

QUANTUM SENSING @ BOSCH

—

OUR JOURNEY INTO A NEW WORLD

DR. KATRIN KOBE,
CEO QUANTUM SENSING START-UP

AGENDA

Who we are?

What do we do?

Quantum technology – an overview

GenN advantages

Generating quantum systems of the GenN

Application fields of quantum sensors

Current fields of action

The vision

WHO WE ARE?

BOSCH QUANTUM SENSING



BOSCH QUANTUM SENSING

OUR OBJECTIVE & MOTIVATION



Our objective

We shape the future as **global leader** in quantum sensing providing most **sensitive, portable** and **successful solutions**.

“CreateTheUnthinkable”



Our motivation

We create **game-changing** solutions to improve the **quality of life** for **everybody worldwide**.

WHO ARE WE?

A FAST AND INDEPENDENT START-UP @BOSCH

- ▶ Launched as **new organizational unit** in **September 2021**
 - ▶ CEO (Dr. Katrin Kobe)
 - ▶ 7 dedicated associates
 - ▶ Own location in Renningen
- ▶ Since **January 2022 Internal start-up**
 - ▶ Located @ **grow platform**, a Bosch internal incubation platform for start-ups and intrapreneurs **in Ludwigsburg**
 - ▶ CTO (Dr. Frederik Schaal)
 - ▶ Currently 24 associates, 30 associates in perspective



WHAT DO WE DO & HOW WE DO IT?

WHAT DO WE DO & HOW WE DO IT?

QUANTUM SENSING #LIKEABOSCH



Research excellence

Bosch has been researching quantum technology for seven years, and we see ourselves as global leaders in this area.



Start-up environment

As an in-house start-up, we act fast and agile to transform the excellent research results into powerful products & solutions.



Rockstar team

We are a team of highly skilled technology and business experts combining corporate & start-up expertise.



User centricity

We put the users in the center of our activities to create solutions that offer real added value to our customers.



Global network

We benefit from Bosch's worldwide network, know-how and global market access.



Leaving an impact

Our revolutionary technology aims to improve the quality of life for everybody worldwide.
#InventedForLife

QUANTUM TECHNOLOGY – AN OVERVIEW

QUANTUM TECHNOLOGY – AN OVERVIEW

GenO (OLD) VERSUS GenN (NEW)

GenO

- ▶ Quantum technologies are already being used every day, e.g.:



COMPUTER

DATA NETWORKS



MEDICAL IMAGING

LASER



GenN

- ▶ Quantum effects are no longer only used indirectly, but controlled in a targeted manner

HIGH-PERFORMANCE COMPUTER



EXTREMELY HIGH SAFETY FOR DATA COMMUNICATION



MUCH MORE PRECISE MEASUREMENTS, E.G., MORE POWERFUL SATELLITES



QUANTUM TECHNOLOGY – AN OVERVIEW

HOW QUANTUM SENSORS WORK

Quantum sensors GenO consider an ensemble of quantum states

If this ensemble is stimulated, it decays; one sees the superposition of many quantum states (probability distribution = wave character)

Example

- ▶ If you have coherent light, such as laser light, you can see a wave pattern behind the illumination of a double slit

Only the technological progress of the last 20 years has made it possible to manipulate individual quanta

