Diamond Detectors for RMS applications

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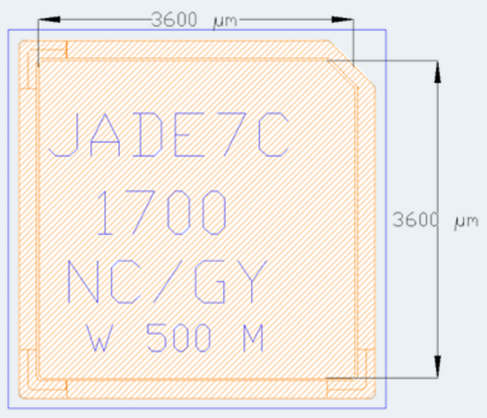
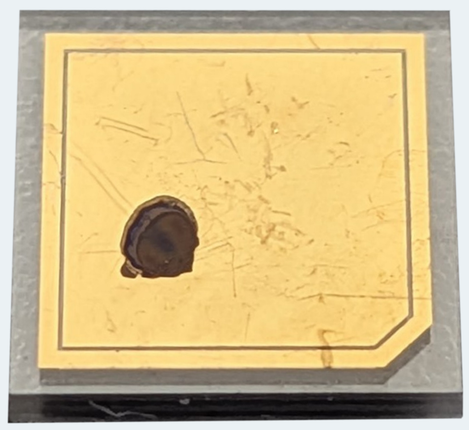
Introduction

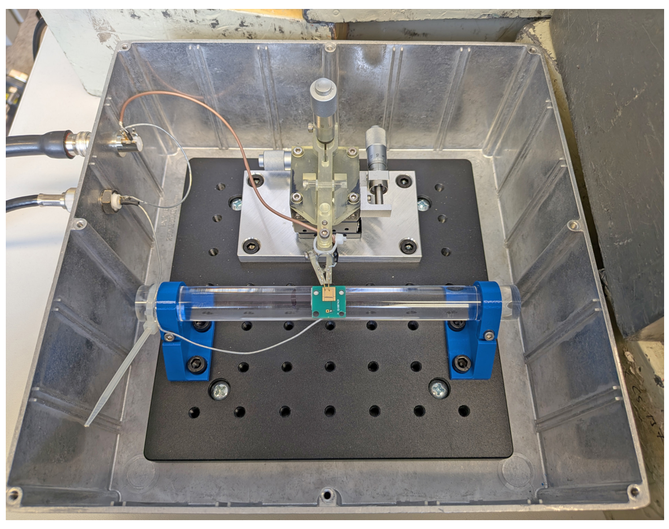
Diamonds show promise for radiation monitoring applications in both gamma and neutron fields. A 4.5 by 4.5 by 0.5 mm³ detector was characterized for and has been shown to be able to comply with IEC 60532.

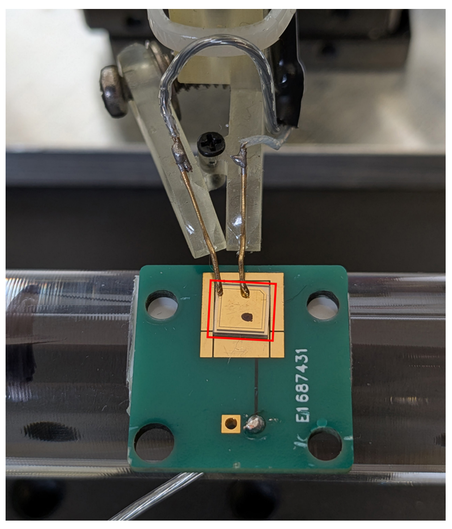
Diamond based semiconductor detectors have been used in high energy physics for years, but are lacking in their field applications for RMS. Previous works have shown that single crystals can operate at up to [1]500 °C and a TID of over 1 MGy. It outperforms silicon in all properties.



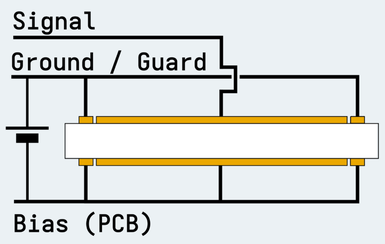


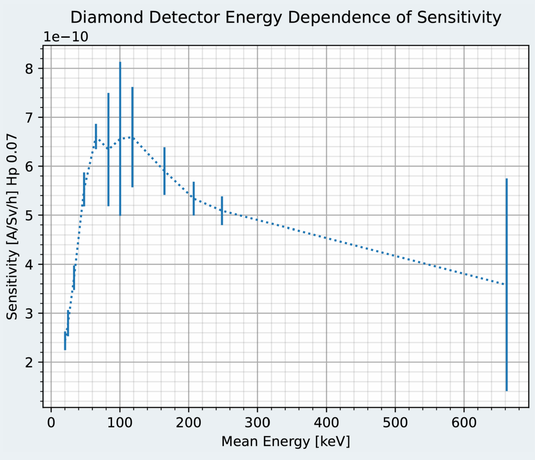
Effective radiation monitoring requires reliable performance at both low and high dose rates across a wide energy spectrum.

