Purdue QuarkNet Workshop 2013

Purdue University
Department of Physics

June 24-28, 2013

Second Exercise

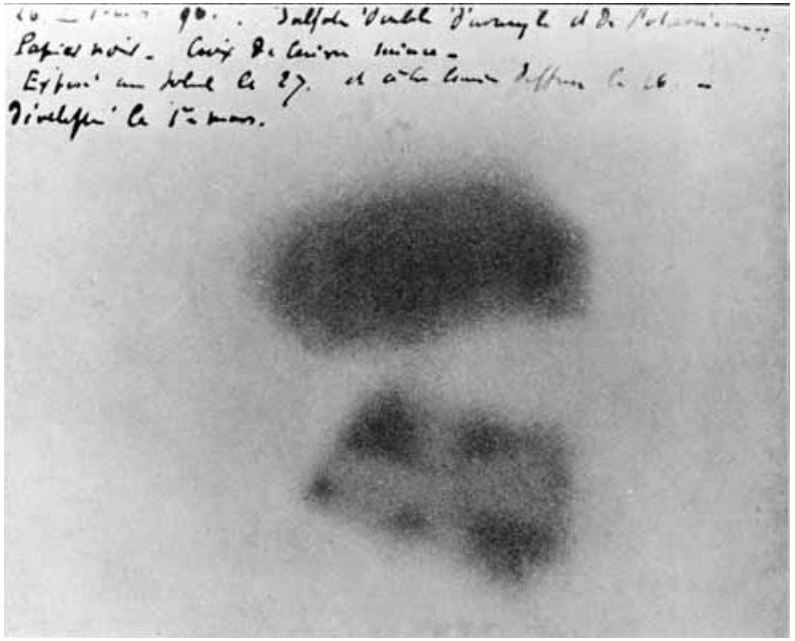
It is the year 1896 and Henri Becquerel has announced his observation that some minerals emit "penetrating rays" that are invisible to the naked eye.

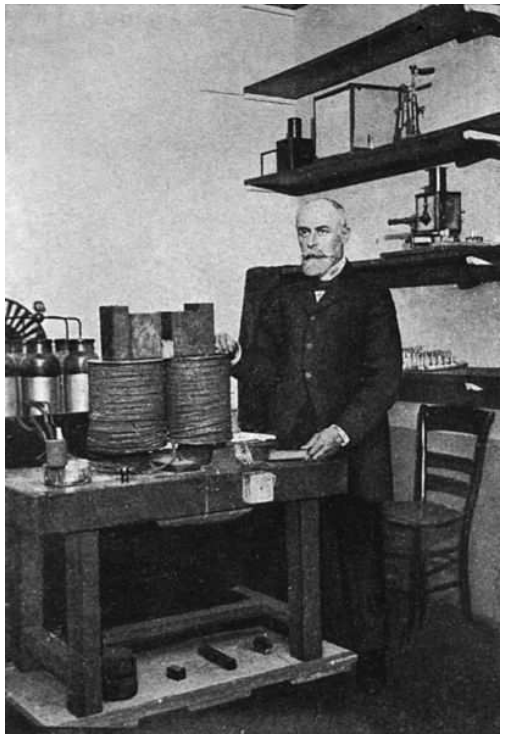
What are the properties of these "rays"?

Do all materials emit the same kind of rays or are they different?

