Quo Vadis Laser

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TRUMPF Laser Marking Systems AG

Buchs, December 2nd 2010

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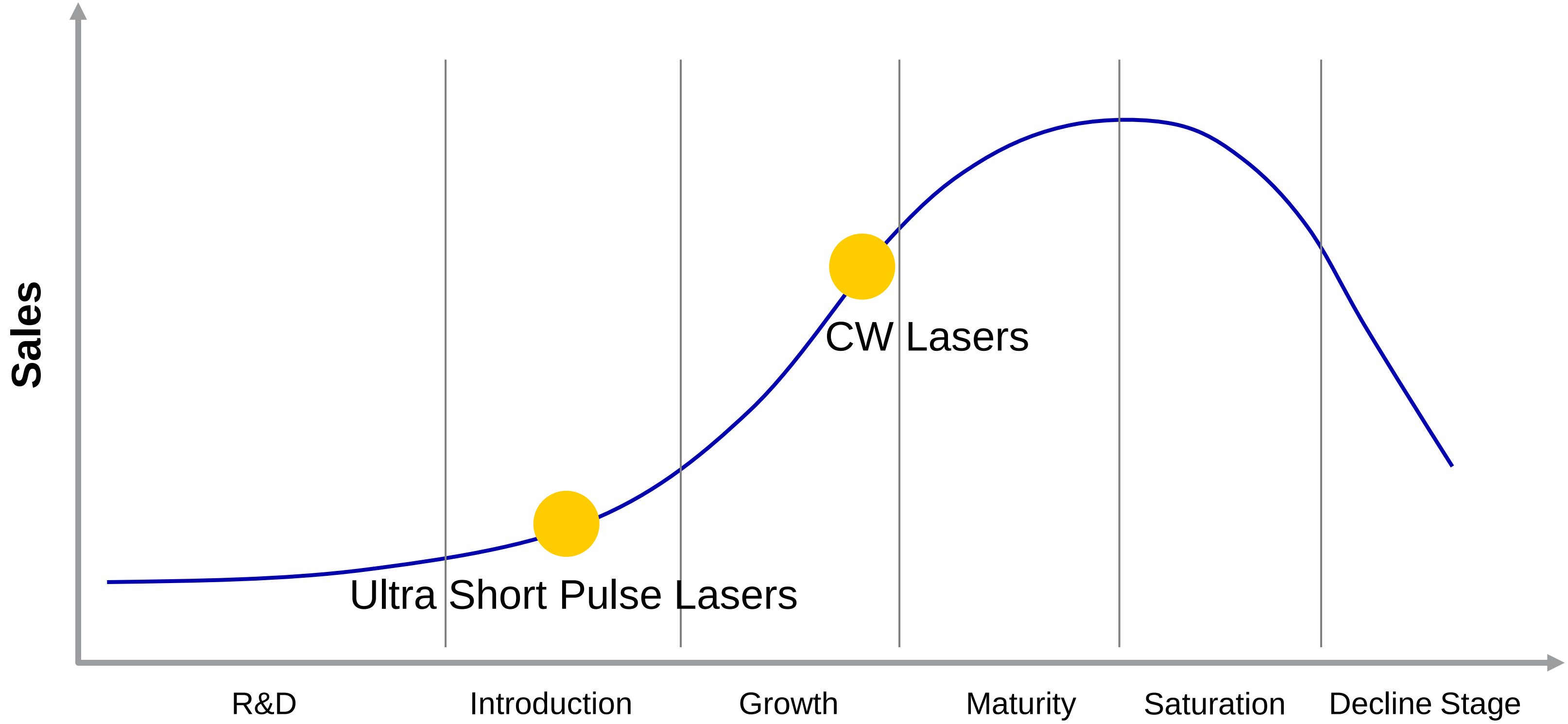
Stages of the Product Life Cycle
(Qualitative Estimation)



