Perspective: Way of Sustainable Manufacturing for Disposable Quantum Spin Biosensors and Sticker-Like 2-Qubit Quantum Computers

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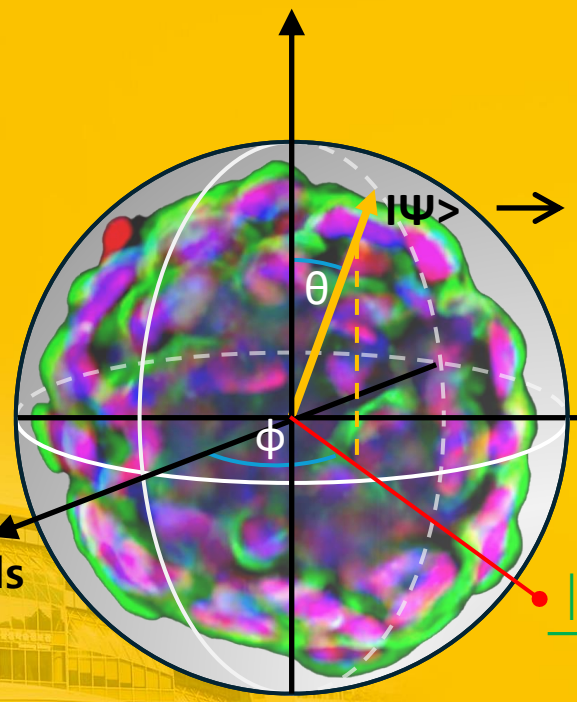
IQB VISION

Institute of Quantum Biophysics

I Incurable diseases >



Multi-omics

Multi-organoids

I World's first personalized quantum healthcare>

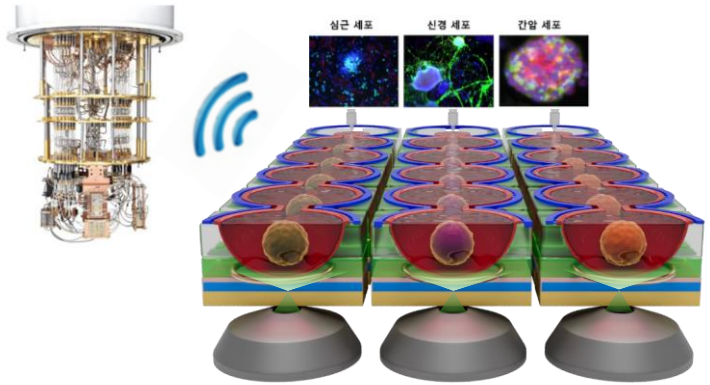
- Q-PoCT of acoustic imager, NMR, and MRI
- Q electron tunneling-based rejuvenation of dysfunctional mitochondria
- Q-sensor integrated multi-organ monitoring platform
- Q computing for multi-omics

$$\frac{|\,Seed\ fund> + \ |\,IQB\ fund>}{\sqrt{2}}$$

I Quantum spin, entanglement, and tunnelling >

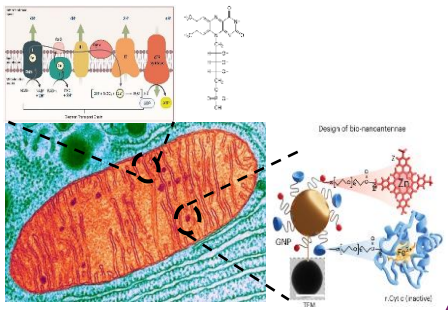
IQB: *Aligning in quantum biotechnology (QBT)*

Quantum Computing for Omics of Human Axis Organoids



Personalized Rx: *Quantum sensor Integrated Organs on System (qSOS-Rx)*

Basic Research in Quantum Electron Tunnelling in Mitochondria



Rejuvenate dysfunctional mitochondria

Preventive QD for gene mutation

Quantum Bio-Sensor Integrated Human Axis Organoid System

Q-acoustic imager, NMR & MRI for Q-PoCT

System Design for Q PoCT of acoustic Imager, NMR & MRI

Large-scale Advanced Manufacturing Platform (LAMP) for Q-acoustic imager, NMR & MRI

Cho, Gyoujin | Large-scale Additive Manufacturing Platform (LAMP)

Professor, Vice Director of Institute of Quantum Biophysics and Director of Research Engineering Center for Flexible Computer

Biophysics

031-299-4793

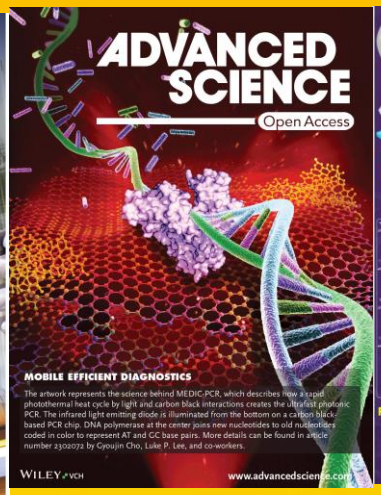
Current Research

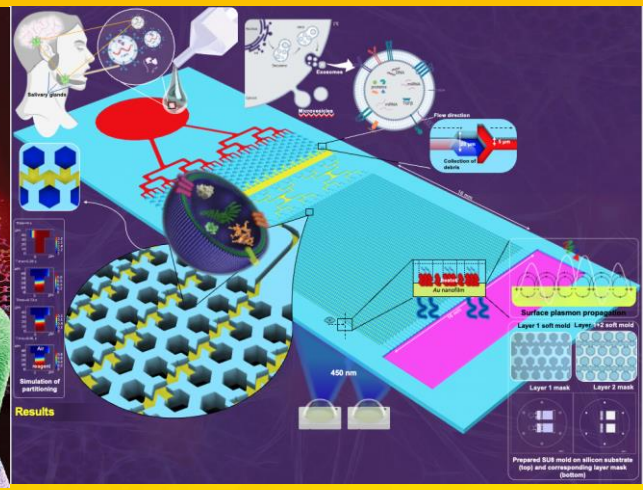
Developing nucleic acid-based 3-**U** (**u**ltra-fast, **u**ltra-low cost, **u**ltra-sensitive) diagnostic technology by:

