Wire assembly and straw tube operation

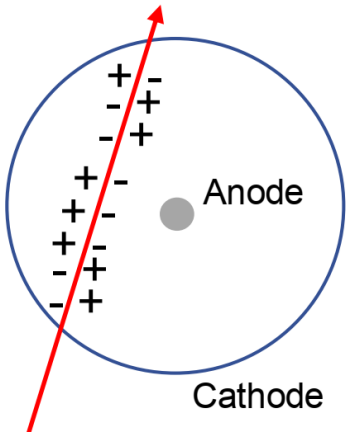
Sean DZIUBINSKI

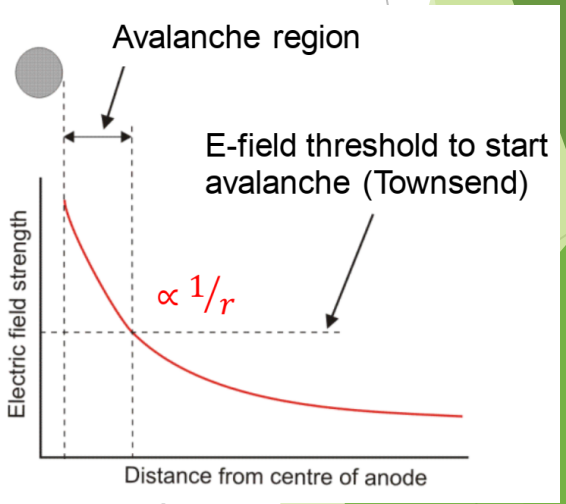
Leonardo FAVILLA

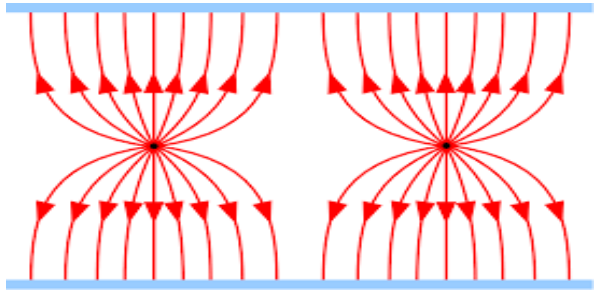
Ana QUINTANA GARCÍA

WIRE BASED DETECTORS: Basics

- Biasing scheme:
  - +HV on thin wire
  - Grounded cathode
    - Parallel plate (large area plane, densely spaced wires, pads)
    - Tube that encapsulates thin wire
- Electric fields:
  - 1/r for thin wire
    - Avalanche region very close to wire
    - Can look like a uniform drift field sufficiently far away from the wire (depending on orientation of cathode)
- Used for PID, tracking, cluster counting
- Charge division readout method for position
  - QL/QR -> position along wire

