acta physica slovaca vol. 45 No. 1, 89 – 91 February 1995

PC BOARD FOR SPECTRA REGISTRATION IN A TIME-MODULATION MODE[1]

D. Žák[†], M. Mašláň[†2], A.L. Kholmetskii[‡]

[†] *Dept. of Exp. Phys., Palacky University, Svobody 26, 771 46 Olomouc, Czech Republic*

[‡] *Dept. of Nucl. Phys., Belarus State University, Skorina 4, 220 080, Minsk, Belarus*

Received 6 September 1994, in final form 12 December 1994, accepted 19 December 1994

A PC board for Mössbauer spectra registration with simultaneous sampling of the velocity signal and time scale (time-modulation mode) is described in the paper. This mode of spectra registration is similar to the modulation mode, because address of the registration channel definition is carried out by the instantaneous value of the relative velocity, however the spectrum accumulation is performed in the multiscaler mode and hence the amplitude analysis is skipped. The equality of channel opening time is implemented.

One can observe two major methods for spectra registration with variable velocity in Mössbauer spectroscopy .

The first method (time registration mode) samples time axis with a fixed fine interval for the making of a multichannel mode accumulation of Mössbauer spectra. In such a case linearity of the velocity scale and the velocity resolution are predominately determined by the quality of the driving system and transducer.

The second - less frequently used - method of the spectra registration (modulation registration mode) is based on dividing of the velocity axis into fixed steps of quantization. The implementation of the latter method is ensured by the amplitude modulation of the detector output signal according to the real velocity of the relative motion of the radiation source and absorber. The multichannel amplitude analyser is used to record spectra. The quality of the driving system is less important for such a method of spectra registration.

The alternative method of the spectra registration system (time-modulation registration mode) [1] uses the simultaneous sampling of the velocity axis as the time axis as well. The functioning of the Mössbauer spectrometer with the time-modulation registration mode is based on the principle of a measurement of the velocity, and digitalization of this analogue signal.

---

[1] Presented at the Colloquium on Mössbauer Spectroscopy in Material Science, Kočovce, Slovakia, October 3-6, 1994

[2] E-mail address: maslan@risc.upol.cz

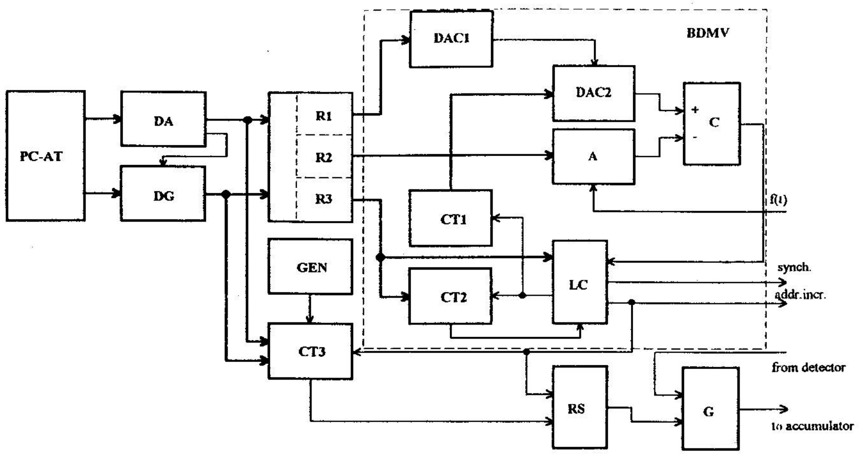

Fig. 1. The block diagram of a PC board for Mössbauer spectra registration with simultaneous sampling of velocity signal and time scale (time-modulation mode): C: comparator device; A: amplifier; DAC1, DAC2: digital to analogue converters; CT1, CT2, CT3: counters; GEN: frequency generator; G: gate; RS: RS-trigger; LC: logic circuits; R1, R2, R3: registers.

A special PC board was mounted on our PC based Mössbauer spectrometer [2,3] for the implementation of the time-modulation mode of the spectra registration.

