

# Lasers on their way to industrial applications

Personal reminiscences of 50 years exciting development

Dr.-Ing. E.h. Paul Seiler

## Ruby laser drills metal

---



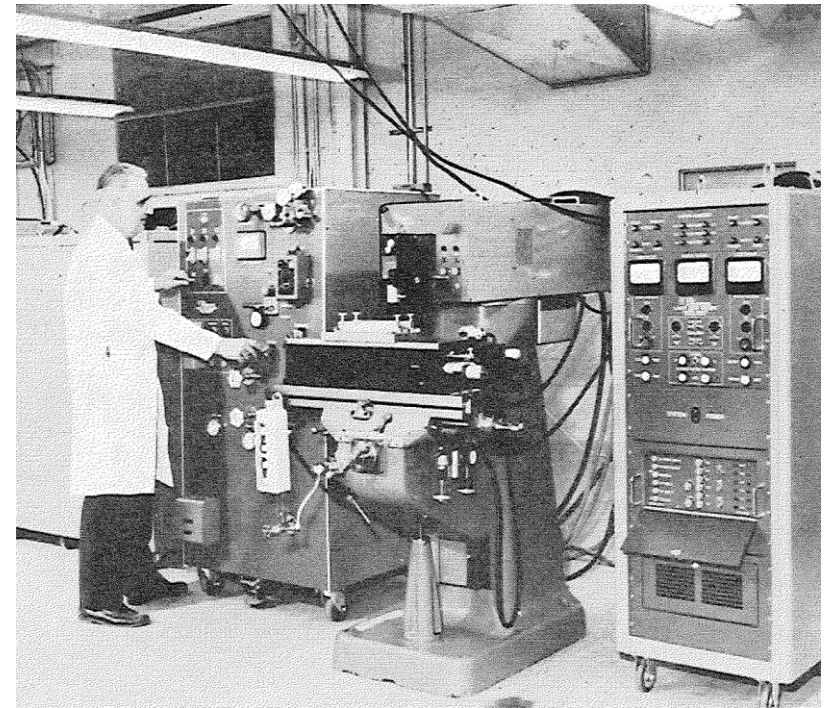
*Source: Weber/Herziger*

## 1961/63: first experiments with light as a tool

---

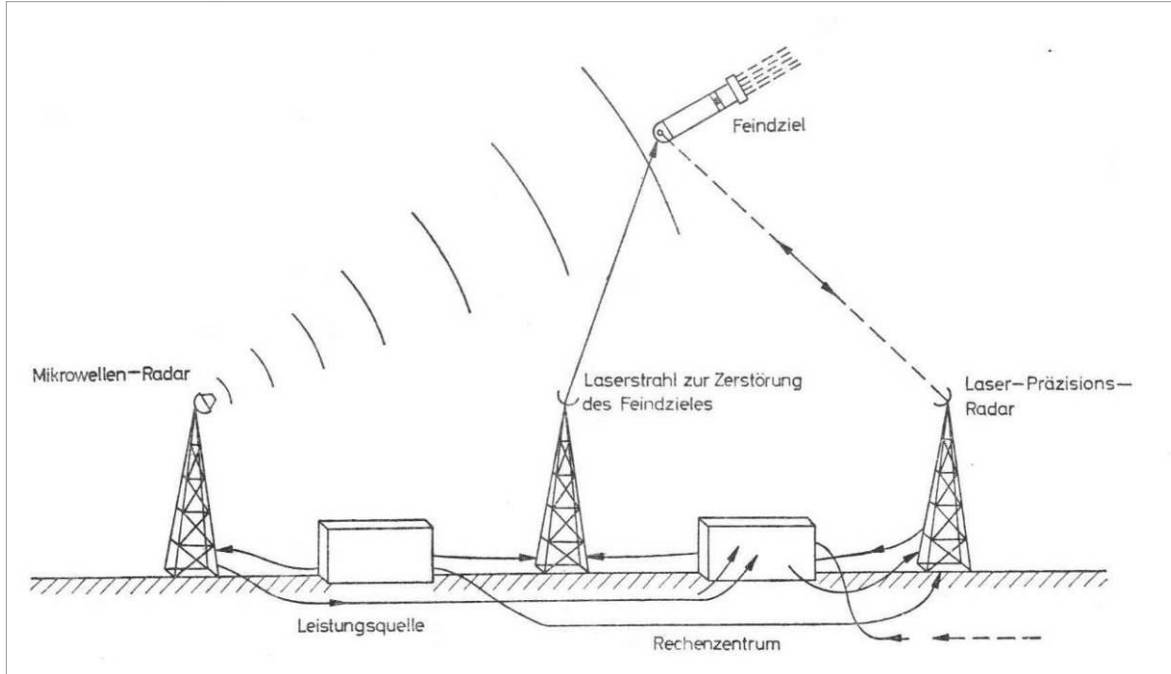


Drilling of apertures,  $\varnothing < 10 \mu\text{m}$   
Weber/Herziger, TU Berlin

