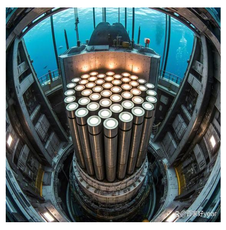
VisionAlpha Long Range Alpha Camera

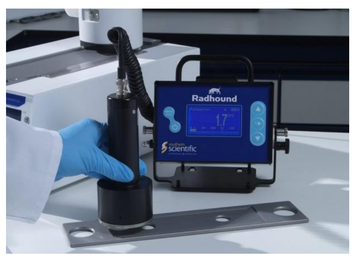
Introduction

Alpha emitters are widely present across the nuclear industry, from nuclear fuel processing and routine reactor operations to spent fuel reprocessing, where uranium and plutonium are handled and separated. They are also common in radioactive waste storage, decommissioning and site clean-up activities.

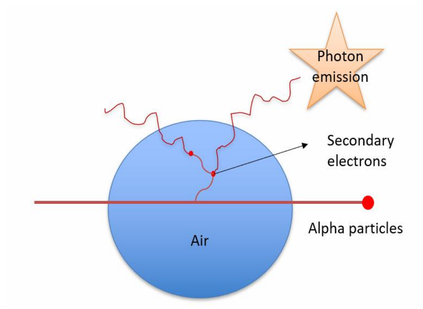
Alpha emitters present a significant hazard if inhaled or ingested and therefore require reliable monitoring. However, alpha particles travel only a few centimetres in air, making remote detection extremely challenging. Gamma detection is not always an effective alternative: many important alpha emitters, such as U-238, Pu-239 and Pu-238, have little gamma emission, while others such as Am-241 and U-235 emit low-energy gamma that can be strongly attenuated.

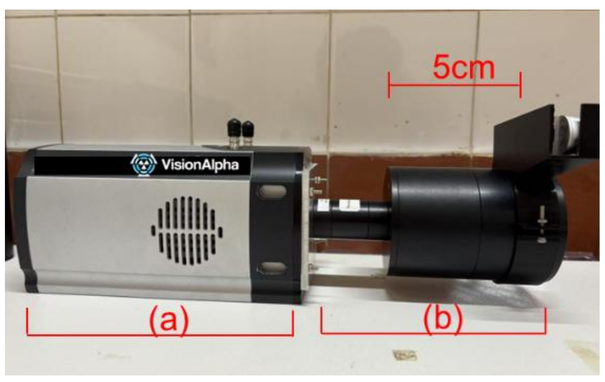
Conventional alpha monitors such as GM counters need to be positioned very close to the contaminated surface and typically rely on point-by-point scanning. This approach is labour-intensive, time-consuming, increases operator exposure, and is difficult in complex, confined or inaccessible environments.



Hardware

VisionAlpha Ltd, a spin-out from the University of Bristol, develops a long-range alpha radiation imaging system. The technology detects the faint ultraviolet (UV) light generated when alpha particles travel through air or other gases.

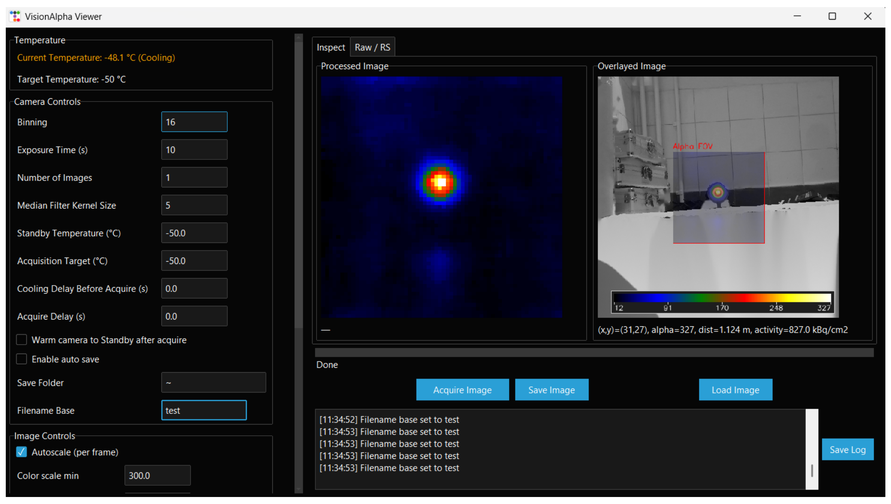


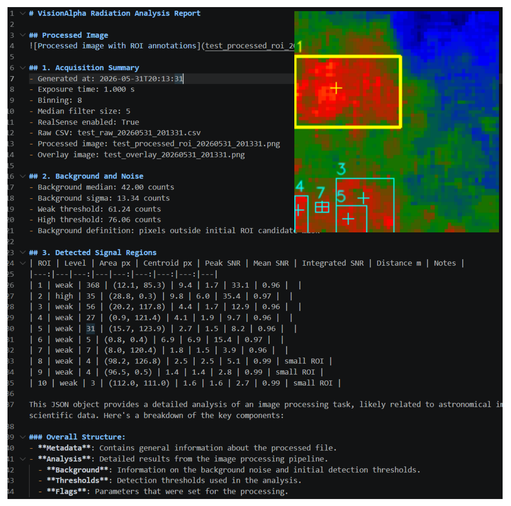


The camera integrates (a) ultra-sensitive CCD to capture the alpha signal. (b)A switchable high-blocking multi-layer filter system isolates characteristic UV emission while suppressing background light. A 337 nm channel is used in low-UV environments such as indoor areas, gloveboxes and night-time operation, while a <280 nm solar-blind channel enables detection in environments with strong sunlight. (c) A co-aligned depth camera provides visual context for rapid localisation and depth information for calculating the alpha activity.

