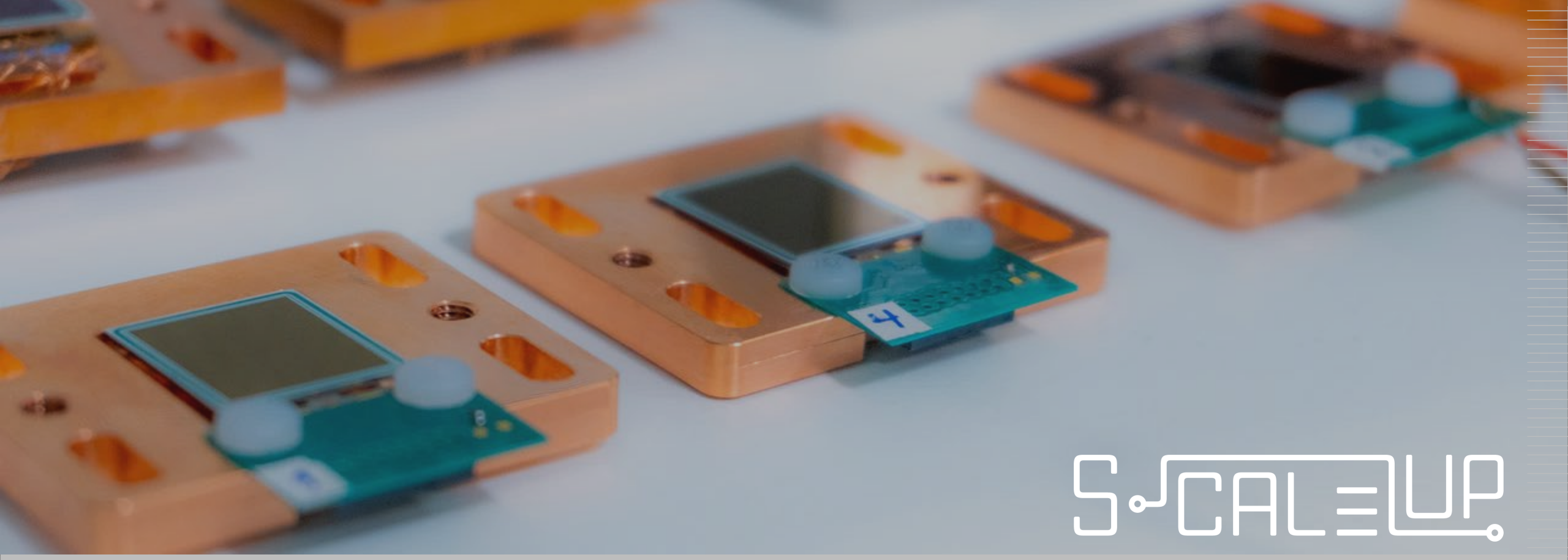
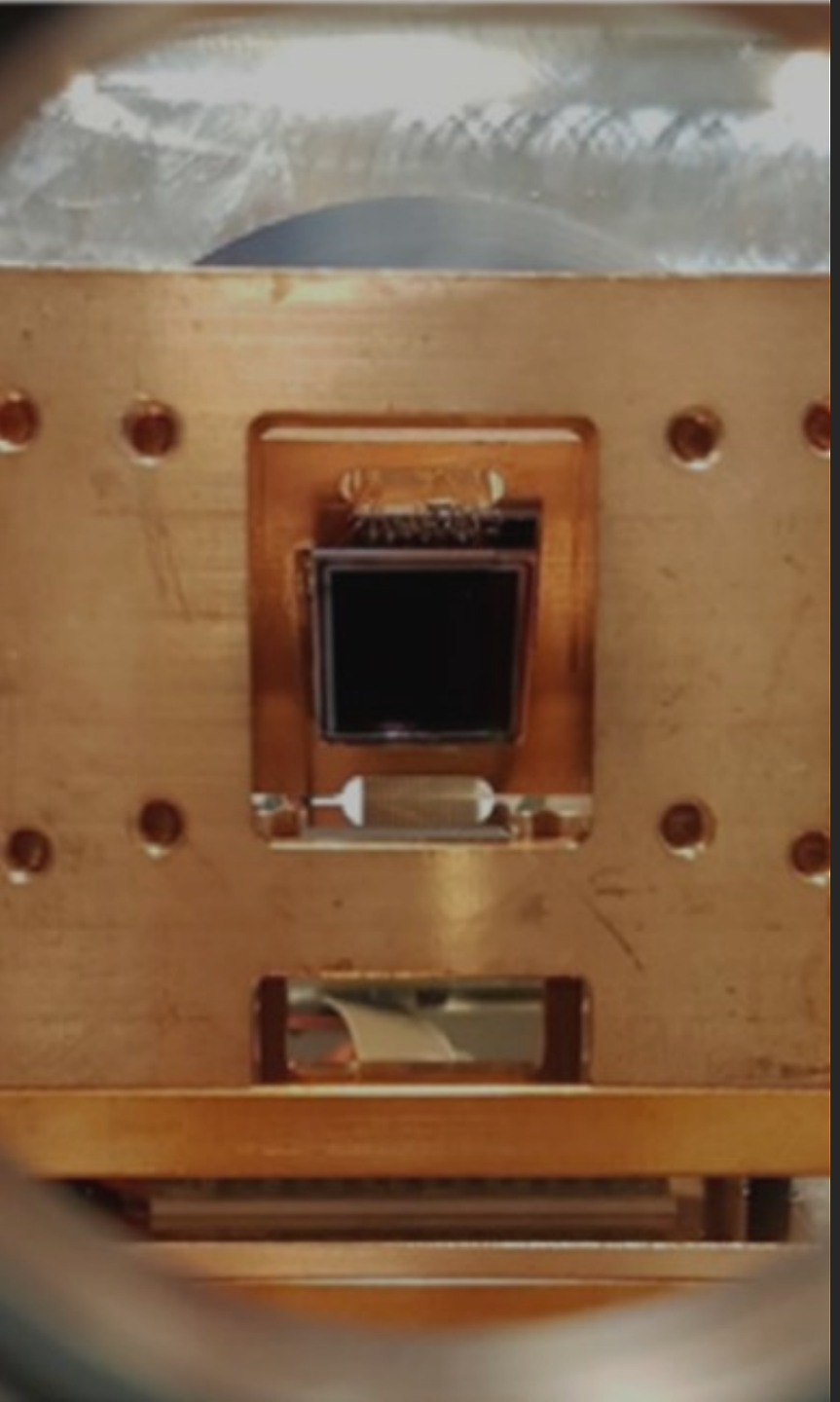


Radiometric NMI-on-a-chip

Predictable spectral response scale from 200 nm – 1050 nm

Jarle Gran, Trinh Tran, Johanne Solheim and S-CALe Up consortium

Justervesenet



OUTLINE

- NMI ‘s ROLE
- S-CALE-UP
- OUTLOOK

Justervesenet - Our role and mission

National Metrology Institute (NMI)

