25 Years of TOPTICA
Lesson learned - and lessons to forget

Thomas Renner, President TOPTICA Photonics

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TOPTICA Group: Key Figures

TOPTICA Headquarter Gräfelfing/Munich

Key Figures

Employees	480
Revenues	110 Mio € (119 Mio $)
Founded	1998

Technology

Diode Laser Systems	190 – 4000 nm
Ultrafast ps/fs Fiber Lasers	390 – 15000 nm
Terahertz Generation	0.1 – 6 THz
High Power Laser Diodes	630 – 1120 nm (TOPTICA eagleyard)

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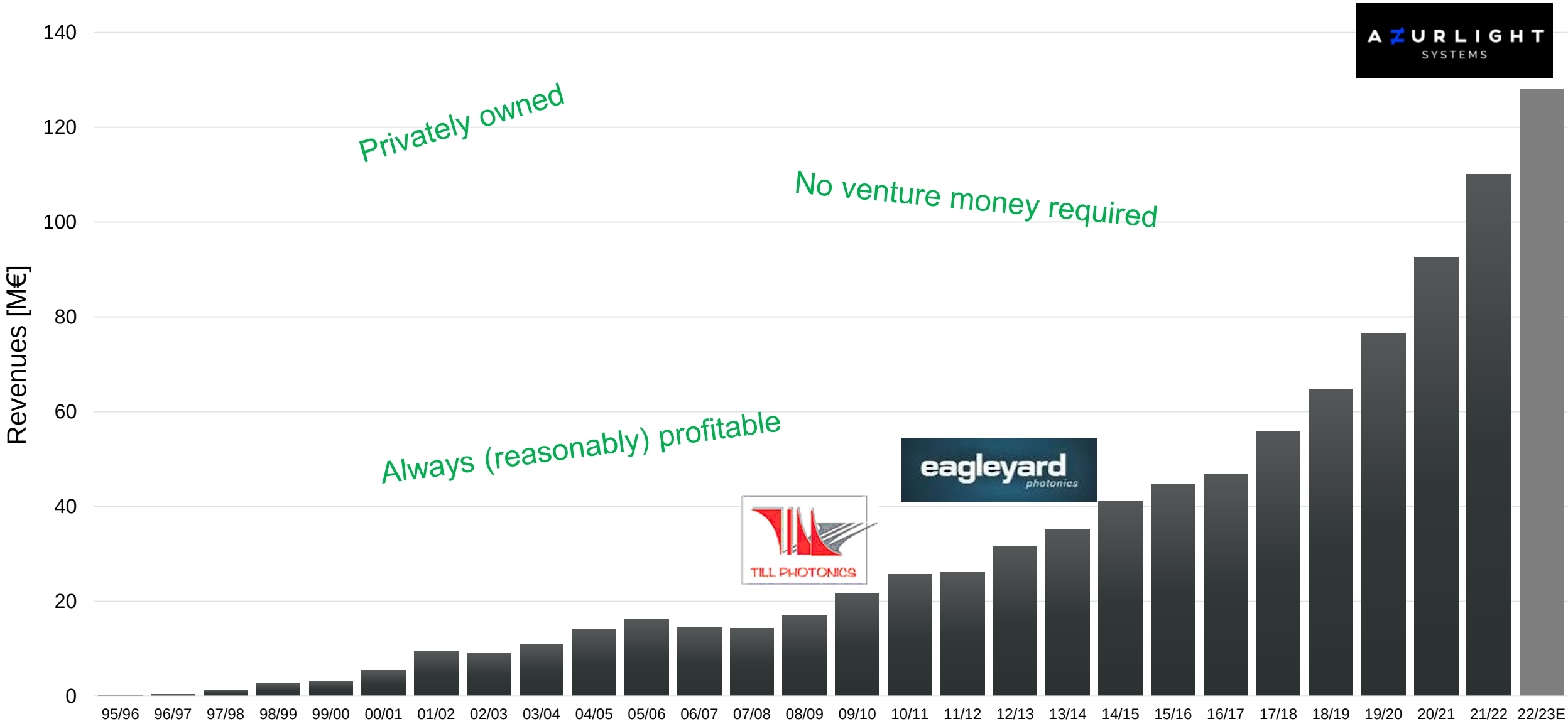
TOPTICA: From zero to hundred in 25 years



