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How useful are (quantum technology) gravity measurements for on-site inspection?

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Gravitational field mapping is permitted by paragraph 69 of the CTBT treaty (1996; UN A/50/1027) to be deployed during the continuation period of an on-site inspection (OSI) to look for features relevant to underground nuclear explosions (UNEs). Examples of features of interest include tunnels used for horizontal emplacements, and underground voids and collapse features caused by vertical emplacements. Whilst current spring based gravity instruments used are limited both by their resolution and by sources of environmental noise superimposed on the measurements, the imminent arrival of quantum technology (QT) gravity sensors based on atom interferometry promise both a far greater resolution and the ability to suppress environmental noise by measuring a gravity gradient, creating a sensor useful in field applications such as during an OSI. This paper will present computer simulations based on mathematical forward modelling of buried UNE relevant targets and realistic noise sources to explore the potential uses of these new sensors in an OSI context. This will allow quantification of the overall improvements to detectability of UNE observables in terms of the depth and size of resolvable features when utilising QT sensors.

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