$$E = kT = hf = eV = mc^2$$

Justervesenet as an NMI

- ESTABLISH NATIONAL STANDARDS
- PROVIDE SERVICES
- RESEARCH

USUAL BUSINESS MODEL

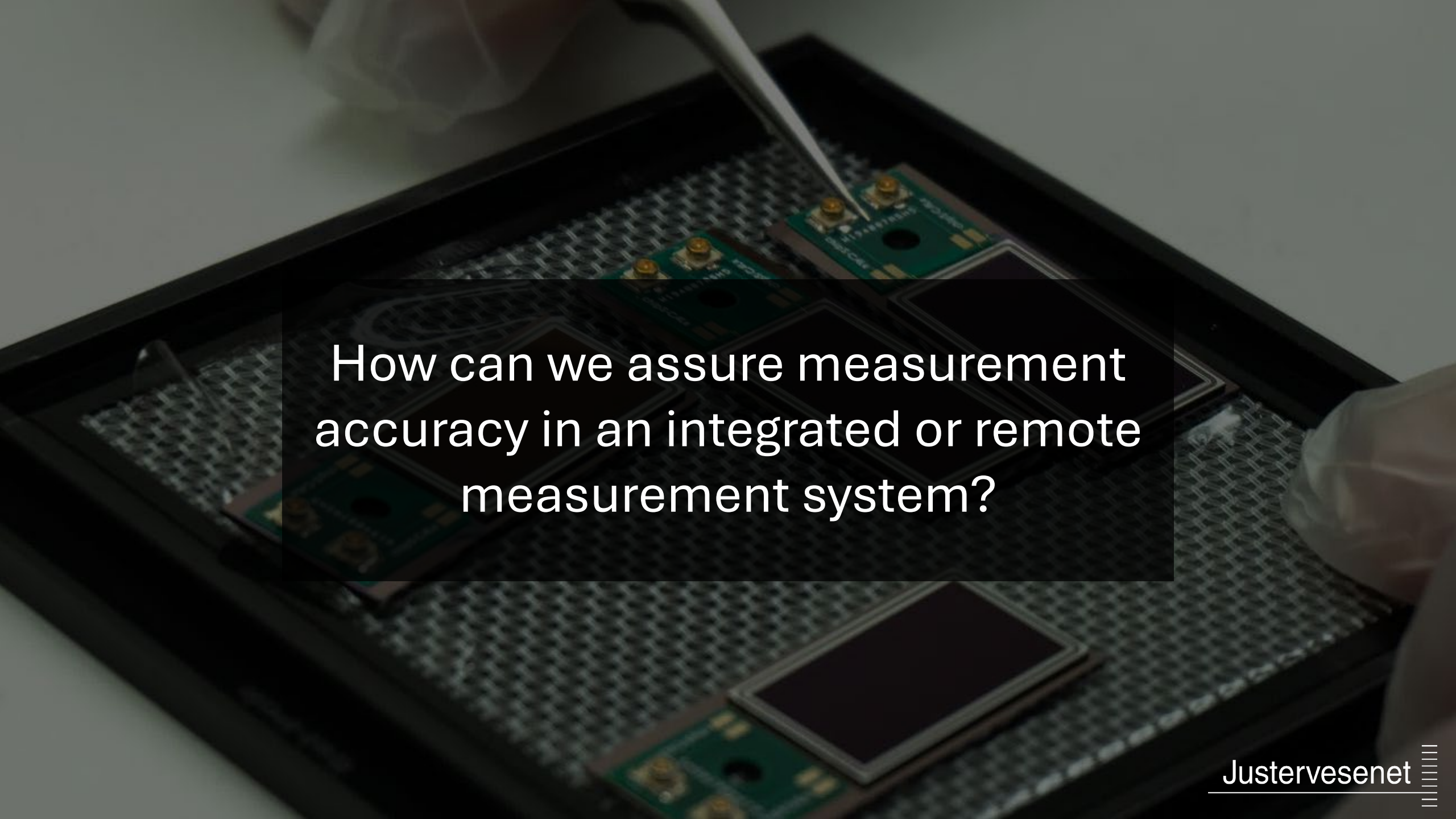
INSTRUMENTS **SENT TO NMI** FOR CALIBRATION

CONSULTATION SERVICES

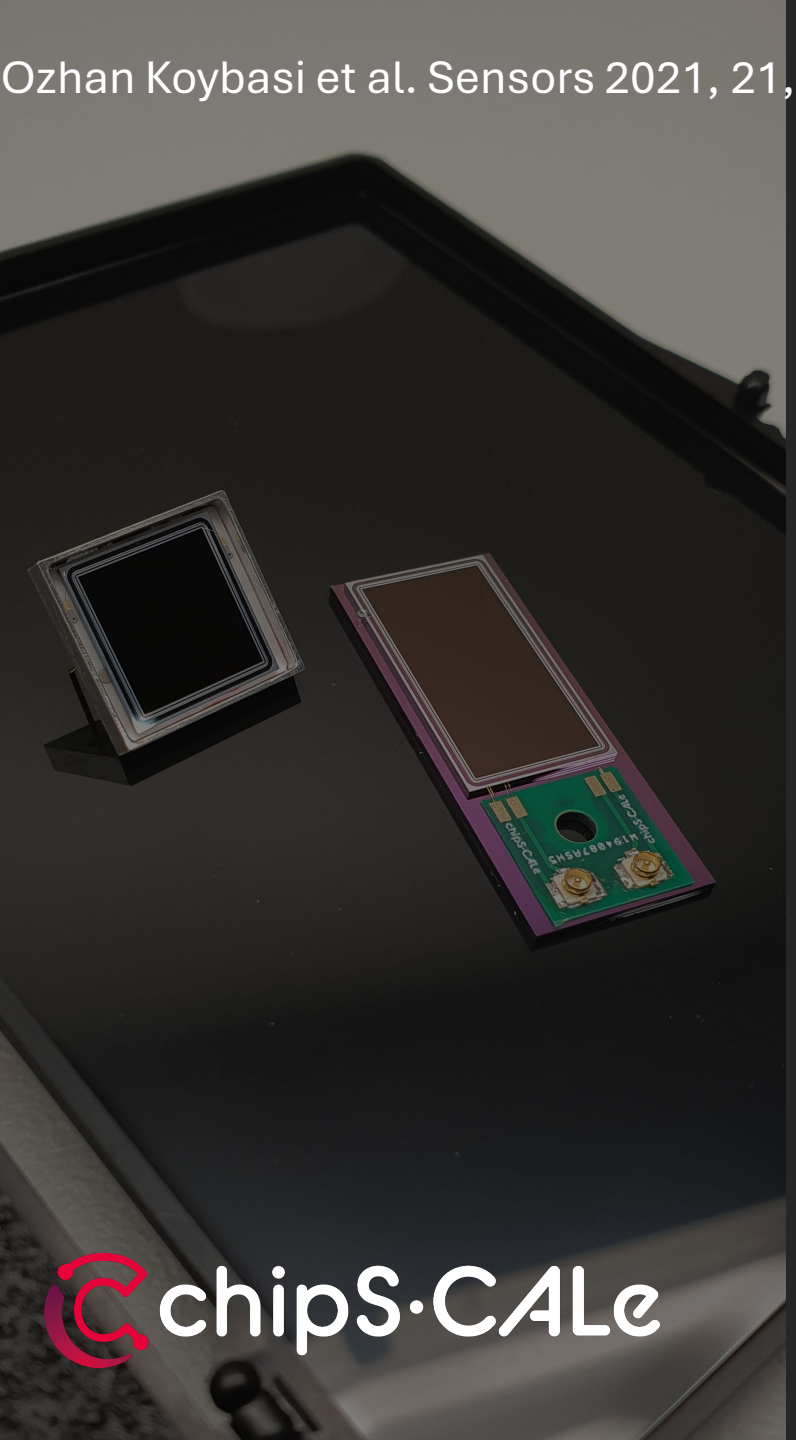
NMI-on-a-chip

«. . . It’s not about taking instruments to the lab. . .

It’s about taking the lab to the instrument . . .»


How can we assure measurement accuracy in an integrated or remote measurement system?