Stages of the Product Life Cycle
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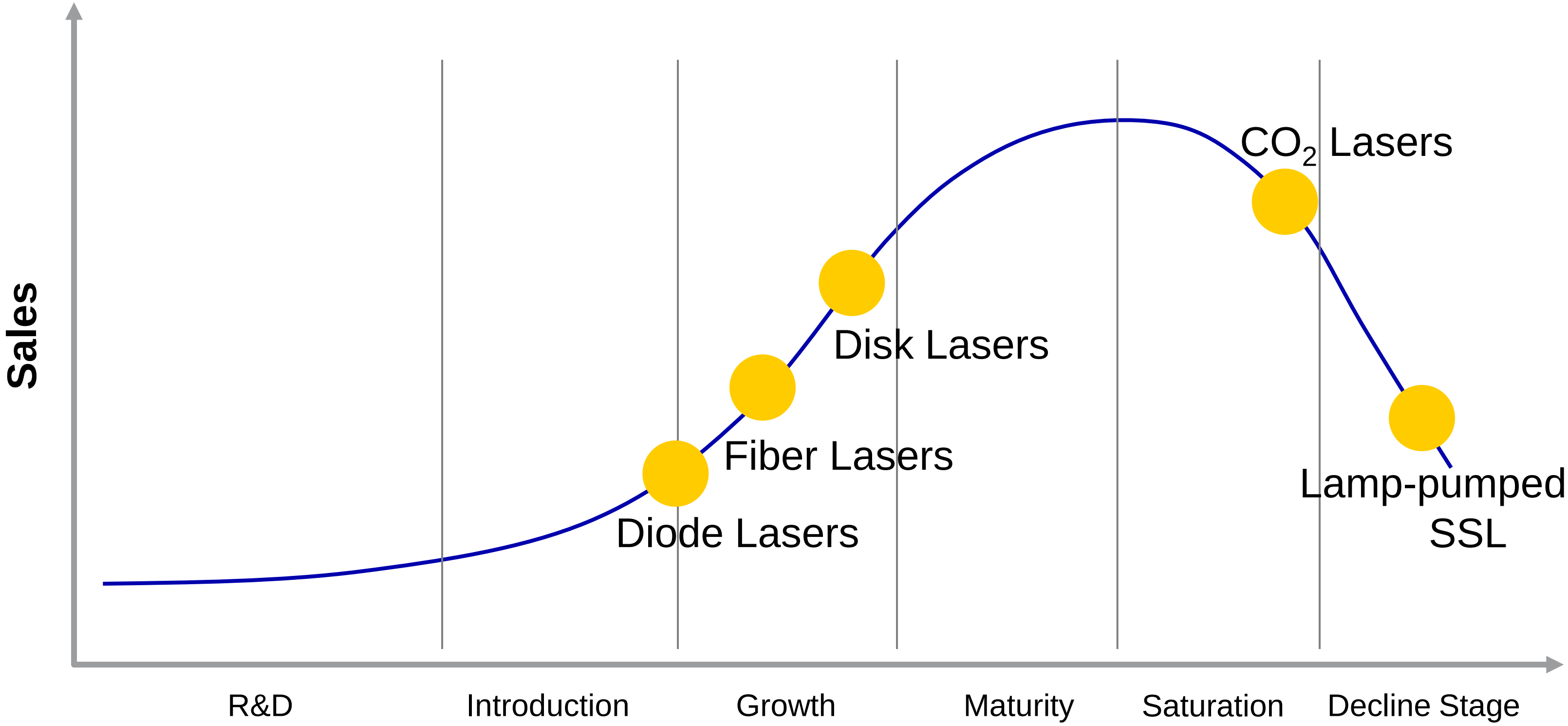
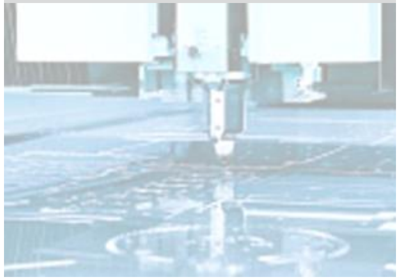
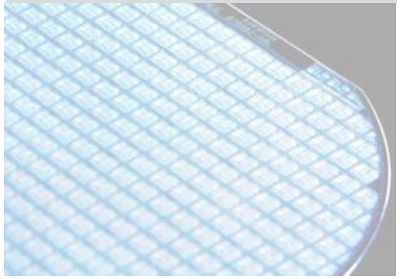