- utilizing surface plasmonic resonance and q-spin to attain ultra-sensitive detection
- roll-to-roll gravure integrated imprinter for high-throughput sustainable fabrication.

Prospective Research

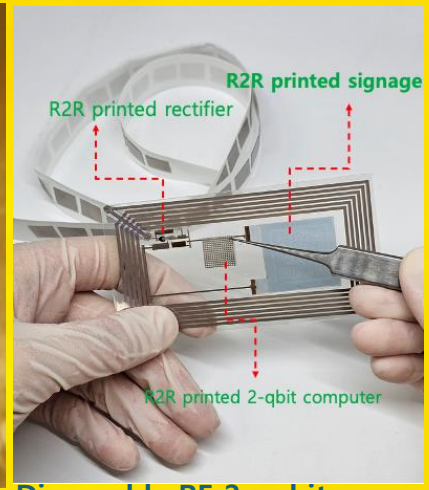
- Optimization of R2R gravure integrate d imprinter as LAMP to manufacture a limitless number of d-PCR and Q-spin sensors to monitor the health of organisms via exosome assay.
- Development of a high-throughput, all-a utomatic, multi-organoid monitoring Q -sensor system for drug screening.





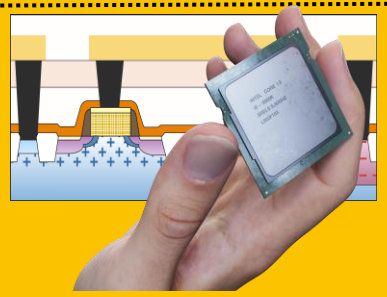
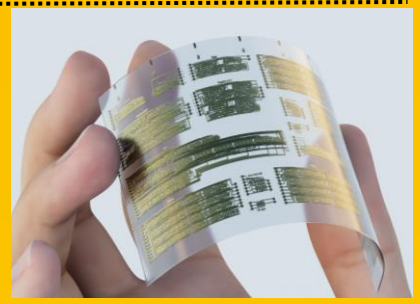
Disposable plasmonic digital PCR