Ozhan Koybasi et al. Sensors 2021, 21, 7807



chipS·CALe

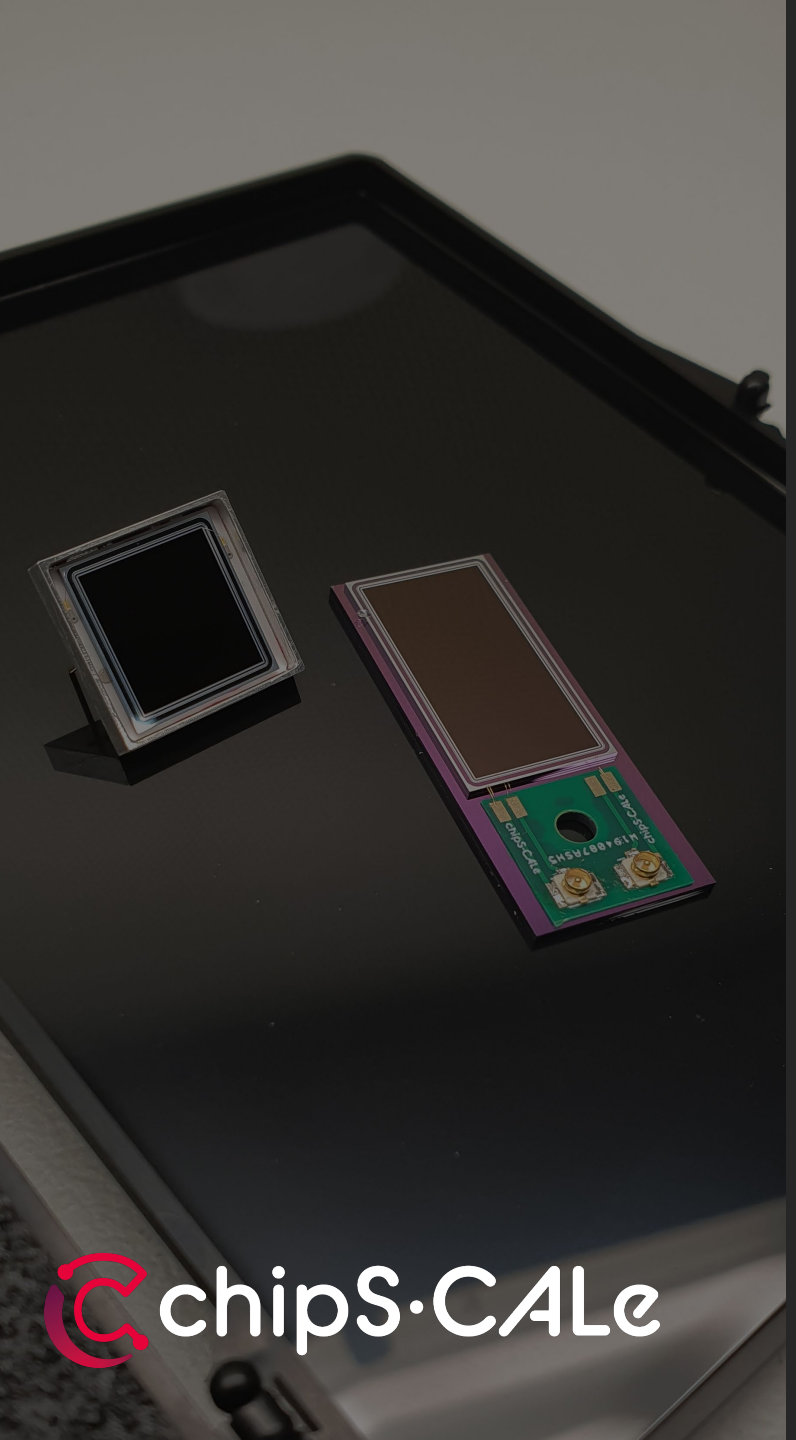
RESEARCH TOWARDS NMI-ON-A-CHIP

How to develop NMI-on-a-chip?

IMPROVED detectors

- Microelectronics ensures miniaturisation and scalability

New **independent experimental techniques** developed



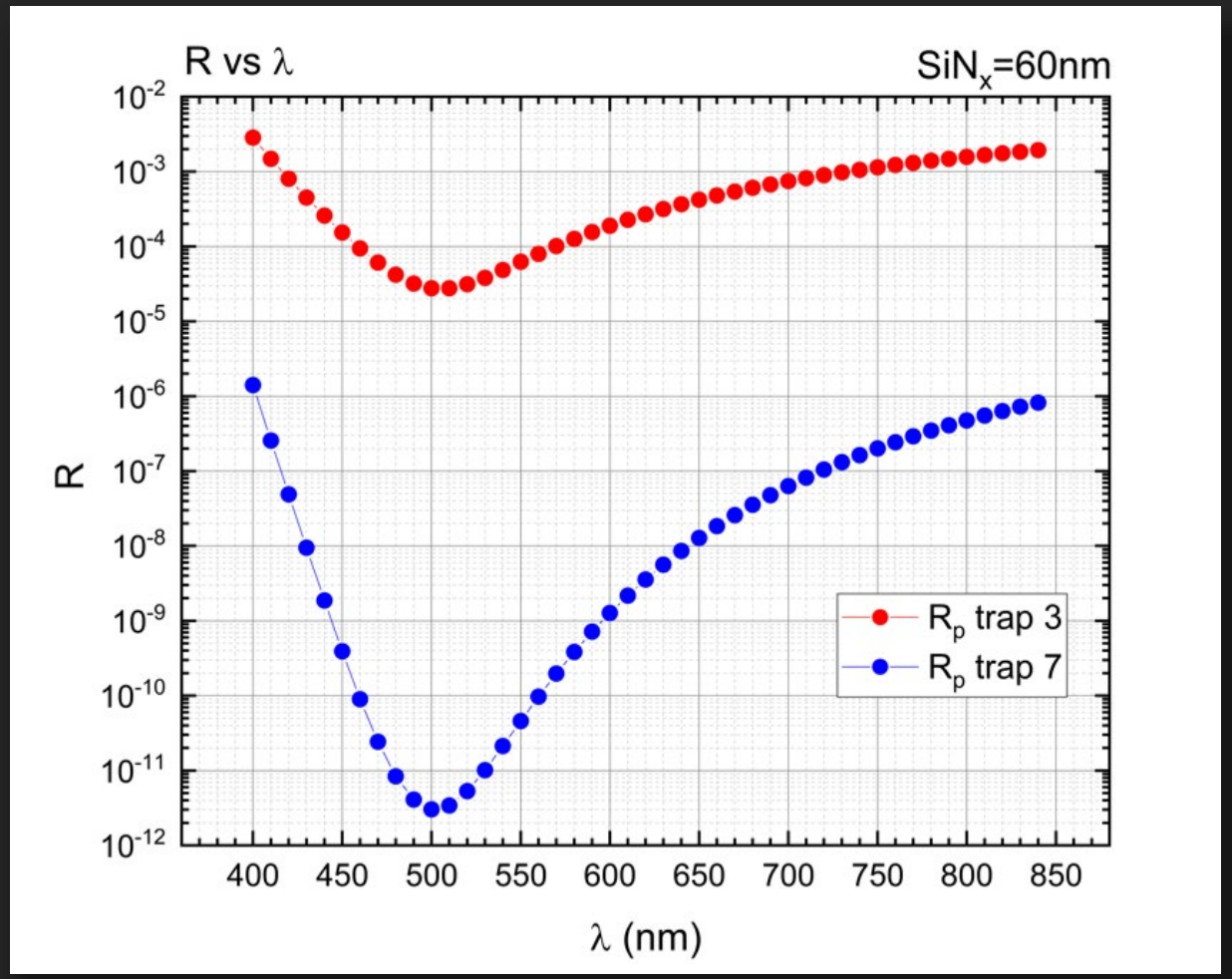
chipS·CALe

RESEARCH TOWARDS NMI-ON-A-CHIP

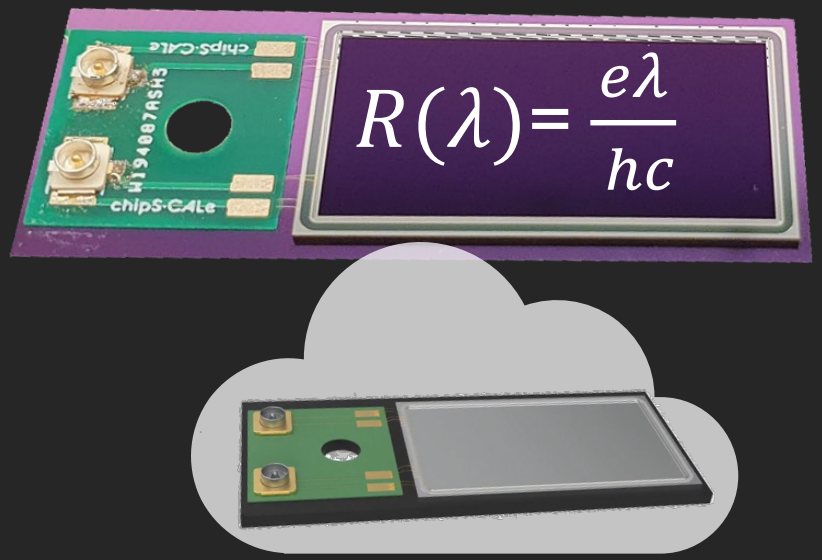
How to develop NMI-on-a-chip?