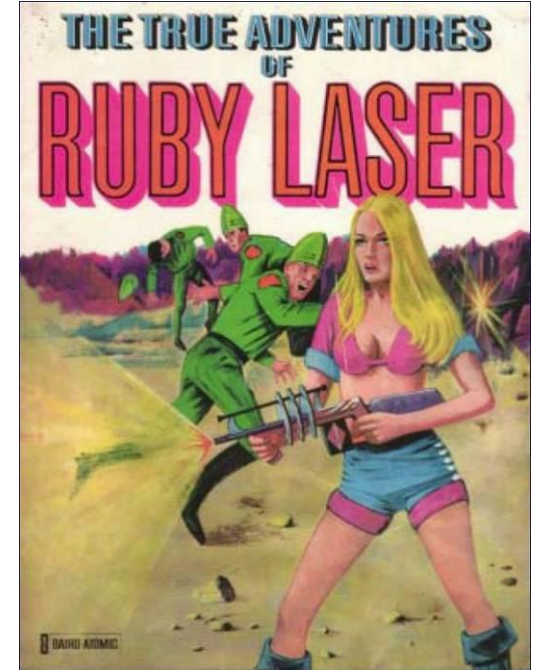


Welding at TRG, USA  
50 J pulse energy, 1 Hz pulse frequency

# Strongly pushed by military



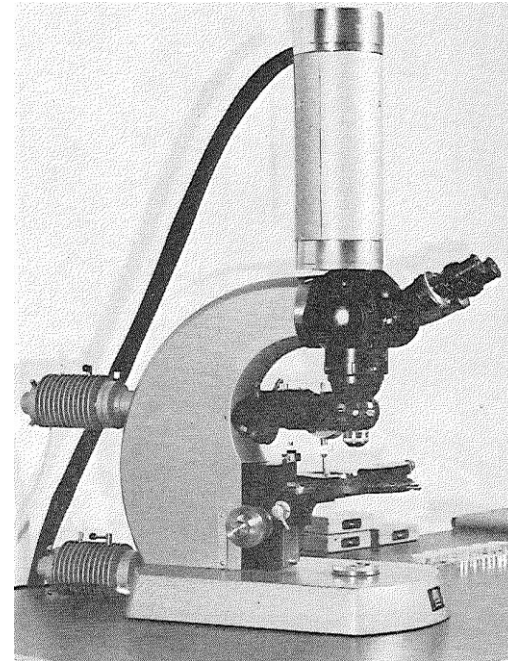
Source: H.H. Klinger: „Laser“ (Stuttgart 1964)



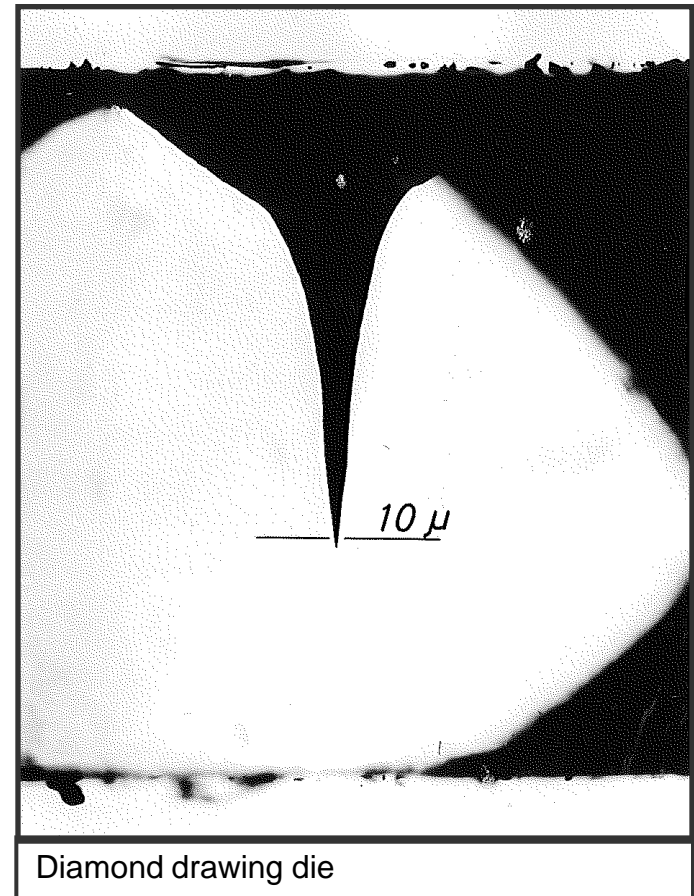
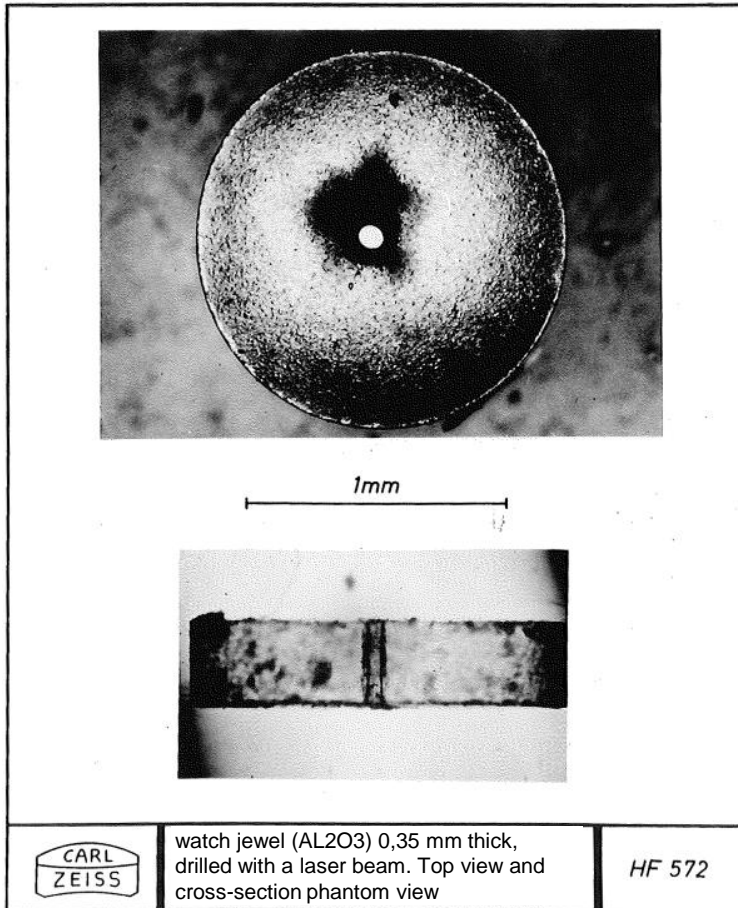
## 1963/64: start of laser activities at Carl Zeiss, Oberkochen