Quantum sensors at GenN look at individual, specially prepared quanta

GenN manipulates the state of a single quantum

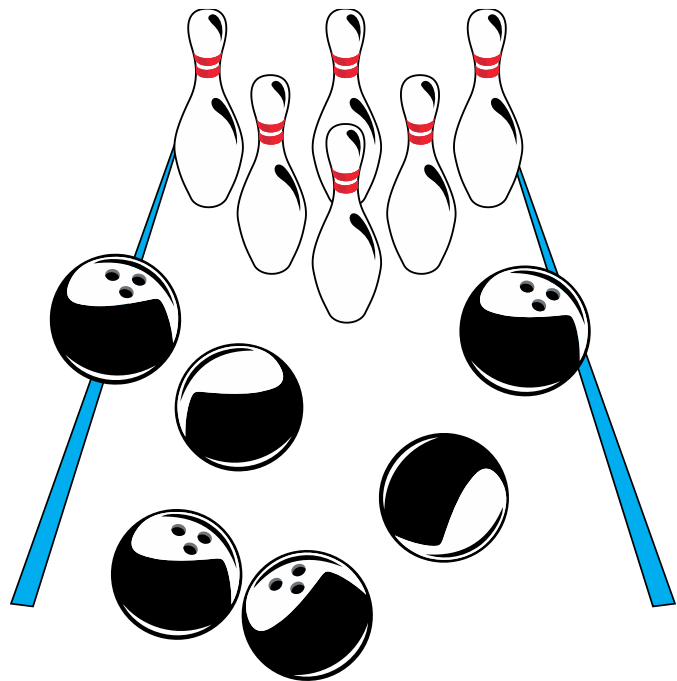
Example

- ▶ The electron will be excited in a well-defined spin state
- ▶ The spin remains in this state, until it is disturbed
- ▶ A minimal interaction with the environment (e.g., measured variable) initiate the decay of the system

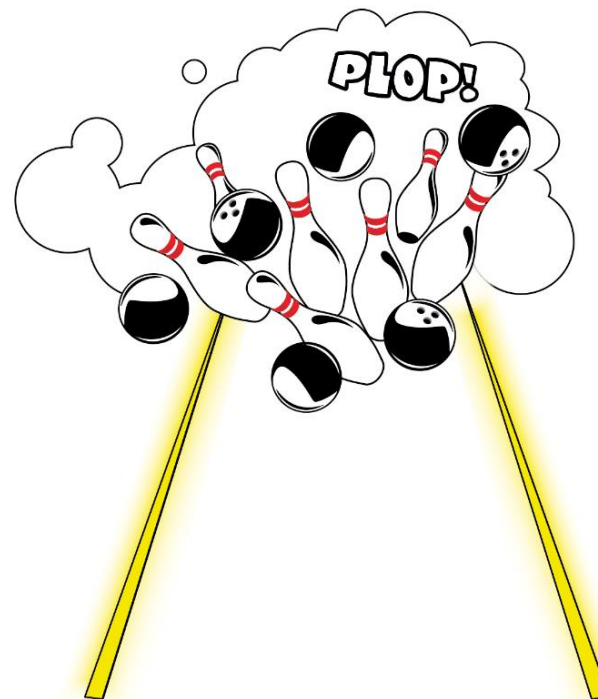
You can measure the smallest changes in the environment