$$R(\lambda)=\frac{e\lambda}{hc}\left(1-\rho(\lambda)\right)\left(1-\delta(\lambda)\right)\mathrm{Y}(\lambda)$$

REFLECTANCE

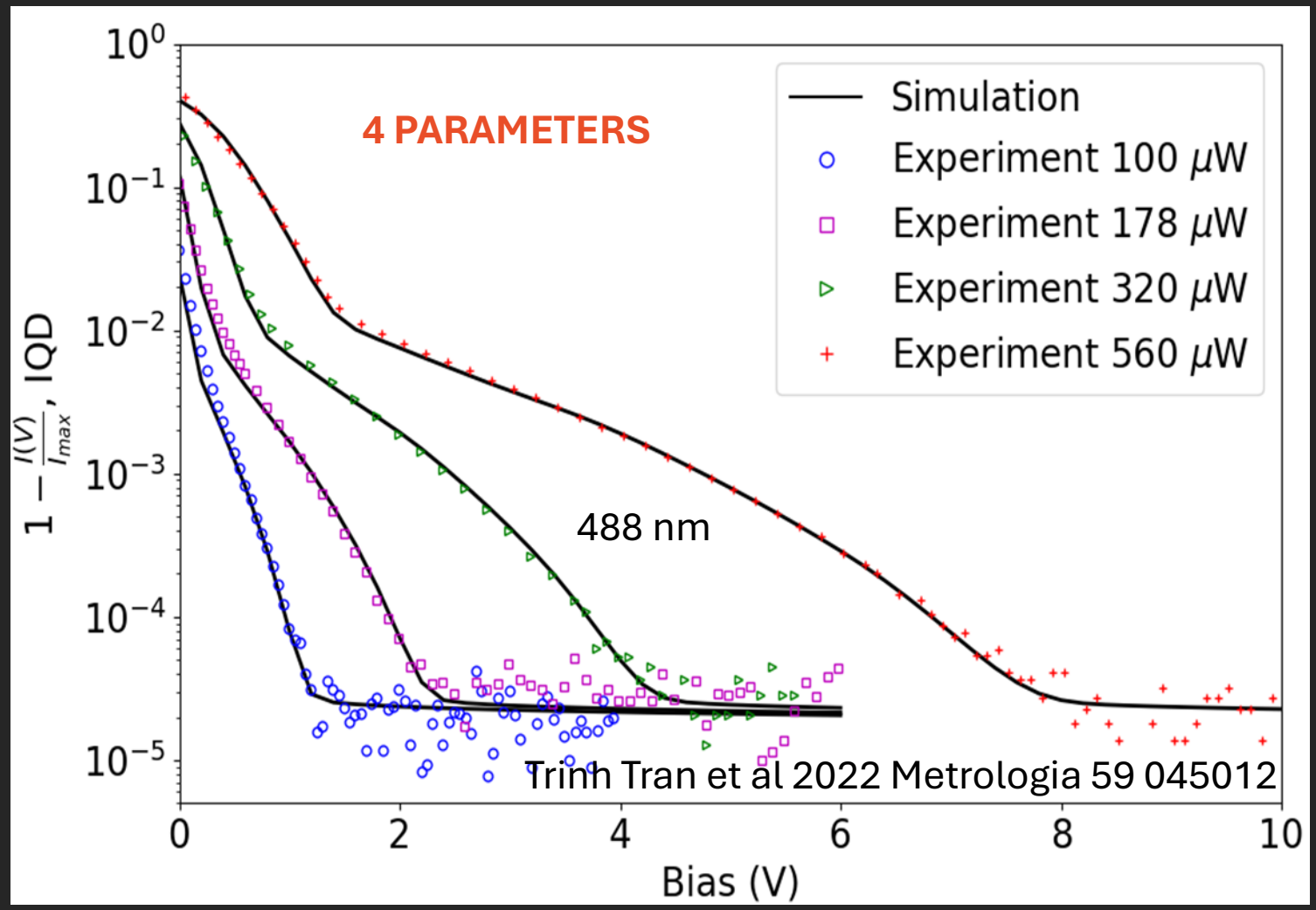


I-V EXPERIMENT – 3D MODEL FIT

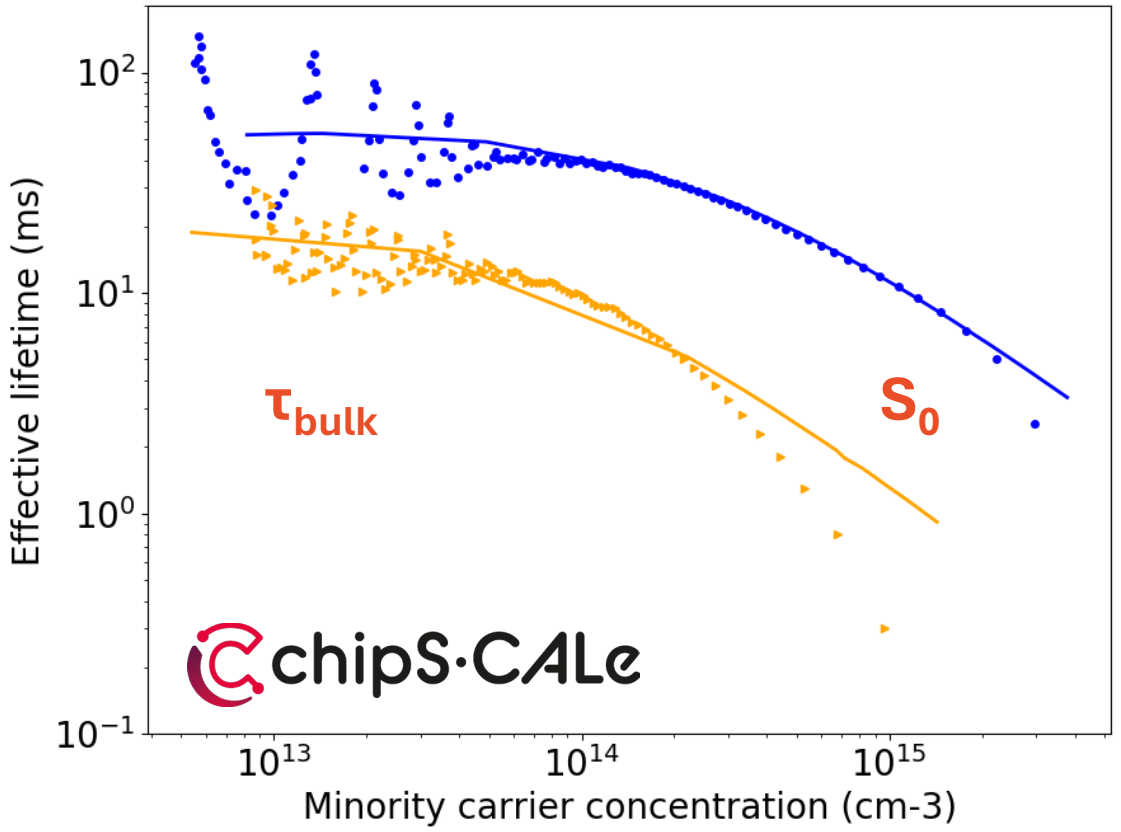


