

The Mössbauereffect

Bibliography:

- Melissinos, "Experiments in Modern Physics". Academic Press, 2003
- E. Wegener, "Der Mössbauereffekt". Band 2/2a, 1966
- G. Wertheim, "Mössbauereffect: Principles And Applications". Academic Press, 1964
- H. Frauenfelder, "The Mössbauereffect". Benjamin Inc., 1963

Apparatus:

- 1) Nuclear source Co-57 . Nominal activity 185 MBq (5 mCi) measured on 3/2012
- 2) Mössbauer Bench
- 3) Mössbauer Velocity Transducer
- 4) Mössbauer Drive Unit
- 5) Digital Function Generator
- 6) Proportional counter
- 7) Pre-Amplifier (for the proportional counter)
- 8) High Voltage supply
- 9) Amplifier
- 10) Data Acquisition Module for Mössbauer Spectroscopy
- 11) Personal computer for the data acquisition
- 12) Digital Oscilloscope

Measurement:

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### Without the target and with the source at rest ###  
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- 1) Check the functionality of the apparatus and try to use to Velocity Transducer
 1. Check that the pre-amplifier works (use the test function and check the signals on the Oscilloscope)
- 2) Raise very slowly the high voltage to the nominal value of 2 kV.
 1. **The pre-amplifier is very sensitive to the HV. Always lower and raise the HV very slowly.**
 2. **Don't exceed the value of 2.2 kV** (if you don't want to destroy the proportional counter)
- 3) With the help of the Oscilloscope set proper values for the Amplifier (signals that exceed 10V will be always considered as 10V)
- 4) Operate the Data Acquisition Module in Pulse-Height mode (PHA)
- 5) Identify the peaks form the gamma-source. (How many peaks do you expect?
Suggestion: take into account the fact that what you observe depends on the detector technology that you are using.
- 6) Select the peak at 14.4 keV (a region around it)

With the target in place and the source moving ###
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- 1) Mount the alpha-Iron foil on the target support. Be careful with it. Even if it is only a small piece of metal costs 200 Euros! **Handle it with tweezers. Don't touch it with your hands.**
- 2) Set the speed of the Mössbauer Velocity Transducer at a appropriate value. Which value do you expect to be used? Please consult the literature.
- 3) Run the Data Acquisition Module in “MULTICHANNEL SCALING [WINDOW]” mode.
- 4) Identify and fit the peaks. How many do you expect? From which physics effect are they caused?
- 5) Use the identified peaks to calibrate the velocity of the source
- 6) Substitute the alpha Iron target with the Steel target.
- 7) Obtain the Mössbauer spectrum for it. How many peaks do you expect this time? Why?

Security issues

Gamma-sources can be very dangerous and are difficult to treat.

- 1) Don't dismount the source from the experimental setup
- 2) Work near the experiment as short as possible (staying 1 or 2 meters far away from the source is always better)
- 3) Don't dismount the protective shielding of the experiment
- 4) For every problem with the source call immediately the supervisor

The three words for security in nuclear environment are:

- 1) Distant from the source
- 2) Use it for the shortest possible time
- 3) Use a proper shielding

LINKS

The basic experimental setup:

http://www.wissel-gmbh.de/index.php?option=com_content&task=view&id=66&Itemid=93

The Digital Function Generator

http://www.wissel-gmbh.de/index.php?option=com_content&task=view&id=25&Itemid=43

Mössbauer Velocity Transducer

http://www.wissel-gmbh.de/index.php?option=com_content&task=view&id=14&Itemid=33

Mössbauer Drive Unit

http://www.wissel-gmbh.de/index.php?option=com_content&task=view&id=22&Itemid=38

Preamplifier for Proportional Counters

http://www.wissel-gmbh.de/index.php?option=com_content&task=view&id=43&Itemid=66

Data Acquisition Module for Mössbauer Spectroscopy

http://www.wissel-gmbh.de/index.php?option=com_content&task=view&id=45&Itemid=68

A detailed manual for this is in attachment (CMCA-550-WISSOFT2003-Manual-FEB2004.pdf)

Mössbauer Bench

http://www.wissel-gmbh.de/index.php?option=com_content&task=view&id=57&Itemid=83

The proportional counter

<http://www.lndinc.com/products/41/>