



**Quantum Delta**  
the Netherlands

# NanolabNL

Enabling Quantum Device Fabrication

# Contest

- 1 What is NanolabNL
- 2 Key Enabling in the Quantum Ecosystem
- 3 What are the plans in the QuantumDelta
- 4 What can we do for you: Q&A



1

What is NanolabNL



# About NanolabNL

- The Dutch national facility for micro- and nanotechnology research, since 2004
- We offer the use of our facilities and expertise to universities, research institutes, start-ups and industry
- 5 locations in NL; strong regional hubs for research and innovation
- Included in the National Roadmap for large-scale research facilities.
- *Our mission: providing a full-service and open-access infrastructure for R&D in nanofabrication*



# Locations



Groningen  
Zernike NanoLab



Enschede  
MESA+ NanoLab



Amsterdam  
AMOLF NanoLab



Delft  
Kavli NanoLab | Else Kooi Lab | TNO NanoLab



Eindhoven  
NanoLab@TU/e



# Expert Functions for Quantum

Q-2D-materials (Groningen)

Q-nanotechnology, sensing en photonics (Twente)

Q-nanophotonics (Amsterdam)

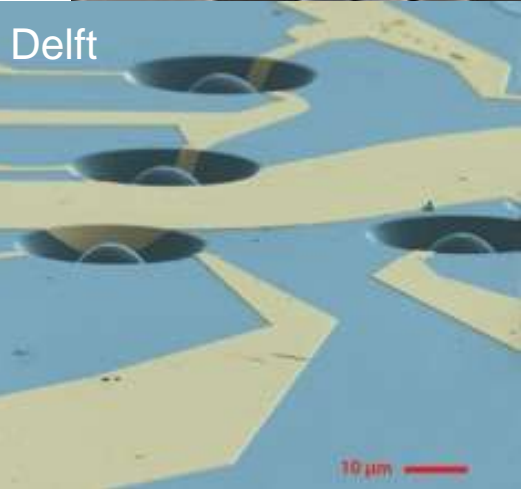
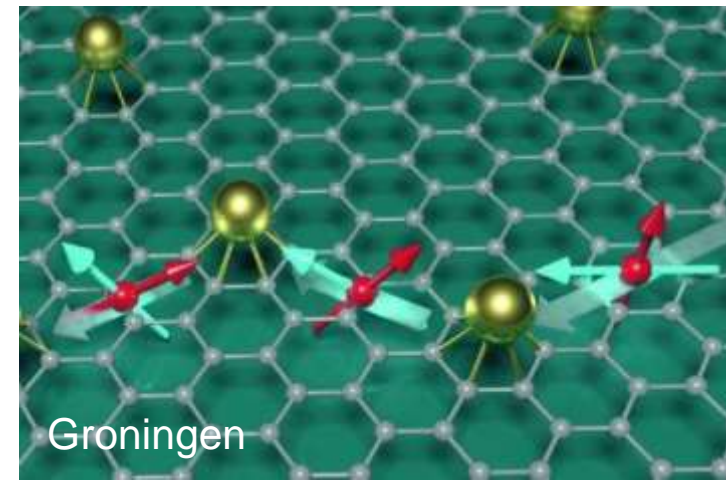
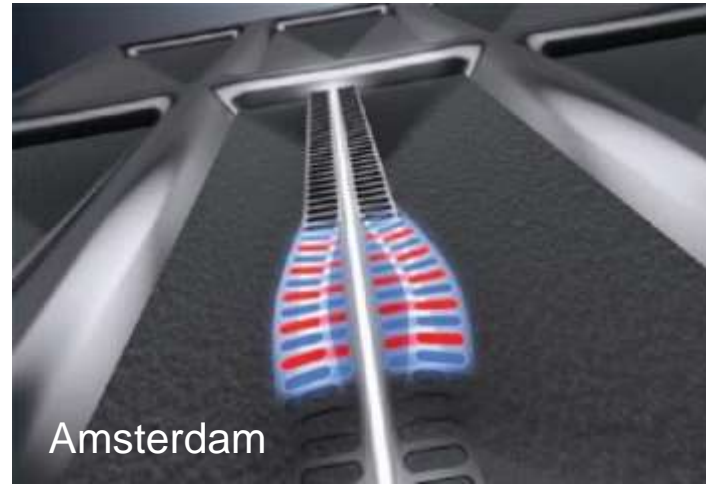
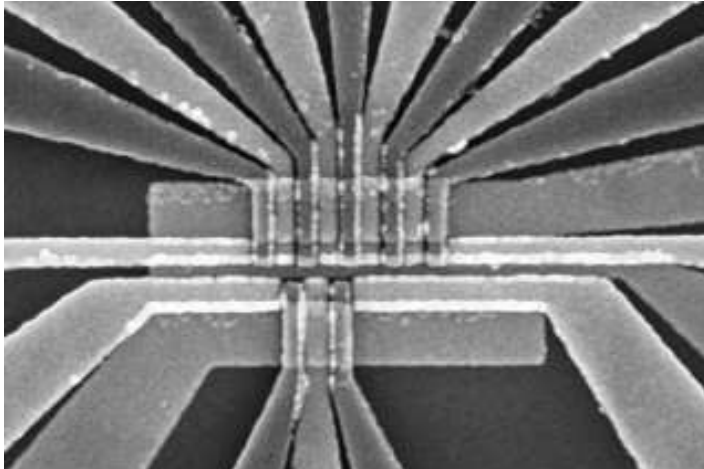
Q-computing en internet (Delft)