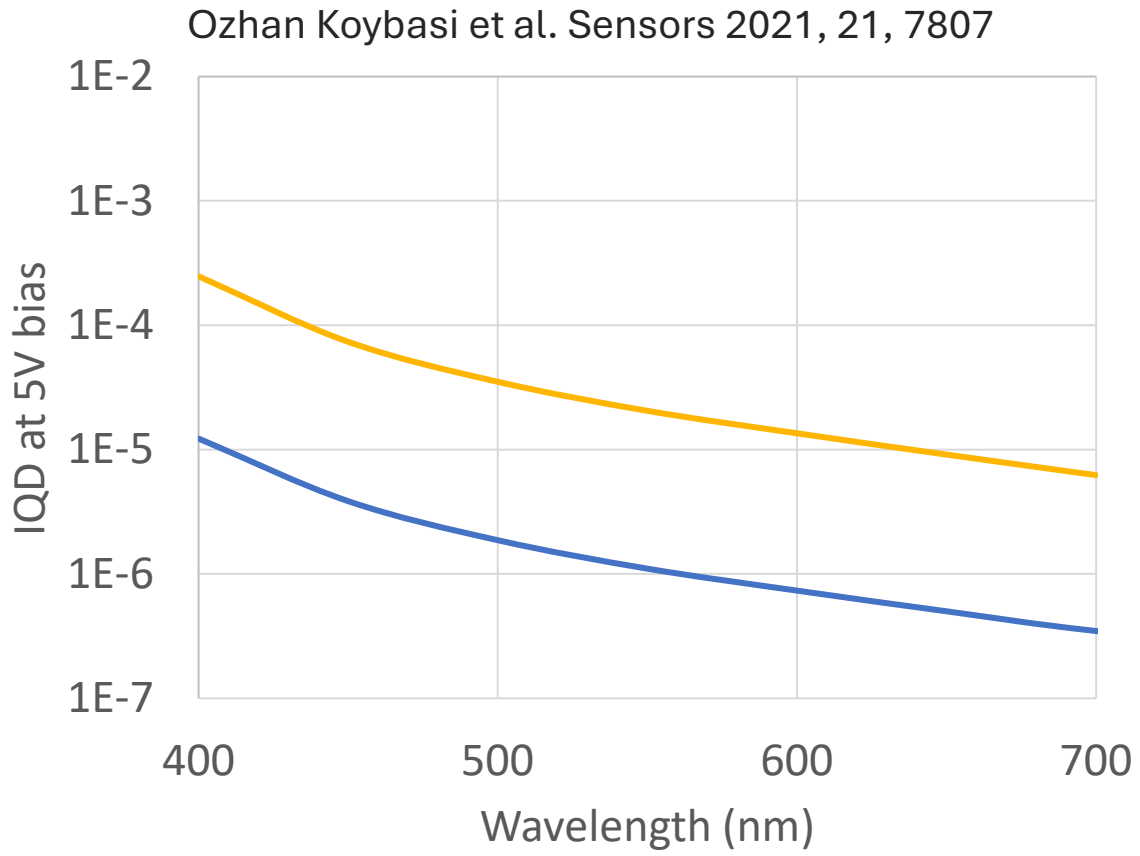
True to 99,999 %

Deviation from ideal perfomance



CHARGE CARRIER LIFETIME – MODEL FIT





THE
DUAL-MODE METHOD

Reaching uncertainties of 0.03 % at room temperature

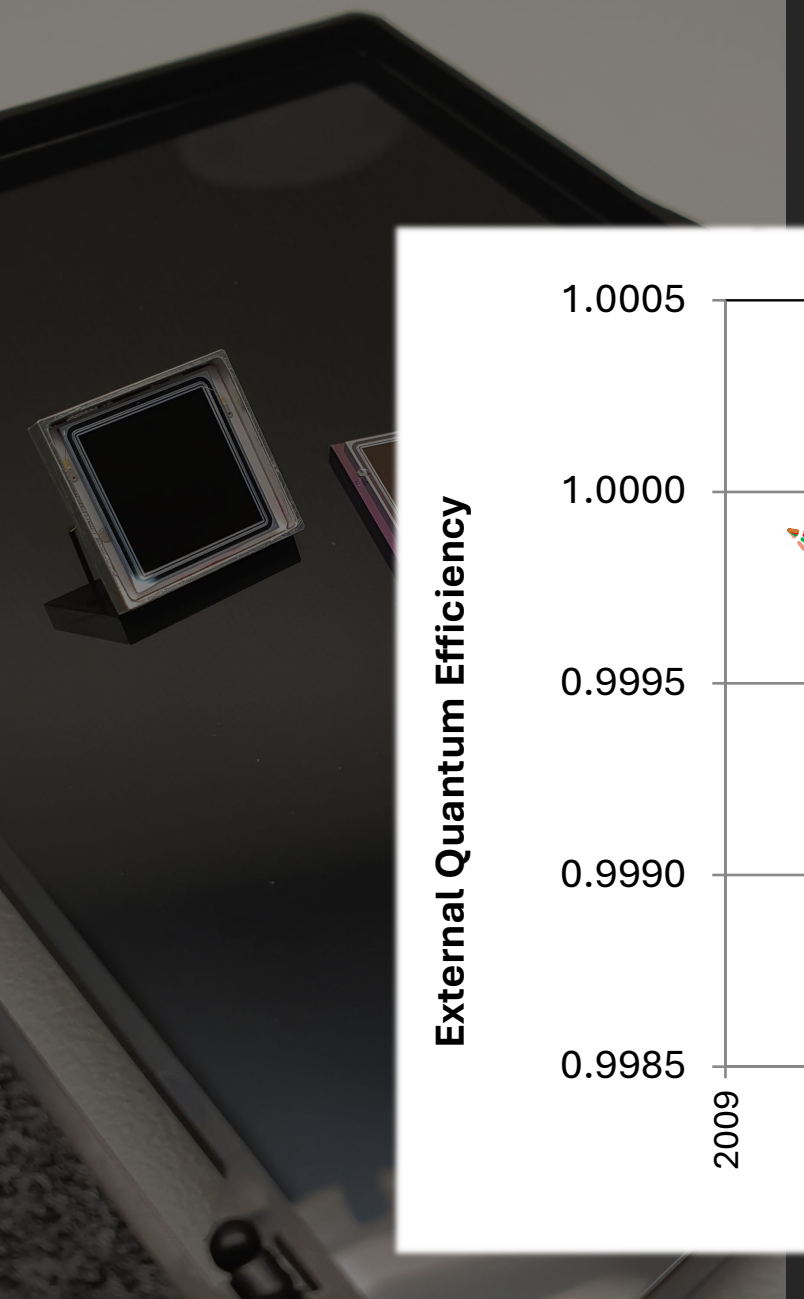
