



Environment

## Low-Power Charged Particle Detector

Compact, solid-state charged particle counter for detecting and monitoring radiation

Innovators at NASA's Glenn Research Center have developed a miniature, solid-state radiation detector that can be used in situations where compact size, low weight, and low power consumption are required. Conventional scintillator-based charged particle counters rely upon a glass photomultiplier tube (PMT) to translate light energy from the radiation source into an electrical signal. Because PMTs are bulky, fragile, and require high voltages to operate, they are not well-suited for harsh environments. Glenn's technology is solid state, thus eliminating PMTs, which means the device can operate in cramped, harsh, and low-power environments. In addition, because the detector uses a low-voltage, UV-sensitive photodiode, a wave shifter is not required, improving efficiency and further minimizing weight and bulk. Originally developed for space exploration, this compact, robust particle counter can also be used in medical dosimetry, mining, oil and gas exploration, nuclear facility monitoring, and more.

### BENEFITS

- ⇒ Compact: Detector is less than 6 inches long and eliminates the need for PMTs and wave shifters
- ⇒ Low-power: Low-voltage photodiode components replace high-voltage PMTs
- ⇒ Portable: Lightweight design enables use in a variety of applications
- ⇒ Robust: Solid-state components make this technology suitable for operation in extreme vibration environments, as well as high- and low-pressure environments

technology solution

## THE TECHNOLOGY

Conventional scintillation radiation detectors make use of materials that emit light when hit by ionizing radiation. These large, bulky scintillators range anywhere from 6 inches to 6 feet in size. They are attached to glass photomultiplier tubes (PMTs), which are fragile, require high voltages, and are extremely sensitive to temperature changes. Conventional detectors also include a wave shifter (a material with a dopant to re-emit the scintillator light to match the sensitivity of the PMT or photodiode) which reduces efficiency and introduces unwanted weight and bulk. Glenn's particle counter overcomes these challenges. A prototype was constructed from off-the-shelf components, and features a small scintillator (less than six inches long) and a low-voltage, UV-sensitive, wide-bandgap photodiode as the detector. Careful matching of the properties of the light emitted from the scintillator, and tailoring the sensitivity of the photodiode eliminates the need for a PMT and a wave shifter, not only saving space, weight, and power but also eliminating potential failure modes. By using wide-bandgap detectors, it can operate in changing temperature, vibration, pressure, and gravity conditions without need for a temperature compensation system. Built from solid-state components, Glenn's device is compact and robust.



Flying high above Earth with little atmosphere to protect them, pilots can absorb significant doses of cosmic rays and solar radiation.



NASA Glenn's Low-Power Charged Particle Detector is compact and robust.

## APPLICATIONS

The technology has several potential applications:

- ⇒ Biomedical (dosimetry, including nuclear medicine, x-rays, and positron emission tomography (PET) scans )
- ⇒ Environmental monitoring (mining, oil and gas, radiation, weather, nuclear)
- ⇒ Satellites

## PUBLICATIONS

Patent No: 10,429,521

See also LEW-TOPS-142 "Compact Full-Field Ion Detector System (CFIDS)"

National Aeronautics and Space Administration

### Agency Licensing Concierge

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