TRUMPF Business Unit Laser Technology

Machine Tools/ Power Tools	Laser Technology	Electronics	Medical Systems





TRUMPF Laser- und Systemtechnik GmbH, Ditzingen

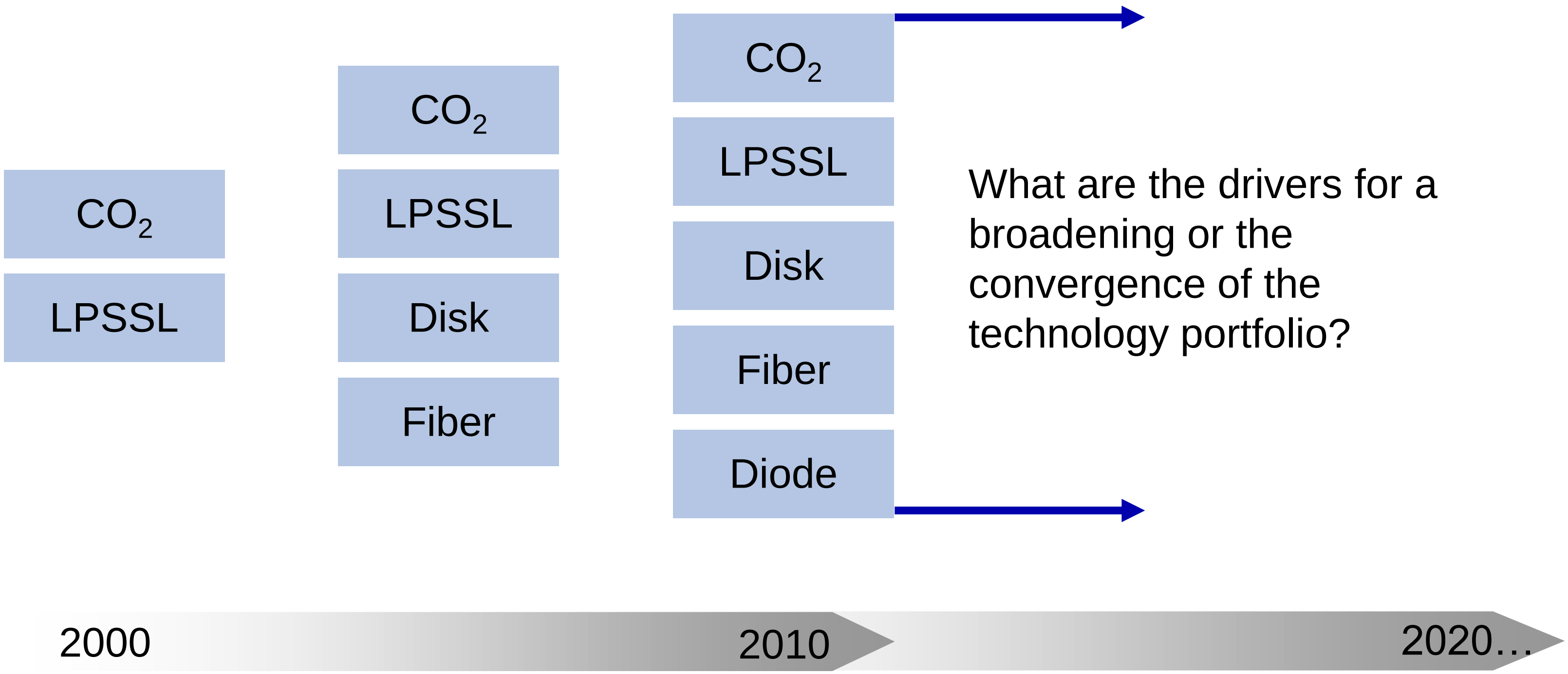
TRUMPF Laser GmbH + Co. KG, Schramberg

TRUMPF Laser Marking Systems AG, Grüsch, CH

TRUMPF Photonics, Princeton, USA

SPI Lasers, Southampton, UK

CW Laser Concepts in Material Processing



What are the drivers for a broadening or the convergence of the technology portfolio?

Drivers of the Technology Portfolio

1. Specialization of laser usage in the manufacturing world:

- Applications drive special needs for beam characteristics.
  - Brightness
  - Wavelength
  - Power
  - Pulse width and pulse shape

2. Invest and TCO:

- Cost is paramount, however, a more differentiated approach is needed. Application-specific models will succeed.
  - Invest
  - Energy consumption
  - Process efficiency and process cost (i.e. cutting gas consumption)
  - Maintenance

Example: Cost and Complexity of 4kW cw System

	Power Supply →	Pump →	Beam Shaping →	Beam delivery
	Complexity	**Complexity**	**Complexity**	**Complexity**
Disk		low brightness diode bars	resonator	
Fiber		high brightness diodes	resonator	
Diode		high brightness diodes	passive system	

Cost and performance of diodes will substantially impact system cost performance. Competition of concepts will lead to specialized systems for individual power and brightness levels.