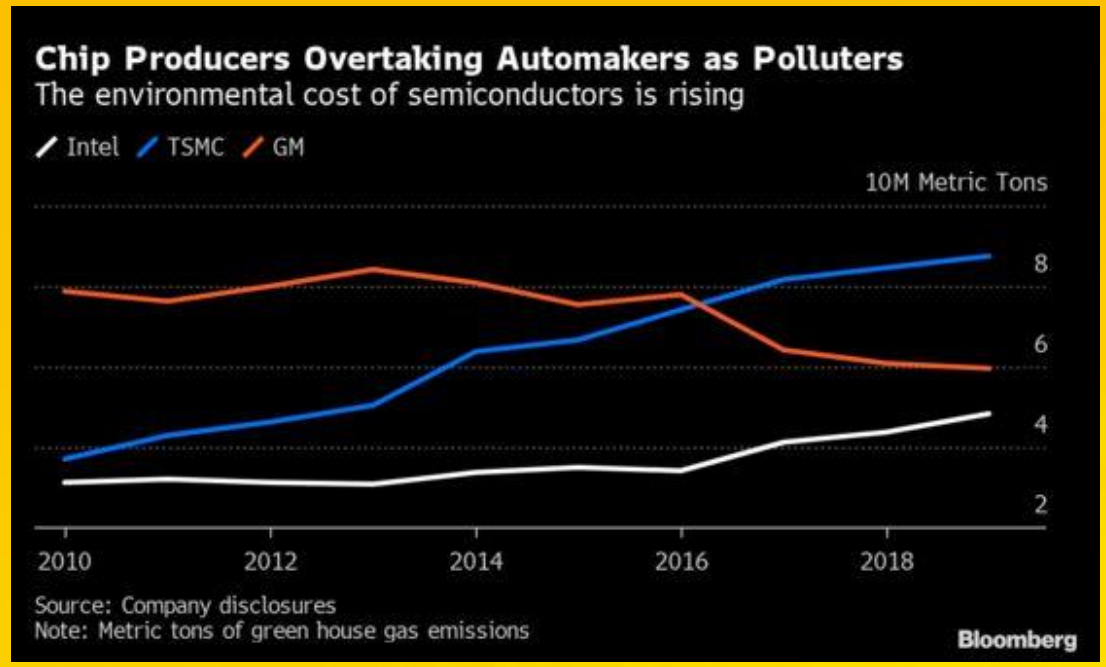
Disposable Q-spin sensor

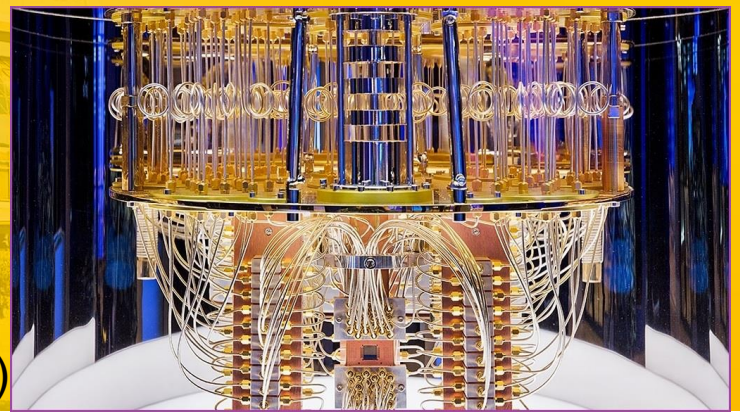


Disposable RF 2-qubit computer

Why do we care about sustainable manufacturing?

	Vacuum tube based computer	CMOS based rigid computer	Printed CMOS based flexible computer
			
Fabrication Process	Glass tube seal/gettering	Photolithograph/vacuum	R2R gravure printing
Power consump	> 100 kWh per 1 inch	10,000-50,000 kWh per 1 inch	<0.9 kWh per 1 inch
By product	~ 10 kg (per 1 inch) of waste-water/solid	~ 10 kg (per 1 inch) of waste-water/solid	Rear zero (per 1 inch) of water/solid
Fabrication time	~ 7 days	~ 7 days	< 1 hr
Application	Simple function computer	Smartphone with AI	Sticker label for edge computing





(https://ia.acs.org.au/)

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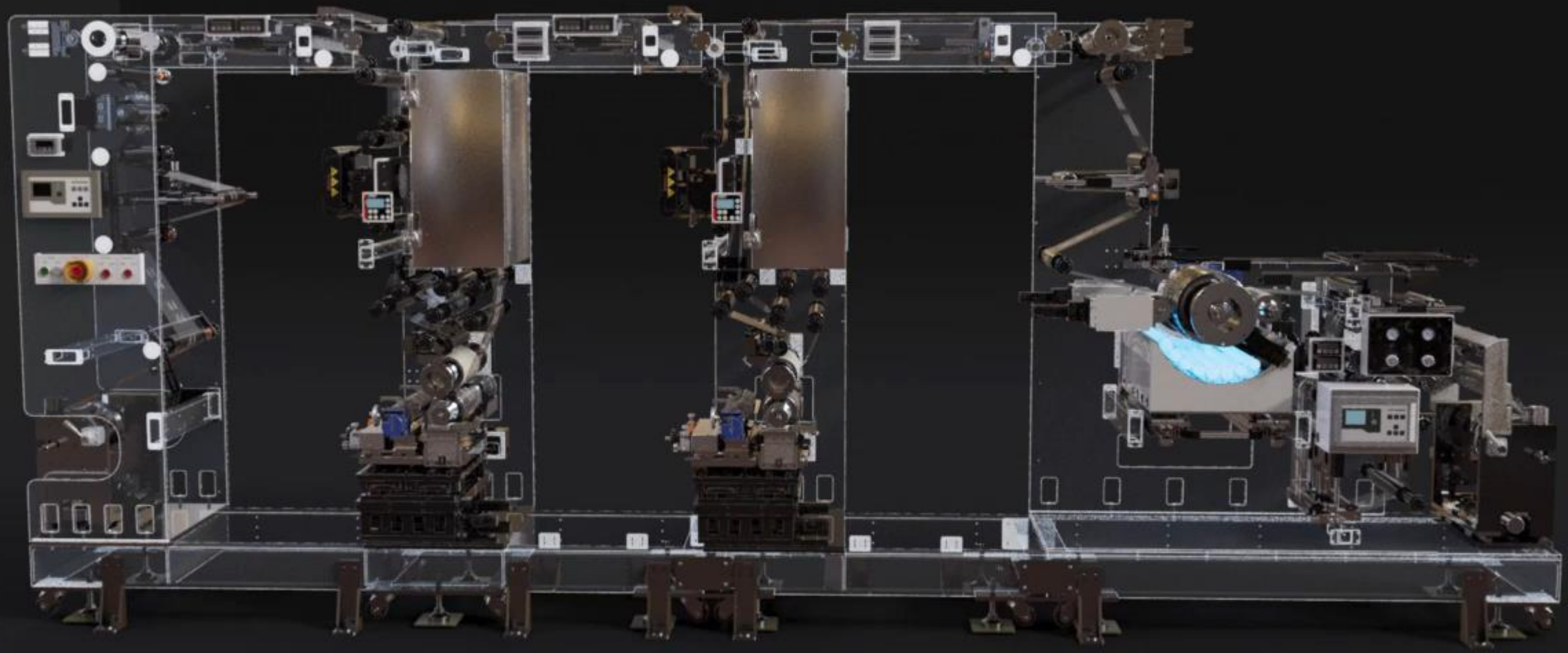
R2R Gravure Fabrication: Sustainable High-throughput Manufacturing



