G.A.R.R.E.T.T RAY

Gas-balloon Array for Ray Research: Emission Timing Tracker

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PROJECT OVERVIEW:

In this project, we are planning on launching a sensor on the balloon to detect cosmic rays at different altitude levels. Our tracker will be based on the CosmicWatch project, which uses a scintillator to detect particles. The data will be tracked on an SD card, and, after the flight, we will connect and analyze the data to find the relationship between the frequency of cosmic rays per minute with the altitude of the tracker.

OBJECTIVES AND HYPOTHESIS:

- **Objective:** Our objective in this test is to find the relationship between cosmic ray frequency and altitude from sea level to 100,000 feet.
- **Hypothesis:** We have predicted that there will be a consistently positive correlation between altitude and cosmic ray frequency.

DATA COLLECTION:

- **Cosmic Ray Data:**
  - **Type:** Frequency (counts per minute)
  - **Sensor:** Scintillator detector
- **Altitude Data:**
  - **Measurement:** Altimeter readings (logged every minute)
- **Supplementary Data:**
  - **Time Stamps:** For synchronizing cosmic ray counts with altitude measurements

METHODOLOGY AND CONSTRUCTION:

- **Detector and Sensor Integration:**
    - **Scintillator:** Used for detecting cosmic rays
    - **Arduino Interface:** Gather data from the sensors using libraries from Arduino compatible libraries.
- **Electronics and PCB:**
    - **PCB Design:** Custom board to integrate the scintillator sensor, Arduino microcontroller, SD card interface, and altimeter
    - **Power Supply:** A battery pack designed to support a 3-hour flight
- **Data Logging:**
    - **Interval:** Once per minute, recording both cosmic ray frequency and altitude
    - **Storage:** Data saved onto an SD card
- **Calibration:**
    - **Method:** Calibration will be performed using a cloud chamber. The detector's output will be compared against the chamber's visual observations to set accurate detection thresholds.

FLIGHT AND RECOVERY:

- **Launch Method:**
    - High-altitude balloon carrying the detector assembly inside a Styrofoam box
- **Recovery System:**
    - GPS tracking to facilitate location retrieval after the flight
- **Data Retrieval:**
    - Logged data will be collected from the SD card once the detector is recovered

POTENTIAL CHALLENGES AND SAFETY CONSIDERATIONS:

- **Data Integrity:**
    - **Noise:** Basic code-level thresholding may be necessary if noise or false detections occur
- **Environmental Factors:**
    - **Temperature and Pressure Variations:** Although the Styrofoam box provides insulation, rapid environmental changes may affect sensor performance
- **Flight Considerations:**
    - **High-Altitude Risks:** Adherence to aviation regulations and proper tracking are essential
- **Component Reliability:**
    - Calibration discrepancies between the cloud chamber and detector readings may require iterative adjustments

CONCLUSION:

The G.A.R.R.E.T.T Ray project is designed to investigate the behavior of cosmic rays at high altitudes. With a well-integrated detector system and robust data logging, the project aims to reveal the relationship between altitude and cosmic ray frequency. The detailed calibration process using a cloud chamber and the use of cost-effective components make this a promising venture in cosmic ray research.

BILL OF MATERIALS:

Materials:			
Item	Description	Mass (lb)	Price ($)
Box	Insulates our electronics.	0.035	27.99
Batteries	Powers our electronics.	0.192	39.99
PCB+Stencil		0.066	10.00
Arduino Nano	Microcontroller	0.04	7.99
Pressure Sensor	Calculate altitude of balloon.	0.019	29.95
Micro SD Card	Store log data	0.01	12.49
Miscellaneous	Resistors, Capacitors, OLED Screen, etc.	0.0656280795	65.12
SiPM		0.017178	25.47
Plastic scintillator		0.05638322	20.00
Kill Switch		0.0125	1.25
TOTAL:		**0.5136892995**	**240.25 (excl. tax & shipping)**

Scintillator Drawing: