

## Comparison between proportional counter and GM tube

### Common:

Both tubes are gas filled counter-tubes. The outside is a cathode cylinder (tube), inside is an anode wire.

The basic functional description: The gamma quant interacts with the cathode cylinder or the gas-molecules and creates a free electron. This free electron moves towards the anode wire accelerated by the accelerator- (anode-) voltage. This moving electron collides with gas-molecules and establishes additional free electrons. A multiplying occurs, it is gas-amplifying. The electrons reaching the anode wire, cause electrical pulses.

Both types of tube require energy compensation. This is generally realised through Sn-Pb energy filters. The difference lies in the operation:

### GM tube:

The multiplication in GM tube (gas-amplifying) is that big, that the whole volume of the tube is ionised. The outgoing pulse is wide and large. The big gas-amplification is achieved usually through low gas-pressure ( $P < 1 \text{ Bar}$ ). Putting out the whole ionisation occurs either by extinguisher-gas mixed with the filling-gas or through switching off the ioniser's high voltage. The lifetime of GM tubes filled with an organic gas-mixture like Argon-Methane is considerably limited, because of the decay of the organic molecules caused by ionisation.

***Results from the operations theory: every pulse is followed by a dead time-zone, i.e. the GM tube is saturated above a certain level of dose-rate, therefore more GM tubes are used in parallel in case of large range applications.***

### Proportional tube:

The gas-amplification is smaller in the proportional tube. Only one local self broadening channel is settled, not the whole tube is ionised. The outgoing pulse is smaller and shorter (1-2 ms) in comparison with the GM tube. The gas-pressure is a little higher than 1 Bar. Putting out the whole ionisation occurs by inorganic extinguisher-gas mixed with filling-gas.

***Results from the operations theory: the proportional tube has no dead-time, it is not saturated.***

More local channels can be settled at the same time. At large dose-rates you can measure the integral of pulses, so ***only one proportional tube can span 9 decades in dose-rate.***