---

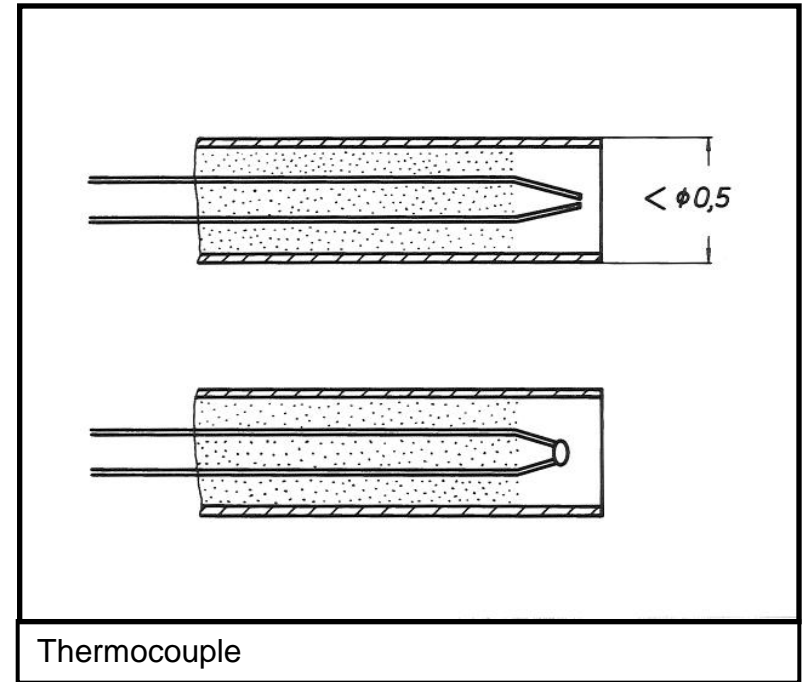
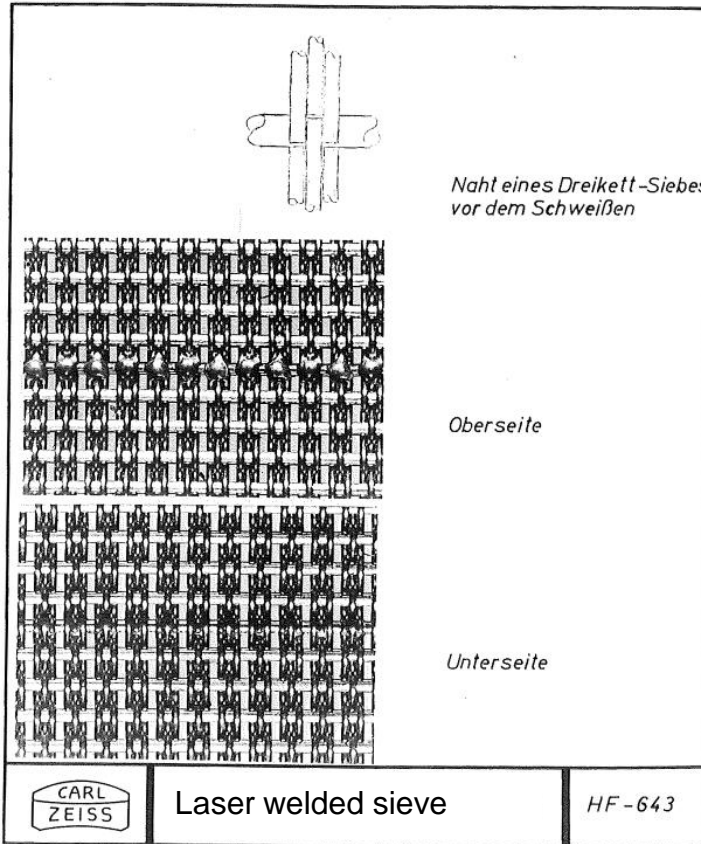
- Megawatt pulses with ruby lasers using a q-switch kerr-cell
- First steps in material processing with laser + microscope
- 1964/65 publications of Dr. Siegfried Panzer