QUANTUM TECHNOLOGY – AN ILLUSTRATION

GenO



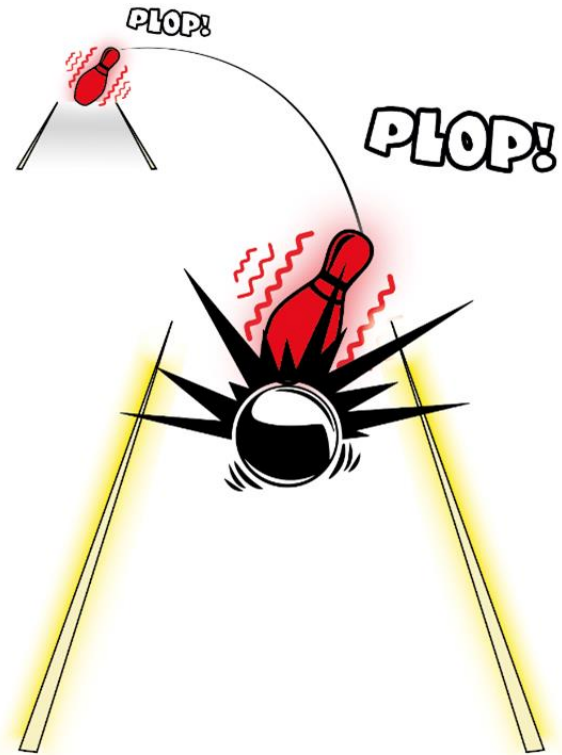
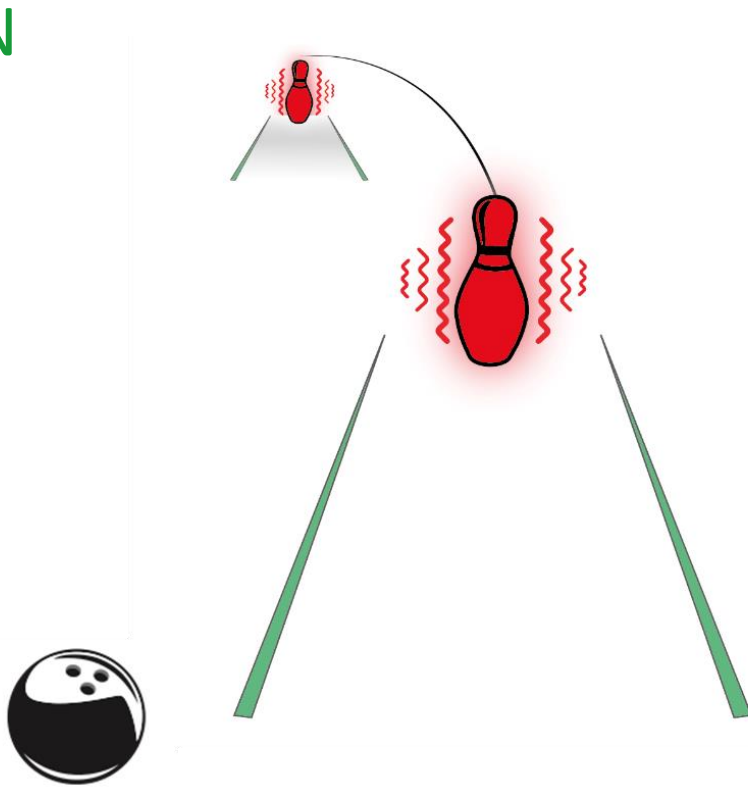
- ▶ A **large number of cones** must fall all at the same time in order to hear the bang, i.e., for a measurement signal to be generated



- ▶ For all cones to fall at the same time, **many balls must** be thrown onto the track

QUANTUM TECHNOLOGY – AN ILLUSTRATION

GenN



- ▶ We have practiced a lot in the last 20 years, and now we are able to hit and knock down the cones **with just one ball**
- ▶ At the same time, we've learned to **prepare the cone** to be able to hear when only one pin falls and makes a smaller noise

- ▶ In addition, we can **connect** two cones on different alleys so that when the cone is knocked down, the cone on the other alley also falls over at the same time (this is called entanglement or teleportation in physics)

ADVANTAGES OF GEN N

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EXAMPLE: MAGNETIC FIELD – QUANTUM SENSORS