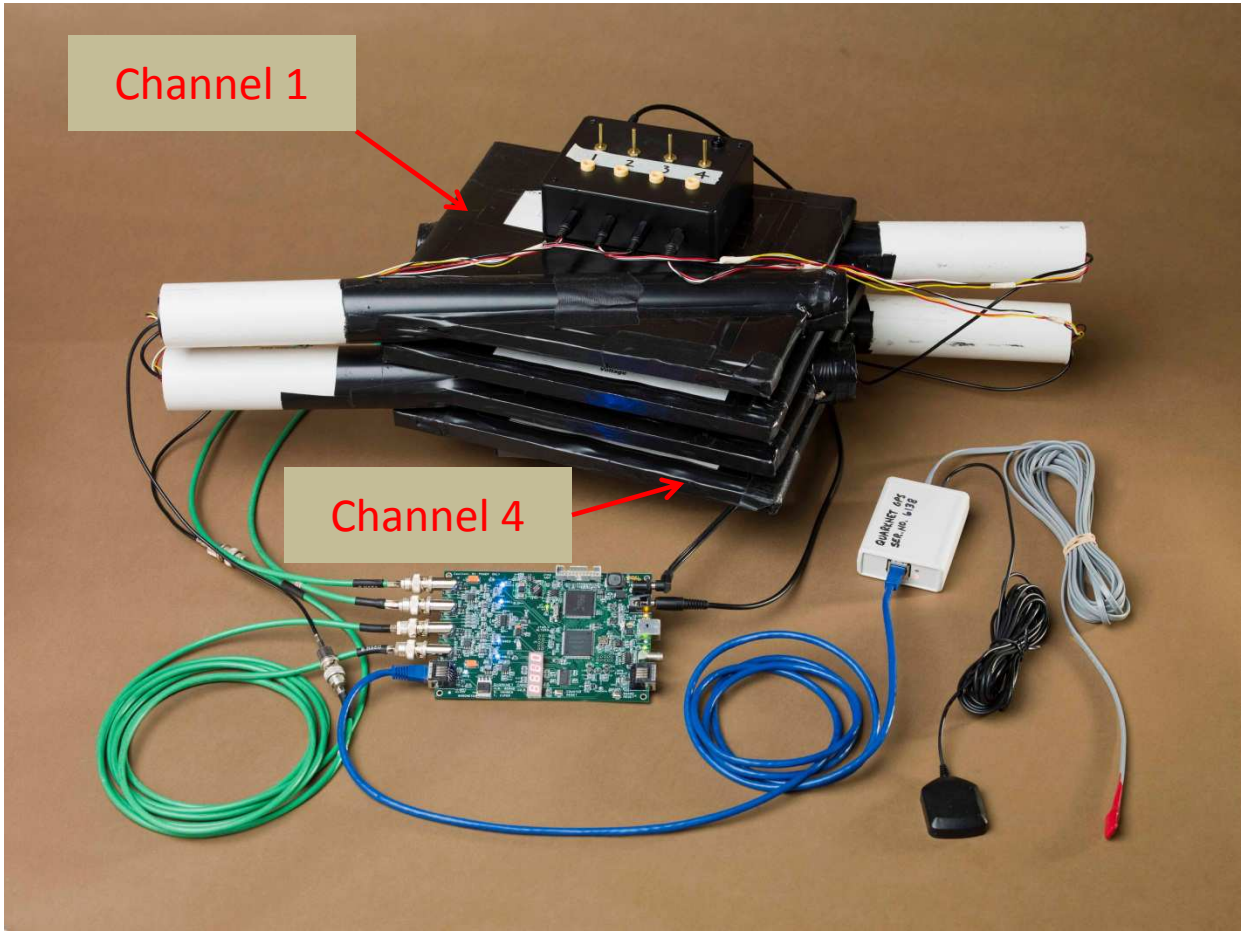
Second Exercise

- Becquerel used photographic plates wrapped in opaque paper and screened by different types of material.





