies E_2 for each detector have been performed. Figures 4a and b show the raw data of figure 3 transferred to an energy transfer scale and corrected for incident spectral shape. The elastic line shown in figure 4a has a fwhm \sim 0.27 meV compared with a calculated width \sim 0.3 meV. Figure 4b shows the fundamental vibrational mode and three overtones of zirconium hydride. The absence of any significant background bodes well for the future. Intensity calculations are in reasonable agreement with the data. The inherent width of the zirconium hydride features does not place any demands on the instrumental resolution. It is intended to demonstrate the resolution with more suitable samples in the near future.

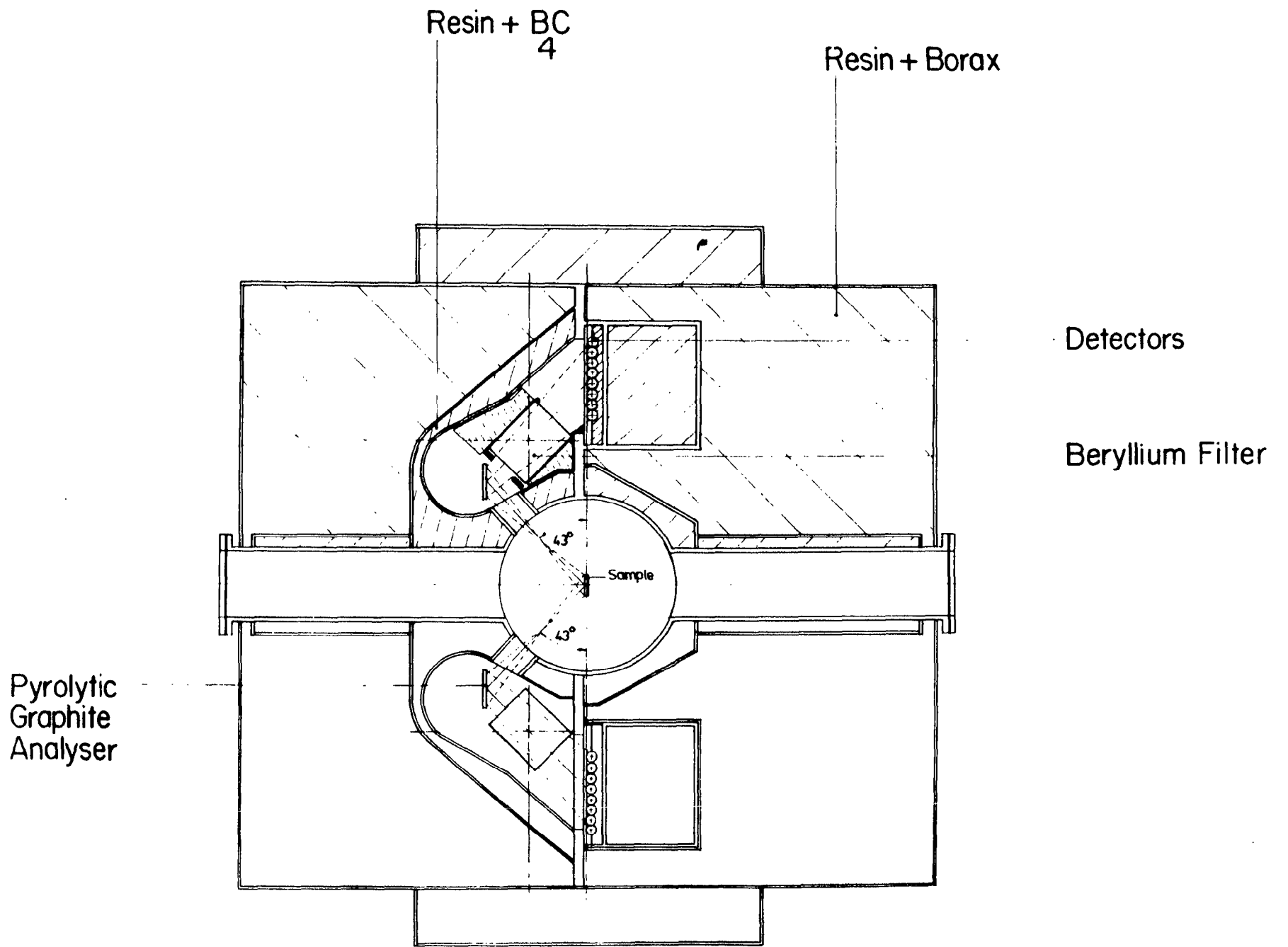
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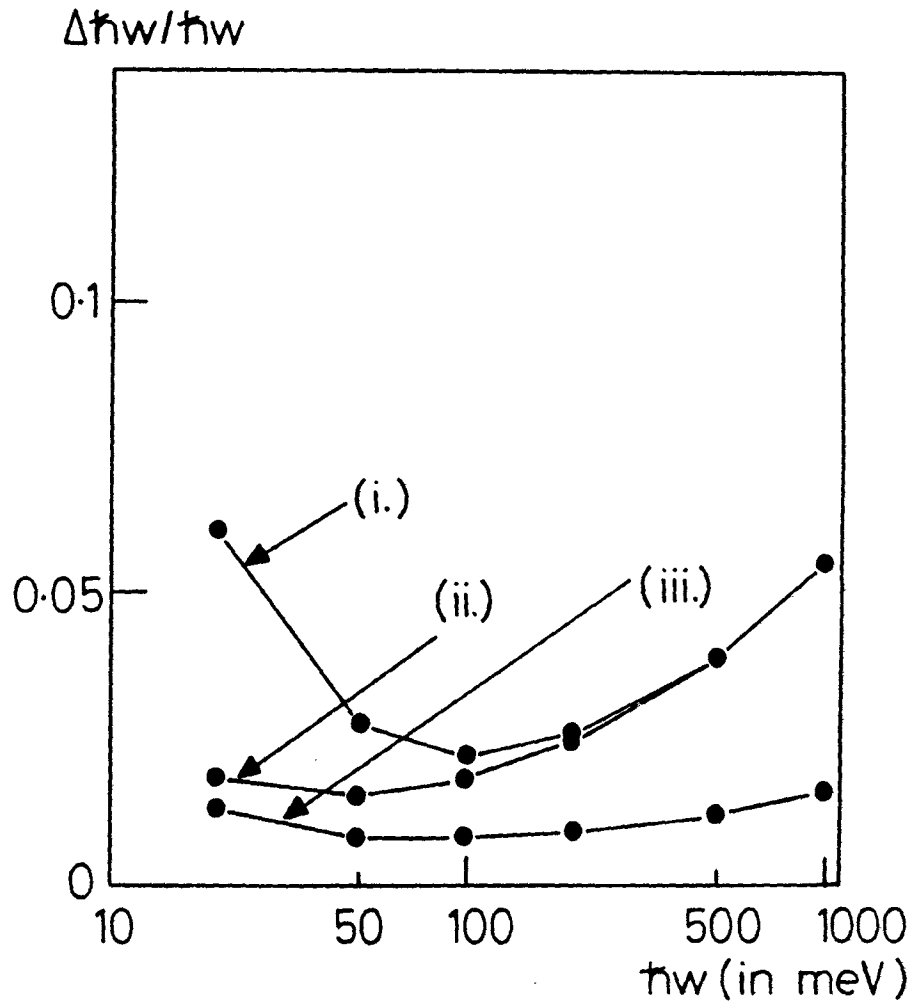
We wish to acknowledge the advice of D K Ross and R N Sinclair, and the advice and help of colleagues at RAL.