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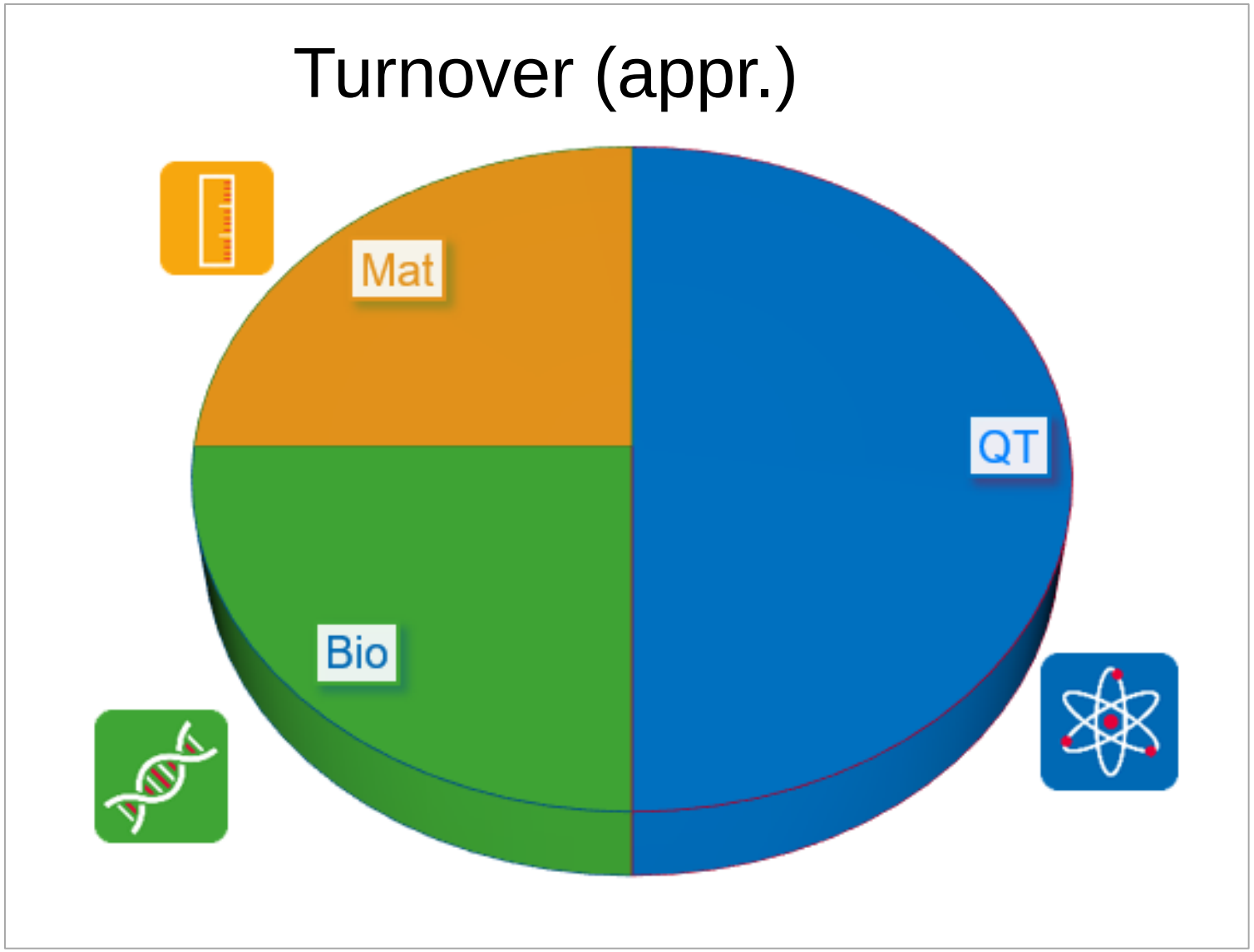
TOPTICA Markets

Semicon Metrology
THz Imaging
3D Lithography
Material Processing



Biophotonics
Microscopy
Ophtalmology

Quantum Metrology
Quantum Communication
Quantum Computing

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The Quantum Revolution

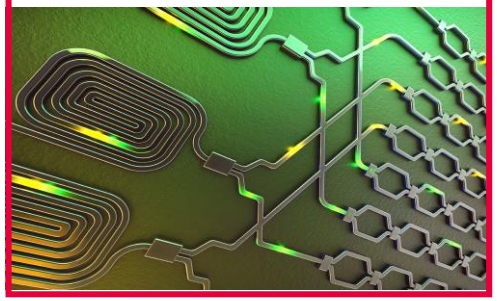
Focus Quantum Computer: TOP Technologies and selected Players

Supercond. qubits
Player: *Google, IBM, IQM, Rigetti, Origin Quantum, …*
Challenge: *Cooling (mK) & Scalability*
Laser&Photonics: *Small*

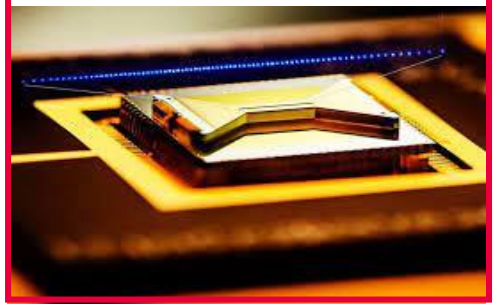
Topological qubits
Player: *Microsoft*
Challenge: *Physics*
Laser&Photonics: *No*