ARE SIGNIFICANTLY **MORE SENSITIVE**



HAVE AN **EXTREMELY WIDE MEASURING RANGE**

ARE IN PRINCIPLE **MUCH SMALLER**



CAN PROVIDE **ADDITIONAL INFORMATION**



HAVE A **HIGHER SPATIAL RESOLUTION**



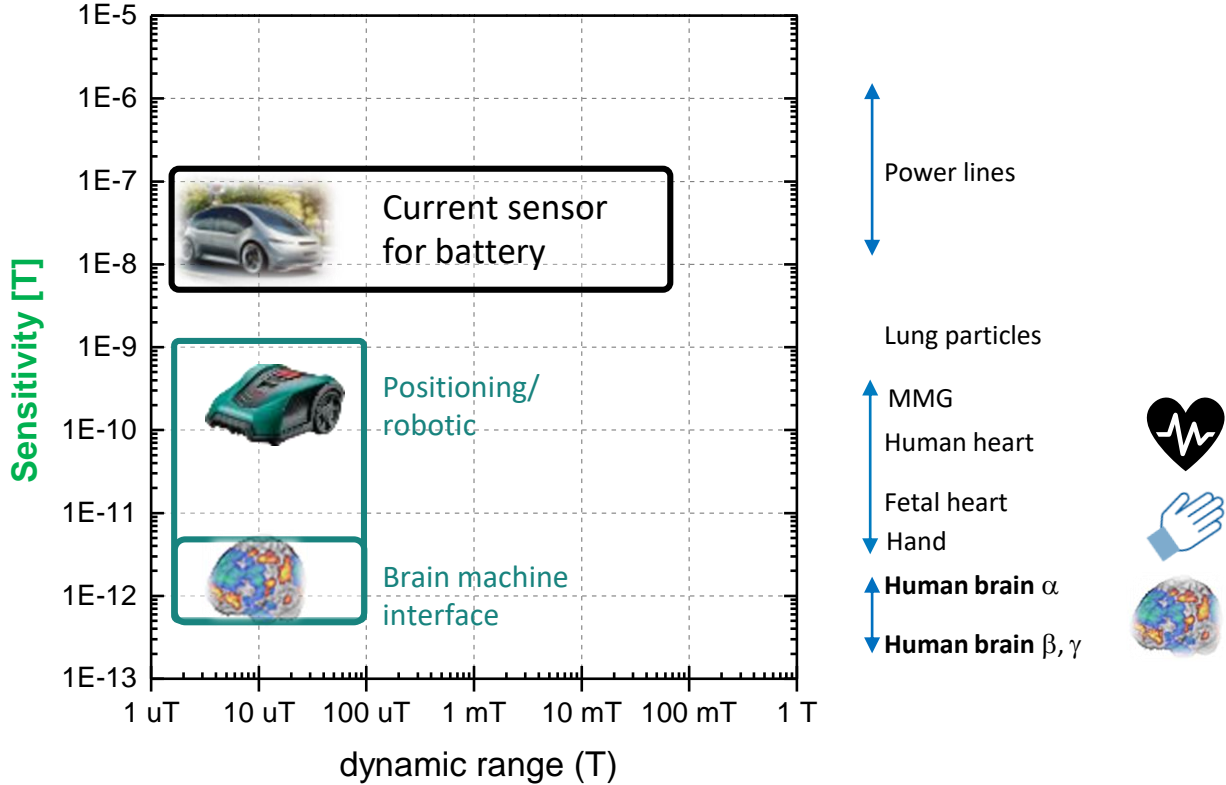
ROBUST

CALIBRATION FREE



ADVANTAGES OF GEN N

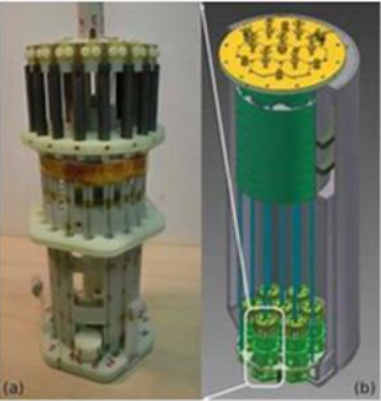
SCOPE OF QUANTUM SENSORS



Quantum magnetometers open new and lucrative fields of application

GENERATING QUANTUM SYSTEMS— GEN N

GENERATING QUANTUM SYSTEMS OF THE GENN CAPTURING INDIVIDUAL QUANTA

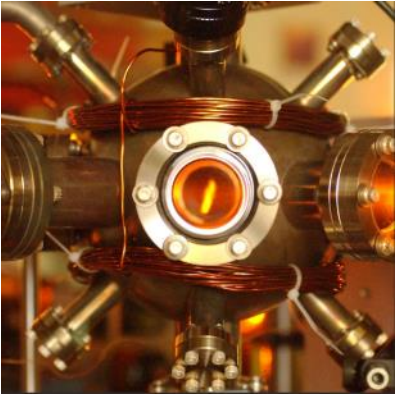


400 mm

Squids

(superconducting quantum interference device)

