[time-focused CAS]
(Chapter 6.2.7 of *Elements*)

Time-Focused Crystal-Analyzer Spectrometers

Most of the existing high-resolution backscattering instruments are based on the simple principle $\cot\theta_A \approx 0$ in (*Elements* Eq. 6.22). Better resolution and higher instrument throughput may be accomplished in many circumstances using more general geometric time-focusing principles. These ideas exploit opportunities that lie in special orientations of the moderator surface; in the extended sample; in the analyzer crystal cutting angle and orientation; using mosaic crystals that allow greater counting rates; analyzer scattering angles considerably different from the backscattering condition; and special choices of distances between spectrometer elements. The descriptive variables are then correlated and the expression for the resolution involves only the variances of the truly independently distributed variables. These generalizations offer flexibilities in design of high-resolution spectrometers. TOSCA at ISIS and VISION at SNS are time-focused in an elegant but simple sense.

In resonance detector spectrometers, E_f is fixed according to the resonance energy. In crystal-analyzer spectrometers, E_f is fixed by the analyzer crystal Bragg angle.

The standard setups for measuring pulsed moderator emission time distributions are more completely time-focused; see Figure 6-TFXA-1.

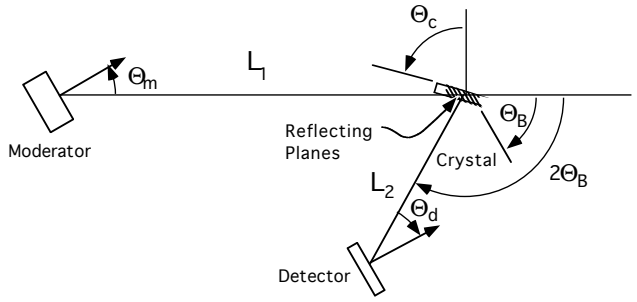

Figure 6-TXA-1. Time-focused crystal analyzer arrangement for measuring moderator emission time distributions. (See Graham and Carpenter 1970 and 1972.)

The time focusing conditions are

$$\tan\Theta_m = \frac{1}{2}\left(1+\frac{L_2}{L_1}\right)\cot\Theta, \qquad \text{(6-TFXA-1)}$$

$$\tan\Theta_d = \frac{1}{2}\left(1+\frac{L_1}{L_2}\right)\cot\Theta_B, \qquad \text{(6-TFXA-2)}$$

and

$$\cot\Theta_c = -\frac{\cos\Theta_d \tan\Theta_m + \sin\left(2\Theta_B + \Theta_d\right)}{2\sin\Theta_B \sin\left(\Theta_B + \Theta_d\right)}. \qquad \text{(6-TFXA-3)}$$

The angles are measured in the sense shown in the figure. Note the implication of an "off-cut" crystal: unless $L_1 = L_2$, the physical crystal face is not parallel to the reflecting planes. In the instance shown, (111) are the reflecting planes, while the cut face is the (110) plane, differing by $\Theta_c = 35.3° = \cos^{-1}\left(2/\sqrt{6}\right)$.

References

Graham, K. F and J. M. Carpenter. Pulsed moderator studies using a time-focused crystal spectrometer. *Nucl. Instr. & Meth.* **85** (1970) p 163 and *Nucl. Sci. & Eng*. **49** (1972) p 418.)