J. Solheim, sumitted to Metrologia

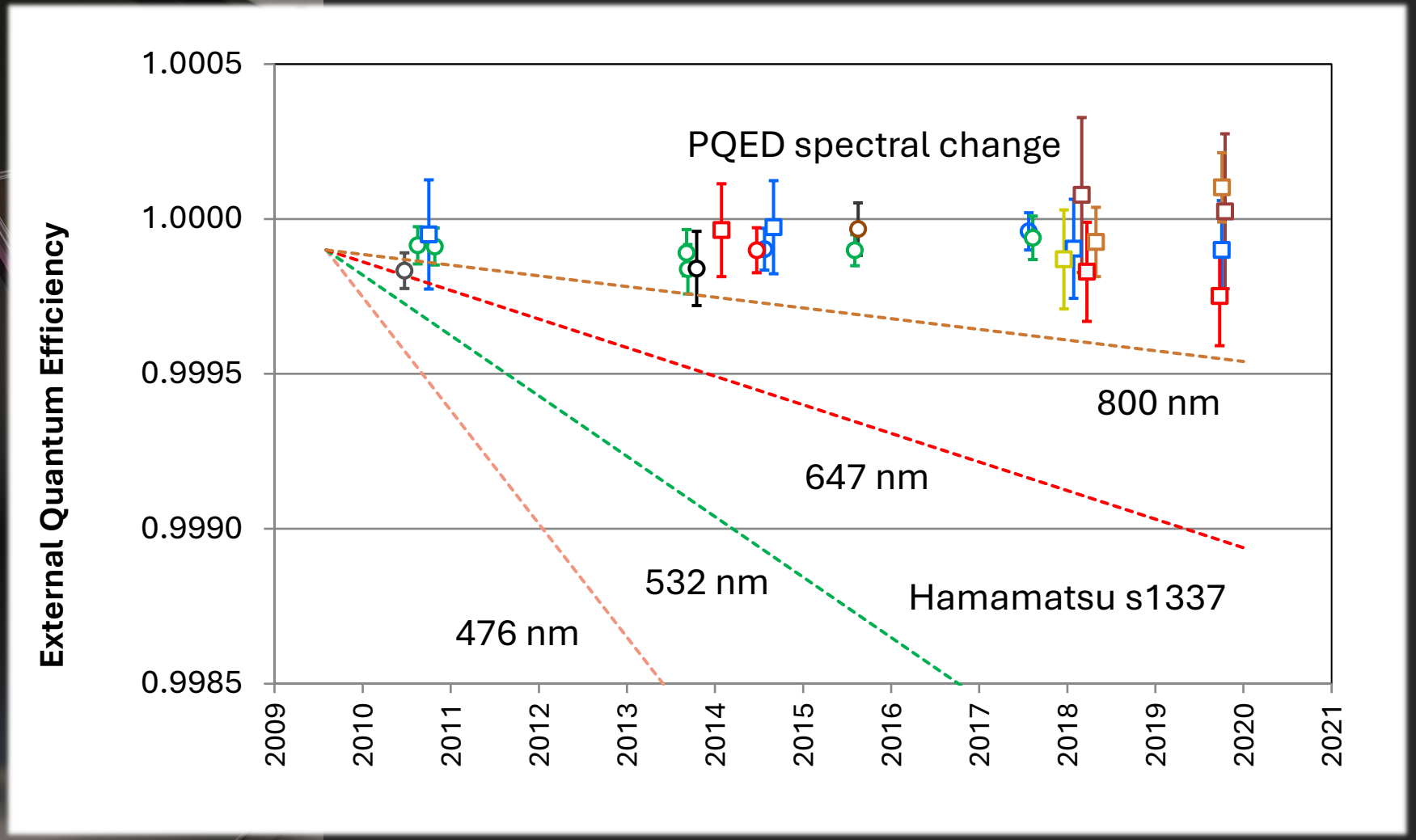
Calibrate Internal quantum deficiency (IQD) at room temperature through two experiments:

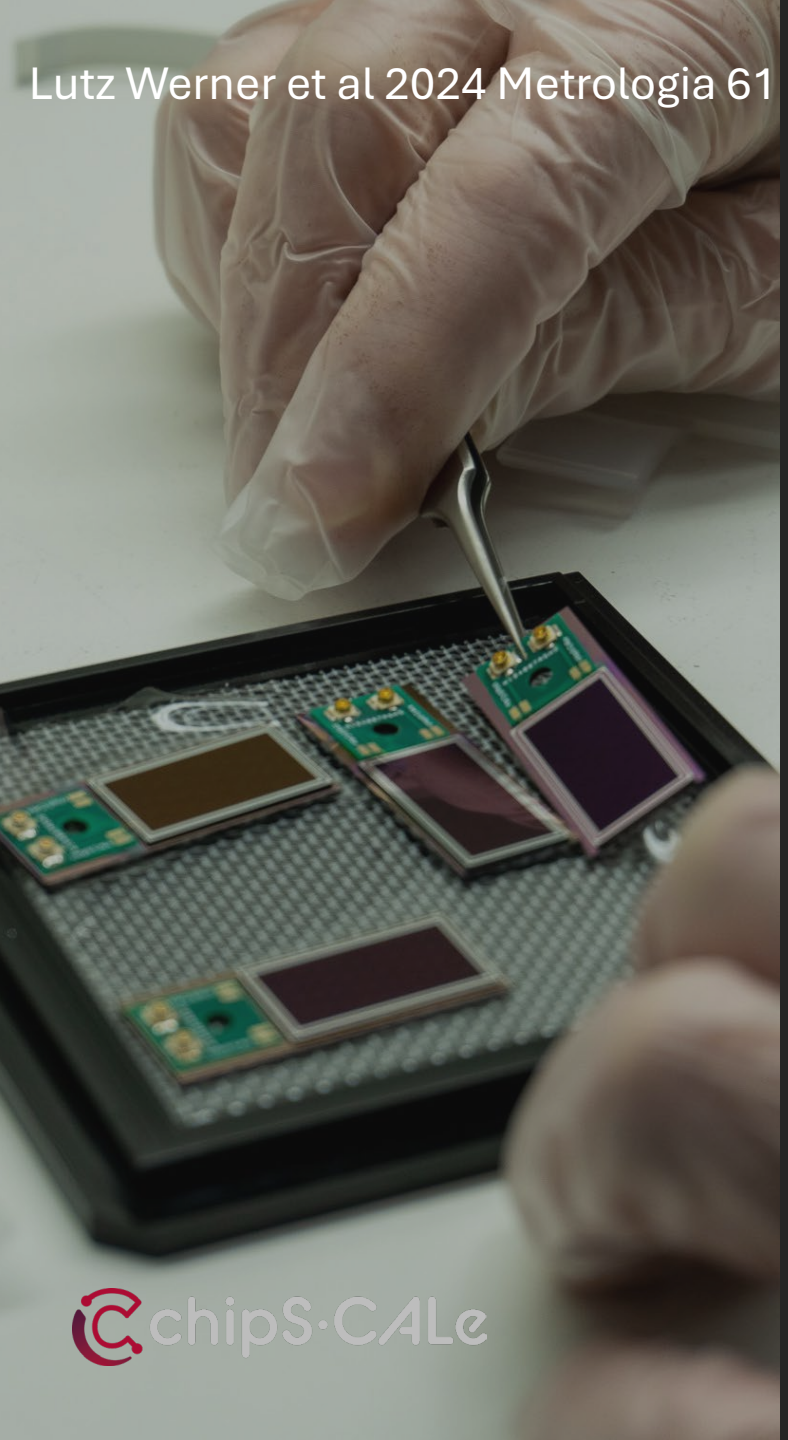
$$\delta = 1 - \frac{P_{opt,pc}}{P_{opt,es}}$$