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Example of Specialization at the Customer: Cutting

Thin sheet metal cutting with SSL: TruLaser 5030

Thick sheet metal cutting with CO_2-laser: TruLaser 3030

Future Topic (1): High Power Ultrafast Lasers

- Ultrafast lasers will become the new workhorse:
  - Kilowatt-class ultrafast lasers for industrial production
  - Modulation of pulse width and duration
  - Modulation of brightness

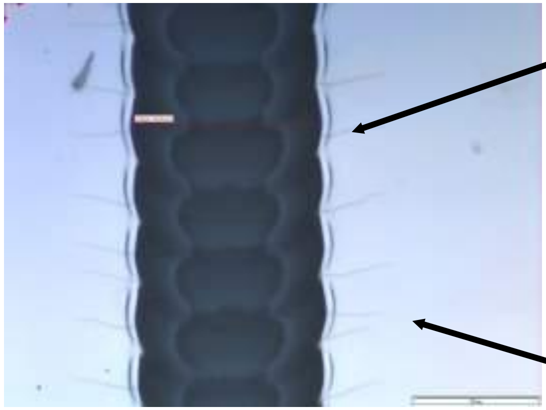
- Application fields:
  - Mass production of lightweight structures
  - Substitution of less energy efficient processes
  - **Enhancement of existing and established (laser) processes**

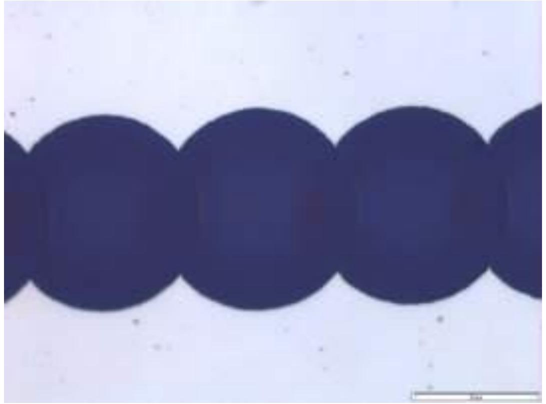
Solar Cell Production: P1 Sribing of CI(G)S modules

Patterning of Molybdenum

- Burr free
- Melt free
- No Delamination
- Isolation (P1)

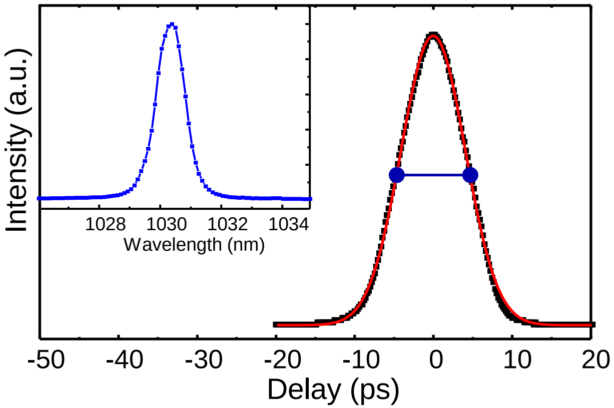
Spot diameter: 40 – 50 µm
Feed Rate: 6 – 8 m/s





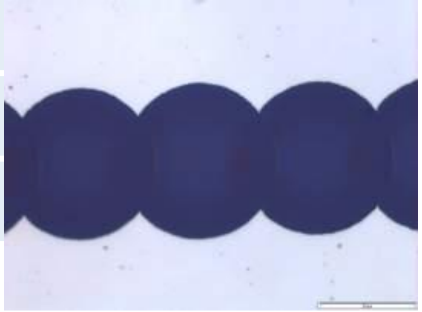
Laser Specifications – Demands

	TruMicro 5050	TruMicro 5250	TruMicro 5350
Mittlere Leistung	50 W	30 W	> 15 W
Wellenlänge	1030 nm	515 nm	343 nm
Pulsdauer	< 10 ps	< 10 ps	< 10 ps
Max. Pulsenergie	250 µJ	125 µJ	> 75 µJ
Pulsfrequenz	200-800 kHz	200-800 kHz	200-800 kHz
Strahlqualität	$M^2 < 1.3$	$M^2 < 1.3$	$M^2 < 1.3$



Products – Patterning CI(G)S

	TruMicro 5050	TruMicro 5250	TruMicro 5350
Average Power	50 W	30 W	> 15 W
Wavelength	1030 nm	515 nm	343 nm
Pulse length	< 10 ps	< 10 ps	< 10 ps
Max. Pulse energy	250 µJ	125 µJ	> 75 µJ
Rep. rate	200-800 kHz	200-800 kHz	200-800 kHz
Beam quality	$M^2 < 1.3$	$M^2 < 1.3$	$M^2 < 1.3$