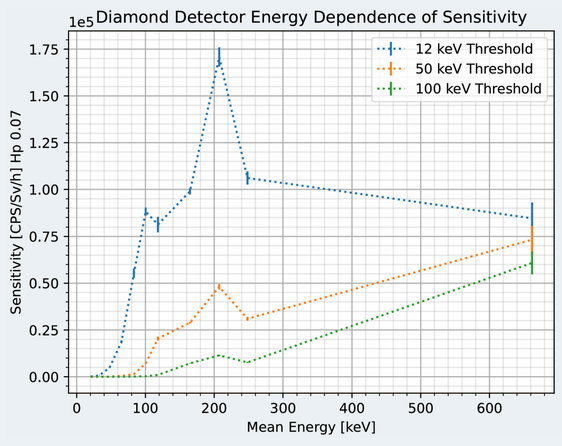


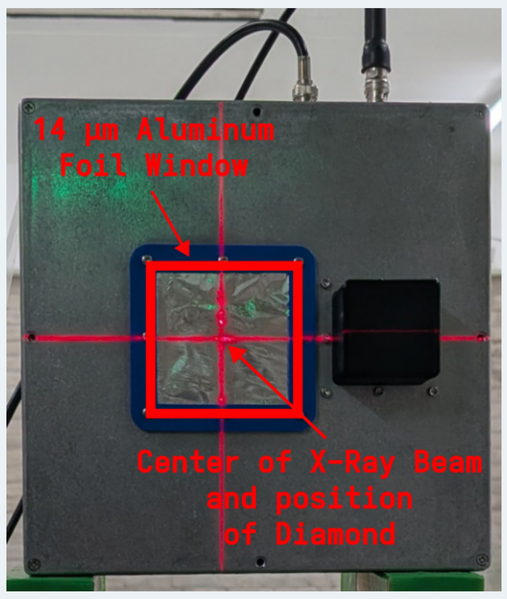


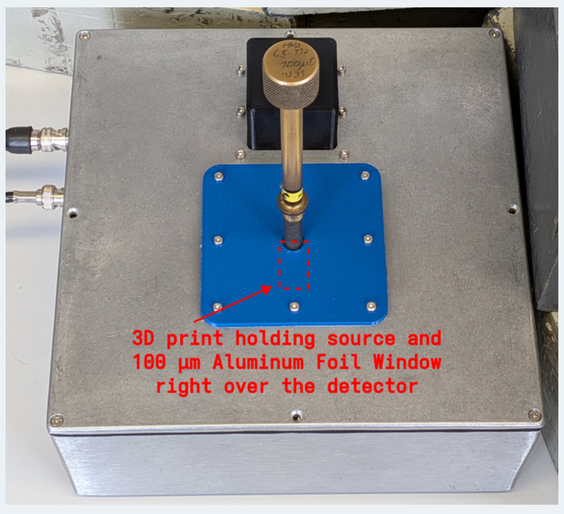
Diamond is sensitive to fast neutrons through scattering on carbon atoms, though quantitative validation is still pending.