# 1964/66: first drilling applications

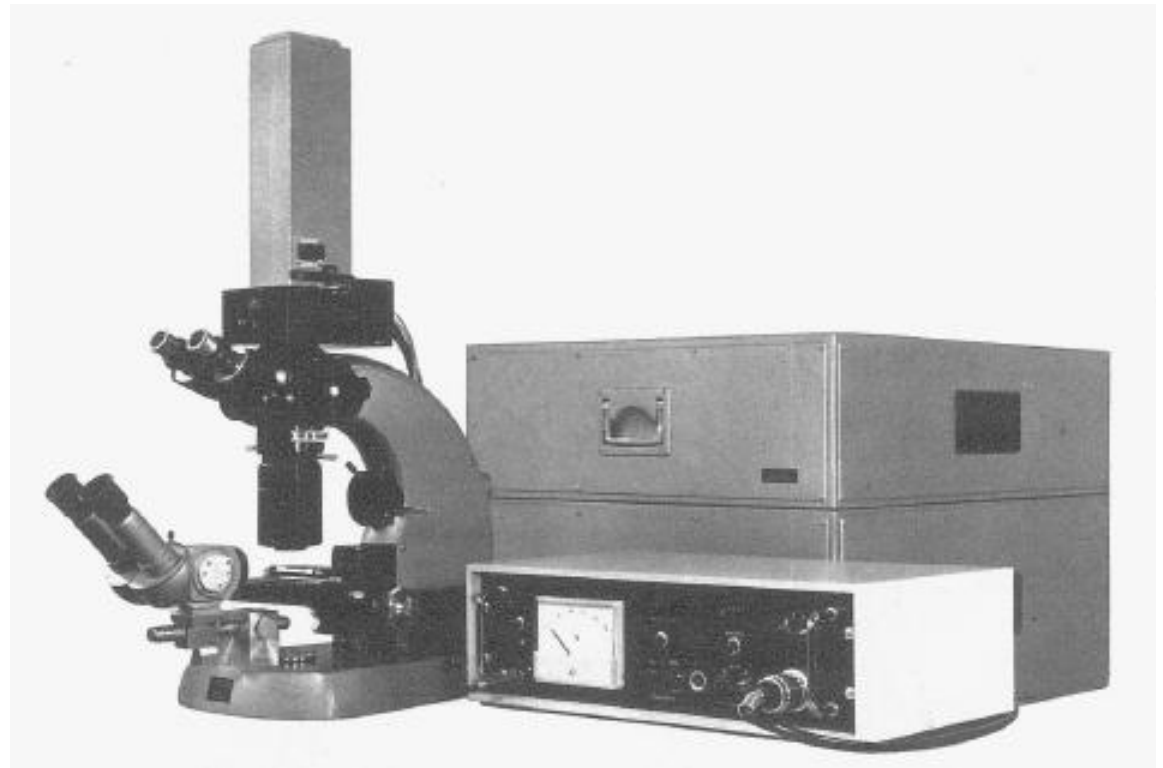
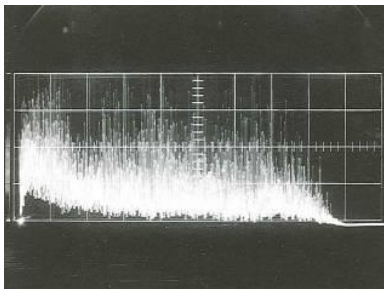