G Porrovecchio et al 2022 Metrologia 59 065008

STABLE UV-PHOTODIODES

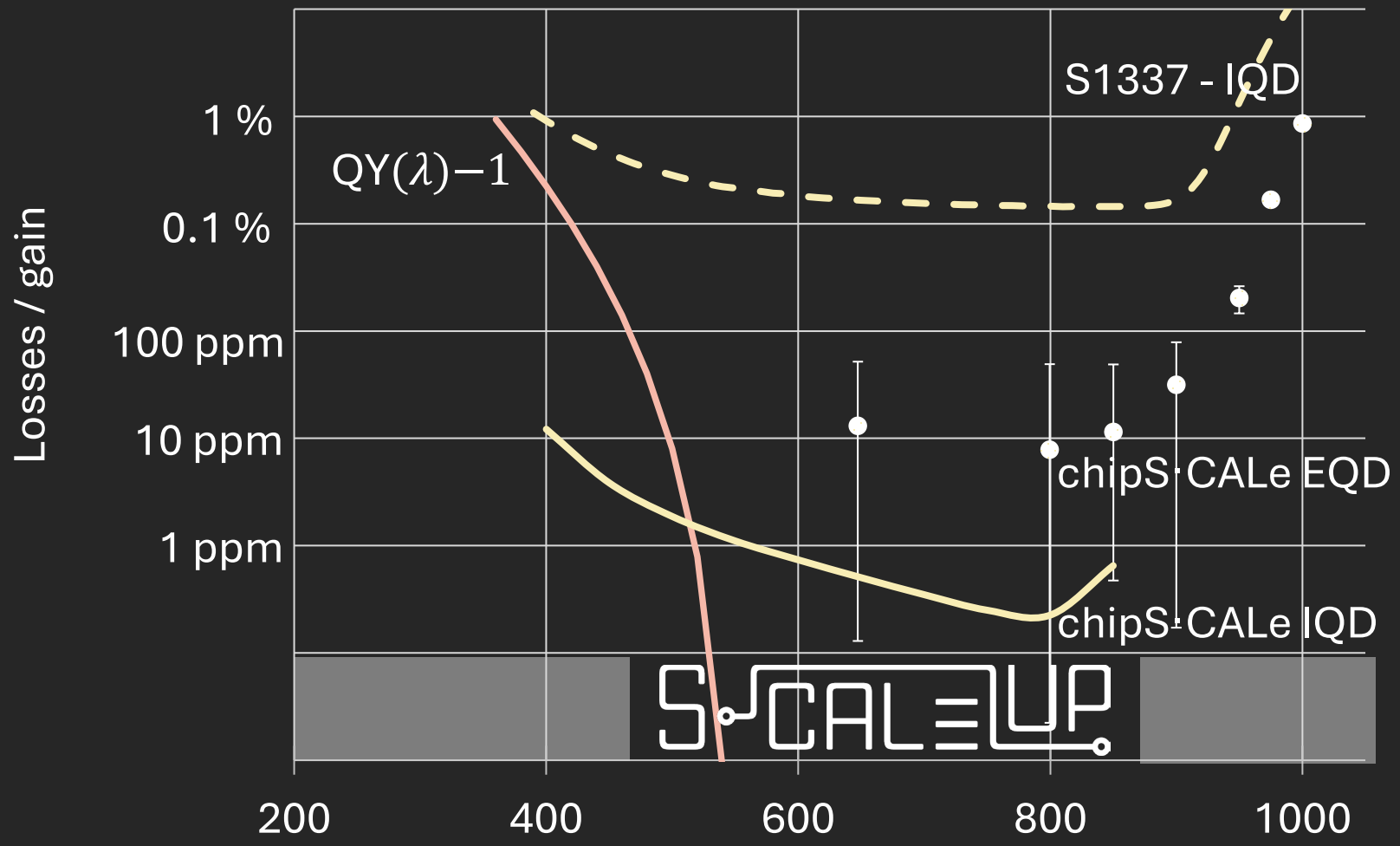






Lutz Werner et al 2024 Metrologia 61 035002

SPECTRAL RESPONSE SCALE



IMPROVED
SIMULATIONS

HPC 3D SIMULATIONS

Improved simulation speed and accuracy

SIMPLER HIGH SPEED MODELS

Applicable low cost high speed models calibrated against 3D simulations

APPLICATIONS

FILTER FREE PHOTOMETRY
Using the PQED directly as a photometer

https://scaleup.aalto.fi/

APPLICATIONS

FILTER FREE PHOTOMETRY
Using the PQED directly as a photometer

PICs and FIBRE OPTICS
Explore suitability of applying a PQED as a reference in emerging applications

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APPLICATIONS

FILTER FREE PHOTOMETRY
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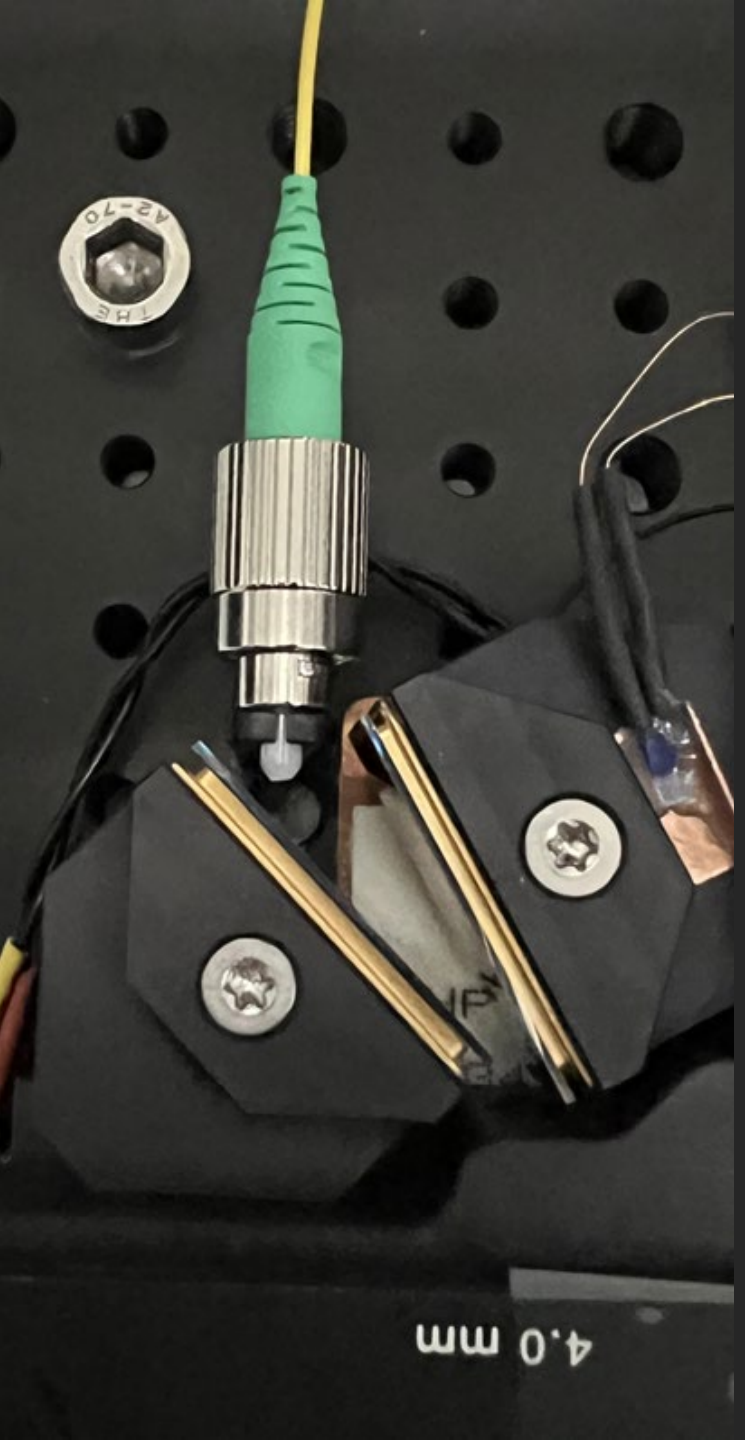
Explore suitability of applying a PQED as a reference in emerging applications

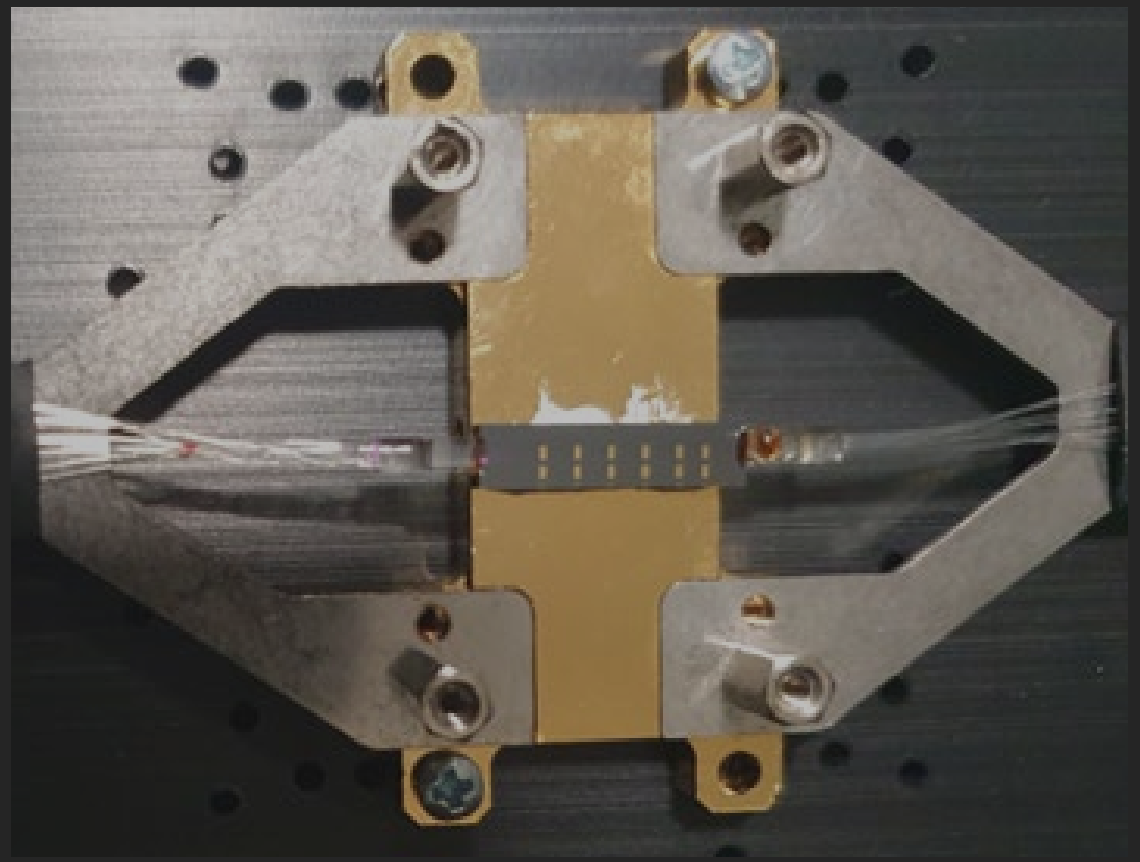
SELF-CALIBRATING POWER METER
Simplified readout and control electronics

