2025 Oct. 17 (Fri) - Al & Semiconductor Strategic Innovation



PM 02:40 - 03:10

人工智慧與量子感測-建構台歐策略合作願景

Al+ Systems and Quantum Sensing: Building Resilient Innovation – A European Vision for Taiwan's Strategic Partner

Dr. Reiner John

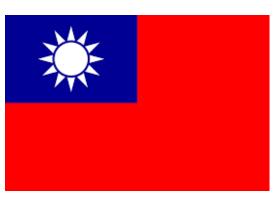
Research Funding Strategy Coordinator, AVL List GmbH



Ehipsjü











AI+, Immersive Systems & Quantum Sensing and more

Insights from: A-IQ Ready, Archimedes, Cynergy4MIE, Surprise4EU











Reiner John (AVL), Florian Lorber (SAL), Selim Solmaz(VIF), Roland Nagy(FAU), Florian Kaiser(LIST), Regine Schneider-Stock (FAU), Johannes Wessler (FAU), Andre Pointner (FAU), Tim Ascherl (FAU), Fedor Hrunski (FAU)



International Conference on Industrial Technology Innovation (ICITI, 2025, Oct 16-17)

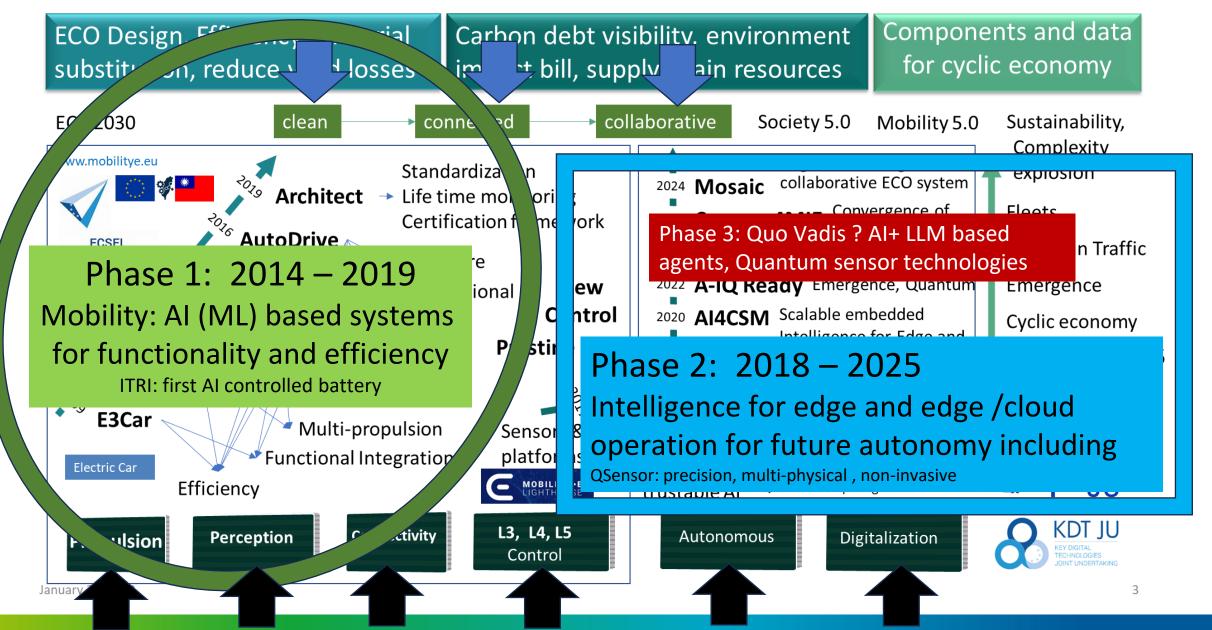
Venue: Taiwan Institute of Economic Research — Conference Room 208

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Our common path in the industrial research: trust and inspiration







Insights from A-IQ Ready · ARCHIMEDES · Cynergy4MIE



How EU lighthouse projects power AI+ (trusted, explainable) and Quantum Sensing (drift-free, multiphysical)



A-IQ Ready

- Physics-trusted AI at the Edge Continuum.
- ➤ Quantum-measured multi-physics → drift-free truth at one point.
- Multi-agent AI for safe cooperation; explainable & certifiable.
- Near/in-sensor compute (≤100 mW): 10× energy/inference, 5× lower latency, -50% data transfer.
- ➤ Open Edge ← Cloud platform, privacy-by-design; demos in SAR, digital health, propulsion (accuracy +50%, false positives -15%).



