

Dark matter search yields technique for locating heavy metal seams

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The search for dark matter turns up glistening mineral deposits. Credit: Swinburne University of Technology

A method for locating seams of gold and other heavy metals is the unlikely spin-off of Swinburne's involvement in a huge experiment to detect dark matter down a mine in Stawell, Victoria.

Associate Professor Alan Duffy, from Swinburne's Centre for Astrophysics and Supercomputing and a member of the Sodium iodide with Active Background REjection (SABRE) project, said [cosmic radiation](#) was effectively creating an X-ray of the Earth between the [underground detector](#) and the surface.

In the mine, the SABRE experiment seeks to detect particles of dark matter, something no one has conclusively achieved yet. Any signal from dark matter would be miniscule, and so the SABRE team created a phenomenally sensitive detector, which, it turns out, is also sensitive to a host of cosmic particles that can help us to locate gold.

Detecting particles that aren't dark matter is unwanted noise to SABRE—which is why they located the experiment one kilometre down a mineshaft, where the rock above was thought thick enough to absorb any cosmic radiation.

However, the team found some radiation still penetrated—not ideal for isolating rare [dark matter](#) events, but creating a powerful source of information. "Nature has given us the most powerful penetrating scanner you can create, and there's no licence required," said Duffy.

These particles that make it to the Stawell Underground Physics Laboratory are muons: short-lived particles similar to electrons, but 200 times heavier. Muons are preferentially scattered by atoms with high atomic numbers and so deposits of [heavy metals](#), such as gold, whose atomic number is six times greater than that of carbon, create shadows similar to bones in a medical X-ray image.

The idea's not entirely new, but Duffy noted that the technology "had come of age." The team's redesigned muon detector prototype is a far cry from its 1960s predecessor, a box of bulky high-voltage electronics that needed two people to lift it. Miniaturisation of electronic

components driven by smartphone technology contributed to Duffy's device, which he likens in size to "a fashionable paperweight."

"The first one we built was a cylindrical piece of scintillating plastic in a paint tin. You've never seen anything that looked so rough and ready, but it just gave the most beautiful detections."

The size is perfect for lowering into mineral exploration boreholes, and because the technology is cheap and can connect via optical fibre, Duffy envisages "deploying half a dozen of them and walking away." Weeks later a picture of the minerals in the surrounding rock could be reconstructed from the data, which will require processing similar to that used in astrophysics.

Duffy is excited by plans to build a company around the device, and the team already has interest from potential partners. But, the first step is to turn their prototype into an instrument robust enough for an active mine site.

"Dark matter is ethereal," Duffy added. "It's fundamental to physics, but it's hard to think of practical uses. Yet I see real commercial outcomes in this spin-off."

Provided by Swinburne University of Technology

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