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# TAKING THE LEAD IN QUANTUM TECHNOLOGY: CHINA'S QUANTUM COMMUNICATION SATELLITE

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China had recently launched the world's first quantum communication satellite named *Mozi* that would help in transfer of highly classified data. The technology uses quantum particle physics principles to encrypt key transmissions.[1] This is a great technological leap for China. China's work horse Long March (2C) Rocket carried the satellite from the Jiuquan Satellite Launch Centre and placed it in orbit. This closely watched quantum communication satellite was under development for five years, i.e. since 2011.

The launch of quantum communication satellite by China is seen as a first step towards the next generation information security. China, according to Pan Jianwei, is also planning to launch the next quantum satellite Mo II and Mo III.[2] As of now, China has taken the lead in implementing long distance quantum satellite communication concept. However, other countries like United States as well as some European countries are also catching up. China will have to sustain the lead in this technology to maintain an edge. According to Chinese sources, around a dozen such satellites would be sufficient to cover the entire globe.[3] The quantum communication satellite is an experimental pilot project and will be controlled by the China Academy of Science. The Chinese government has funded research in this area heavily. In the year 2015 the total amount reached $10 billion for basic research on quantum physics.[4] It is not known how much China specifically spent for this project.

The government has been supporting the program not only monetarily but via other means as well. For instance, China had recruited China-born western- educated specialists in this field to work on this project. Pan Jianwei is the Vienna educated (PhD) physicist who is the chief scientist heading this satellite programme.[5] He specialises in quantum entanglement, upon which this cryptology is based and is presently affiliated with the Chinese University of Science

and Technology in Hefei. The experimental satellite *Mozi*is named after a Chinese philosopher who lived during the Hundred School of Thoughts period.

Traditionally, secret data are encrypted with a pre shared key and transmitted. With large computational power super computers, these keys could possibly be intercepted and cracked thereby compromising the secret information. In this case, the encryption will be done with the keys generated with quantum photon entanglement and transmitted via a laser which is very secure, as any intercept would be detected.

This experimental satellite encryption system works on the principles of quantum particle theory and quantum entanglement. There are two principles. The first theory states that any particle will remain in one of two possible fixed states when observed. However, when not being observed it could be in any of the two states, called a superposition, much like Schrödinger's concept. The other principle is of quantum entanglement where when two particles are entangled, their properties become correlated and this state remains (i.e the particles remain entangled) even if they are separated by any distance. Hence, by observing one particle the state of the other particle can be known.

The Chinese satellite's equipment creates entangled particles and beams it to two different stations separated by thousands of kilometres. By having access to the entanglement, information can be exchanged. The satellite will be used to distribute quantum entangled distribution encryption keys and not the actual message via the satellite. Regarding security against interception, the first principle applies. If the particles are observed by a third party the superposition collapses (i.e. changes), which will let the user know that it has been tampered with, which means that it is not the traditional encryption method but a sort of intrusion detection method and hence considered 'hack proof' or to be precise 'interception proof'. However, the communication will be vulnerable to the sort of Denial of Service (DoS) attacks by way of constant interception to force the communication down.

The present satellite is more like a proof of concept. China plans to build a large quantum satellite network by the year 2030.[6] At present the satellite will carry out quantum communication, spatial scale quantum entanglement distribution and quantum teleportation experiment.[7] There are four ground stations that were built for this satellite which will perform teleportation between these stations where the distance will be 1200 km. [8] This is the longest demonstration of quantum entanglement principle. Recently, China's quantum satellite made its first communication with the Nanshan Observatory in Xinjiang. The contact was established for a total

of 10 minutes while the satellite was passing overhead.[9] The satellite has a life span of two years and further experiments would follow during this period.

The first objective of this satellite is to test the quantum distribution keys at a short distance. Later, China plans to test establishment of quantum distribution keys between Beijing and Vienna using this satellite relay. China would certainly have plans to use quantum communication satellites for military purposes apart from some strategic military application. The technology also looks promising for commercial applications. Some well-known Chinese investors have already started investing in quantum R&D.

***(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])***

[1] "World's First Quantum Experimental Satellite MoNo Launched", http://news.xinhuanet.com/local/2016-08/16/c_129231459.htm, 16th August 2016

[2] ""墨子号"开启星际首航——全球首颗量子卫星揭秘", http://news.xinhuanet.com/2016-08/16/c_129231460.htm , 16th August 2016.

[3] ibid

[4] "'MoNo': World's first Quantum Satellite – in Orbit",http://www.ftchinese.com/story/001068957 , 16th August 2016

[5] No.1

[6] "外媒:中国欲建量子卫星网掌握"制天权"助打航母",http://news.ifeng.com/a/20160909/49944049_0.shtml, 9th September 2016

[7] No.1

[8] ibid

[9] "Xinjiang Observatory Nanshan Station receive a 'Quantum Satellite Signal'", http://www.xj.xinhuanet.com/2016-09/07/c_1119525581.htm, 7th September 2016