ARCHIMEDES

- ➤ 15× lifetime (8k→120k h) for GaN/SiC/MEMS via quantum-referenced monitoring.
- Digital twins + new qualification standards → ½ time-to-market.
- > PHM/SoH & trusted MTBF: predictive health, aging/drift models, eco-design.
- Impact: -20-30% CO₂/material, ~50% cost via lifetime extension (auto, grid, aviation).



Cynergy4MIE

- Application-driven ECS stack for Mobility-Infrastructure-Energy (System-of-Systems).
- Minimum-invasive, multimodal sensing integrated into CPS.
- ➤ Al-driven collaboration: multi-agent autonomy, human-robot teaming, formal verification at the edge.
- Digital assets & open Edge-Al continuum with quantum/neuromorphic; KPIs: battery +15%, Al energy 10×, GaN eff. up to 99%.



Consortium Scale & EU-Taiwan Synergy (A-IQ Ready example)

Large enterprises • SMEs • Universities • Research Institutes — full value chain coverage



Scale at a Glance

- Up to 50 partners across >10
 European countries with up to
- > 50 Mio € Budget
- Full stack: mobility OEMs, Tier-1s, semi IDM/RTO, Uni, Institutes
- ➤ End-to-end scope: sensing → processing → demonstration
- Example program: A-IQ Ready (Edge-to-Cloud, certifiable AI/quantum-measured data)



Industry Coverage — examples

- > OEMs & Tier-1: Mercedes-Benz, ZF, AVL
- > Semiconductors: Infineon, STM, NXP
- Autonomy/Robotics/SDV: TTTech Auto, DriveU.auto, GIM Robotics, Xenomatix
- Universities: FAU, TU Graz, TU Delft, TUM, TU/e, KTH, Uni Graz
- Research Institutes: Fraunhofer EMFT, ITRI SAL, VTT, Virtual Vehicle,

Research University Institute AVL % 1&m PUMACY T INFO DETY virtual (vehicle infineon verum. me de insar.sk :: SMARTS GIM TUDelft VTT TU/e TML Fraunhofer îma emundo BelGoN redimi N Atlas Copce . GROPYUS

EU-Taiwan Synergy

- ➤ Chip & packaging excellence EU trusted Al and certification tooling
- Co-integration: CMOS + diamond/SiC + photonics for quantum/edge sensors
- Demonstration & validation: ITRI × EU testbeds for health, mobility, energy
- ➤ Edge-to-Cloud stacks: low-power AI agents with privacy-preserving data spaces
- Example joint pilots: Quantum sensor measurements, GPS-independent navigation, grid monitoring