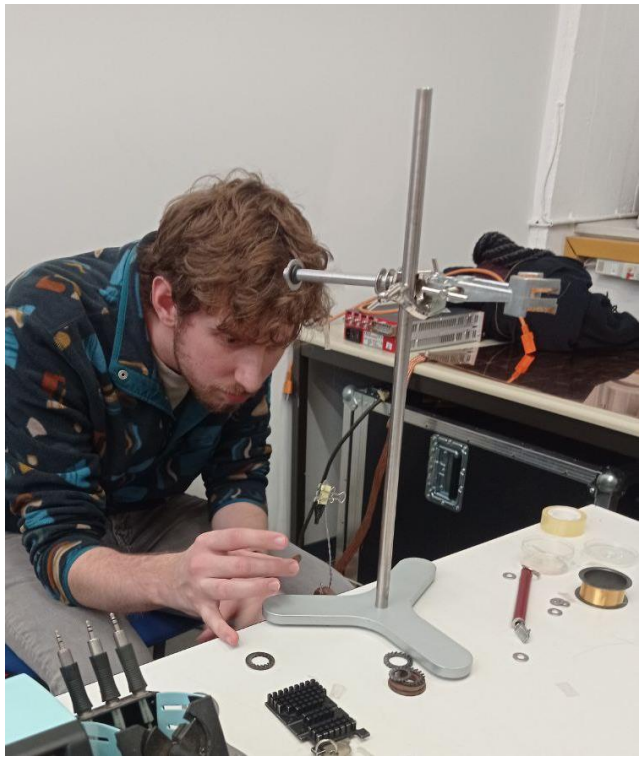


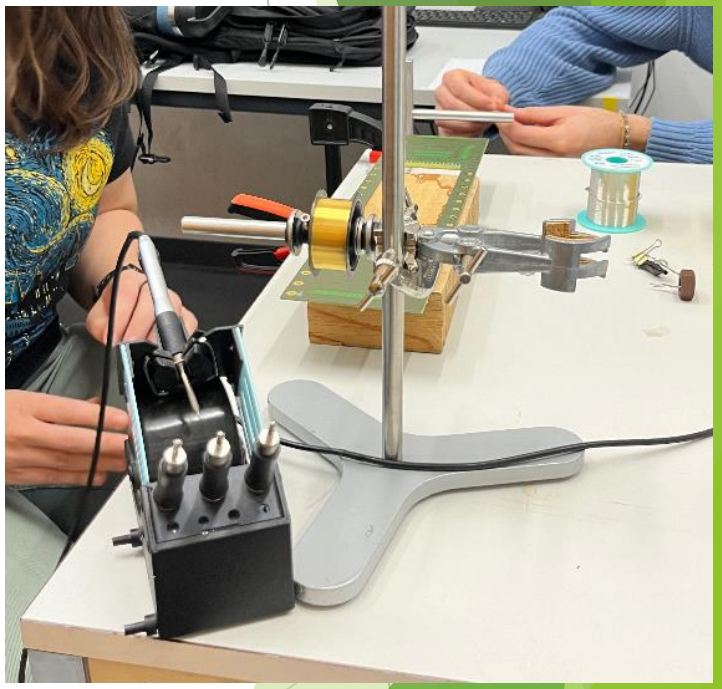




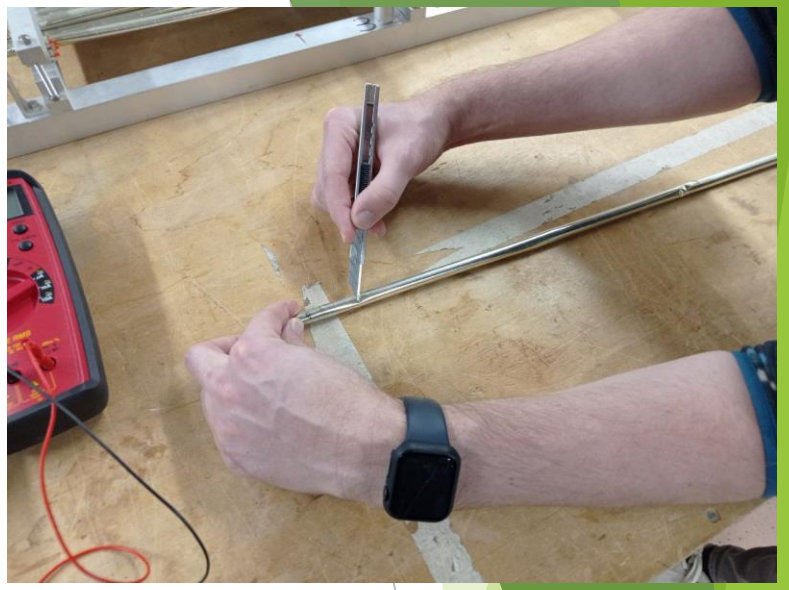
WIRE CHAMBER: Assembly

- Thin anode wire examples
  - 20 um gold-plated tungsten
  - 50 um gold-plated tungsten
  - 90 um 5056 aluminum (5% Mg)
- Tension measurements
  - Elasticity region
  - Maximum
- Wire placement and attachment
  - Stretching by a (nominal) mass weight
  - Solder to pads
  - Crimped ends
- Results
  - 90 um Al -> we didn't reach the max. weight
  - 20 um W -> max. weight ~90 g -> stretching done with 50 g