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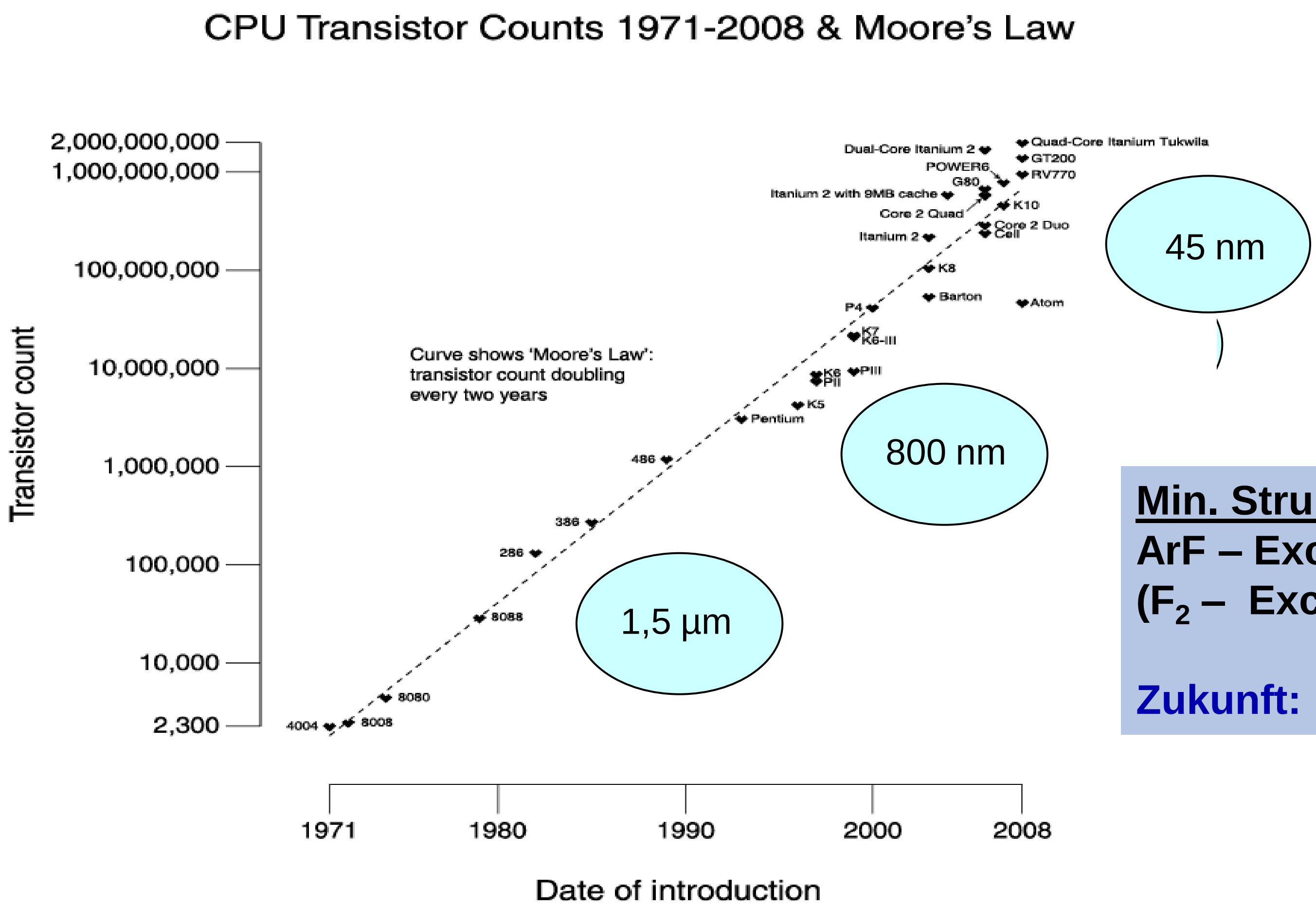
Future Topic (2): CO2- Lasers for EUV Generation

