



**Physicists design \$100 handheld muon detector:** A team working in MIT's Laboratory for Nuclear Science led by Spencer Axani have designed a pocket-sized cosmic ray muon detector to track these ghostly particles. The detector can be made with common electrical parts, and when turned on, it lights up and counts each time a muon passes through. Once up and running, detectors can be carried around to measure muon rates in virtually any environment. The team has helped supply nearly 100 detectors to high school and college students, who have sent the instruments up in planes and weather balloons to measure muon rates at high altitudes. Students have also, as Axani has done, taken the detectors underground.

1. The **CNS ECC** purchased the parts to build two Cosmic Watch detectors – the parts cost was ~\$600 each! (The \$100-unit cost cited is based on quantity 100.)  
We built these for use at science teacher conferences to demonstrate that it is possible to monitor muons generated by Cosmic Rays in the classroom (neither cheap, nor easy to build.)
2. Two detectors facilitate coincidence detection that is required to identify muon events.
3. Each detector includes a plastic scintillator, a “Si Photo Multiplier” and an Arduino processor (plus many more parts).
4. The detector supports digital display OR logging to a micro-SD card / logging on a PC (not both, different versions of the software.)
5. Peter Bunge (a retired AECL technologist) helped with machining and electronic debugging (fancy digital storage scope), and Spencer Axani provided many suggestions to my problems.
6. The sensitivity of detector #1 was adjusted to provide similar counts for side by side tests.
7. For coincidence counting the two detectors are stacked vertically, and are connected with a power/synchronization cable. Only the top one is powered from a supply. A deliberate resetting sequence puts the lower detector in slave mode.
8. The top detector provides a gross count while the lower counts only the coincident events.

COSWATCH Count Data

Date	Time [M:SS]	Master	Slave	Master CPM	Ratio	Comment
2019-06-09	28:00	890	168	31.7	5.3	Stacked, both right side up
	32:32	999	349	30.7	2.9	Stacked Master inverted
	22:07	757	797	34.4	0.9	Both right side up, side by side

Notes: Inverting the master detector minimizes the difference in shielding.

The times recorded are elapsed totals. The values shown are differences.

The side by side counts are not master/slave – both are “masters”.