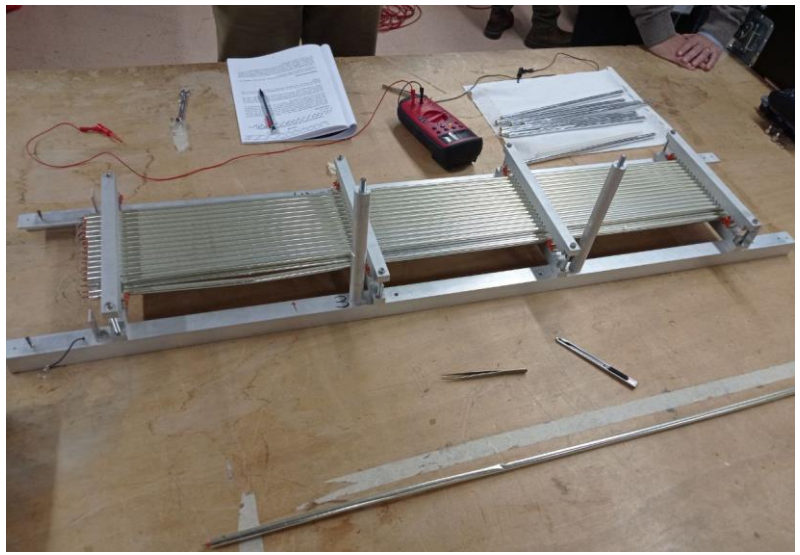




STAW TUBE: Inspection

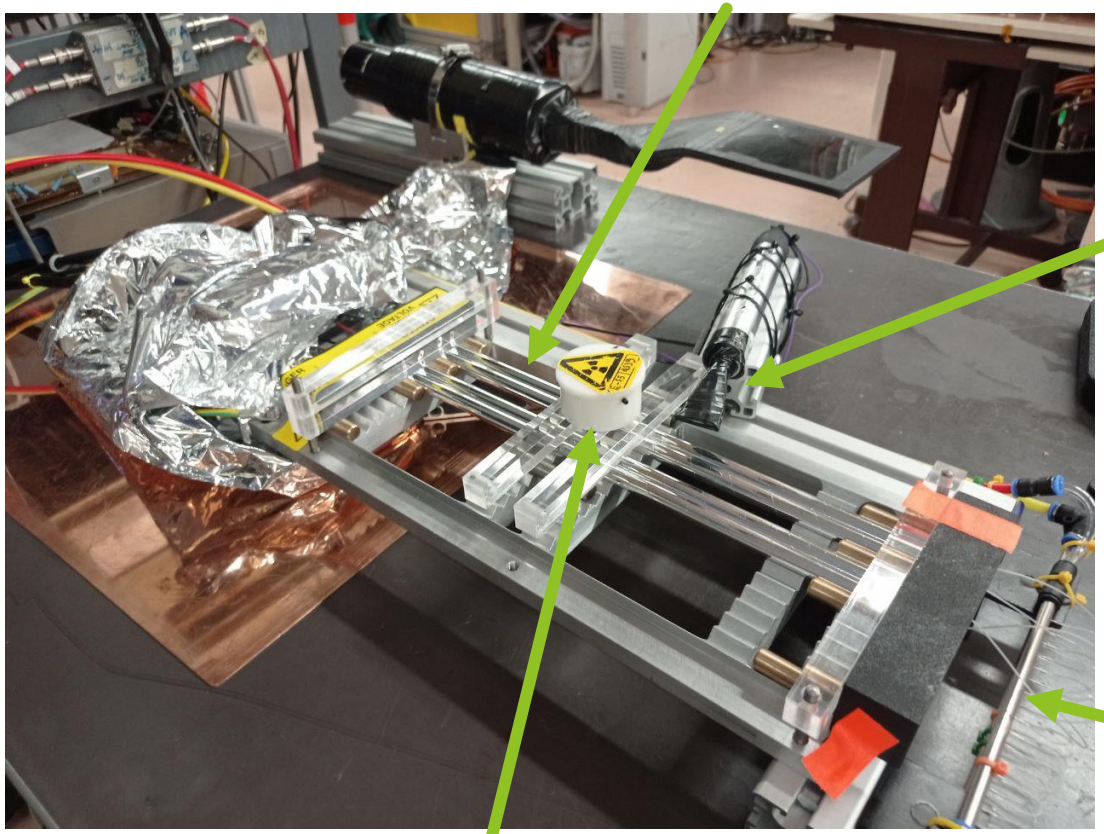


1. Check for broken wires -> Measure resistance (~320 Ohm)
2. Cut open straw tubes with blade
3. Inspect wire and straw tube for deposits/defects
4. Measure resistance as we deconstruct -> final resistance ~309 Ohm