QuarkNet Cosmic Ray Detector

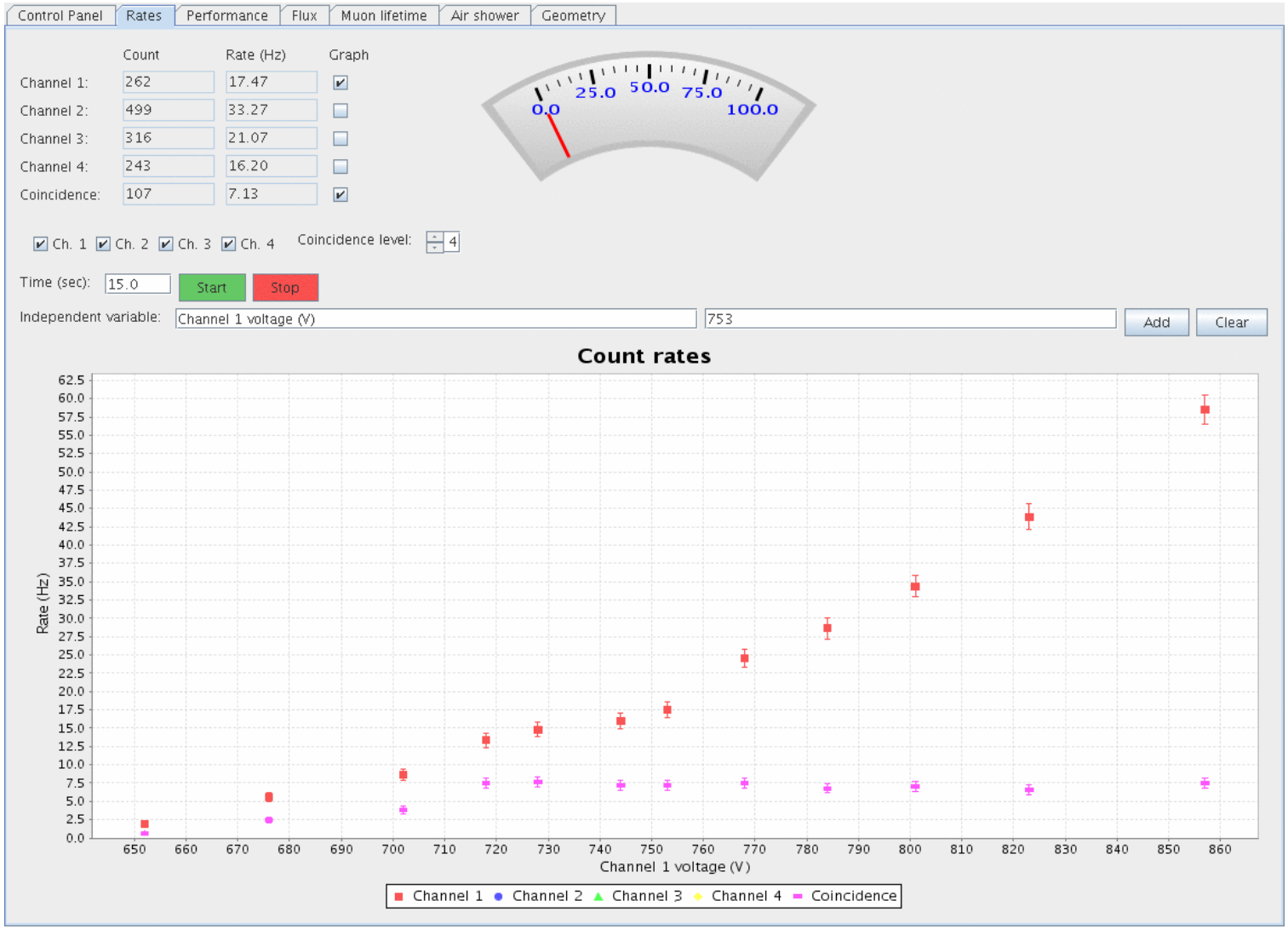


Same technologies used in modern particle physics experiments.

Second Exercise

- The “detector” consists of plastic scintillator which a “ray” causes to emit light
- A photomultiplier tube converts the light into an electronic pulse
- The circuit counts the pulses
  - It also counts how often 2, 3 or 4 pulses happen at the same time (or within a very short time interval)
- This is the same procedure that Becquerel used, but it is much faster…