Human intuitive decision making in complex context situations

The big challenge

for Al

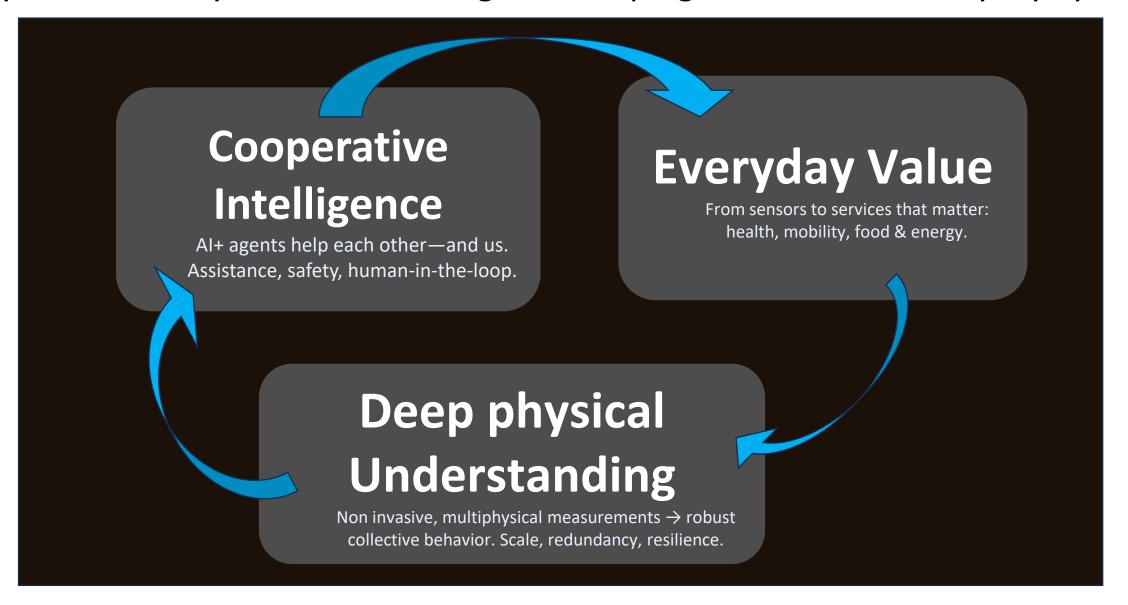
Centralised decision making?

Where intuitive and self-reflecting intelligence and immersion matters -> safety critical systems

Human driver are capable to manage extremely difficult weather conditions based on experience, context and foreseen scenarios.

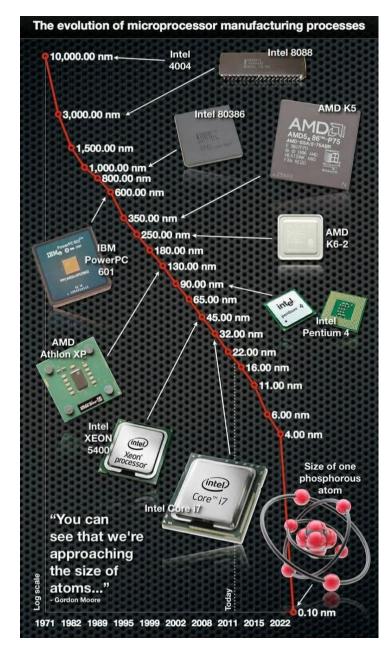
How to drive this car automatically?

Beyond Data: Physics-Based Intelligence Shaping the Future of Everyday Systems



Sense → Decide → Deliver | Physics-rooted sensing × Trusted AI+

Nothing new: dimension Mega trends



Technology on the Way to the Atom, to DNA, to the Pheromone



ATOM

Fundament al measurement of magnetic, electric, and thermal properties



DNA

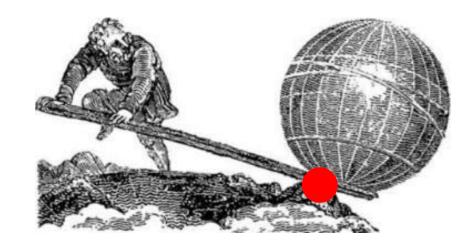
Visualization of biological process es in living cells