Photonic

Photonic Qumode
Player: *Xanadu, PsiQuantum, QuiX, Q.ant, Quandela, …*
Challenge: *loss of Photons*
Laser&Photonics: *A lot* ☺

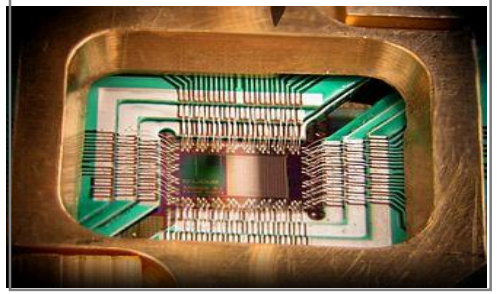


Ion Traps
Player: *AQT, Quantinuum, IonQ, Universal Quantum,...*
Challenge: *Scalability*
Laser&Photonics: *A lot* ☺

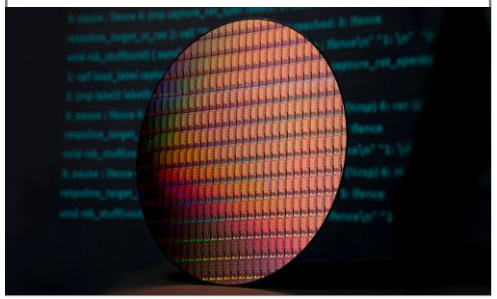


Non Photonic

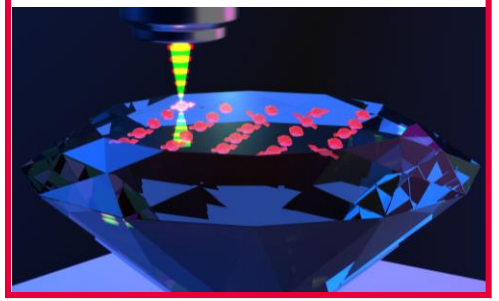
Quantum Annealing
Player: *D-Wave*
Challenge: *Special only*
Laser&Photonics: *No*



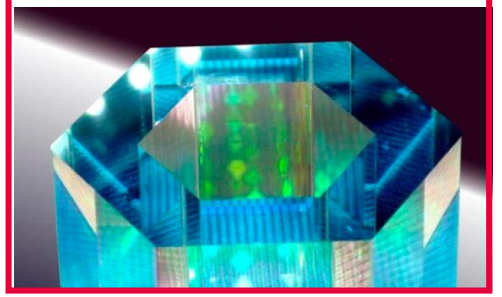
Spin qubit
Player: *Intel, SQC, …*
Challenge: *solid state*
Laser&Photonics: *No*



NV Centers
Player: *QuTech (NL), Quantum Brilliance (AUS)*
Challenge: *Solid State*
Laser&Photonics: *yes*



Cold Atoms
Player: *Infleqtion, Pasqal, Atom Computing, QuEra,…*
Challenge: *Complexity*
Laser&Photonics: *A lot* ☺



Siehe auch: c´t 2021/17

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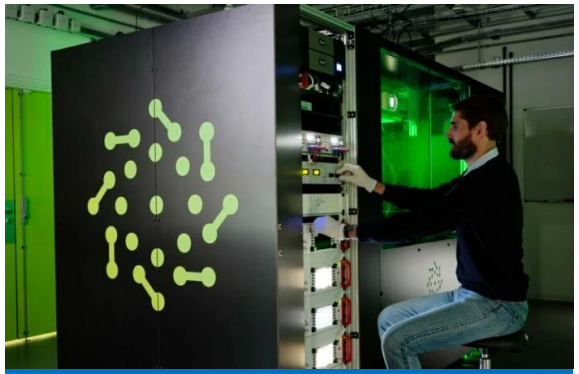
Laser-based Quantum Computers (Selection)

IonQ, Aria, 25 qubit

AQT, 2 19“-racks, 128QV

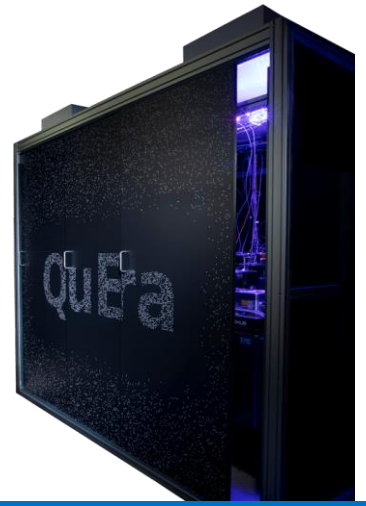


Pasqal, 100 qubits

Atom Computing

Quantinuum, H1-1 (32768QV)

Infleqtion (ColdQuanta)