5. Proof of construction: wire does not break when folding tube
    1. Straw tube structure keeps wire a fixed length provided little to no extra tension when folding



STRAW TUBE: Setup

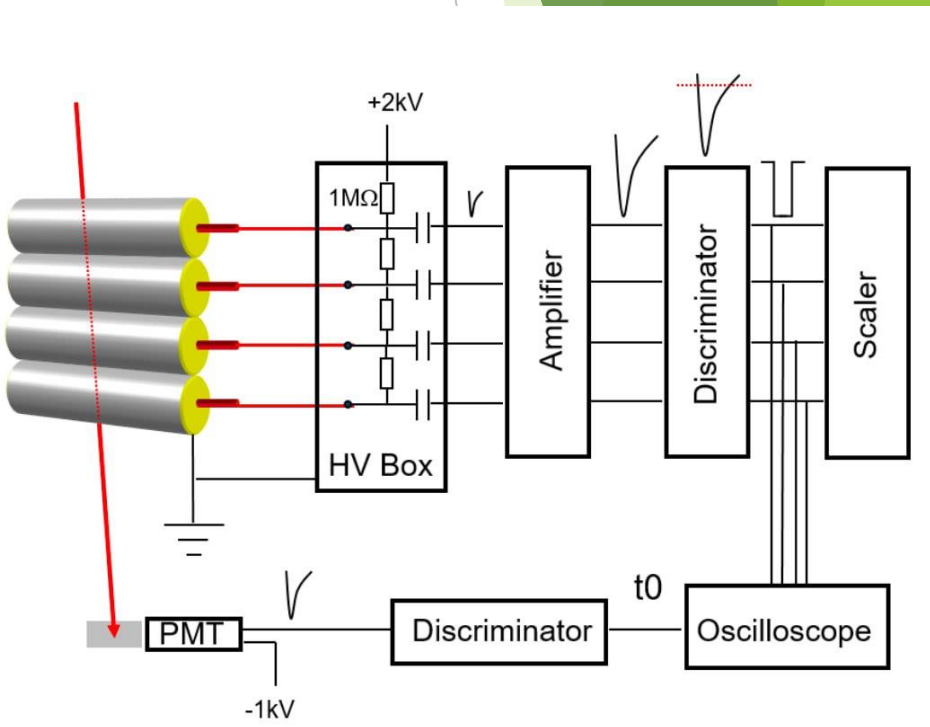
Straw tubes
- 30 cm
- 1 bar over-pressure