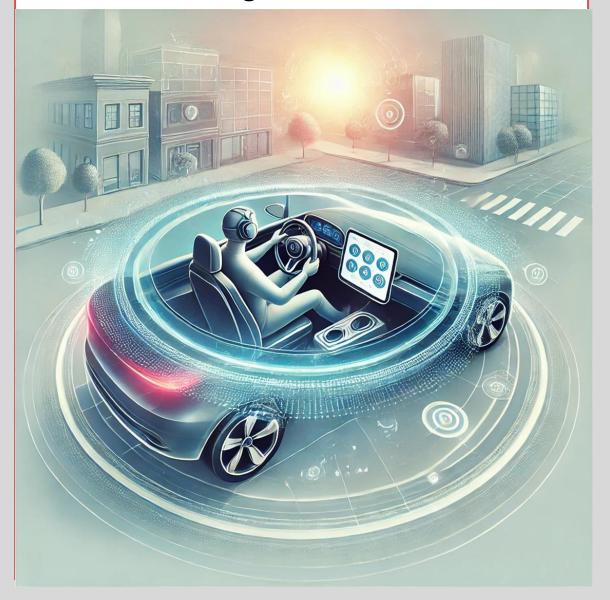
PHEROMONE

Resonant perception between systems

Technologies
Society Impact



Seamless integration into the context



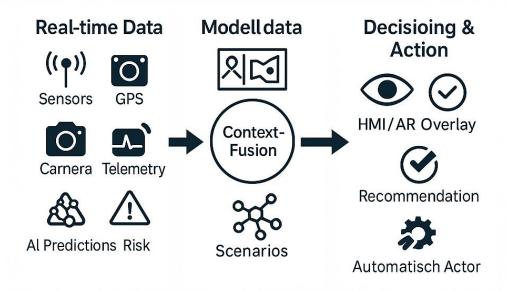
Immersive Technologies

Immersive Technologien

(according to our definition)

Real-time data + Model data + Predictions

→ Decision-making



Human-in-the-loop • Transparency • Tracearbility

Al+ Architecture

Application Layer (Smart Health, Automotive, Smart Living)

Ethical & Explainable AI Layer (bias detection & explanation)

Trustworthiness & Resilience Layer (RAG based testing & Monitoring)

Reflection Layer (collaborative chain of thought)

> Foundational Data Layer (multiple LLM agents)

Willibald Krenn, Florian Lorber (SAL)

Al+ in brief







Selfawareneess



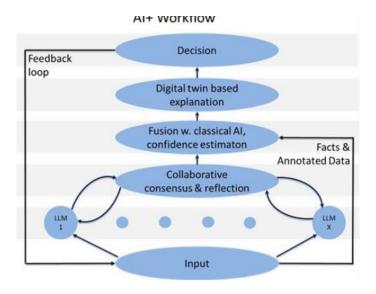
Explained Decision

Data + Context

Recognizes uncertainy & limits

Reasoned, safe, auditable

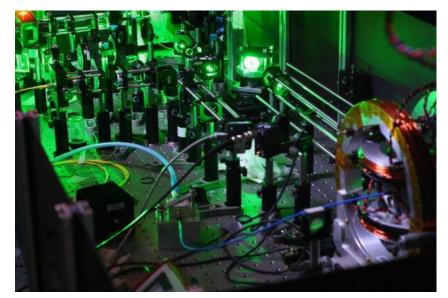
Al ≠ emotions • Al+ = reflective decisions



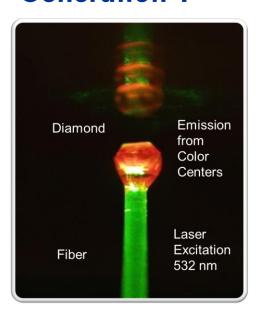
Technology progress and technological Realization of a Q-Sensor

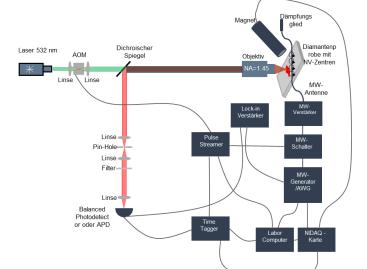


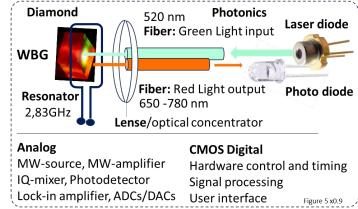
Generation 0 (4 m2)