Rate Panel

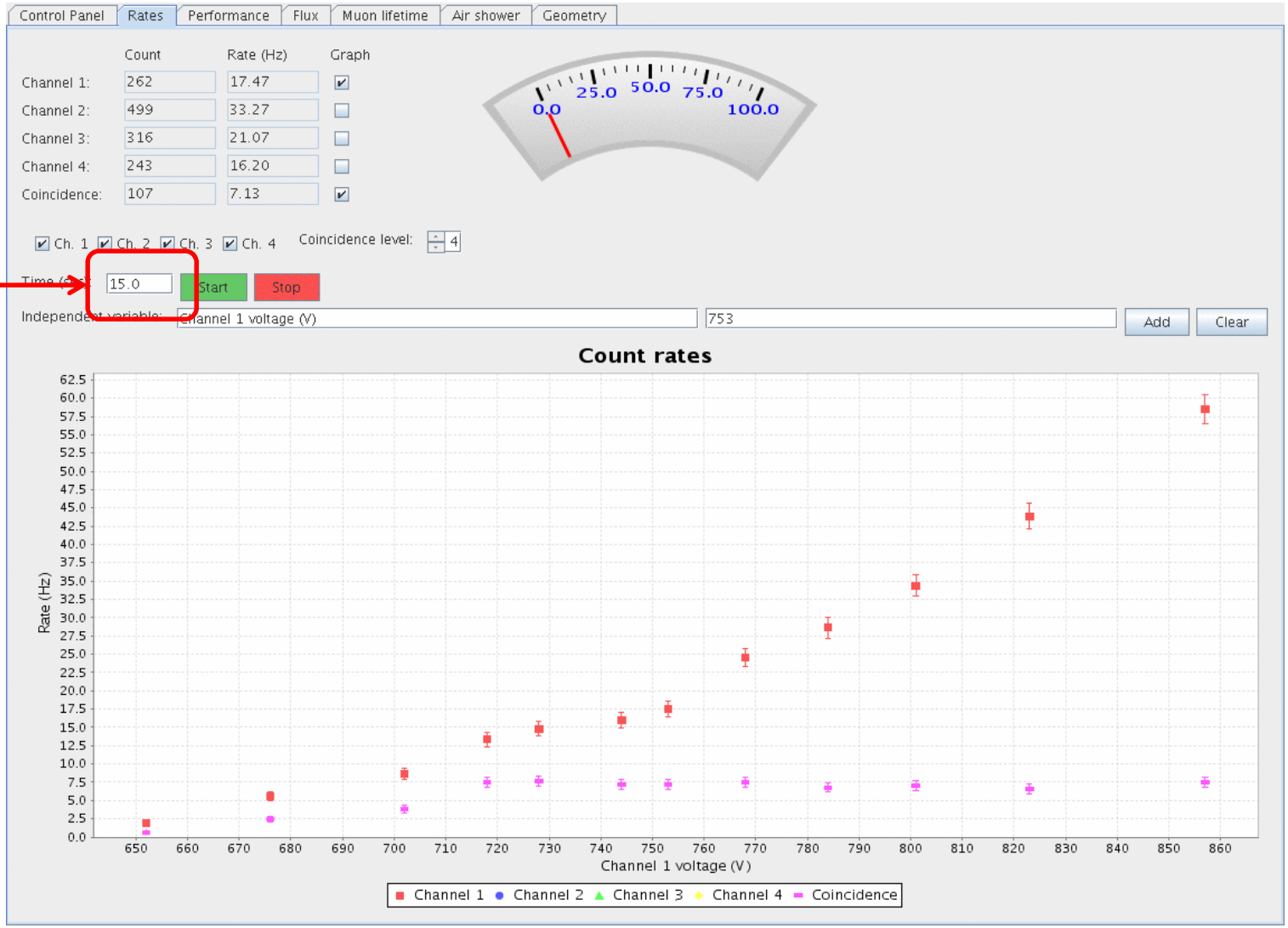

Control Panel
Rates
Performance
Flux
Muon lifetime
Air shower
Geometry
Count
Rate (Hz)
Graph
Channel 1: 262 17.47
Channel 2: 499 33.27
Channel 3: 316 21.07
Channel 4: 243 16.20
Coincidence: 107 7.13
0.0
25.0
50.0
75.0
100.0
Ch. 1
Ch. 2
Ch. 3
Ch. 4
Coincidence level: 4
Time (sec): 15.0
Start
Stop
Independent variable: Channel 1 voltage (V)
753
Add
Clear
Count rates
Rate (Hz)
Channel 1 voltage (V)
Channel 1
Channel 2
Channel 3
Channel 4
Coincidence