Q-materials en photonics (Eindhoven)

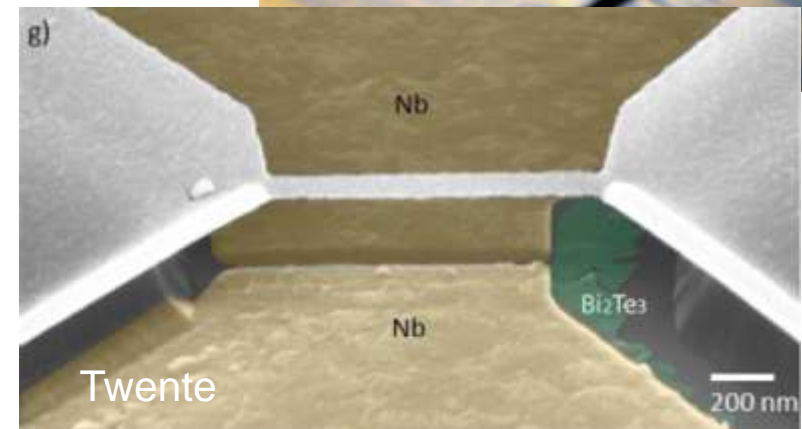
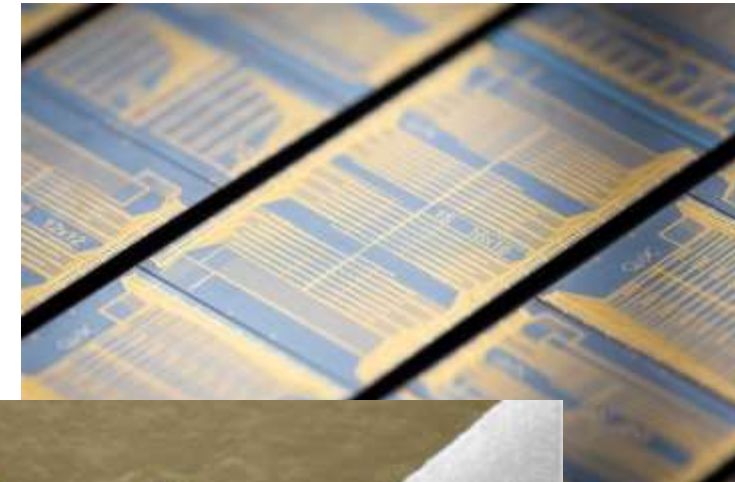
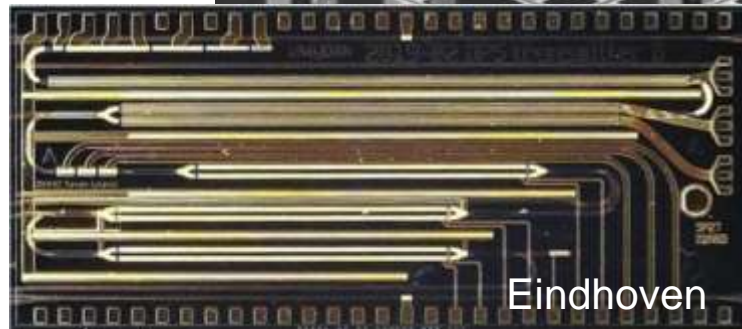