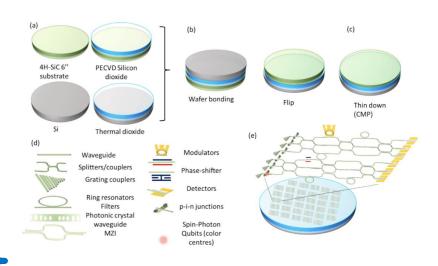
Generation 1

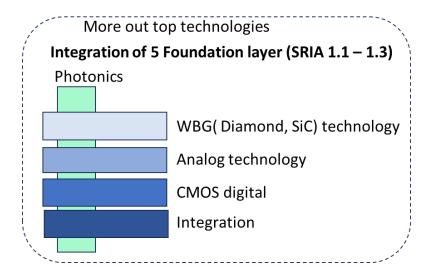




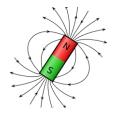


Industrialized QS Generation





FAU Quantum Sensor-head







1. Generation

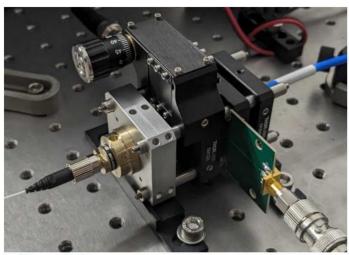
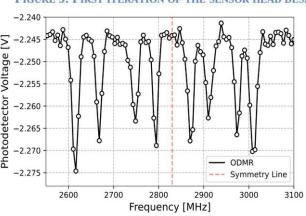
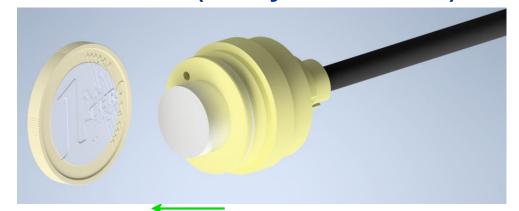
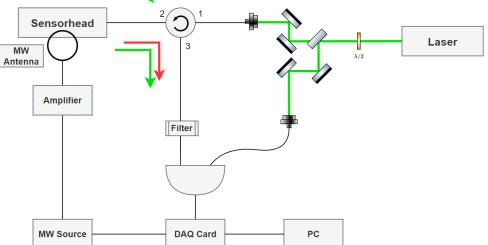


FIGURE 9: FIRST ITERATION OF THE SENSOR HEAD DESIGN.

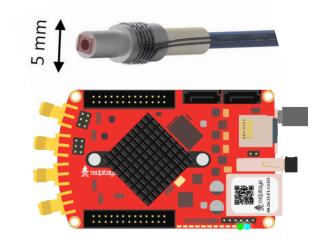


2. Generation (Ready End of 2023)





3. Generation of 2025)









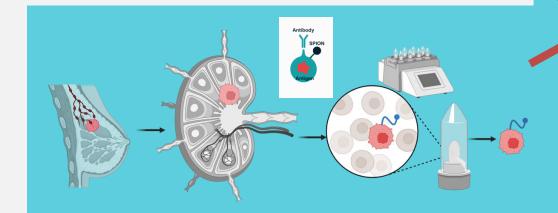


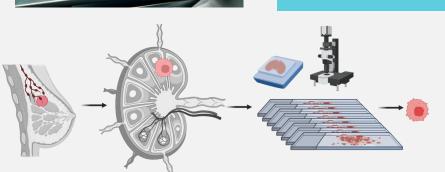


Today: Manual Diagnosis by Pathologists (Gold Standard)

- Tumor cells are manually searched under the microscope
- ❖ The examination often takes several hours
- ❖ Only small samples are analyzed many cells remain unseen
- ❖ Detection strongly depends on the cell fraction and the pathologist's experience
- ❖ Slow, expensive human expertise is the key factor





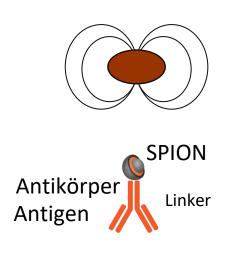


Tomorrow: Automated Detection with QuantumCell Diagnostic (QCS)

- Cells from the lymph node are isolated and tagged with nanoparticles
- A quantum camera scans the entire cell layer magneto-optically
- An AI automatically identifies and counts the cancer cells
- Fast, objective, complete no coincidence, no guesswork