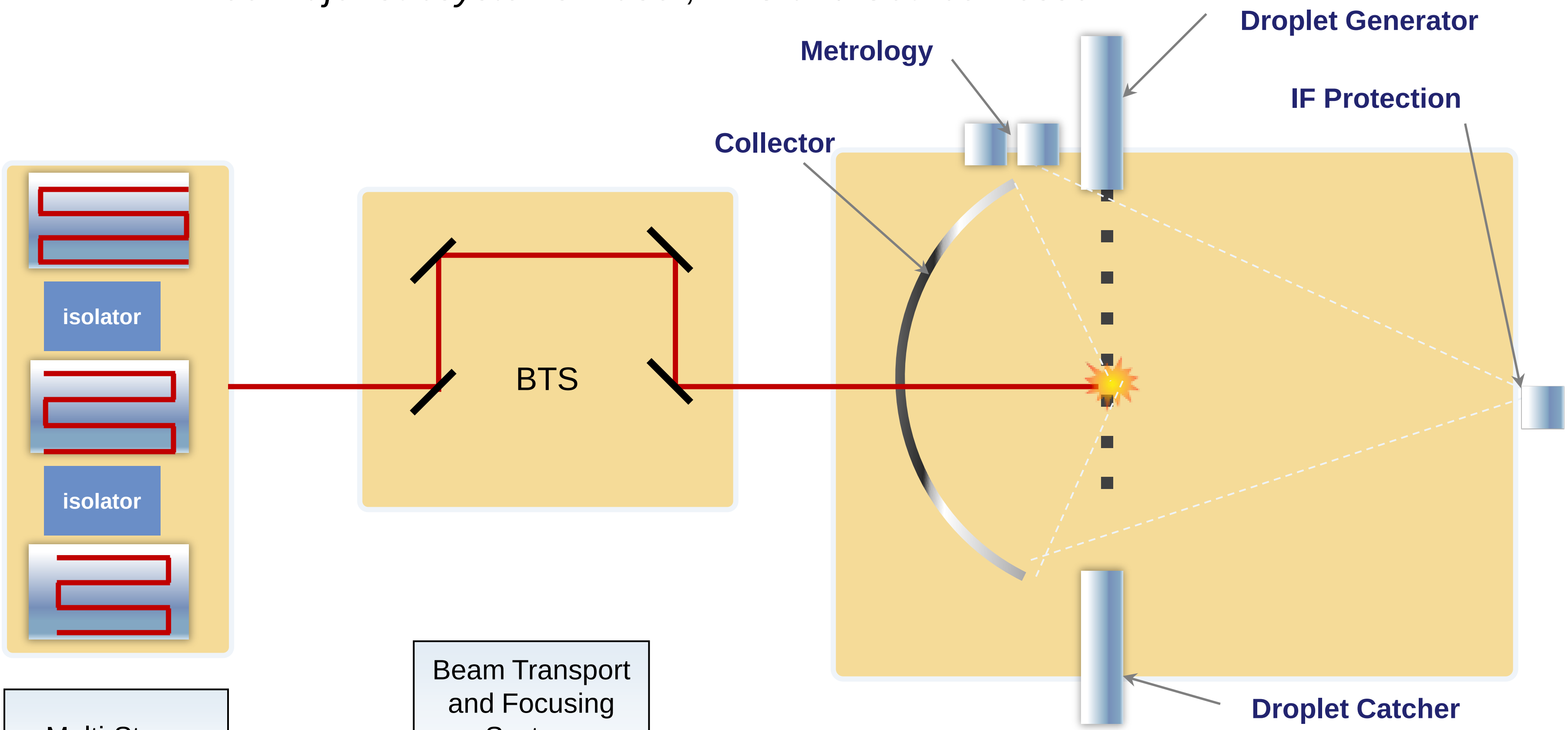


Min. Struktur ~ λ :
ArF – Excimer 193 nm
(F_2 – Excimer 157 nm)

Zukunft: EUV: 13.5 nm

Laser Produced Plasma EUV Source Architecture

Three major subsystems: Laser, BTS and Source Vessel



Multi-Stage CO_2 Laser (in sub-fab)

Beam Transport and Focusing System (through the fab floor)

EUV Source Vacuum Vessel (inside the scanner)