Disposable Quantum Spin Biosensors

Typical Instrumentation and setup of NV^- diamond based nanoscale NMR

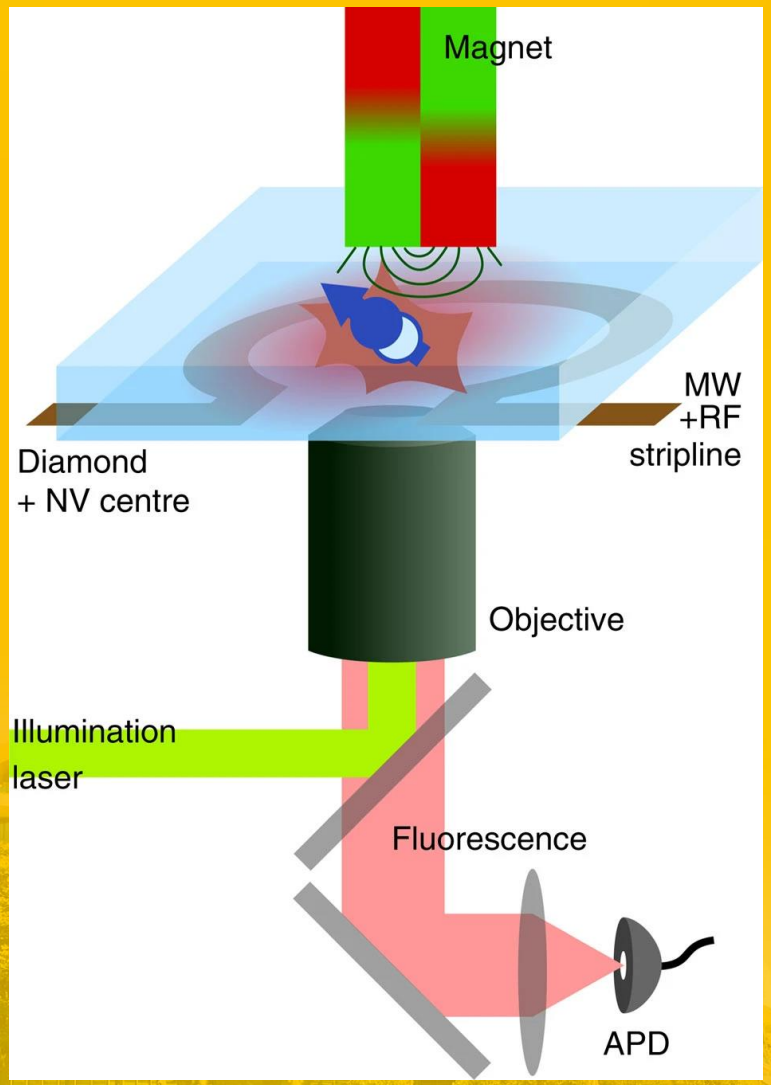
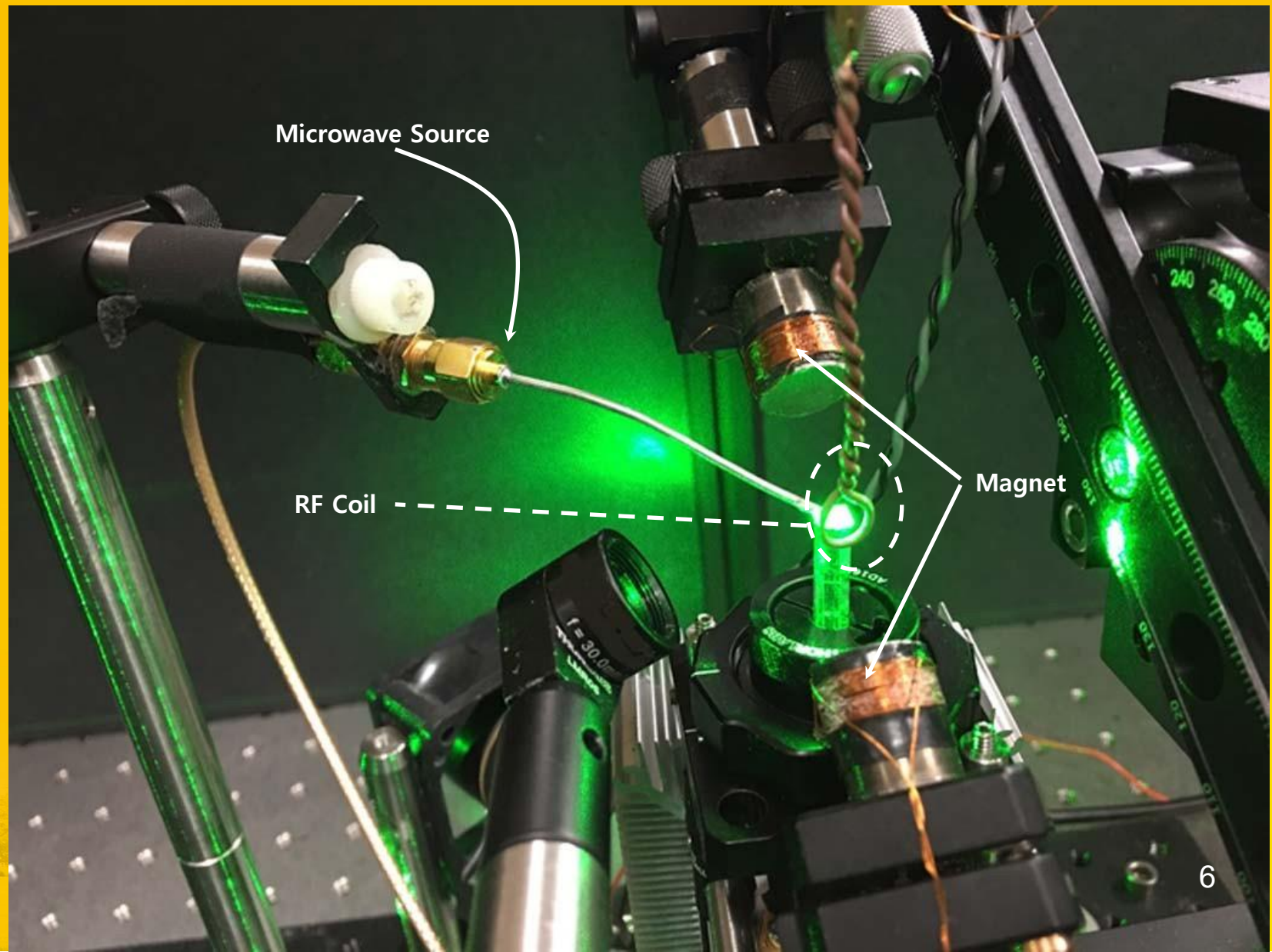
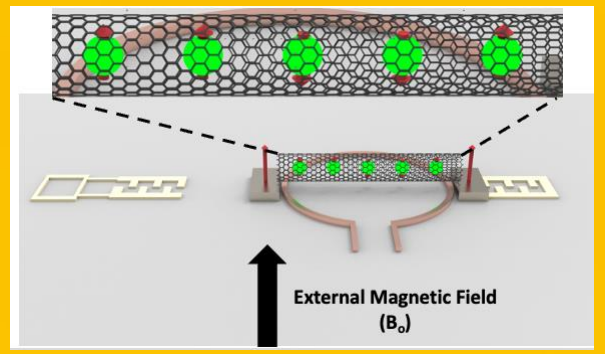


