Advanced Lab Mossbauer Manual

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**Equipment Settings and Descriptions**

**Function Generator** (Hewlett Packard 3311A)

The function generator delivers a 0-5V 6Hz square wave to the bistable input of the Mossbauer Drive. This waveform is used by the Mossbauer Drive electronics to control the linear motor.

**SETTINGS**

Range Hz: 1  
Frequency 6 Hz  
Function: Square  
Amplitude: 5 Volts pk to pk  
DC Offset: Adjust to create a signal from ground to 5 Volts  
600 Ohm Output Connector (on the right)  
Coax Center Conductor: HI  
Coax Outer Conductor: LO (line up the ground arrow on the banna plug to bnc adapter)
NIM Bin Crate (Canberra Model 2000)
The NIM bin crate powers the Mossbauer Drive, H.V. Power Supply, and Spectroscopy Amplifier.

Mossbauer Drive (Austin Science Associates ECON S-700)

Description goes here..

It was originally designed to receive the bistable signal from a multichannel analyzer or a PCA card for a computer. If the elected experiment setup includes a PCA card then the sync signal is required to alleviate some problems due to software timing. The velocity and drive connectors are to be connected to the linear motor. The "Data In" and "Data Out" connectors are for constant velocity mode only and they should be hooked up to a single channel analyzer and possibly scaler.

SETTINGS
Time/Channel: 30 (constant velocity mode only)
Numeric Dial: 99.9 MM/S
Mode Constant Acceleration (C.A): ASYM
Fidelity: ramp up to get maximum mechanical dynamic range without distortion
See calibration procedure to adjust velocity waveform

Mossbauer Linear Motor (Austin Science Associates K3)

Description goes here..

Digital Oscilloscope (Tektronix TDS 220)

Description goes here..

Detector (Austin Science Associates PC-KR1 Proportional Counter)

Description goes here..

Preamp (Canberra Model 2006)

Description goes here..

H.V. Power Supply (Canberra Model 3102)

Description goes here..

Output Polarity: Positive
Voltage: 1850V

Spectroscopy Amplifier (Canberra Model 2021)

Description goes here..

SETTINGS
Fine Gain: 0.8 (0.788)
Coarse Gain: 30
Input Polarity: +
Shaping Multiplier: x1
Shaping Time: 6 micro seconds
Rate: AUTO
Mode: ASYM
**EXPERIMENTAL PROCEDURE**

_Below are excerpts from Christopher Fabri's Lab Start-Up Manual that need to be completely rewritten._

1.1 Turn on the NIM bin crate.

1.2 Turn on the computer. Open the DAQ software.

1.3 The source to be used with this experiment is Co57. It will be supplied to you by the Professor. You should read the short write-up, which describes the source and the various safety procedures to follow when using it.

1.4 Place the motor approximately 4-5 cm from the detector. Using a gloved hand, attach the source to the end of the motor; the cork should twist onto the shaft.

1.5 Isolate the source by placing lead bricks around it. Use a Geiger counter to determine if the isolation is sufficient. Ideally, the number of counts beyond the bricks should be no more than the usual background noise.

A. Starting the Monitor [STM]

3.11 Slowly ramp up the fidelity setting. As the fidelity setting is ramped up the red and green DRIVE lights should begin flickering back and forth, indicating that the motor is proceeding from a region of negative polarity to one of positive polarity. [If not see troubleshooting STM]

B. Adjusting the Waveforms

3.12 Ramp up the fidelity until the motor begins to move. Check to see the velocity and drive waveforms on the scope. The drive waveform should be adjusted so that there is minimal DC offset [i.e. the red light should be on for as long as the green light, for any given oscillation]; the 'COMP AMP ZERO' pot can be adjusted to change the DC offset. [See appendix 4 for the locations of the pots]. In fact, it is best if one continuously adjusts the 'COMP AMP ZERO' pot while ramping up the fidelity, so that the red and green lights each flash at the same rate and intensity. In this fashion, the motor always remains in an equilibrium position.