QuEra, Aquila, 256 qubits

Ion

Cold atom

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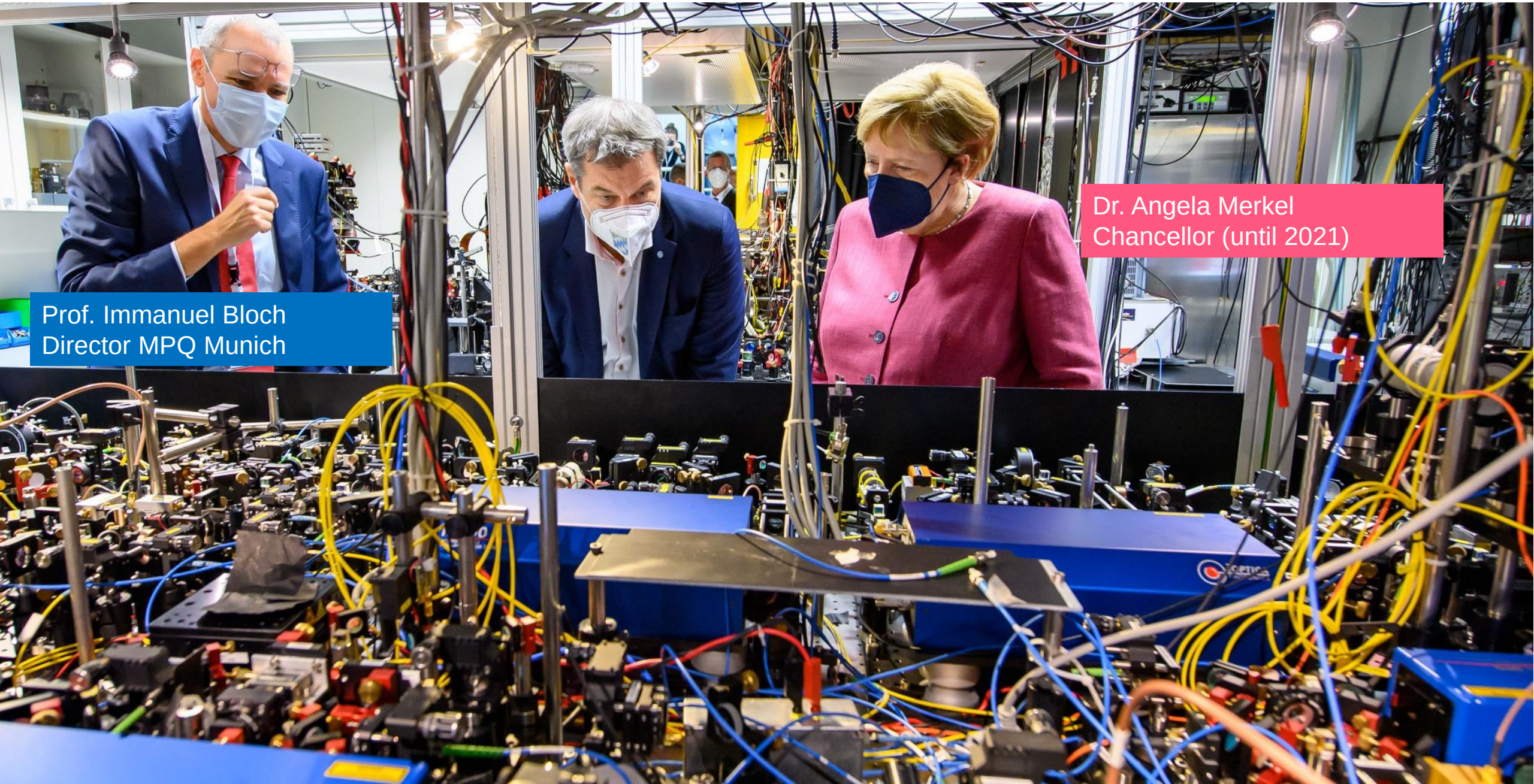
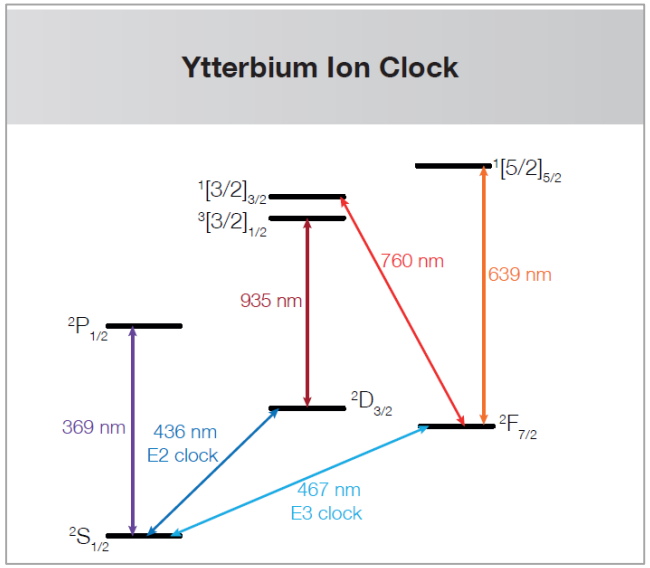
How does a typical Quantum Setup really look like?