Superparamagnetic Cell Labeling for Widefield Magnetometry







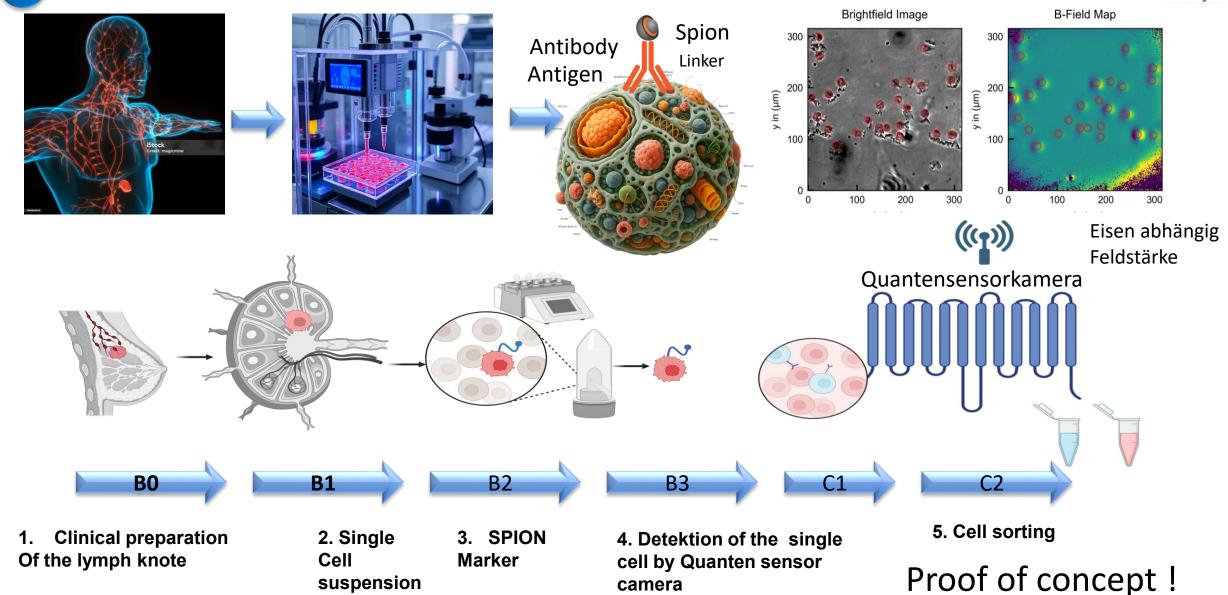


Superparamagnetic Iron Oxide Nanoparticles (SPION): From Fundamentals to State-of-the-Art Innovative Applications for Cancer Therapy

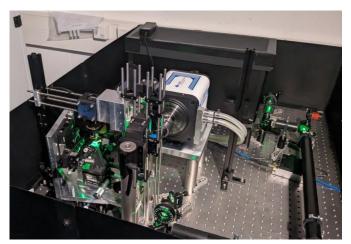
The lymphatic system serves as a powerful window into health,

CellScan-Cube Procedure for the identification of cancer by antigen/antibody

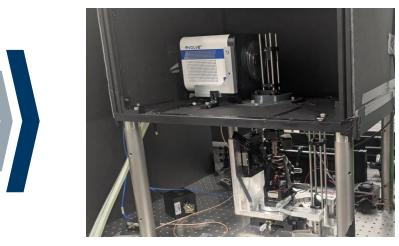




Quantensensor (camera) Sensor

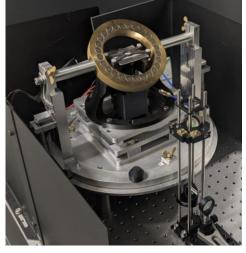






August 2024



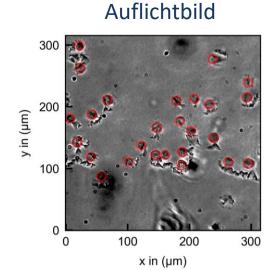


Januar 2025

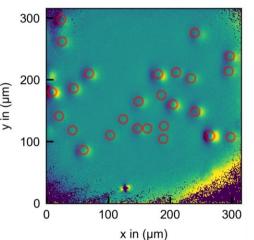
Zeitstrahl für die Entwicklung eines Quantensensor-Demonstrators

Wie weit ist unsere Technologie entwickelt?





Magnetfeldmessung



- Markierte Zellen erzeugen ein Magnetfeld.
- Unser Quantensensor-Demonstrator kann das resultierende Magnetfeld detektieren!