3.13 The velocity waveform should be adjusted so that it is fully linear and asymmetric. The following pot should be used for this purpose, 'C.A ASYM UL'
The following pots are also available,

**SYSTEM CAL.** increase to increase energy to all other pots

**C.A. ASYM CAL.** increase if velocity waveform is not present

The final velocity waveform should be asymmetric and linear [see appendix 2 for example].

3.14 Once the velocity and drive waveform are properly adjusted, then data taking may begin.

Some degree of finesse is required in manipulating these pots; they should be adjusted slowly, to allow the system to adjust. Furthermore, there is some correlation between the settings of the separate pots i.e. adjusting one of them may have an effect on the others and vice-versa; hence. some 'tooling around' may be necessary in order to get things to work properly

4.0 TROUBLESHOOTING THE STM

The motor may not work properly for a number of reasons. The following are a few problems previously encountered and their apparent solutions:

**MOTOR UNRESPONSIVE OR ERRATIC**

a. turn the NIM bin corresponding to the DRIVE unit off for 20 sec or so; there may be a grounding problem with it of the DRIVE; sometimes doing this 'reset' it and the motor begins oscillating properly when turning it back on again.

b. the motor begins oscillating wildly out of control, turn the 'SYSTEM CAL.' pot all the way off, then perform a; make certain the fidelity is low.

c. if the motor does not resonate anytime during the fidelity ramp-up. then something is probably wrong with the motor, check the wiring, a ground wire may have burned itself loose or disconnected and will need to be re-soldered.

d. sometimes the oscilloscope interferes with the motor, increasing the C.A ASYM. CAL. pot may alleviate the problem; if not, then disconnecting either the drive wire or [at the very worst] the velocity wire to the scope remedies this problem; of course, if the wave-forms can't be seen, then they can't be properly adjusted, so this problem may require some ingenuity on the part of the experimenter.

**TOO FEW ABSORBED COUNTS OR TOO FEW COUNTS**

a. If the source is too close to the detector, then the relative absorption [number of counts indicating absorption/number of counts] will be very low. The source seemingly saturates the foil and perhaps interferes with the 'recoil-less' absorption process resulting in fewer absorptions. Move the source away from the detector.

b. If the source is too far from the detector, the relative absorption tends to be quite high but the actual number of counts is very low, because fewer gamma rays actually reach the detector. Move the source closer to the detector.
Problems a and b are complimentary. Some trial and error must occur in order to determine the optimum location. The optimum location is probably somewhere in the range of 3-5 cm depending on the angular distribution of gammas and the intensity of the source.

**Software**

NI DAQ and LABVIEW

**Mossbauer Drive Velocity Calibration Procedure**

The following are used in the Constant Acceleration Mode

```
                          SYS CAL
                          COMP AMP 0
     CAL -         CAL +
     CURVE         SLOPE
                  ASYM
                  CAL
                  UL
                  UL
```

Sys CAL - controls all the generators associated with the Mossbauer drive system
Comp Amp 0 - corrects for any DC offset
ASYM CAL and ASYM UL - adjustments allow for a maximum signal

**CALCULATIONS**

Problems..

**PLOTS**

Required plots...

**REFERENCES**

LIST OF FIGURES

APPENDIX

- Equipment Datasheets
- Handling of $^{57}$Co Sources
- Additional Resources
  - texts
  - websites

**Experimental Setup Problems Paul Bohn Encountered:**
1. Bad HV Power Supply
2. Poor Cables
3. Bad Scope Channel
4. DAQ is improperly hooked up
5. Mossbauer velocity cable was improperly hooked up
6. The BNC input on Spectroscopy amplifier is loose
8. Should the DAQ be synchronized with the Mossbauer Drive?

**Single Channel Analyzer (Canberra SCA 2030)**
NOT USED IN CURRENT SETUP

**Multiport Tennelec Multichannel Analyzer (oxford)**
NOT USED IN CURRENT SETUP