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# CHINA'S CLAIM OF DEVELOPING "QUANTUM RADAR" FOR DETECTING STEALTH PLANES: BEYOND SCEPTICISM

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In the recent times, the scientific community is abuzz with palpable excitement about the prospect of harnessing quantum phenomena for dramatically improving the qualitative and quantitative performance of a wide variety of classical information processing devices. The research in quantum technology is fructifying in development of applications *with experimentally* verified functionality. The long term technological potential of quantum physics and mechanics may become one of the defining characteristics of our time. Some of the quantum technology applications are now being used commercially. Quantum cryptography was applied in real world scenario for the encryption of an Internet bank transfer in Vienna in 2004.<sup>1</sup> Switzerland used quantum cryptography in its National Council elections in 2007 to secure networks for vote counting against tampering.<sup>2</sup> Quantum sensors capable of carrying out highly accurate and precise measurements of gravity in

the Earth's magnetic field and rotation have transited from laboratories to *real-world* applications.<sup>3</sup>

The advances made in quantum information science have bolstered development efforts in quantum sensors i.e. sensing devices that exploit quantum phenomena in order to increase their sensitivity. Theoretical and experimentation studies have shown that quantum radar can provide a quadratic increase of resolution and will be more resilient against the use of jamming countermeasures.<sup>4</sup> As an incidental advantage, a quantum side lobe structure offers a new channel for the detection of RF stealth targets. Some experts believe that in, quantum radar may revolutionize modern battlefield as was done by RF stealth technology by the end of last century.<sup>5</sup> Based on the promising results obtained during experimental trials, the use of quantum radar is being seriously



contemplated for planetary defence and space exploration.

When Chinese state media claimed that a Chinese defense contractor successfully developed the world's first quantum radar system, the news was received with scepticism by the scientific community in general and by the defence sector in particular.<sup>6</sup> The Chinese sources reported that the radar has a range of 62 miles and by greatly diminishing the stealth feature of "stealth" aircraft, including the B-2 Spirit and the F-22 Raptor, will be able to detect them with ease. According to Global Times, the radar was developed by the 14<sup>th</sup> Institute of China Electronics Technology Group Corporation (CETC). The CETC has a sprawling 2,000-acre research campus in Nanjing province of China with a workforce of about 9,000 workers.<sup>7</sup> The Chinese claim was met with scepticism and suspicion, because globally, the research work on quantum radar is marred by serious technical challenges which have prevented its evolution from laboratories to field-trial systems.

The functioning of quantum radar is *hypothesized on the principle of 'Quantum entanglement'*, which is a physical phenomenon that occurs when pairs of particles (photons, neutrinos, electrons etc.) interact in ways such that the quantum state of each particle in the pair cannot be described independently of the other, even when the particles are separated by a large distance. For better elucidation, let us

hypothesize that we have one pair of particles and then we separate these two particles by putting one of them in Delhi and the other in Bangalore. Now, if we measure the particular characteristic of both these particles (say, for example, spin) at geographically dispersed location, we will find that the results of measurement match in a complementary sense, i.e. if one particle is spinning in clockwise direction, the other will always spin in counter clock wise direction.<sup>8</sup> In quantum radar, the quantum entanglement of light (photons) is used. One half of these states is sent towards the target and the other remains in the receiver. Signal detection is enhanced by exploiting the existing correlation between the emitted photons bounced back by the target and the ones kept inside the receiver. Preliminary results show that quantum radar using entangled photons can provide a quadratic increase of resolution over non-entangled photons.