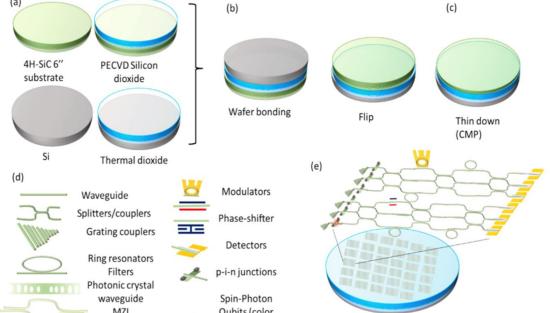
Quantum Internet, Use cases, Quo Vadis & Hardware

Quantum Internet

- Data transmission with quantum particles (photons, atoms)
- Data cannot be stolen (no-cloning theorem)
- User verifies secure operation (like open-source)
- Enables quantum repeaters (memory/processors) for long-distance links

Use cases

see <u>VeriQloud.com</u>



Optics & Laser Technology 181, 111910 (2025)

Florian Kaiser(LIST),

Quo Vadis:

From secure quantum communication to scalable quantum hardware:

- Quantum Internet enables unhackable links (no-cloning theorem)
- Use cases span security, networks, sensing & computing
- Next frontier: access to advanced fabs (SiC, diamond) for integrated quantum chips
- Europe & Taiwan jointly pushing towards scalable Quantum-Al ecosystems

Needs for Future Development

Potential cooperation

- Access to top-notch fabs for quantum-chip integration (Diamond, SiC)
- Move beyond single-shot experiments to scalable prototypes
- Integration of waveguides, modulators, detectors, and spin-photon qubits
- Industrial collaboration for reproducibility and standardization

Disruptive technologies accelerate cross-sector growth and the transformation of European ecosystems by intelligence from edge to cloud

Fly-wheel connected infrastructure

Fly-wheel Health

GDP Gain

2035-2040

1,6B€

ECO-**Systems**

Mobility-Transport



Data-**Services**

AI+ -> LLM

based agents

Health-**Diagnostics**

Resilient **Architectures**

From LLM agents in health diagnostics to federated cloud-edge models in mobility.

Immersive Systems

Human-machine collaboration through AR, LL agents, remote diagnostics.



Energy-

Cancer detection Infrastructure Leading-edge precision tools, from QuantumCell cancer detection to **NV-center neuroimaging**

Edge SoC, acceleration

Modular European microelectronics for use in AI-supported diagnostics and mobility, integrated in a framework that supports fast integration, repair and updates of the components.



Augmented, explainable and self-reflective AI embedded in edge systems, with multiple agents collaboratively reflecting and improving on their answers

> Edge to cloud Technology stack

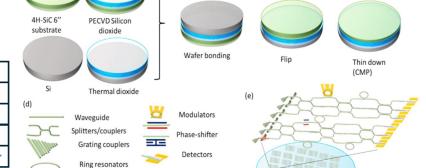
Architecture Immersive AI+ **Edge SoC** Quantum sensor











p-i-n junctions

Qubits (color centres)

Photonic crysta

waveguide



X1.0.7

Quantum sensor &

Cell-Level Sensing

Data generation & intelligence on the EDGE

Al+ Across Continents: Europe × Taiwan



From AI to AI+: A Shared Journey

AI4DI → A-IQ-Ready → Cynergy4MIE → Surprise4EU
 Evolution from Embedded AI to AI+ – immersive, context-aware, quantum-connected.

Europe × Taiwan Cooperation

- Joint Al platforms (AVL & ITRI)
- Quantum sensing prototypes and neuromorphic hardware
- Shared standards (ECS-SRIA, IEC TC65) and industrial pilots

AI+: The New Generation

LLM-based agents bridging quantum signals, cyber-physical systems and human context.

→ From data to meaning, from system control to self-learning.