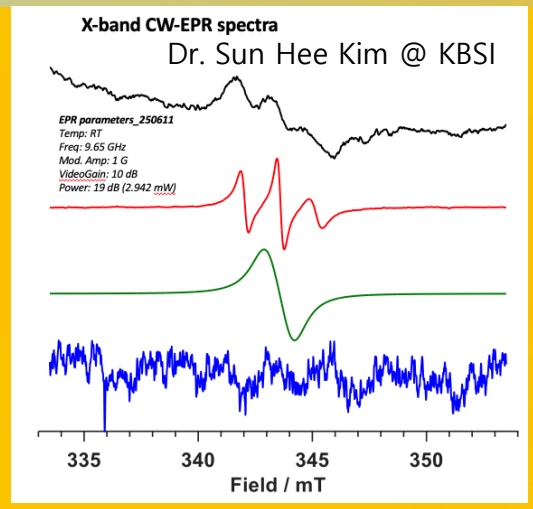
Image taken from NATURE COMMUNICATIONS | 7:12279 | DOI: 10.1038/ncomms12279

Image taken from NATURE PROTOCOLS|VOL 14|SEPTEMBER 2019|2707–2747



Disposable Quantum Spin Biosensors

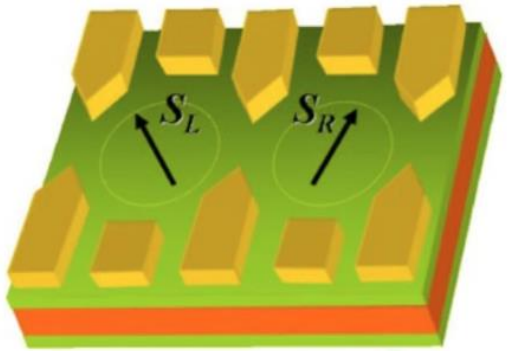




Single Molecular Level Realtime Diagnosis

Sticker-Like 2-Qubit Computer