# 1966/67: first welding applications



# 1967/68: drilling and welding with laser and microscope

---



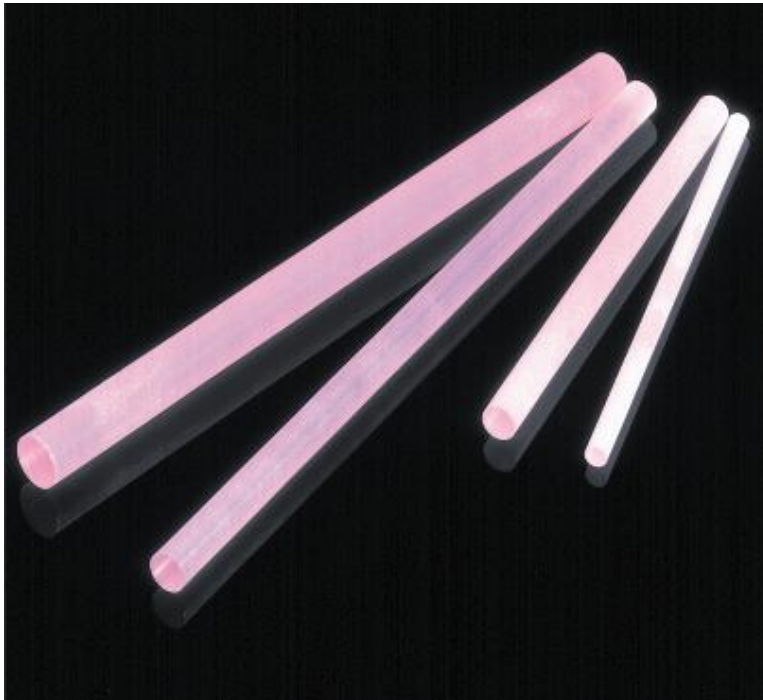


## 1964: YAG and CO<sub>2</sub> lasers

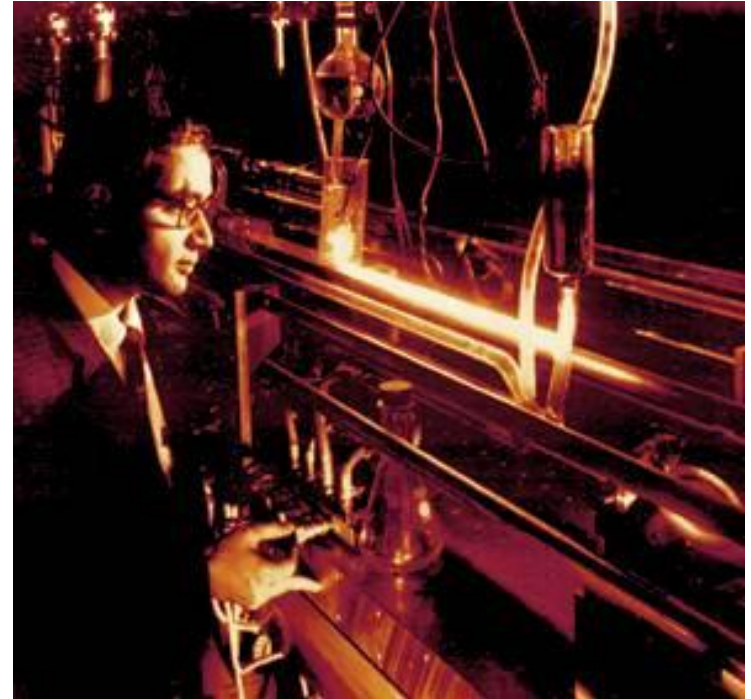
---

Two crucial developments in the USA

YAG cristall of E. Geusic



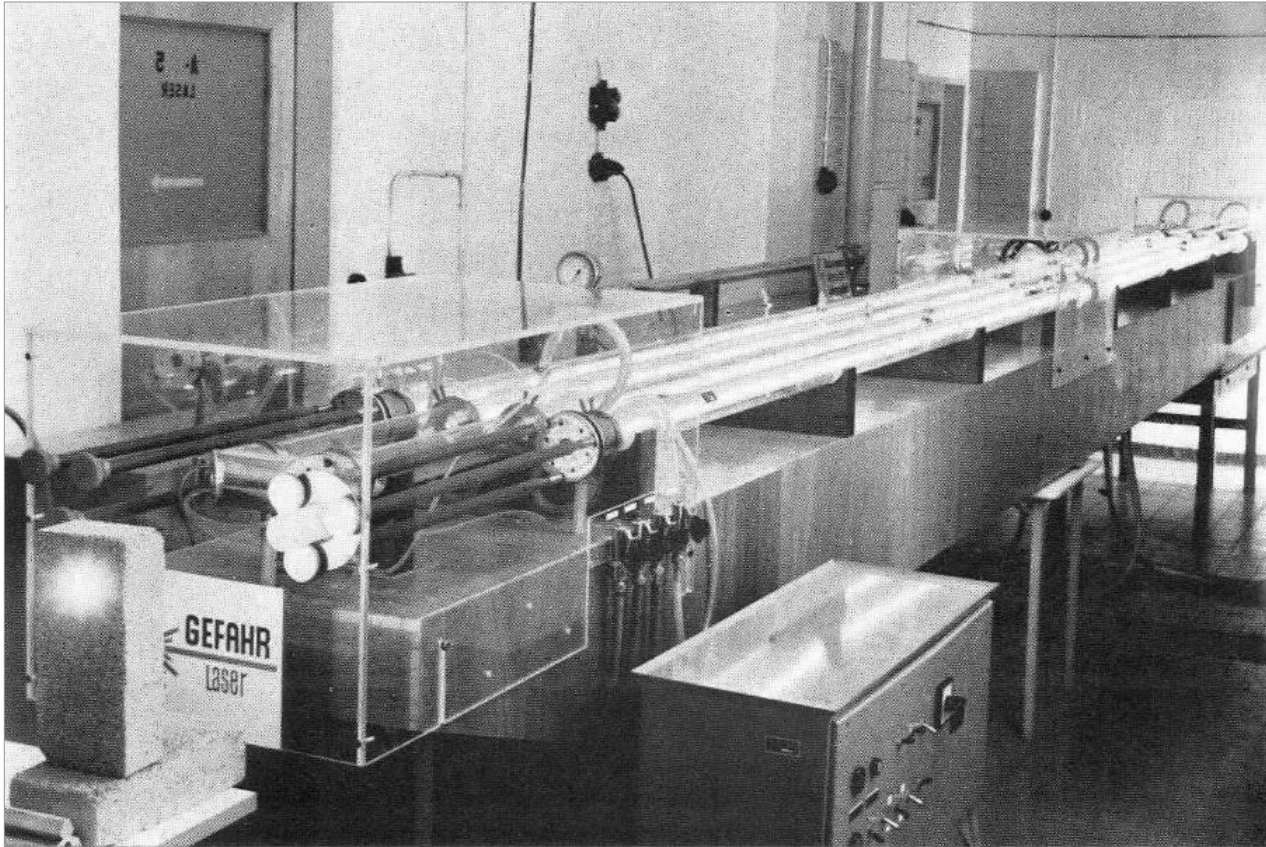
CO<sub>2</sub> laser of K. Patel



## 1968/69: cw power in the kilowatt range

---

CO<sub>2</sub> laser with folded tube, length: 28 m, power: 1.5 kW



*Source: Batelle Institut*

## At the end of the first decade

---

The attention around the laser has settled

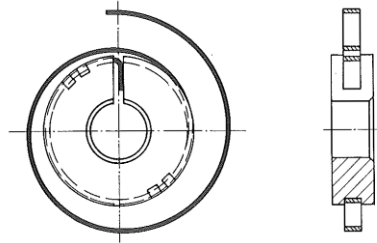
- ambitious expectations are not achieved
- profit cannot be realised yet
- big companies engage less

In America LASER is respelled:

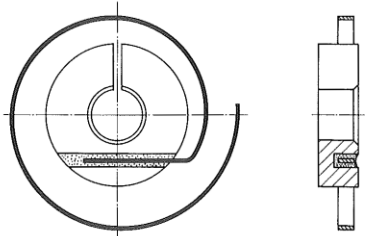
**L**ight **A**ppplied to **S**timulate **E**xpensive **R**esearch