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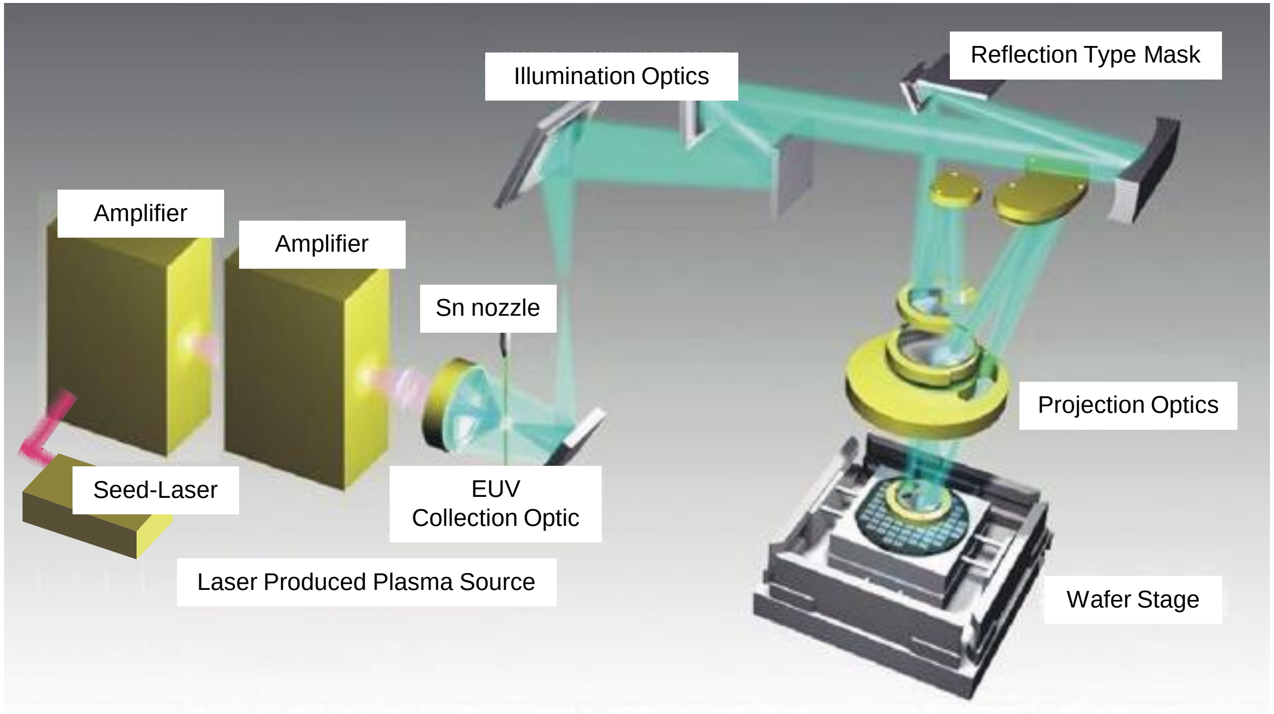
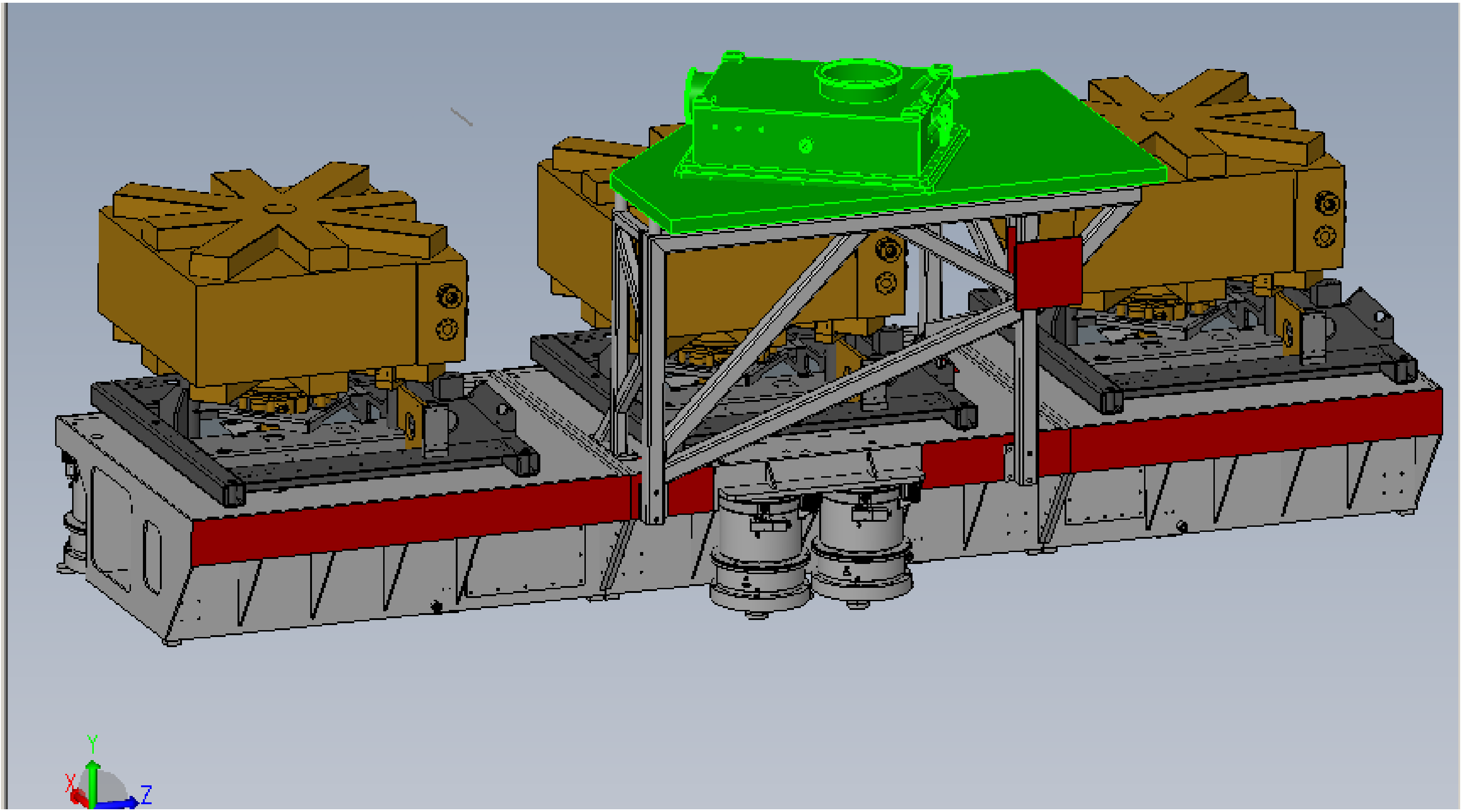
EUV-System