Photo: IQOQI / M. R. Knabl

… and it needs (needed) at least 2 PhD Phycisists to operate it ☺



Optical clock (= half way to Quantum Computer)



Output to comb &
Clock comparisons

Photoionization
398.91066_ nm
369 nm

$^{171}Yb^+$

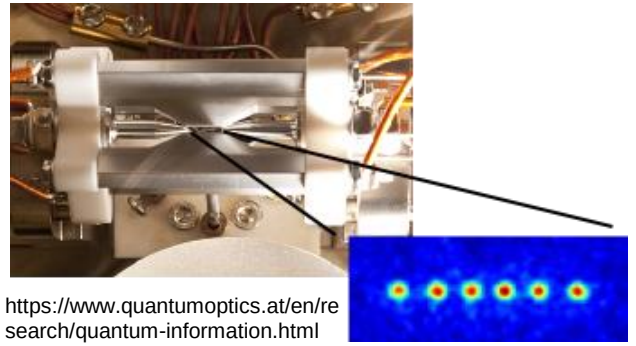
Doppler Cooling
& State Detection
369.52604_ nm

Repumping
935.18768_ nm
760.0747_ _ nm

Stabilization

Clock Interrogation
435.51761073969 nm

Typical 10^{-17} stability & accuracy



https://www.quantumoptics.at/en/research/quantum-information.html

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Technical core identity of the company

All Wavelengths

190 nm – 0,1 THz

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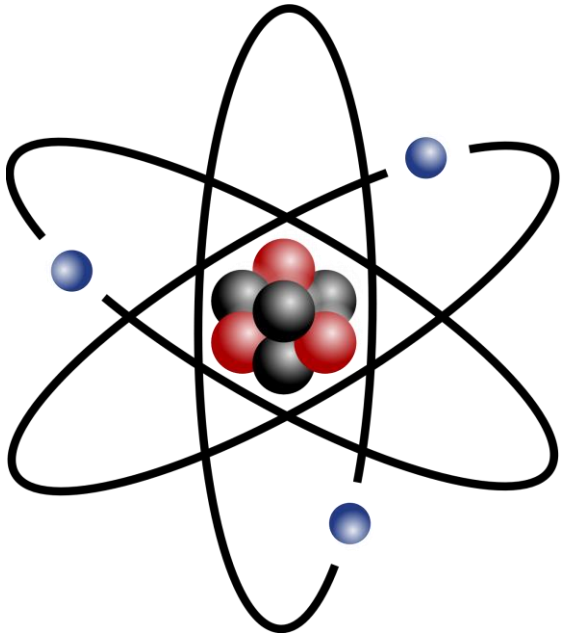
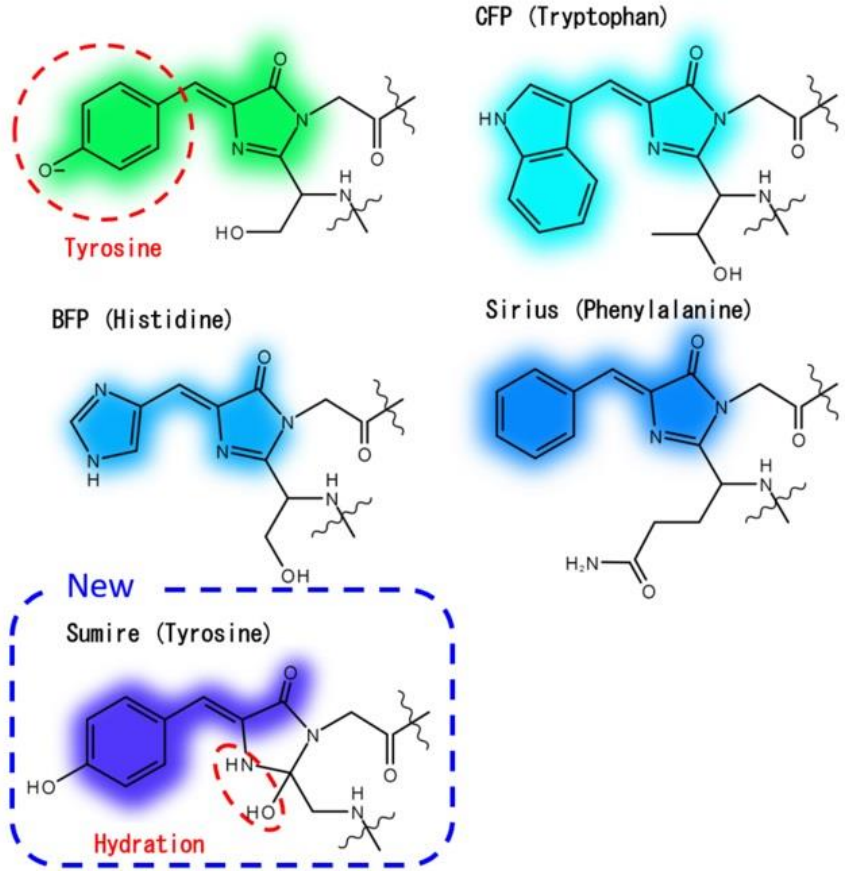
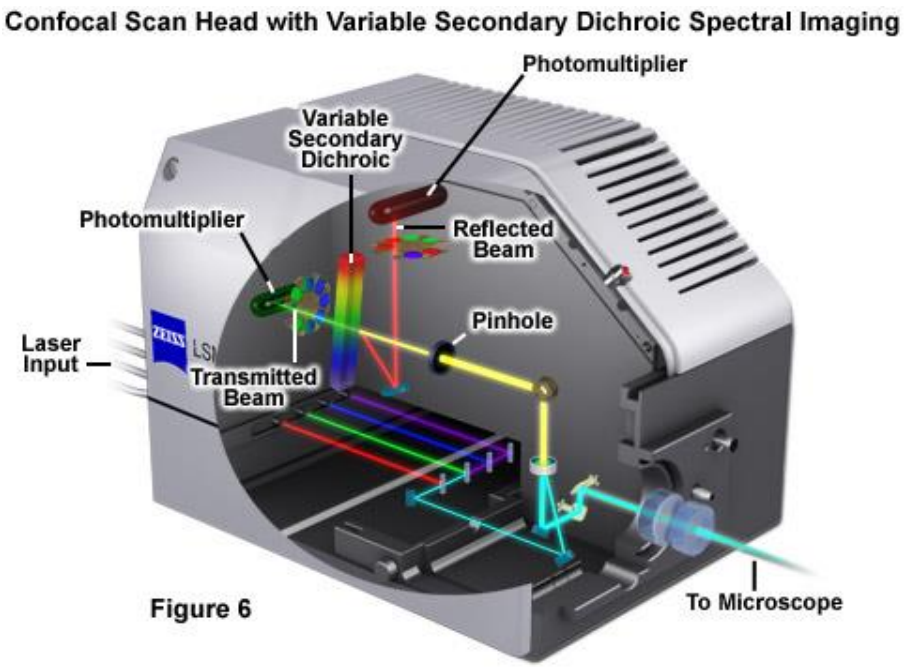
Expanding from one Atom to Molecules