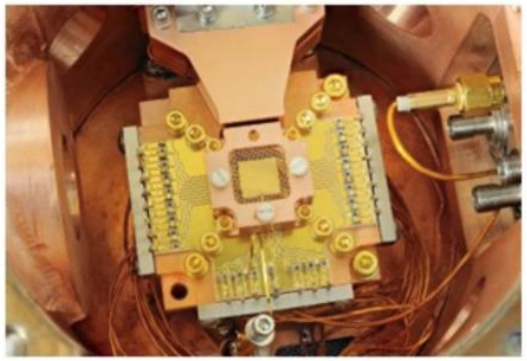
Quantum dot



Spin Up - $|0\rangle$

Spin Down - $|1\rangle$

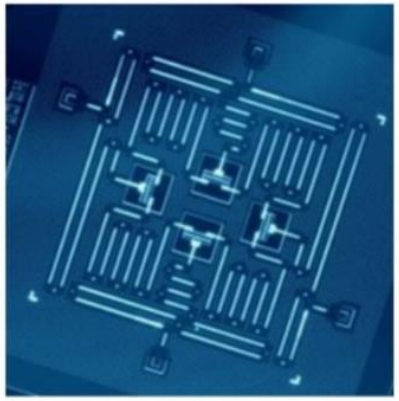
Trapped ion



Spin Up - $|0\rangle$

Spin Down - $|1\rangle$

Superconducting transmon

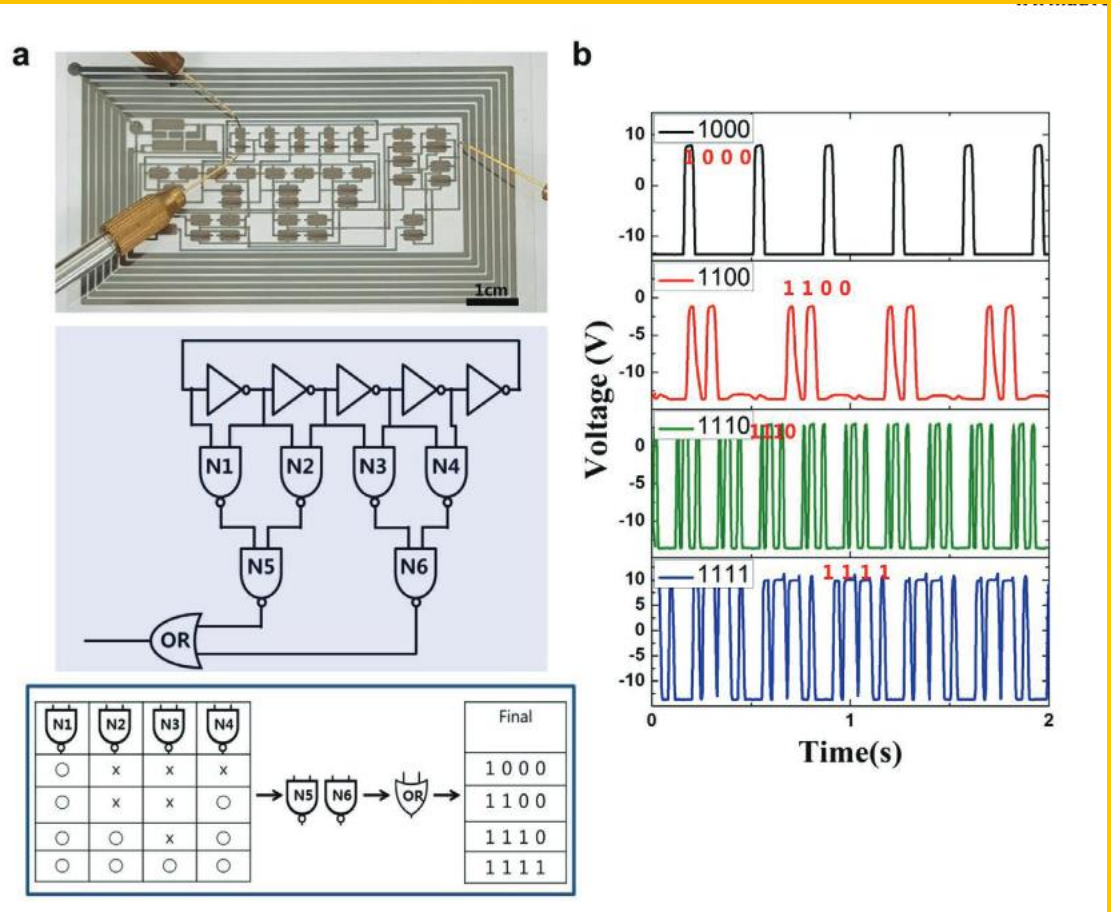


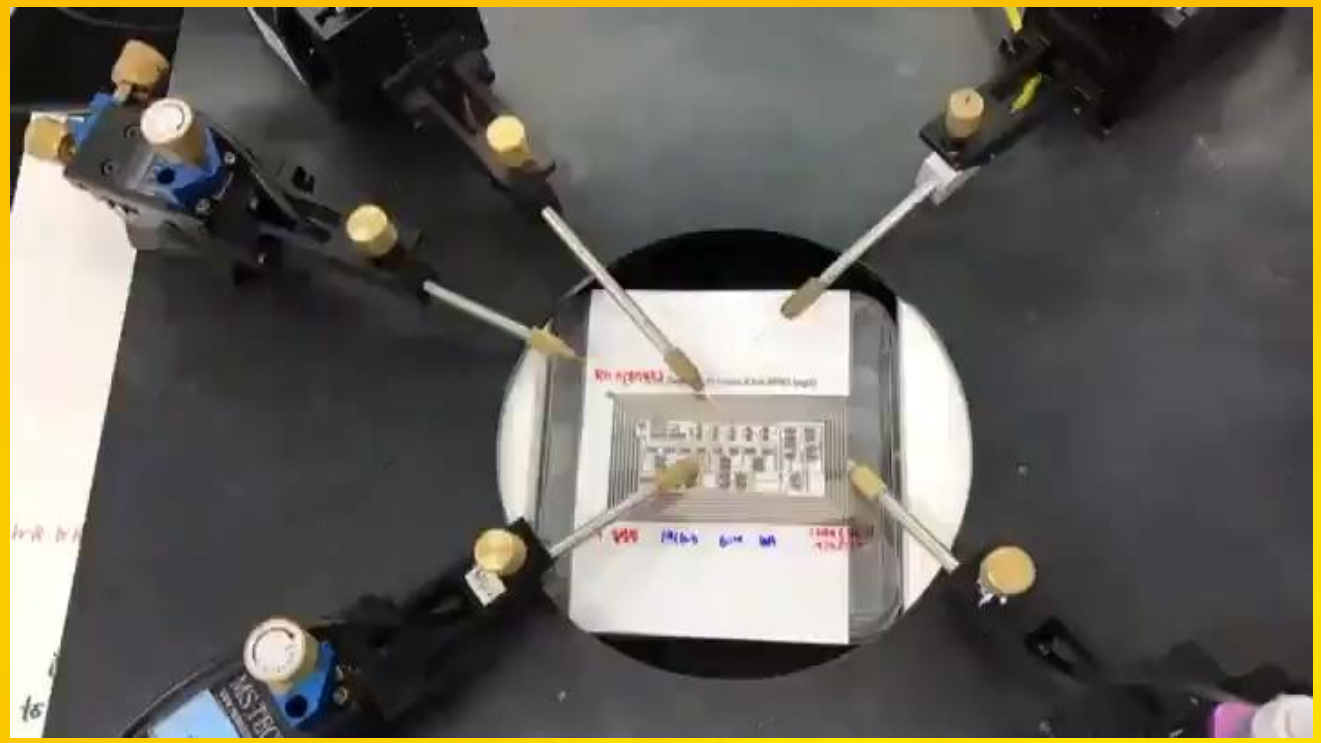
0 Cooper pairs - $|0\rangle$