https://scaleup.aalto.fi/

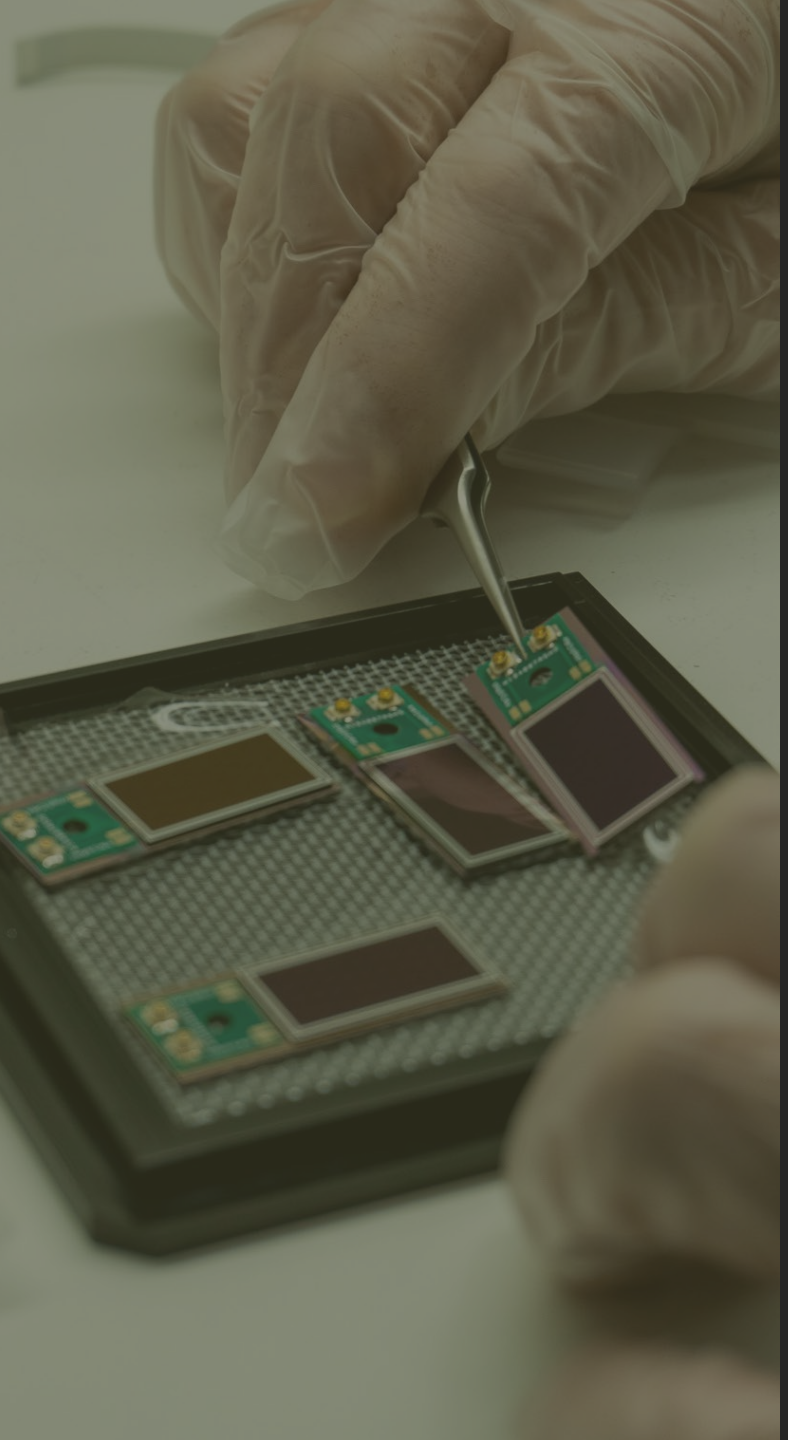
SELF-CALIBRATING OPTICAL POWER METER



PICs and FIBRE OPTICS



https://scaleup.aalto.fi/



OUTLOOK BEYOND 2026

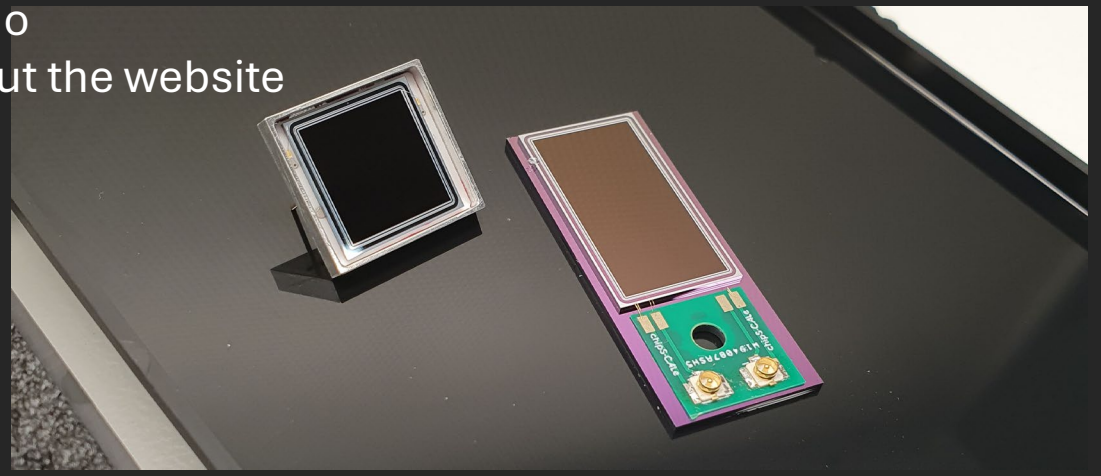
- MORE APPLICATIONS
- FURTHER INTEGRATION
- EXPANDING SPECTRAL RANGE

AVAILABLE THROUGH JOINT ORDER

2 DIFFERENT SIZES: 11 X 22 mm^2 and 11 x 11 mm^2

Expect call this fall

jag@justervesenet.no
Email me or check out the website



https://scaleup.aalto.fi/

The project has received funding from the European Partnership on Metrology, co-financed from the European Union's Horizon Europe Research and Innovation Programme and by the Participating States

SCALEUP

INTERESTED? – TALK TO US

Jarle Gran
Chief Engineer

Johanne Solheim
Senior Engineer

PQED
animation video

https://scaleup.aalto.fi/

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EUROPEAN PARTNERSHIP

Co-funded by the European Union

METROLOGY PARTNERSHIP

EURAMET