Scintillator coupled to PMT for trigger

Gas system inlet

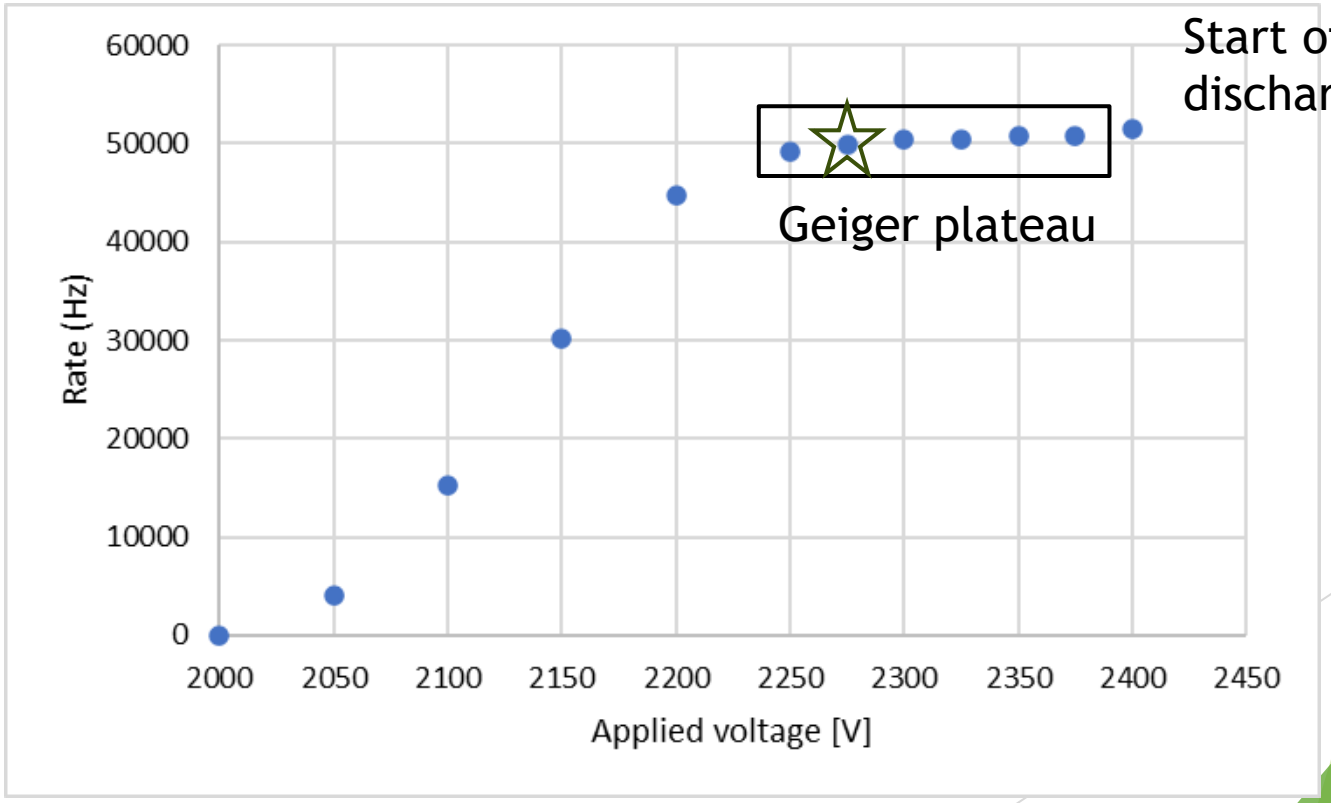
Source: Fe55/Sr90



STRAW TUBE: Operation

- Objective: Determine nominal high-voltage (HV) value for straw tube operations

V (V)	Rate (Hz)
2000	38,5
2050	4005
2100	15251,5
2150	30244,5
2200	44645
2250	49173,5
2275	**49941,5**
2300	50350
2325	50421,5
2350	50776,5
2375	50812,5
2400	51406



STRAW TUBE: Operation

- Measure the drift time spectrum of the straws
  - Used Sr90 source for high rate of events in concentrated area (scintillator/tube ratio of hits close to 1)
  - Scintillator signals provide reference timing
  - Time spectrum (histogram of time stamps) maximum drift time: 222 ns
    - Calculated drift length: 0.49 cm

THANK YOU TO THE DRD1 GASEOUS DETECTORS SCHOOL!