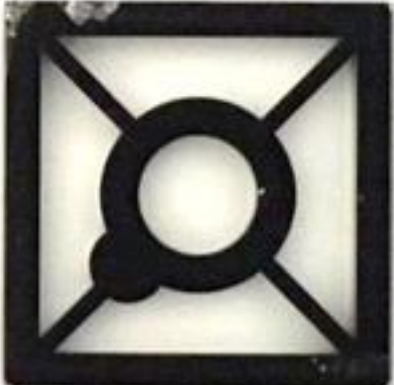
Source: Internet



300 mm

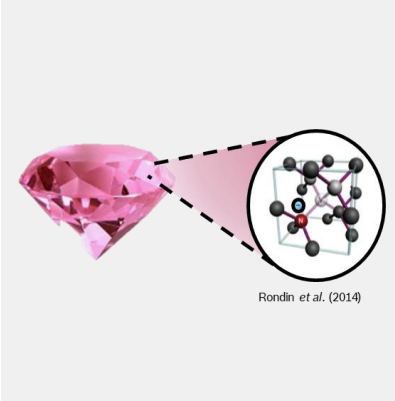
Optical traps

Source: Internet



10 mm

Gas cells



2 mm

NV diamonds

Miniaturization as integrated systems!

APPLICATION FIELDS OF QUANTUM SENSORS

APPLICATION FIELDS OF QUANTUM SENSORS

HUGE POTENTIAL FOR VARIOUS APPLICATION FIELDS



Quantum Sensing

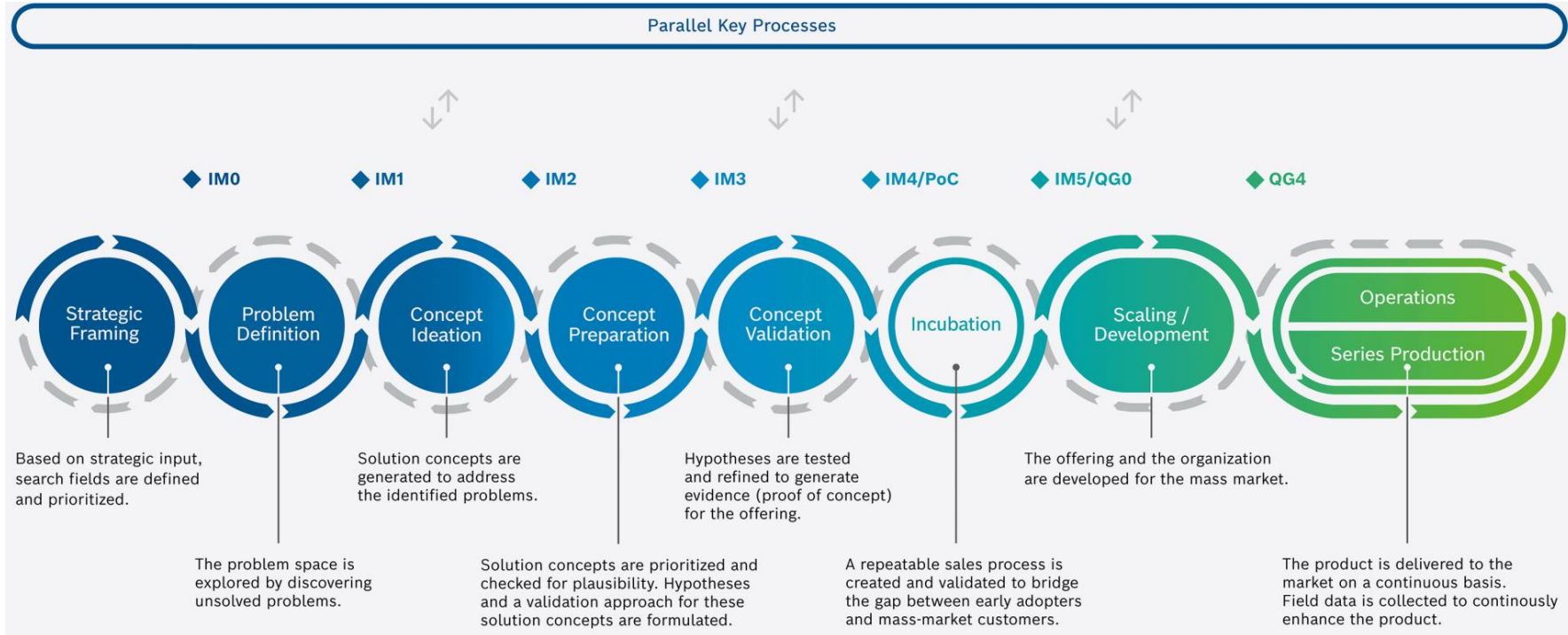


AI

CURRENT FIELD OF ACTIONS

CURRENT FIELDS OF ACTION