# Examples



10:03 500nm



# Key User Data

Average per year 2014 - 2018



Use of NanoLabs

169.635  
hours



Use of NanoLabs

1.304  
persons



PhD Projects

600



Publications

1.452



Industrial use

20 %  
(of total)



Startups / spinoffs

6



Patents

28

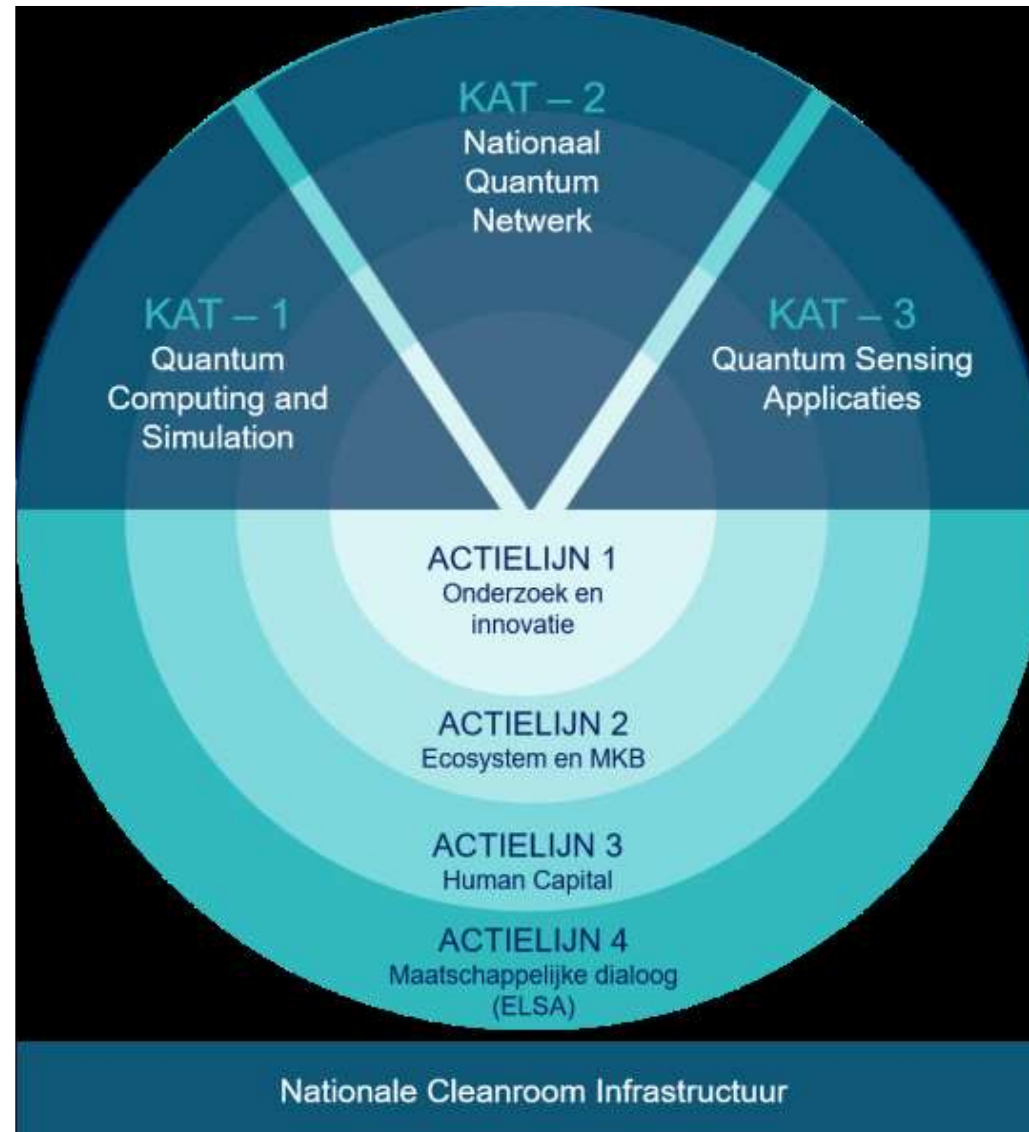


2

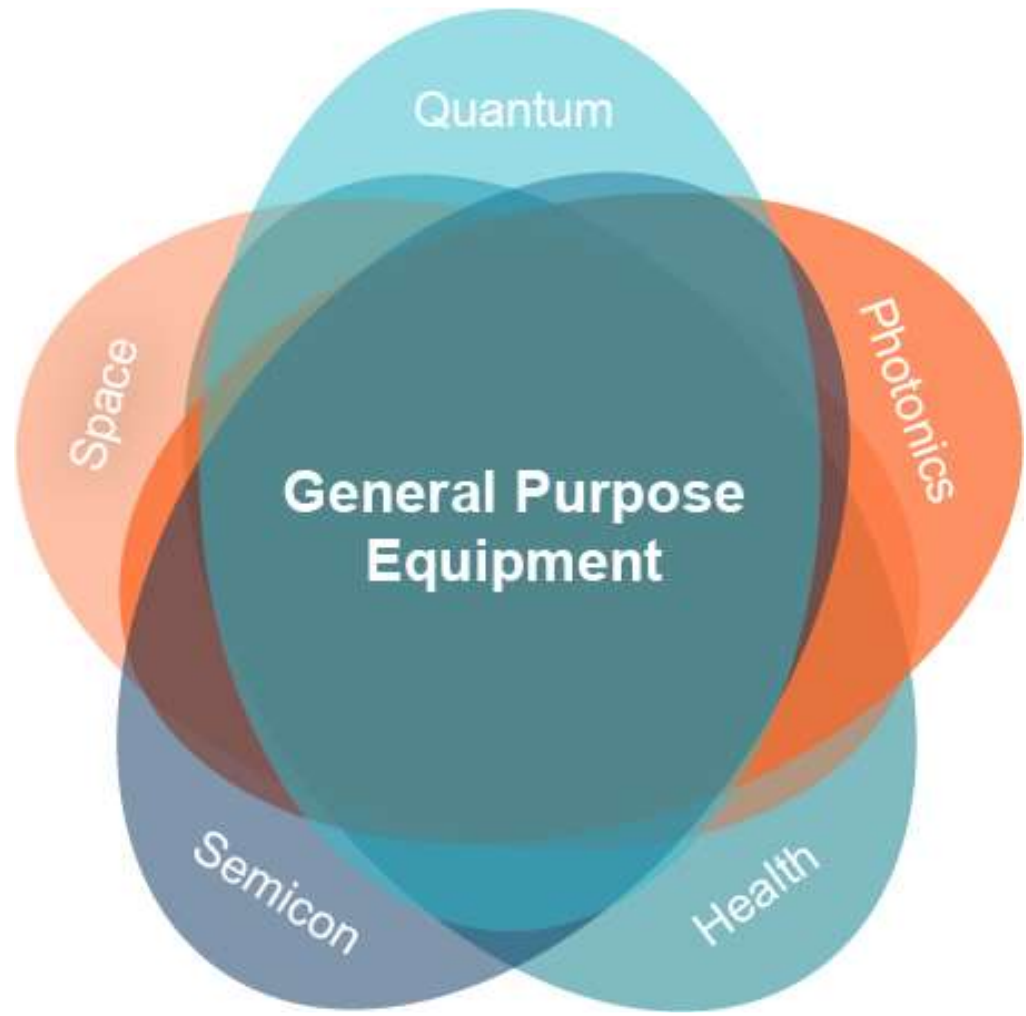
# Quantum Nanofabrication In NanolabNL



# Key Enabling Technology Infrastructure



# Basic & Expert Functions



EXPERT TECHNOLOGIES

## ◎ MESA+ NANOLAB TWENTE

- Micro/nano MEMS, – fluidics, – electronics and – optics
- 2D/3D-nanostructures • Nano devices/materials
- Advanced analysis facilities

## ◎ NANOLABS DELFT

### KAVLI NANOLAB

- Nanostructuring by charged particle beams