Rate Panel

Time interval

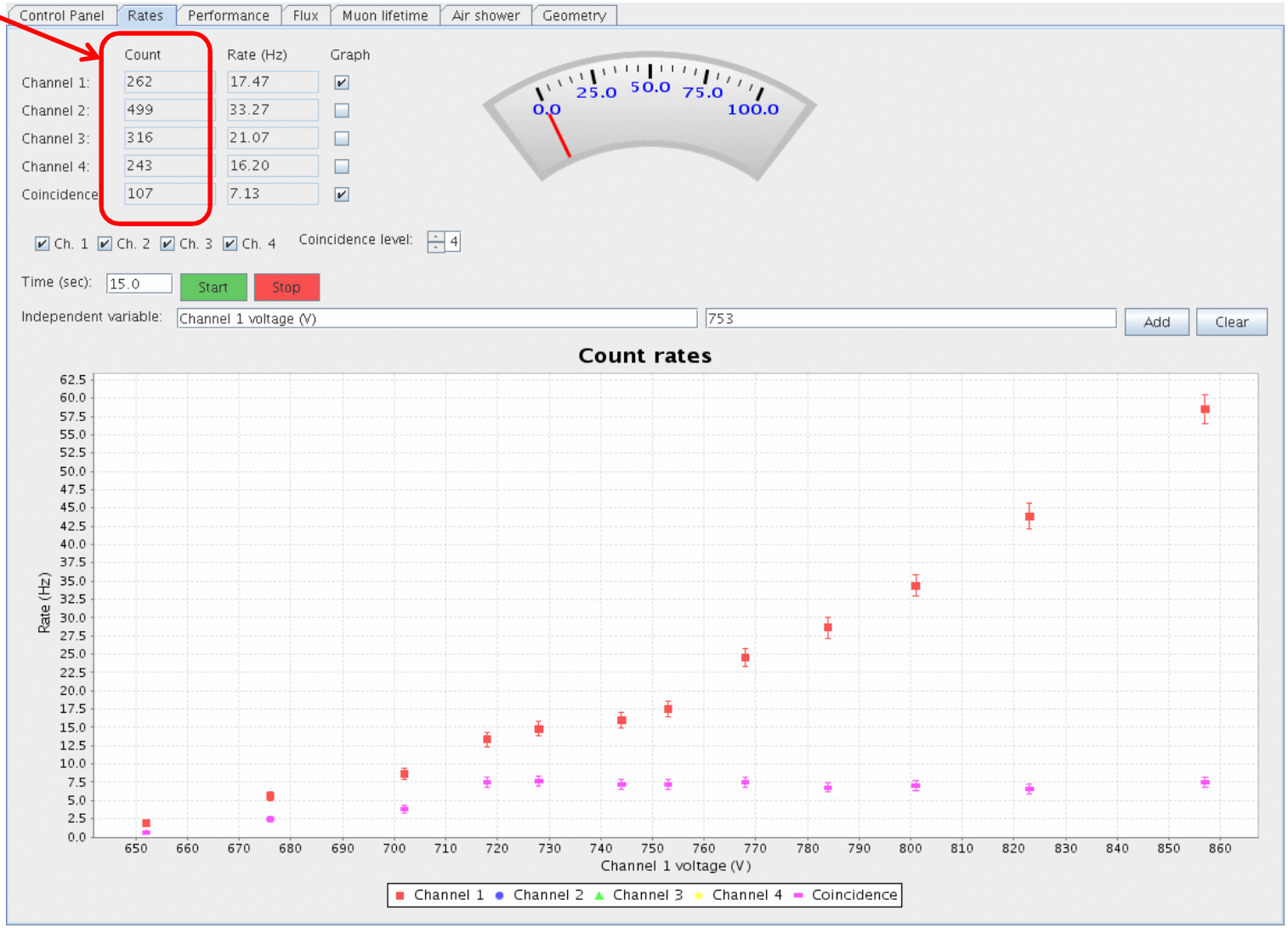
Start

Stop



Rate Panel

Number of counts



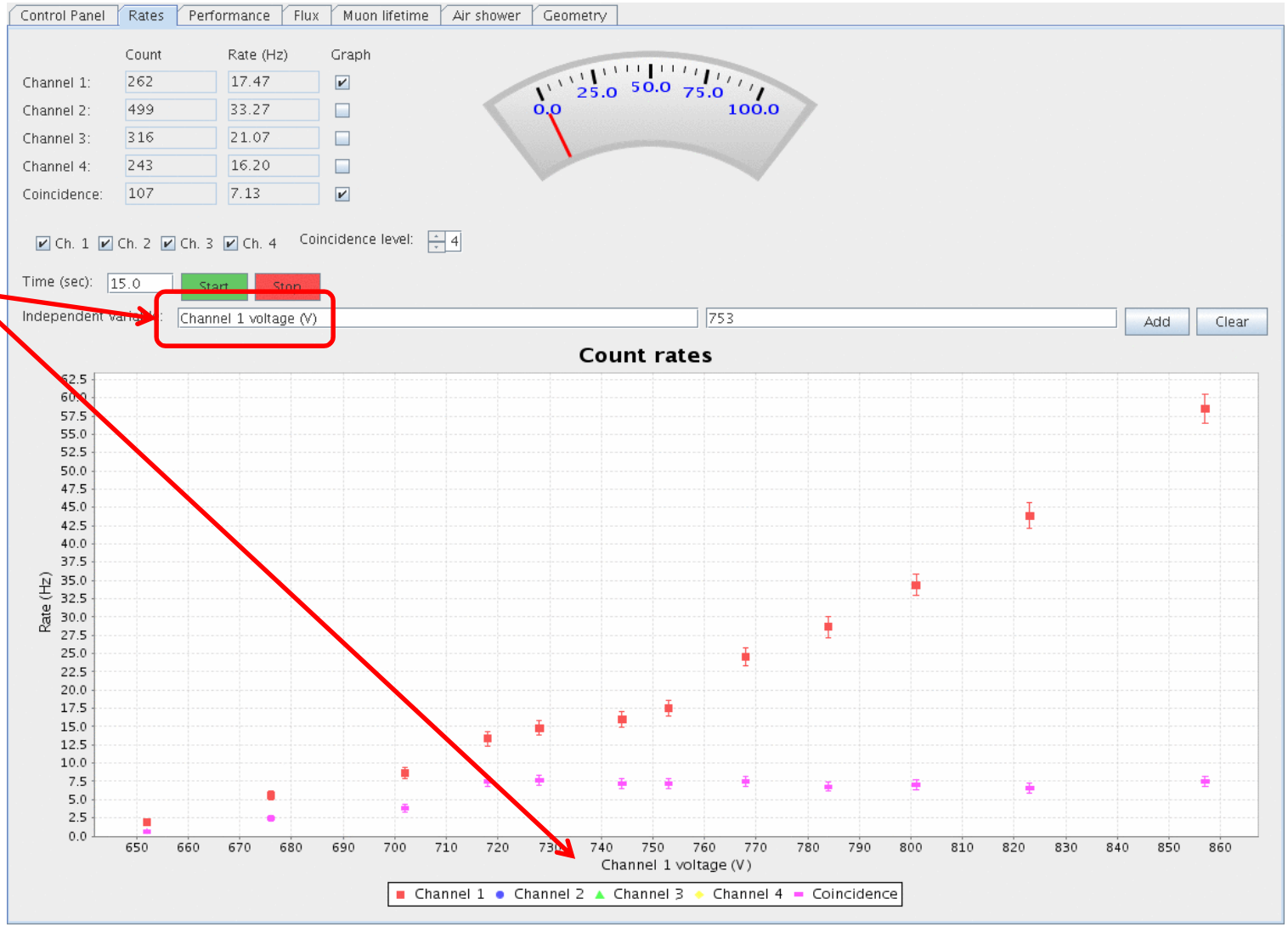
Rate Panel

Count rate:

$$R = \frac{N}{\Delta T}$$

Rate Panel

Independent variable



Rate Panel

- The “independent variable” can be quite arbitrary
- Examples:
  - Operating voltage (more on this later)
  - Time of day
  - Floor of the building
  - Others?
- In this exercise we can use “measurement number” and keep track of what we are measuring on a separate sheet of paper.

Second Exercise

- Measurement conditions:
  - Source, or no source?
  - What type of source? (color coded)
  - On which counter is it placed?
  - Is it facing up or down?
  - Where on the counter is it placed?
  - Is there any shielding material covering it?
- Compare changes when one condition is changed at a time.
- In what ways are the sources similar?
- In what ways are they different?