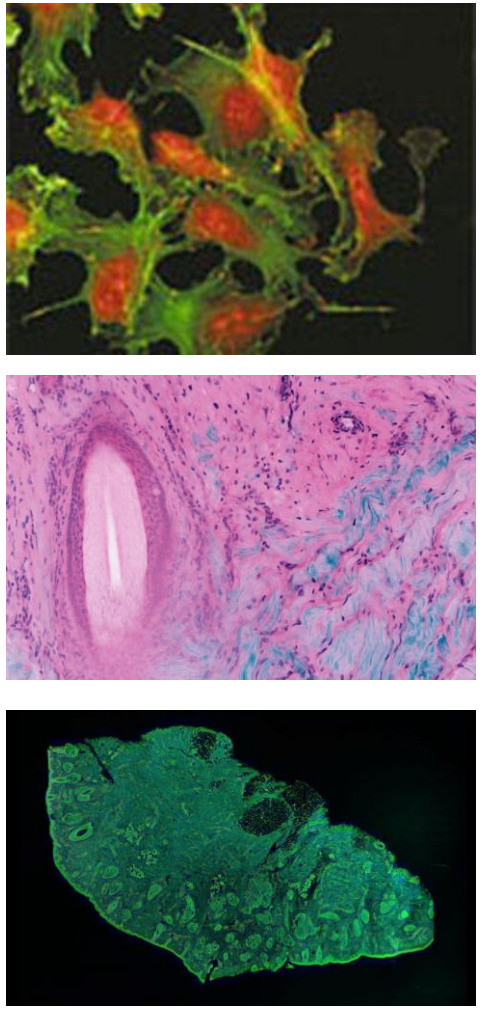


Biophotonics Example: Confocal Microscopy

Multi Laser Engine for Bio



Example setup, © Zeiss Campus



© Prof. Michael Giacomelli / University of Rochester

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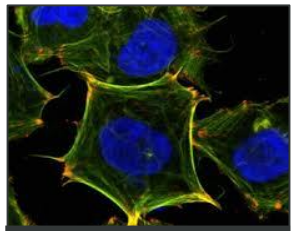
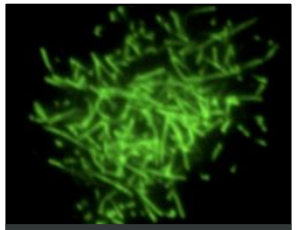
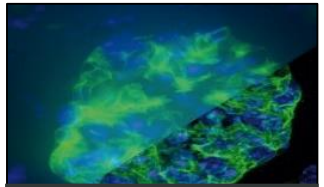
Successfull – via hands-off concept and some tricks ☺