References

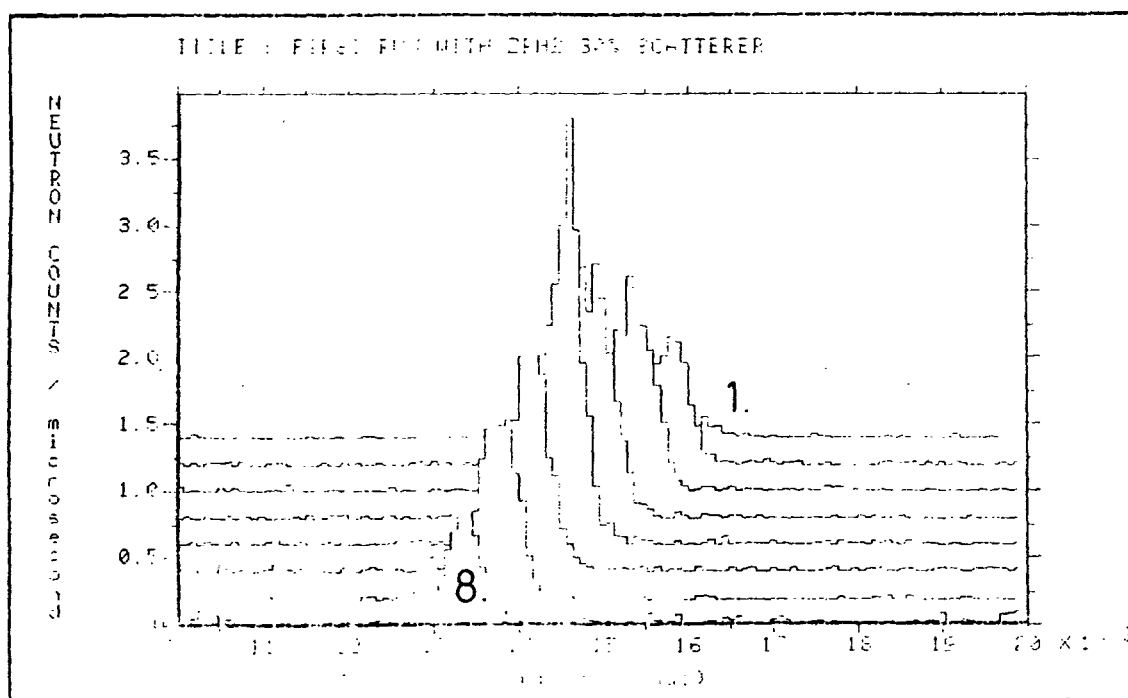
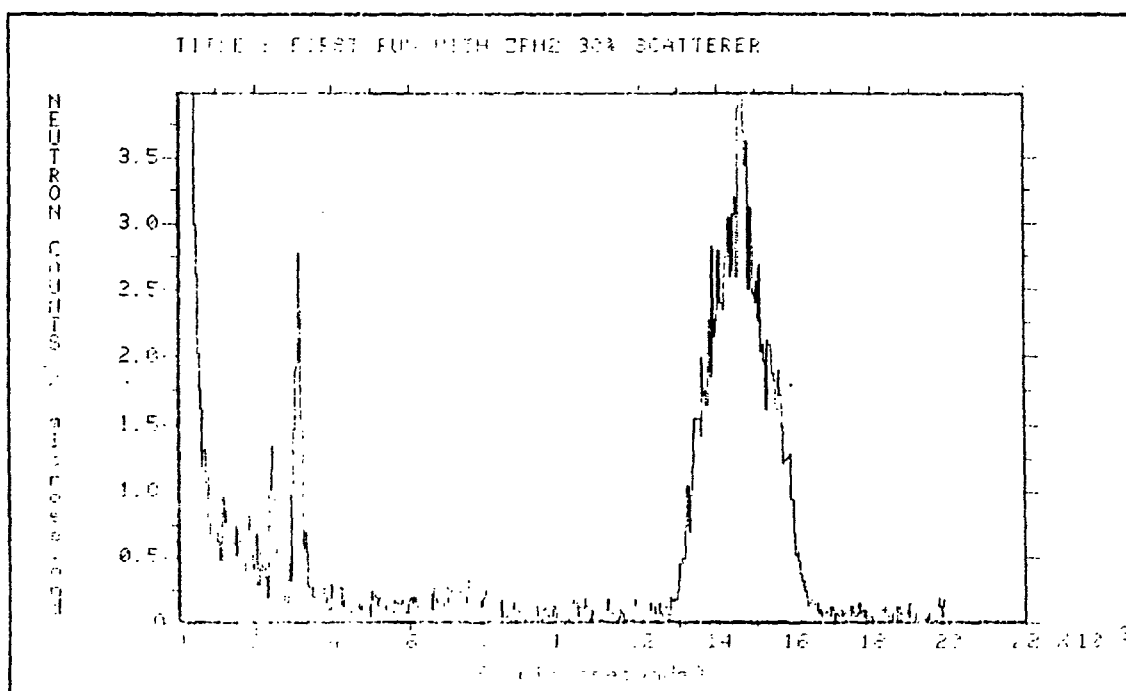
- (1) S Ikeda, N Watanabe and K Kai, Physics 120B (1983) 131
- (2) D K Ross - private communication

(1) Layout of the time focussed crystal analyser spectrometer.