- Quantum nanodevice fabrication • Bio-nano imaging

### ELSE KOOI LAB

- Nanodevice integration • Sensors • Wafer level integration
- Silicon & polymer integration • Microsystems

### TNO NANOLAB

- Contamination control • (EUV) Optics Lifetime
- Nanofabrication for quantum computing

## ◎ NANOLAB@TU/E EINDHOVEN

- Organic, magnetic and semiconducting materials & devices
- III-V integrated photonics • Growth of nanostructures and nanolayers

## ◎ ZERNIKE NANOLAB GRONINGEN

- Quantum electronic materials • Molecular self-assembly
- Device technology for Green ICT

## ◎ AMOLF NANOLAB AMSTERDAM

- Optical and mechanical metamaterials
- Nanophotonic and nanophotovoltaic materials & devices



3

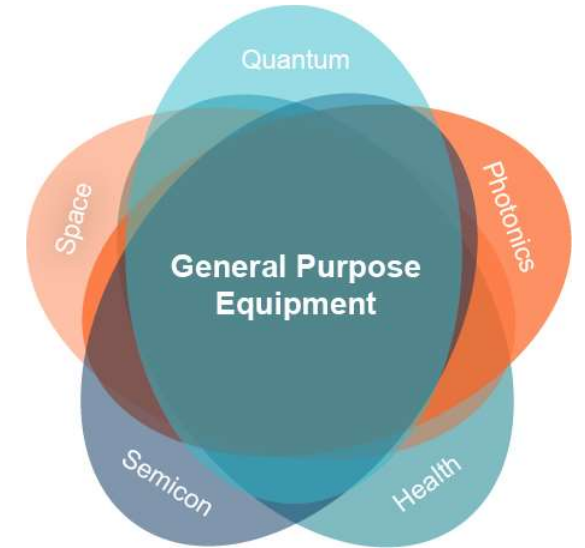
# Plans in Quantum Delta NL



# A. Strengthening the basic infrastructure

Large re-investment program to continue our current service level

- Replacement investments
- Upgrades of existing equipment
- New capabilities



# B. Impuls investment in high TRL infra

- Additional program to strengthen innovation chain (SME's, start-ups, corporate R&D, ... )
- No new capabilities
- Voucher program for starting companies



# Technology Readiness Levels

## Infrastructure Nanotechnology

basic

impuls



1	2	3	4	5	6	7	8	9
Basic Principle Observed	Techn Concept Formulated	Exp Proof of Concept	Techn Validation in lab	Techn Validation Relevant Environment	Demo in Relevant Env	Demo in Operational Env	System Complete and Qualified	Successful Mission Operations