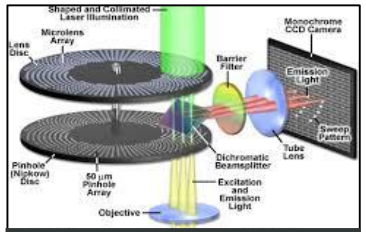
Confocal



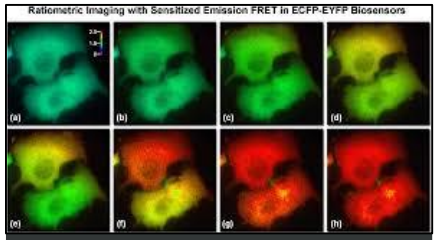
TIRF



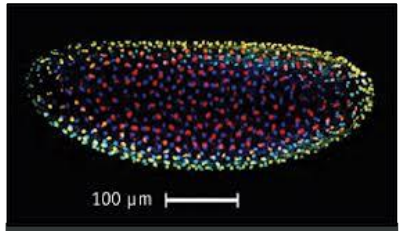
Structured Illumination



Spinning disk



FRET



SPIM

FRAP

iChrome CLE

iChrome MLE

iChrome FLE

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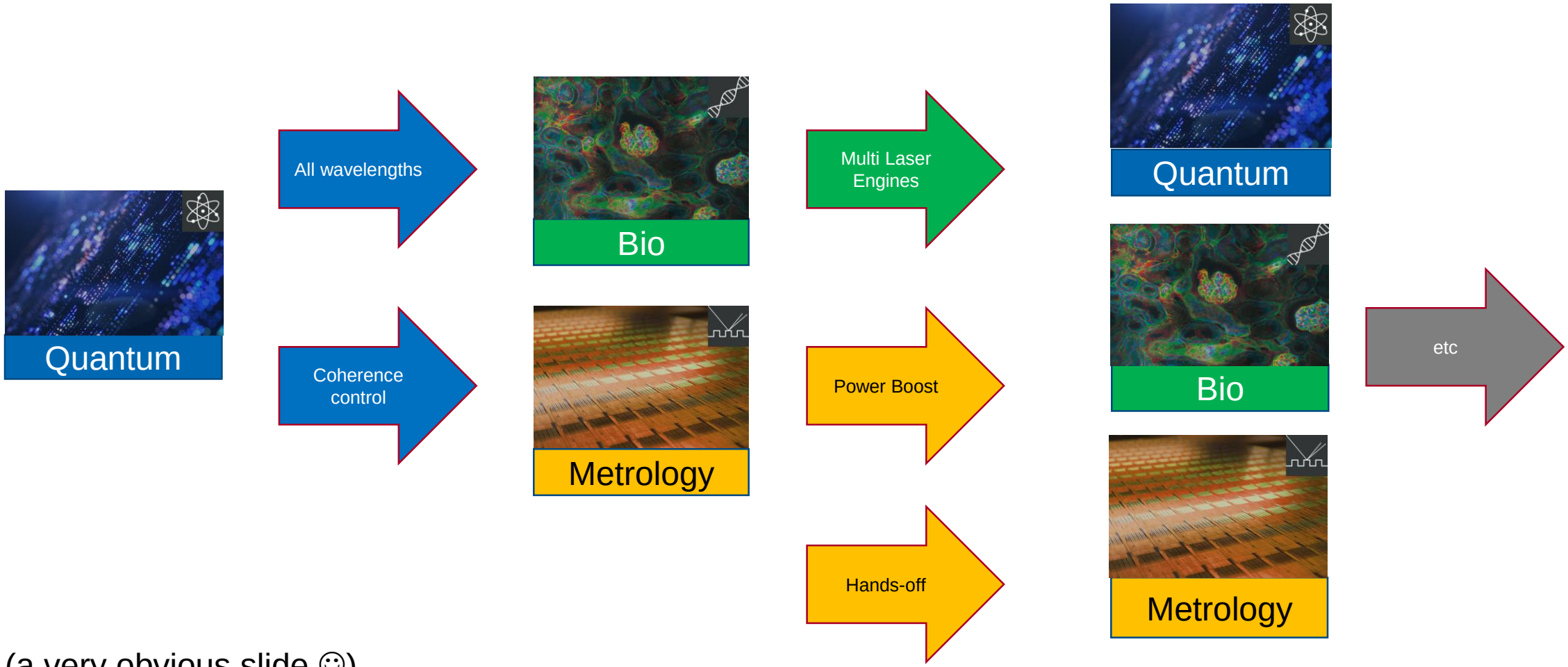
xLE Microscopy Series -> T-Rack Quantum Series

xLE: Multi Laser Engine for Bio

T-Rack: Multi Laser Engine for Quantum

??

