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UK scientists build world's first quantum compass

Tamper-proof device that does not rely on GPS is result of extensive defence funding



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British scientists have built the world's first quantum 'compass' — a tamper-proof navigation device that does not rely on GPS, after millions of pounds of funding from the UK Ministry of Defence (MoD).

The device, the first commercial instrument of its kind, can help pinpoint the exact location of anything on Earth in a way that cannot be interfered with, because it does not rely on external satellites.

"It's completely self-contained," said Joseph Cotter, a researcher at the Centre for Cold Matter at Imperial College, which built the device. "It's particularly useful if you want to navigate a large ship or autonomous vehicles over long periods of time, without having to send or receive any other signals to know where you are."

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The MoD has been pumping money into building an independent navigation device. It sees particular use for it on its nuclear submarines, which need to navigate with stealth and remain isolated from the outside world.

Although GPS is the de facto global navigation system, its reliance on space satellites means it can be blocked, intercepted or masked.

In particular, it is extremely vulnerable to [deliberate disruption](#) or attack. "Satellites can lose signal sometimes due to the space environment or tall buildings, or they can be taken down maliciously, if someone tries to turn them off or they can be spoofed so you think you're somewhere you're not," Mr Cotter said. "It's not possible to get a GPS signal everywhere on earth," he added.

The new system, known as a quantum accelerometer, works by measuring how an object's velocity changes over time. Although precise accelerometers exist in devices such as mobile phones and laptops, they must be recalibrated frequently and can only be used to navigate for up to a few hours at a time.

The quantum device measures the movement of supercooled atoms at extremely low temperatures — close to absolute zero; in this hyper-cold state, a custom-made powerful laser is used to manipulate and control them. The laser, designed by Glasgow-based company MSquared, took nearly three years to develop.

"Pirates are now sophisticated enough to cause disruptions to ships, and lure them to rocks or take over and board them, by disrupting GPS," said Graeme Malcolm, founder and CEO of M Squared. "They can be an even bigger issue in areas of defence and security, where the resilience and security of cities, countries are impacted. This new device is an absolute reference that goes down to the level of atoms."

Funding for the navigation device came from the MoD's research arm — the Defence Science and Technology Laboratory — along with the Engineering and Physical Sciences Research Council and Innovate UK.

Quantum research was identified by the UK government as a priority [in 2013](#), with a focus on military technologies. Since then, through the UK National Quantum Technologies Programme, it has invested £270m into projects in this area over five years.

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