AGILE & USER-CENTRIC INNOVATION APPROACH



START-UP

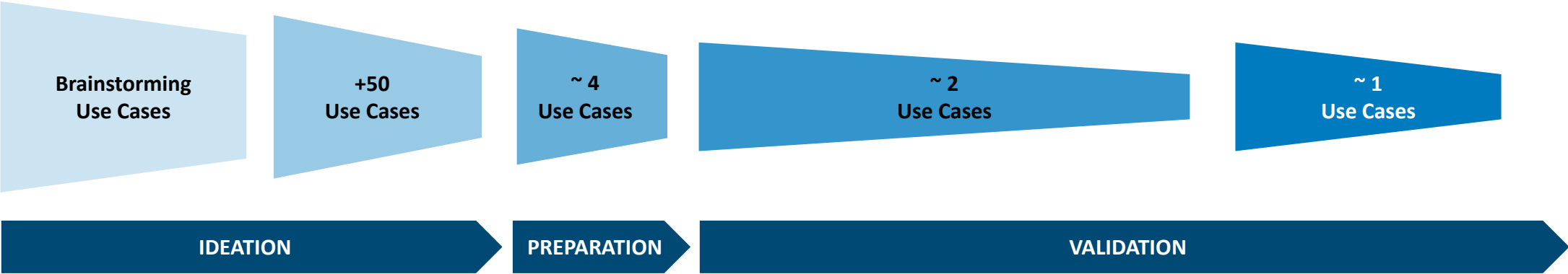
- ▶ Focus on fast & flat interaction, go & no go's
- ▶ Work on several innovation funnel and analysis of several Use Cases at the same time

CORPORATE COMPANY

- ▶ Structured to fulfill requirements of each phase
- ▶ Work on one innovation topic after the other

CURRENT ACTION FIELDS

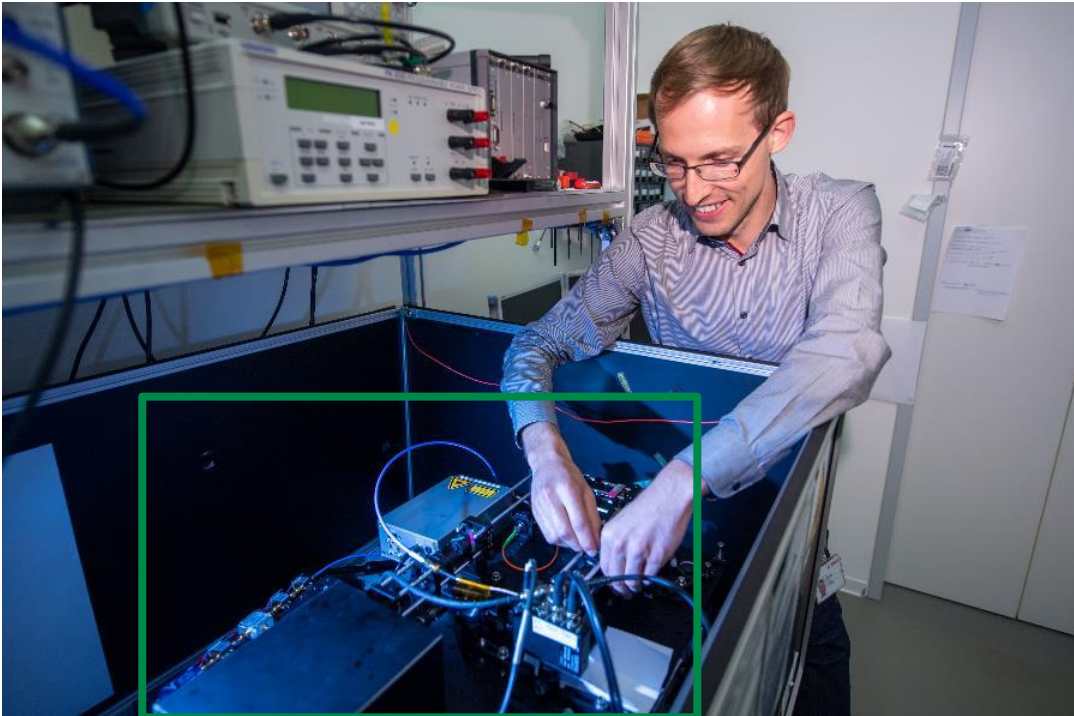
CONTINUOUS FILLING PIPELINE OF USE CASES