1 Cooper pair - $|1\rangle$

SpinQ Gemini
2-qubit Desktop NMR Quantum Computer

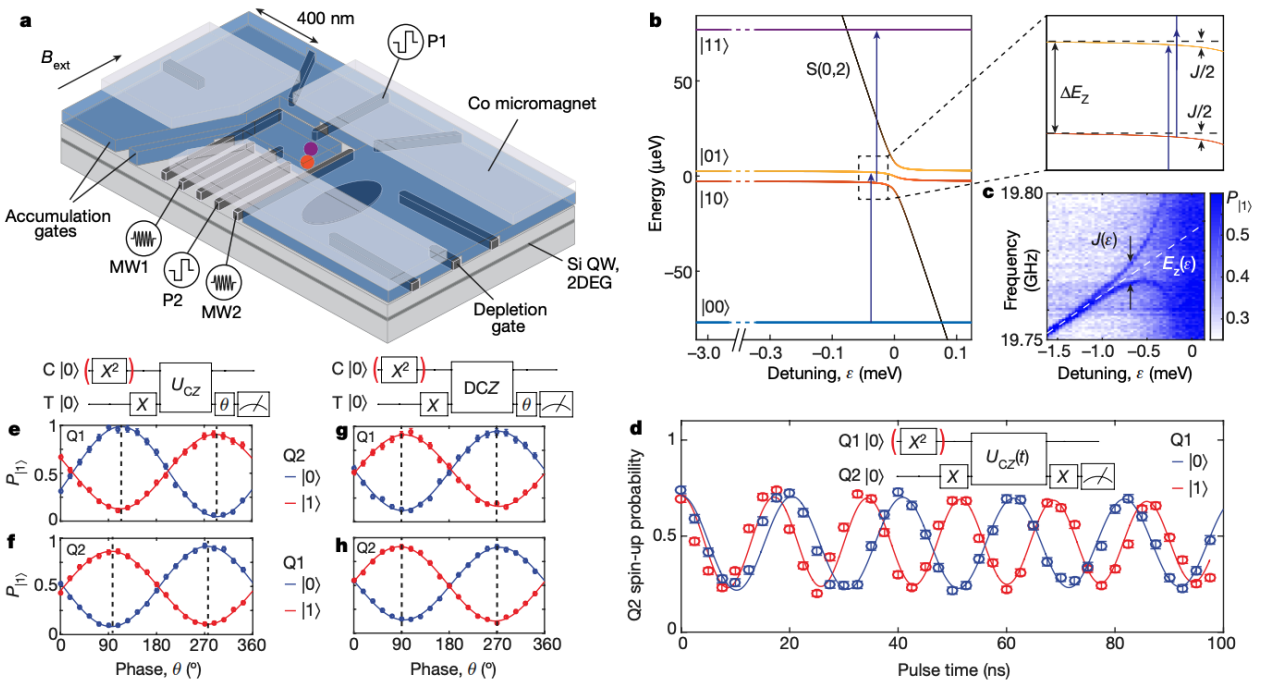
Sticker-Like 2-Qubit Computer





Adv. Electron. Mater. 2020, 6, 2000770

Sticker-Like 2-Qubit Computer



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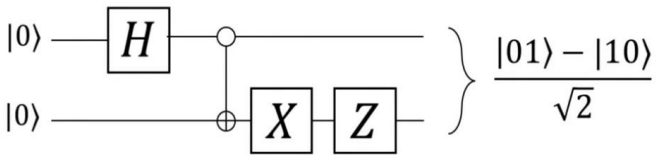