Open-Access Nanolab

Foundries  
Production facilities  
Industry

# high-TRL equipment: yield, reproducibility, uniformity, ...

A. Dedicated functions per machine

1 machine: Material A and B



machine 1: Material A



machine 2: Material B

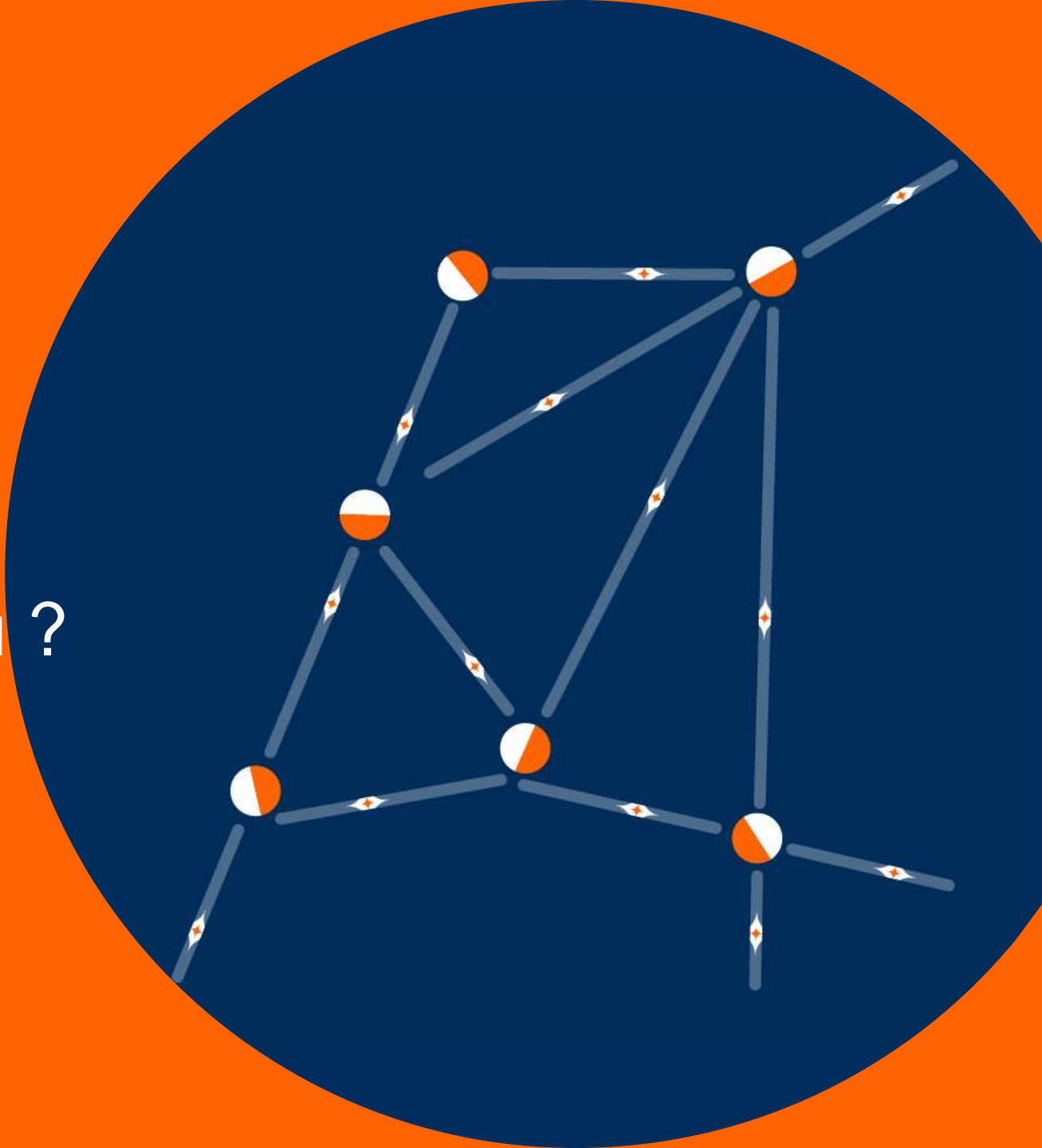


B. Automation: single wafer → cassette-to-cassette



4

What can we do for you ?  
Q&A





**Quantum Delta**  
the Netherlands

Guus Rijnders, Frank Dirne

Contact NanoLabNL: see our website <https://nanolabnl.nl/>