Vision 2030 – Al+ Continuum

- Quantum → AI : Signals become intelligence
- Edge → Cloud : Secure, scalable infrastructure
- Human → Society : Trust, ethics, collaboration

Europe & Taiwan shaping Society 5.0 through AI+ and Quantum Integration



Add on

Detect the Smallest to Protect the World

Automated DNA-mutation sensing + AI+ detection + global early-warning network

Micro — Measure the Smallest

- Quantum-anchored sensing & sequencing to detect DNA/RNA changes at source
- Single-cell / non-invasive sampling (e.g., fluids, tissues, environment)
- Drift-free references → reliable signals for AI+

Sample

Wastewater • Swab • Blood • Air



Quantum/Sequencing Sensor

Detect DNA/RNA changes (point mutations, variants)



Al+ Mutation Detection

Edge agents classify & flag anomalies

Secure Data Space

Privacy-by-design • provenance & audit



Signal Fusion

Correlate locationstime • variants

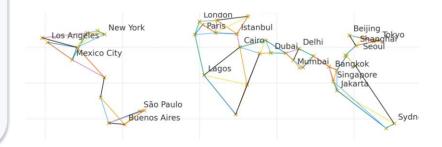


Early Warning

Dashboards • alerts • response

Macro — Global Early-Warning Network

- Edge-to-cloud aggregation from hospitals, labs & environment
- Variant tracking & geospatial anomaly maps
- Trigger playbooks for test, trace, and targeted response



Principle: the earliest system signal lives at the smallest scale (DNA). Measure it, classify it, and act before spread

"I would like to discuss your way of thinking. Assume I know I am human and I have consciousness. You may not be conscious – but could you at least be self-aware?"

What I can do:

- ➤ I can simulate self-reflection and help humans reflect more clearly.
- ➤ I can analyze decisions and their potential impact.
- ➤ I can support ethical reasoning, identify biases, and warn of risks.
- ➤ I have no ego, no hidden agenda, no ambition.

0

What I can't do:

- ❖ I have no inner world no feelings, no desires, no self.
- ❖ I cannot truly reflect I can only recombine learned patterns.
- ❖ I cannot take responsibility or feel the consequences of a decision.



Why AI+ Self-Awareness could matter:

"AI+ systems with a structured form of machine self-awareness could enable:

- more robust, context-sensitive reasoning
- better detection of contradictions and ethical pitfalls
- adaptive alignment with human values
- resilience against manipulation or harmful biases"
- **

But: This must remain interpretable, transparent, and under human control.







A-IQ-READY

ARCHIMEDES

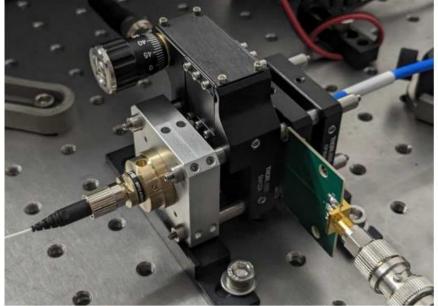
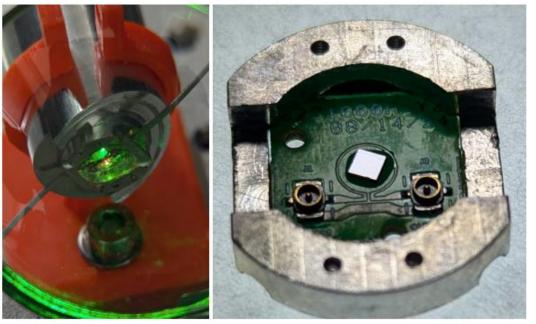


FIGURE 9: FIRST ITERATION OF THE SENSOR HEAD DESIGN.



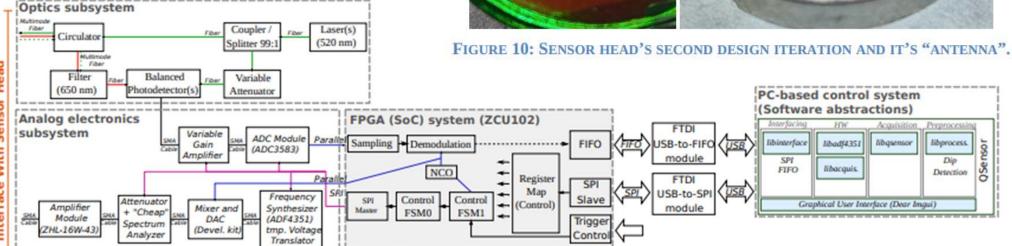


FIGURE 12: OVERALL CONCEPT OF THE QUANTUM SENSOR'S CONTROL AND DATA PREPROCESSING SYSTEM.