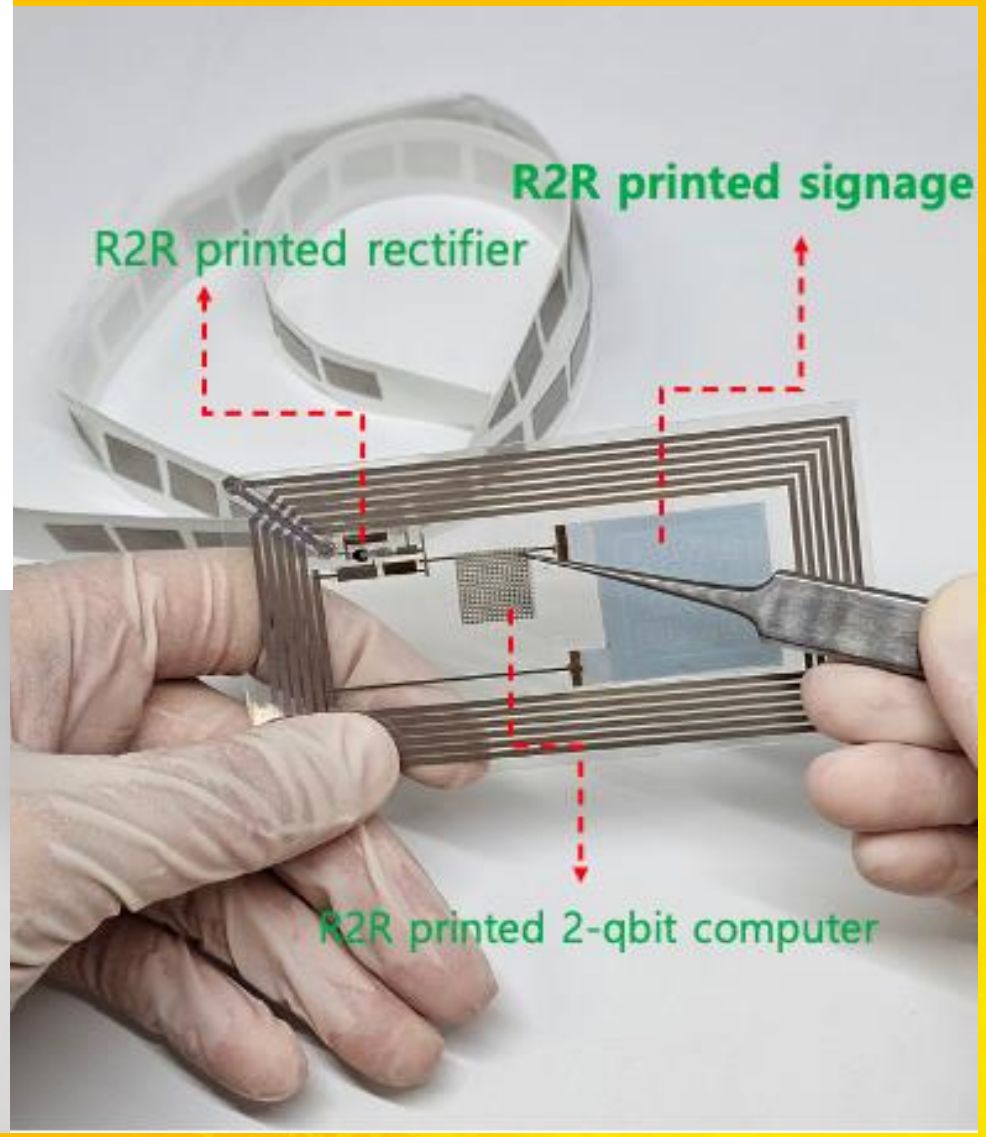
Bell State Preparation



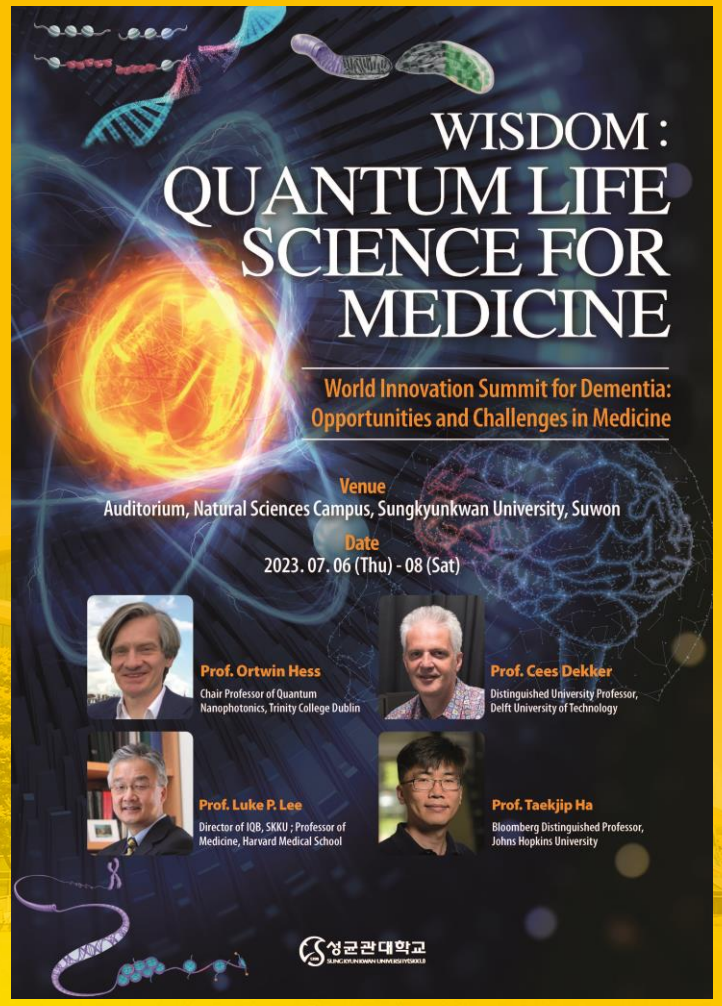
$$\frac{|01\rangle - |10\rangle}{\sqrt{2}}$$

$$(I \otimes Z)|\Psi^+\rangle = \frac{|01\rangle - |10\rangle}{\sqrt{2}} \equiv |\Psi^-\rangle$$



IQB's *Leadership*

Annual International Conference "WISDOM" since 2023



Thank you