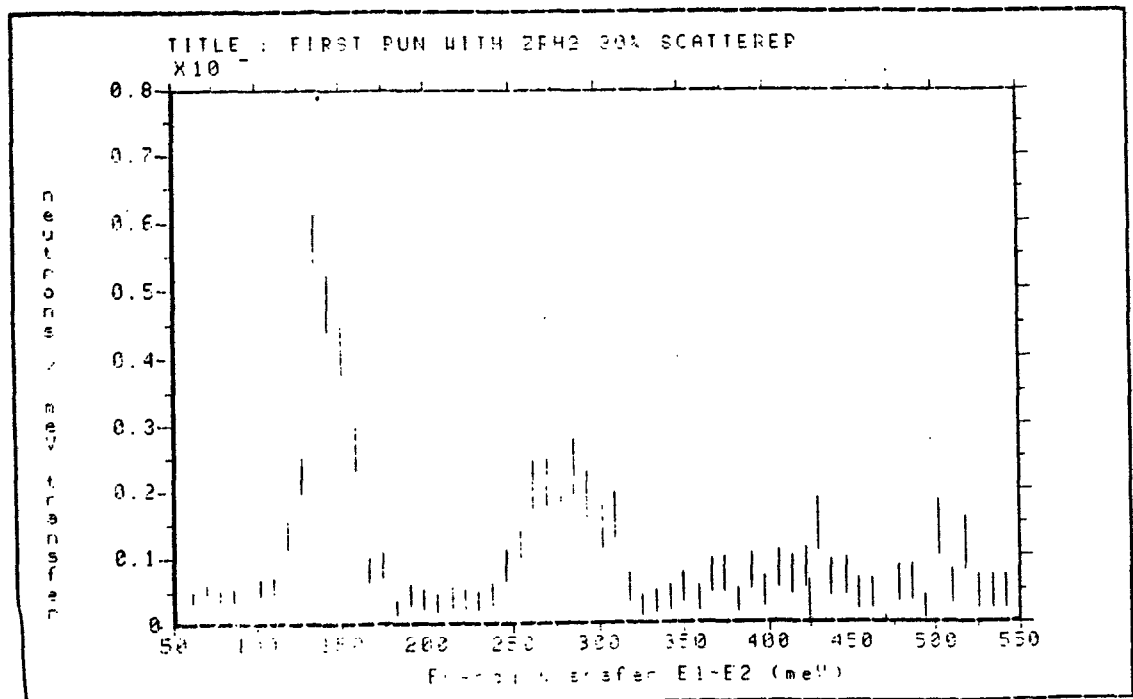
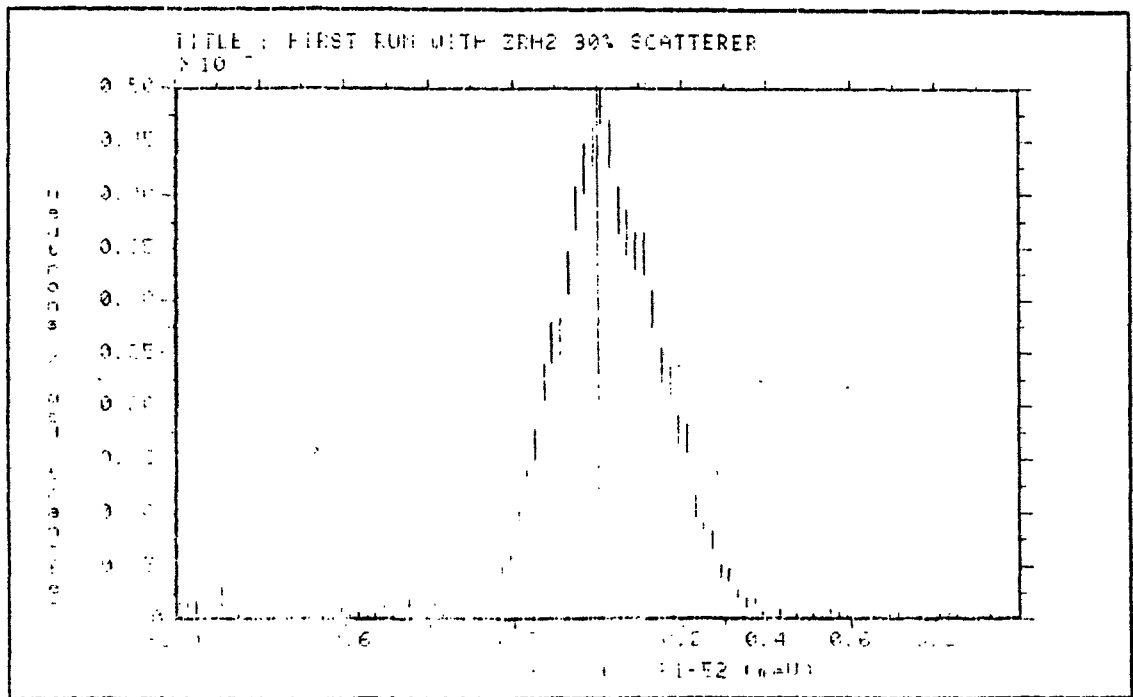


- (2) Time focussed crystal analyser spectrometer energy transfer resolution $\Delta h\nu/h\nu$ for (i) 1" BF_3 detectors, (ii) as (i) but with energy focussing and (iii) as (ii) but with an improved detector system.



(3) (a) Raw tof data of ZrH_2 for the sum of the eight detectors.

(b) Raw tof data of ZrH_2 from the individual detectors.



(4) ZrH₂ data corrected for incident spectral shape and transferred to a energy transfer scale

(a) Elastic line

(b) Fundamental vibrational mode and overtones