# 1973: laser + machine

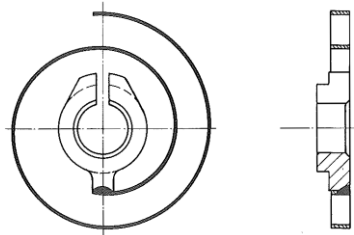
---



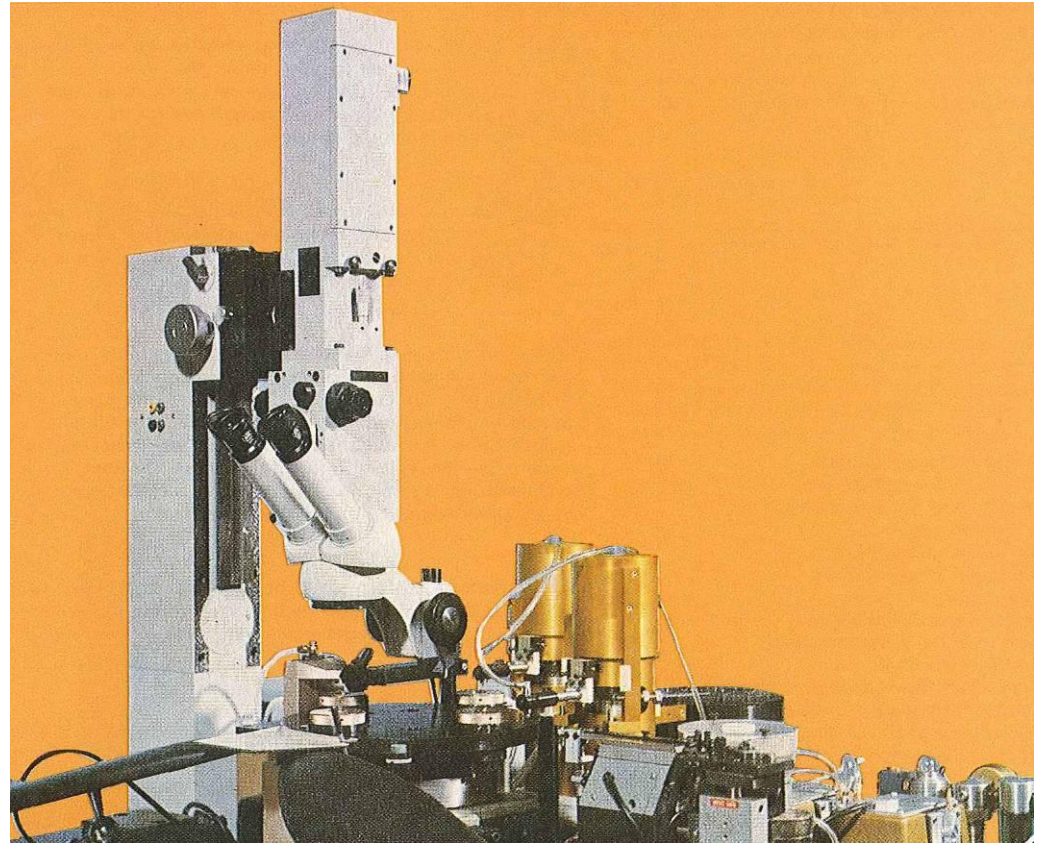
riveted



bonded



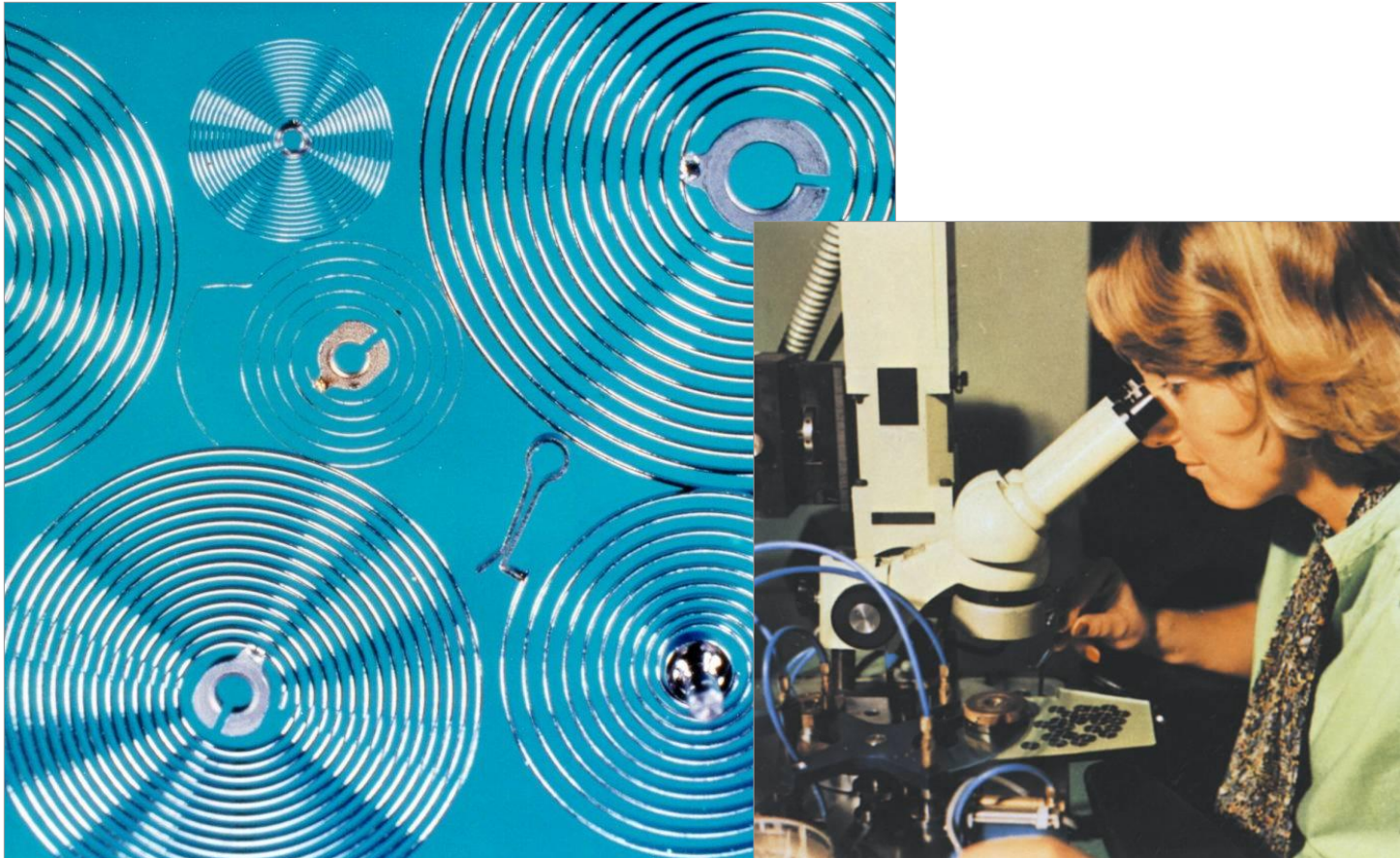
laser welded



Welding machine with LKS 15

## Welding of hairsprings: a success story

---



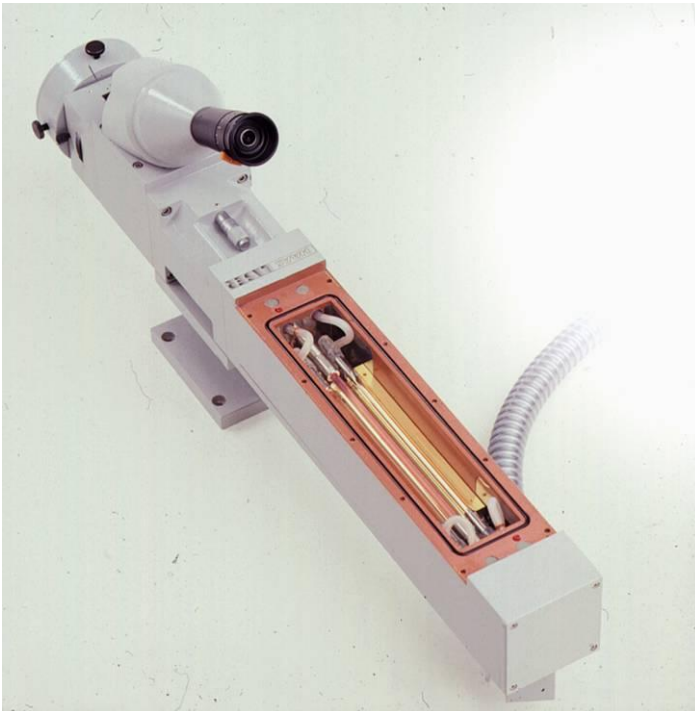
## Unique selling point (USP) with laser welding

---



## From 1973: industrial laser system

---



The LKS - a modular kit of:

- beam sources up to 100 watts
- optical components for beam enlargement and focusing, observation and positioning
- supply unit with control, energy storage and cooling