Specification	Value
Field of View	16 degrees
Optimal Detection Distance	1-2 meter
Resolution	Adjustable, 64 x 64 to 256 x 256
Minimal Detection Ability (1 meter)	Indoor: 500 Bq/cm² in 1 hour Sunlight: 1 MBq/cm² in 10 minutes
Power	100 - 240 VAC, 48 W max
Weight	3.5 kg
Dimensions	Around 100 x 100 x 380mm

Intelligent Software



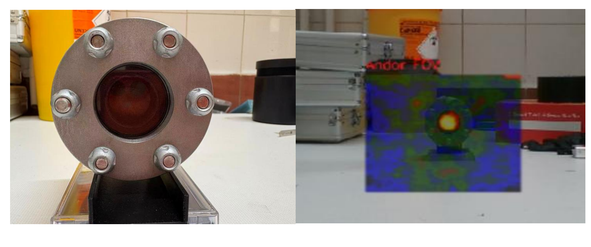


The software provides full camera control, automated image capture and data saving, and remote operation via Wi-Fi or 4G. As shown in the figure, the detected alpha signal is overlaid as a colour map on the visible grey background, enabling rapid localisation of radioactive contamination. In this example, the signal is generated by a 3 MBq Am-241 source. By clicking any pixel on the image, the software can estimate the local alpha activity using the measured signal intensity together with depth information from the co-aligned camera. To simplify operation and reporting, the software also integrates image recognition and a locally deployed large language model, allowing a detailed report to be generated automatically with one click.

Tests

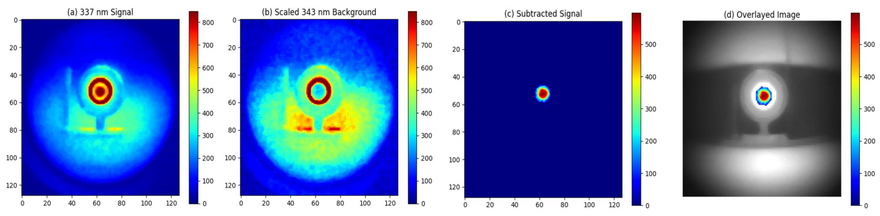
The camera operates at 337 nm in controlled-light environments or <280 nm under direct sunlight. Where possible, 337 nm is preferred, as the alpha-induced signal is over 100× stronger.

A natural uranium metal sample with a surface alpha activity of ~500 Bq/cm² was detected at 1 m in 1 hour. Am and Pu surfaces are typically tens of kBq/cm² or higher and can be detected within several minutes.

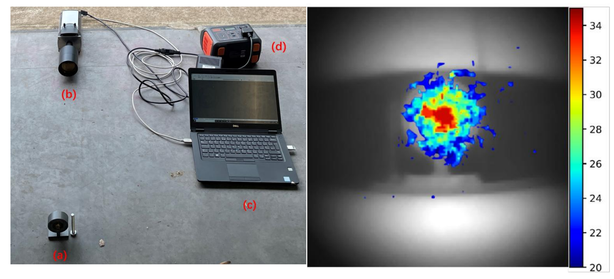


For indoor environment at daytime, simple light blocking material as shown in the picture is usually sufficient to block sunlight.

At night, city and moon light can still contribute UV background. A 343 nm reference channel, where ambient UV is present but alpha signal is negligible, can be used for background subtraction.

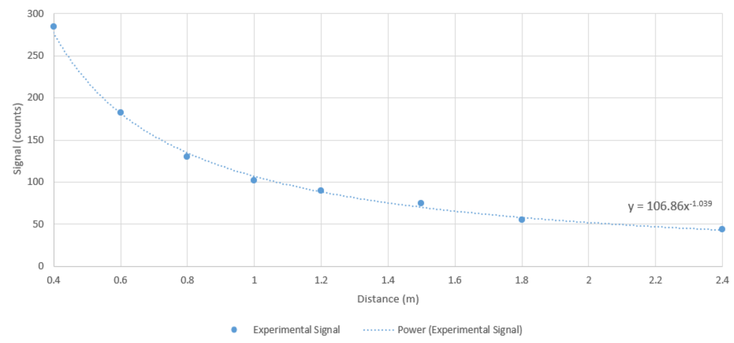


If outdoor operation under sunlight is required, a <280 nm solar-blind filter can suppress the solar background. A 3 MBq Am-241 source was detected at 70 cm in 10 minutes. A portable power supply provided approximately 4 hours of operation during the test.



Alpha fluorescence signal change with distance (0.4-2.4m)

The normalised signal intensity (signal / number of occupied pixels) decreases approximately inversely with distance. This is better than inverse-square loss. This is because the number of pixels occupied by the source also decreases with distance.



Next Generation & Pilot Opportunities

Our next-generation system will deliver improved sensitivity, an operating range of 1–10 m, and automated focusing. Enhanced shielding will enable operation in gamma backgrounds at the mSv/h. Integration with robotic and drone platforms is also planned for remote and large-area inspection. **We are seeking industry partners for pilot projects. Supported by Innovate UK, VisionAlpha can contribute towards the development and trial costs, reducing the risk for pilot partners.**

visit our website at: https://visionalpha.co.uk/
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Gamechanger GC692 Long-Range Alpha Imaging System in various environments

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