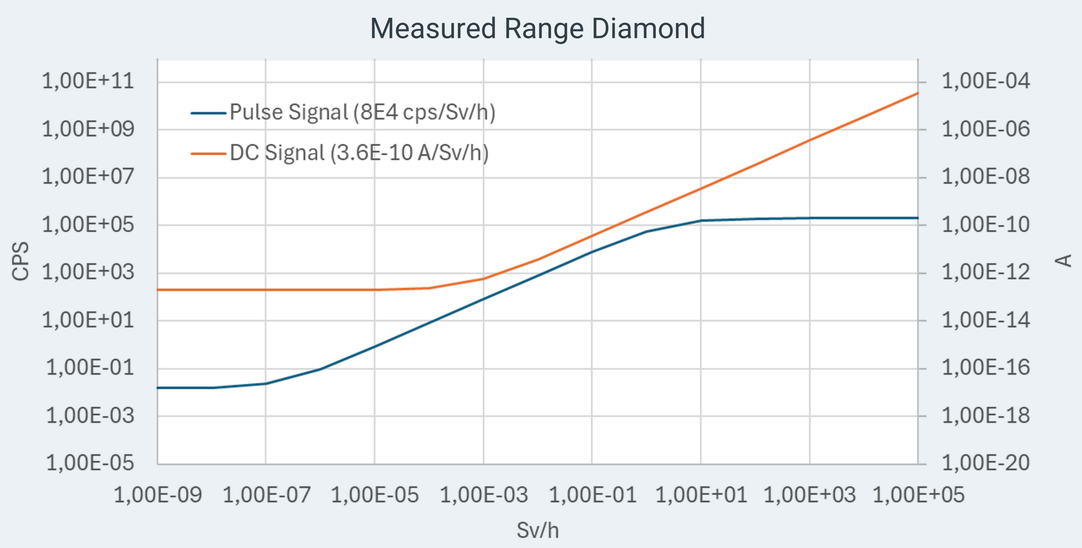






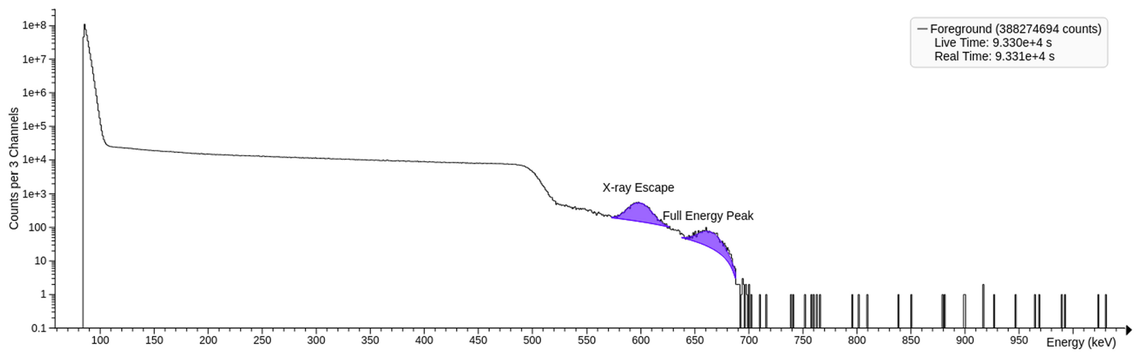
[1]https://doi.org/10.18494/SAM5528

Measured Gamma Sensitivities (Cs-137): 3.6E-10 A/Sv/h (DC), 8E4cps/Sv/h (AC)

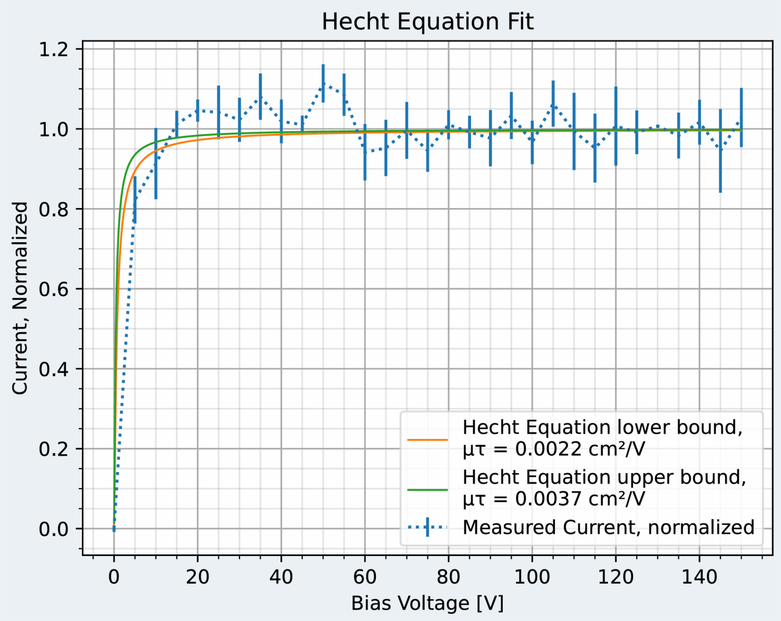


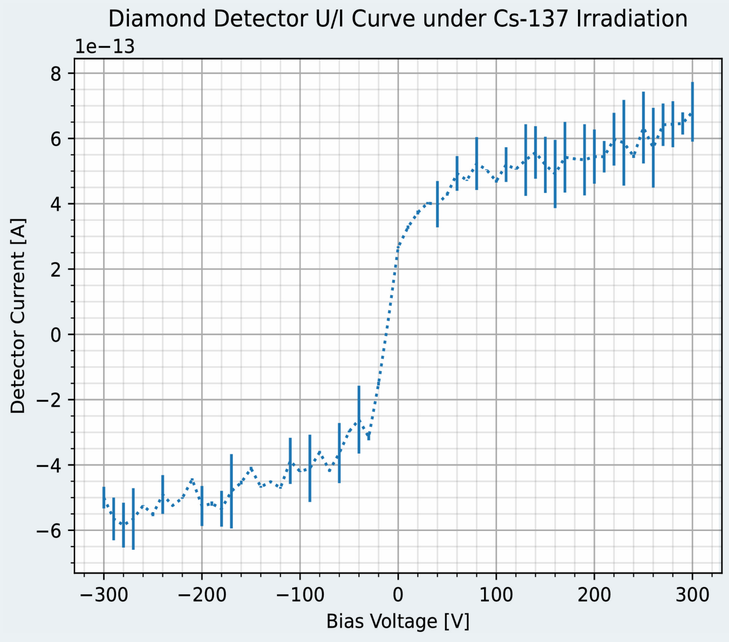
This enables a low-end range below 1 µSv/h while remaining compliant with IEC 60532. In current mode, a low-end threshold of 550 µSv/h is achievable, providing a wide overlap between the two modes.

The detector demonstrates a good charge collection efficiency and with it, a decent spectroscopic resolution.



Charge collection efficiency is well captured by the Hecht equation, enabling low-bias operation with minimal sensitivity loss.





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