CO_2 Laser setup: 3 * TLF 15.000 (15.000W)



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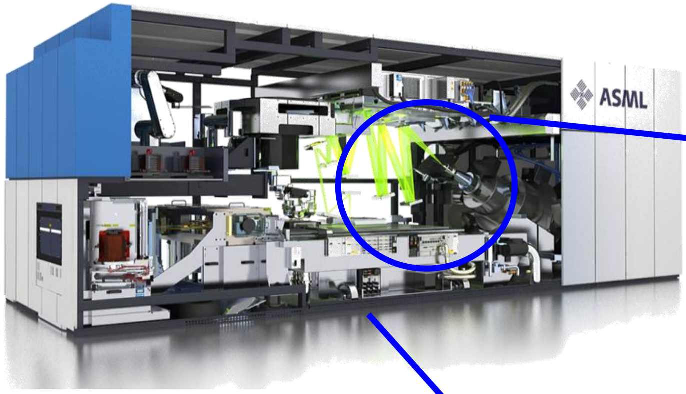
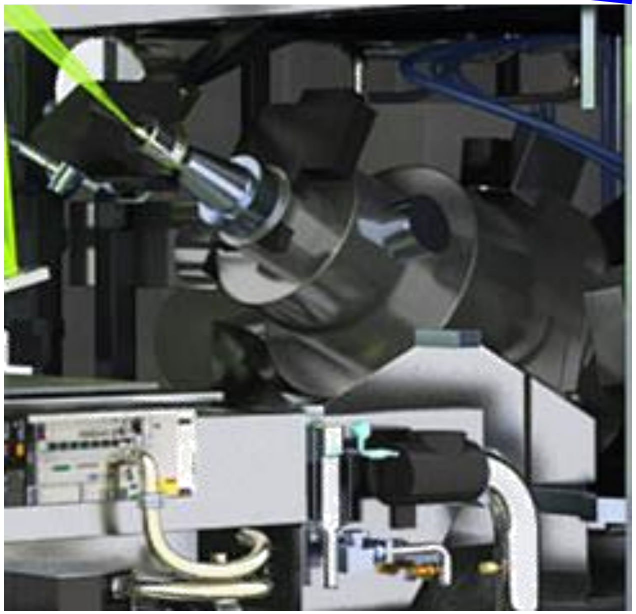
CO_2 Laser setup: picture, made in production

Cymer’s LPP Source for ASML NXE 3100 Scanner



0.5 MW Electricity
=>
50kHz Rep Rate
500 ns pulses
0.4 J Energy
+
30um tin droplets
=>
100W EUV Power
=>
2 W EUV at workpiece



Ich freue mich auf Ihre Fragen