In some quarters of the scientific community, there is scepticism about the prospect of building quantum radar as there are many practical engineering challenges which are yet to be fully addressed. However, almost all the theoretical and experimental trials have given results, which strongly suggest that photons in the 9 GHz frequency can be entangled, transmitted and detected. The photons in the 9 GHz frequency falls within the radar-microwave X band ( 8-12 GHz region) which is extensively used for various military applications (missile

guidance, marine radar, weather radar, ground surveillance, airport traffic control etc). Therefore, quantum radar operating in this band can easily adapt to operational environments of military interest.<sup>9</sup>

There are a number of agencies, universities and research groups that have elevated the focus work on quantum radar and standoff quantum sensing to mainstream research and have made significant breakthroughs. For example, the Defence Advanced Research Projects Agency (DARPA) has collaborated with MIT, Northwestern University, and University of Texas and these universities- through extensive theory; modelling and proof-of-concept experiments- have shown the viability and workability of quantum radar.<sup>10</sup> In August 2006, Lockheed Martin Corporation was granted a patent (Publication number EP1750145A3) to use entangled quantum particles for Radar systems to 'visualise useful target details through background and/or camouflaging clutter, through plasma shrouds around hypersonic air vehicles, through the layers of concealment hiding underground facilities.....".<sup>11</sup> The bold and ambitious attempt by Lockheed Martin Corporation to exploit concepts, which were and are still on the fringes of theoretical hypothesis, have not yet fructified into a working radar system. All the promising results garnered from extensive experimentations conducted in the

laboratories have not yet resulted into actual prototypes.

However, beyond the scepticism, it's appropriate to be cautious about the way *China's* military efforts are focused in developing *cutting edge defence technology, which has a strategic significance*.<sup>12</sup> *China's aspirational* goal of being a global player and its focus on reaching military parity with US would definitely encourage it to research a technology that has a potential in negating the asymmetric advantage that US enjoys as far as the stealth aircraft are concerned.

***(Disclaimer: The views and opinions expressed in this article are those of the author and do not necessarily reflect the position of the Centre for Air Power Studies [CAPS])***

#### Notes

<sup>1</sup> Alexander V. Sergienko, *Quantum Communications and Cryptography*, (Florida : CRC Press, 2006), p. 65.

<sup>2</sup> Paul Marks, "Quantum cryptography to protect Swiss election", *New Scientist*, October 15, 2007, accessed 31 October, 2016. <https://www.newscientist.com/article/dn12786-quantum-cryptography-to-protect-swiss-election/>

<sup>3</sup> Mikio Nakahara, *Quantum Information and Quantum Computing*, (Singapore: World Scientific Publishing Co., 2013). P. 58.

<sup>4</sup> Marco Lanzagorta, "Quantum Radar", in *Synthesis Lectures on Quantum Computing*, edited by Marco Lanzagorta & Jeffrey Uhlmann. California: Morgan & Claypool Publishers, 2012.

<sup>5</sup> Ibid.

<sup>6</sup> Kyle Mizokami, "China Claims It Developed "Quantum" Radar To See Stealth Planes", *Popular Mechanics*, September 22, 2016, <http://www.popularmechanics.com/military/research/a22996/china-quantum-stealth-radar/>, accessed 31 October, 2016.



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<sup>7</sup> China electronic technology group Corporation, “The 14th Research Institute of China electronic technology group Corporation”, [http://en.cetc.com.cn/enzgdzkj/about\\_us/member\\_units/408332/index.html](http://en.cetc.com.cn/enzgdzkj/about_us/member_units/408332/index.html), accessed 31 October, 2016.

<sup>8</sup> Lanzagorta, n. 4.

<sup>9</sup> Ibid.

<sup>10</sup> David Adam, “US defence contractor looks for quantum leap in radar research”, *The Guardian*, March 6, 2007, <https://www.theguardian.com/world/2007/mar/06/usa.science>, accessed 31 October, 2016.

<sup>11</sup> Google Patents, “Radar systems and methods using entangled quantum particles EP 1750145 B1”, <https://www.google.com/patents/EP1750145B1?cl=en>, accessed 31 October, 2016.

<sup>12</sup> Michael Perry, “China's Xi says military must develop cutting edge technology”, March 14, 2016, <http://ca.reuters.com/article/topNews/idCAKCN0WGOHD>, accessed 31 October, 2016.