Yes – you can beneficially combine disjunct markets (Examples)



(a very obvious slide ☺)

Business Development

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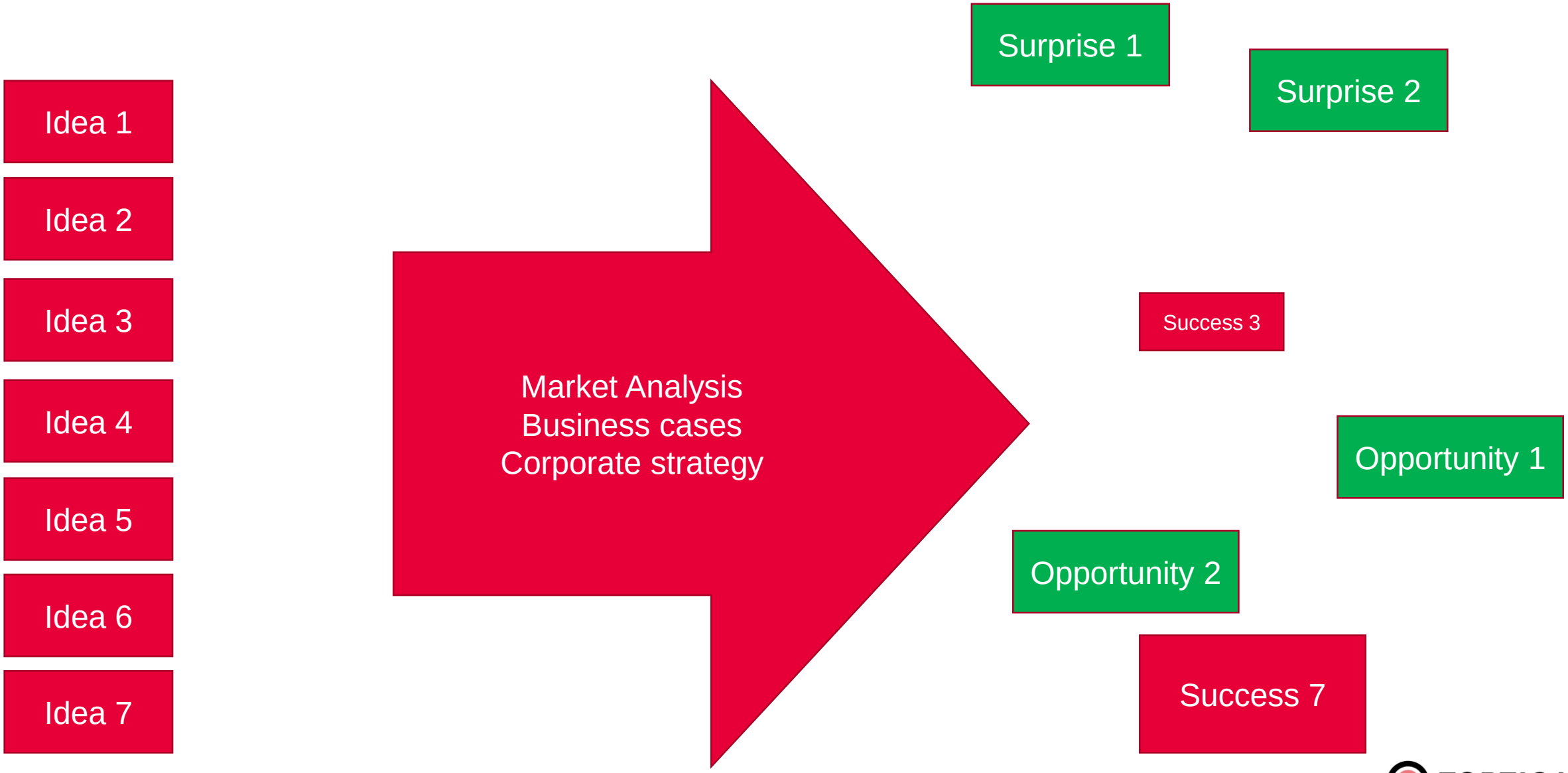
Strategic Planning: Theory

Strategic Planning: How it really worked for us



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The „Formula of successfull Business Development at TOPTICA“ (maybe in Photonics?)

Many of the things, which we planned did not happen

Many of the successes were not really planned

But it works out somehow …

TOPTICA
Spirit

Vision

We are thriving to be the most exceptional and astonishing photonics company.

Mission

Take the right people, agree on a target, provide the means
- and good things will always happen.