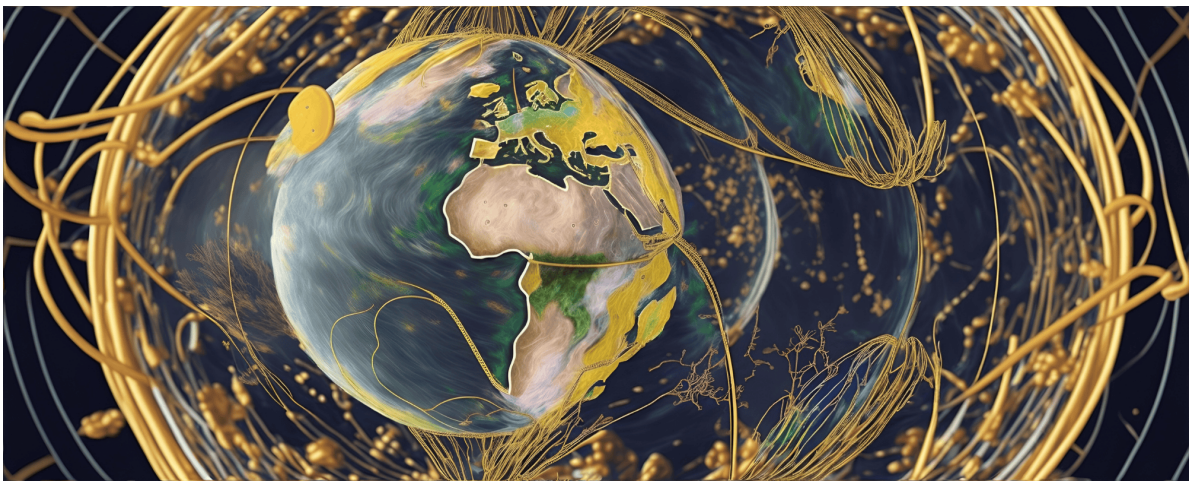
REGIONAL APPROACH: GEOPOLITICS AND GOVERNANCE

The second quantum revolution in Africa

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Quantum universe and ocean. Conceptualization: Luisa Quiroga

One might ask why the second quantum revolution should be important in Africa. Does the continent not have more pressing issues to deal with? Health, sanitation, water, disease control, malnutrition, roads and infrastructure development, electrification, conflict management, to name but a few. The simple answer is that, just as the first quantum revolution brought many developments to the world in terms of technological advances such as in electronics, the second quantum revolution promises, and is already delivering, benefits around the world, of which Africa is a significant part (18%).

Certainly, the second quantum revolution is not all about quantum computing, though quantum computing is currently the “sexiest” topic, with its potential to provide qualitatively different computing, leading to computing that is faster by many orders of magnitude. The second quantum revolution involves research and development in so-called quantum sensors, quantum communication, quantum simulations and quantum precision/metrology, all which have applications for many important issues in Africa.

Quantum sensors

Quantum sensors, particularly quantum gravimeters, will clearly be useful in Africa, which is believed to have many natural resources. These natural resources are mostly buried in the ground, and their presence leads to tiny differences in the value of the acceleration due to gravity (typically denoted by ‘g’) measured at different points on the Earth’s surface.

Detection of these tiny changes requires highly sensitive gravity meters (gravimeters), which are now a reality thanks to quantum gravimeters which rely on the second quantum revolution concepts [1]. It is foreseeable that this technology may help to find more mineral deposits in Africa, and this will in turn lead to greater prosperity for the African continent. This is why more researchers in Africa need to play more significant roles in the second quantum revolution research. Researchers across the African continent need to learn how these new second quantum revolution technologies work, contribute to their development, use them, and find ways to apply them to address different issues in Africa.

Boost research on the continent

Pockets of the second quantum revolution research activities are already being conducted in certain parts of Africa, most prominently in the Republic of South Africa (RSA), with both experimental and theoretical work [2]. A number of individual researchers and small research groups are working in Cameroon, Nigeria, Morocco, Tunisia, Egypt and several other African countries. This brings us to the Quantum Africa (QA) conference series [3], which provides an opportunity for researchers in Africa to share their work and, very importantly, interact with their counterparts in the developed world. The first Quantum Africa conference was held in South Africa in 2010; subsequent conferences have been held roughly every two years since, hosted by different African countries: Tunisia, Morocco, South Africa, and the most recent, QA6, in a hybrid format in Rwanda [4]. The QA6 conference consisted of people from different parts of the world giving talks, both online and in person at the East African Institute for Fundamental Research (ICTP-EAIFR) in Kigali, the capital of Rwanda. Unlike previous QA conferences, QA6 had a larger proportion of industry practitioners alongside researchers in academia.

> The second quantum revolution involves research in fields such as quantum sensors, simulations or metrology, with the potential to solve the most important problems on the African continent

Despite these strides already made, there is a need to increase the number of researchers in the second quantum revolution and build a network of research groups across Africa in the field, as the fraction of researchers in Africa is significantly smaller than the world average. The cost of hardware for research in these technologies is quite high: at least $15 million [5] for a semi-practical quantum computer, for example, making it difficult for most countries in sub-Saharan Africa to acquire or even maintain one. Consequently, most of the second quantum revolution research conducted in African countries, with the exception of South Africa, is concentrated on computational and theoretical aspects and not hardware, due to the limited amount of infrastructure.

The potential of young people

While many parts of Africa currently lack adequate infrastructure, Africa has an abundance of one resource in particular that can be harnessed to make the world a better place through science and technology, the second quantum revolution included: its young people. The African continent has about one billion people under the age of 35, but these young people need adequate training to enable them to make significant contributions to the development of the second quantum revolution. A few training opportunities in the second quantum revolution fundamentals and applications are available. In fact, a recent training session held at EAIFR in Kigali [6] was preceded by a three-part lecture series given by Professor Sanpera of the Universitat Autònoma de Barcelona (UAB) [7]. Organisations including IBM have also been involved in training researchers in Africa in the theoretical and computational aspects of quantum information, through hackathons, for example.

Second quantum revolution research and activities can be catalysed in Africa by supporting intra-Africa mobility and links between the global North and South for increased training, creating two or more high-level quantum systems research centres in geopolitical regions which currently have little second quantum revolution activities, and by organising more systematic and regular training in the field.

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REFERENCES AND FOOTNOTES

1 — Stray, B.; Lamb, A.; Kaushik, A. *et al.* (2022) “Quantum sensing for gravity cartography”. *Nature*, no. 602, p. 590–594. Available online.
2 — Quantum Zeitgeist (2022). “Quantum Africa: A Look At The Development Of Quantum Technology In The Continent”. Article Available online.
3 — To read more about the Quantum Africa conference series go to iqst.ca/qafrica.
4 — Videos of the QA6 talks are available online at qa.eaifr.org.
5 — More details on the price of quantum hardware in this article available online.
6 — For more details of the African School on Quantum Simulation and Quantum Information Science go to indico.ictp.it.
7 — Video recordings are available online.



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