The block diagram of the "time-modulation" PC board is shown in Fig. 1. This additional block for the digital measurement of the velocity ("time-modulation" PC board) makes Mössbauer spectrometer different from its traditional design. The block is structurally similar to the following analogue to digital converter. The electric signal $f(t)$, proportional to the real velocity of the radiation source comes from the output of the velocity to voltage converter and it is fed to the input of the block responsible for the digital measurement of the velocity (BDMV). The velocity to voltage converter is an inductive sensor (velocity pickup coil of the transducer) and it is a part of the standard transducer. The BDMV measures a time interval at which the velocity has a defined value. The subsequent velocity values are separated by a fixed velocity interval Δv, determined by the discrete setting of the digital to analogue converter (DAC2). A logical coincidence of levels, causes the change of the content of the reversible counter (CT1) to the state 1 and subsequently the DAC2 output signal changing in discrete voltage steps ΔU, is formed at the output of the comparator device (C) at the moment of equality of signals on its inputs. Consecutively, the equality of signals on the comparator inputs is impaired and the system returns to its initial state. A recurring equality of signals on the comparator inputs appears only for the velocity signal changes being Δv, and the above mentioned process repeats itself for $\Delta v = \Delta U/k$, where k stands for the proportionality constant defined by the velocity to voltage converter and the amplifier (A) settings. As a result, a sequence of pulses is obtained at the comparator output, where the time intervals between them correspond to the velocity increment Δv. The sequence of pulses determined by the sequence of pulses on the comparator output (by means of the counter CT2) switches between channel addresses of the data storage memory set in the multiscaler mode. The memory is driven by the "addr.incr." and "synch." signals, respectively in order to keep synchronisation. The counter CT2 determines the number of the memory channels. It is obvious that the time intervals between neighbouring pulses are not equal for non-linear perturbations in the velocity signal and dispersion of the velocity in subsequent spectrometer cycles. The equality of channel opening time intervals is provided by means of the RS-trigger, the latter opening the gate (G) for fixed time intervals. This gate controls an access of pulses from the detector to the memory. Channel opening time is determined by means of the counter (CT3) and a precision frequency generator (GEN). This time is set equal to the minimum possible interval between neighbouring pulses.

The Mössbauer spectra registration mode discussed above is similar to the modulation mode because its address-definition of the counting channel is carried out with the instantaneous values of the relative velocity. As a result, the major features of the spectrometer (predominantly the linearity of the velocity scale, the resolution and the stability versus time) are predetermined by the precision of the velocity measurement. The Mössbauer spectrometer features are almost independent of the quality of the driving system. The time-modulation mode does not have the shortcomings of the modulation mode. The counting device works in the multiscaler mode and does not depend upon the multichannel amplitude analyser. The non-linear perturbations of the velocity do not distort the equality of the opening time intervals of the channels. The dead-time effects are virtually absent.

The detailed analysis of the velocity resolution and linearity of the velocity scale in the time-modulation mode of spectra registration [1] shows that this method may become an important addition to the traditional methods of the Mössbauer spectroscopy. This method allows to increase velocity resolution, protects the spectrometer versus the influence of external perturbing factors, allowing to build non-laboratory varieties of the high-precision spectrometers. This method can be used to linearize velocity scale in the Mössbauer spectrometers having non- linear velocity reference signals [4].

References

[1] A.L. Kholmetskii, M. Mashlan, V.A. Chudakov, V.L. Gurachevskii, O.V. Misevich: *Nucl. Instr. and Meth. in Phys. Res.* **B71** (1992), 461;

[2] A.L. Kholmetskii, V.A. Evdokimov, O.V. Misevich, A.A. Fedorov, A.R. Lopatik, M. Mashlan, D. Zak, V. Snasel:*ICAME]93, Book of Abstracts, Vancouver*, Aug. 8-13, 1993, 7-19A.

[3] D. Žák, M. Mašláň, A.L. Kholmetskii, V.A. Evdokimov, A.R. Lopatik, O.V. Misevich, A.A. Fyodorov: *this issue*

[4] A.L. Kholmetskii, M. Mashlan, V.A. Chudakov, V.L. Gurachevskii, O.V. Misevich: *Nucl. Instr. and Meth. in Phys. Res.* **B84** (1994), 120;