CURRENT FIELDS OF ACTION

MAGNETOMETER - LABORATORY SET-UP AND PROTOTYPE

8 MONTHS AGO

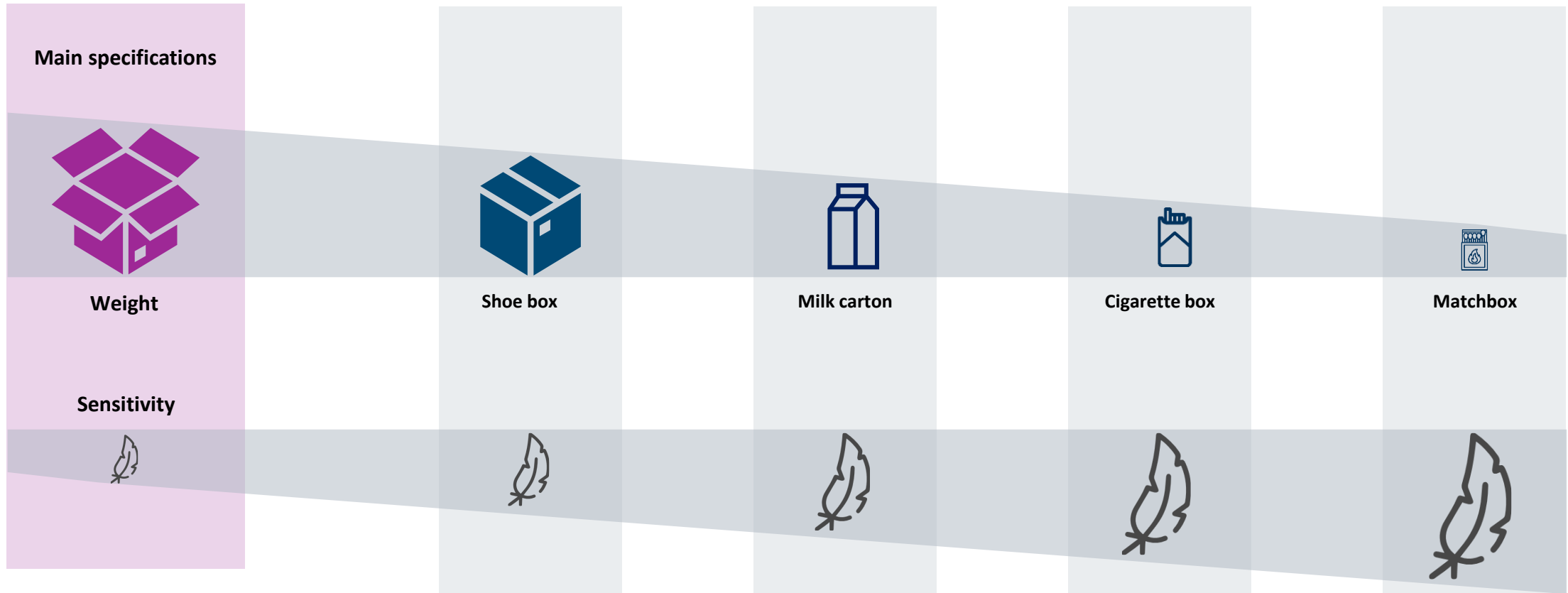


TODAY



Current fields of action - Development of 1st MVPs

Approximation of Performance Demonstrators using Prototypes



THE VISION

WHAT IF I COULD
CONTROL THINGS
WITH JUST
THOUGHTS?"



JOIN US INTO A NEW WORLD!

VISIT:



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WWW.LINKEDIN.COM/COMPANY/BOSCH-QUANTUM-SENSING/



APPLY FOR A JOB:

WWW.BOSCH.COM/CAREERS/JOB-OFFERS/

QUESTIONS?