## 1975: ideal application – the television tube

---

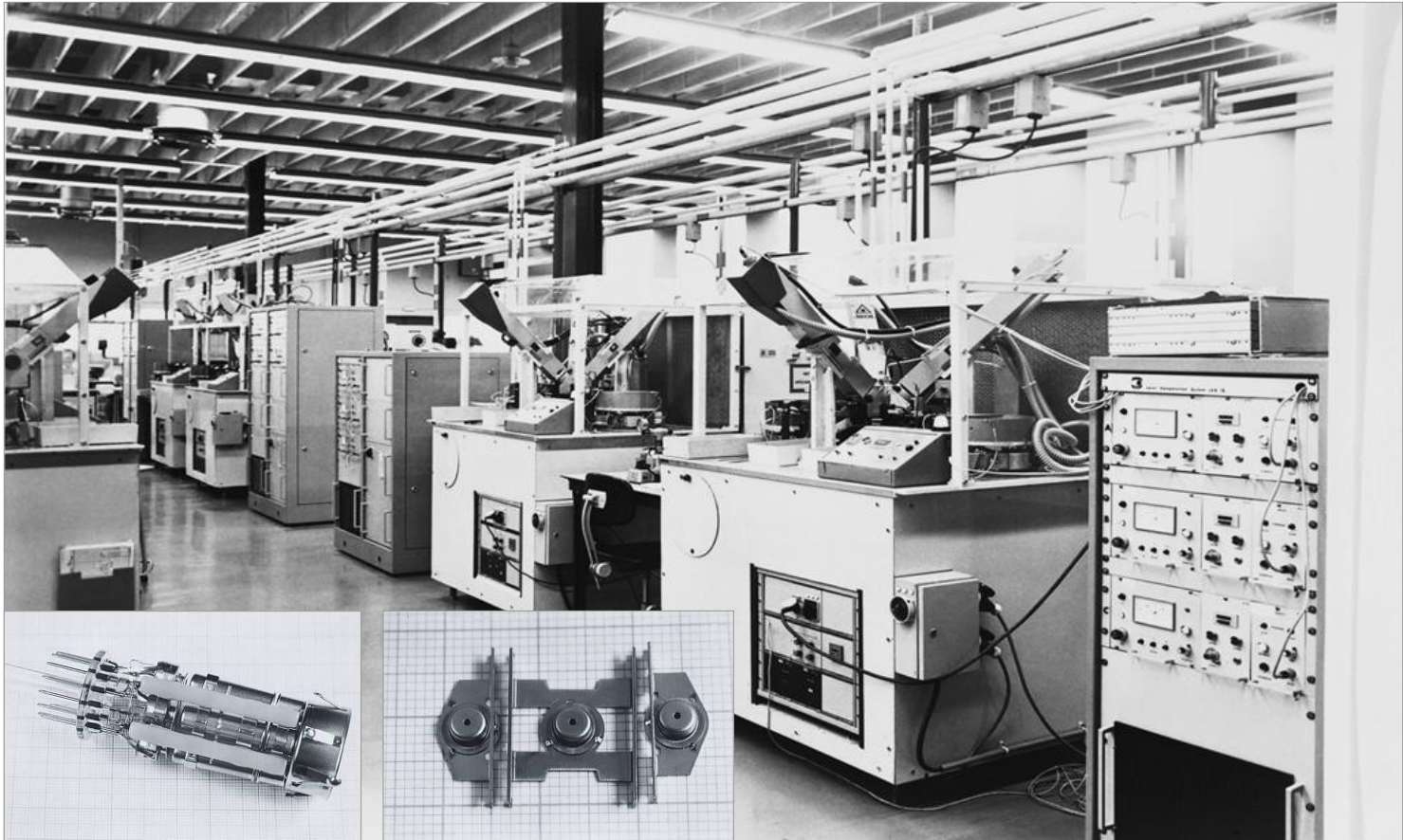


Machine for welding of cathodes for television tubes



# From 1978: final breakthrough thanks to the television tube

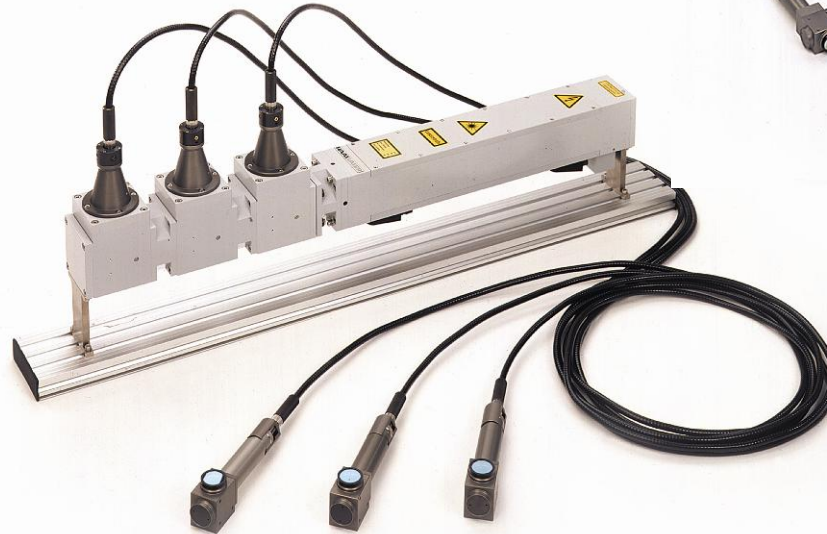
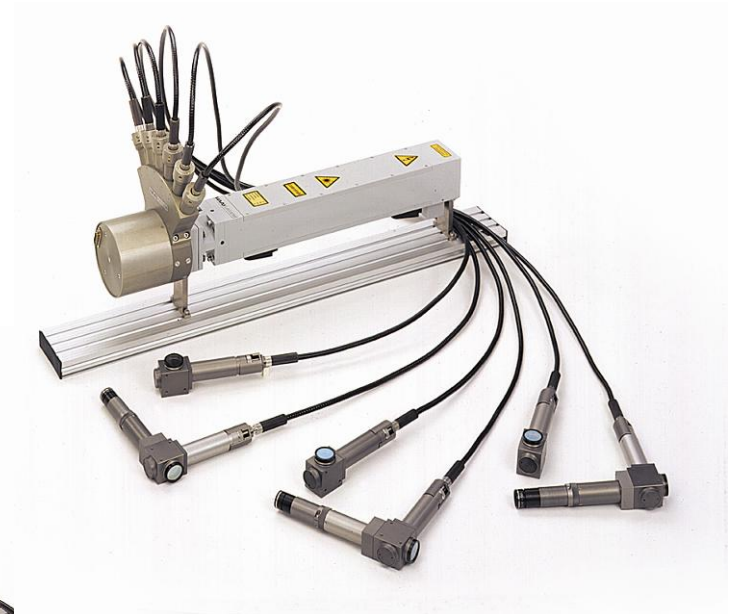
---



Automated production with lasers at Philips

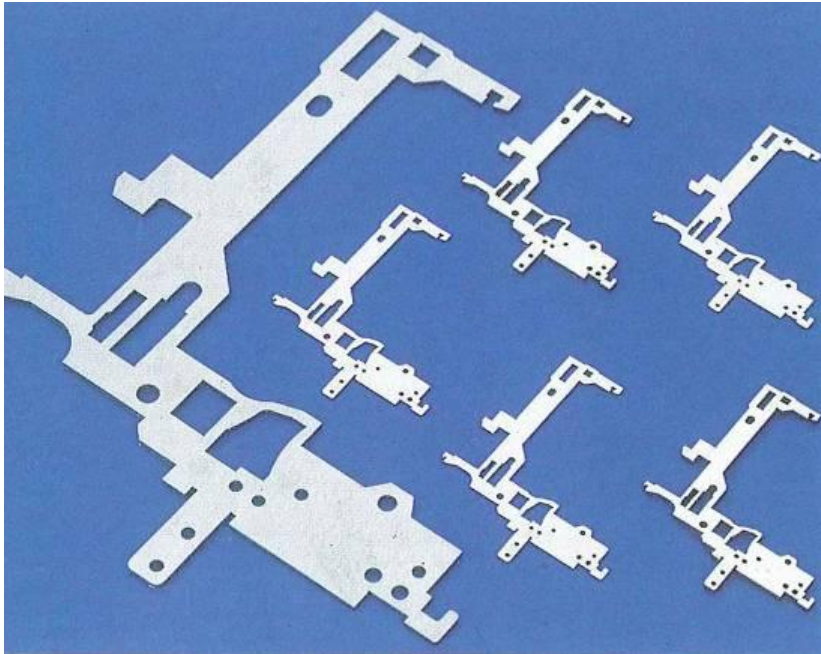
# 1984/85: the laser light cable LLK

---



## In the 1980s: cutting and marking

---



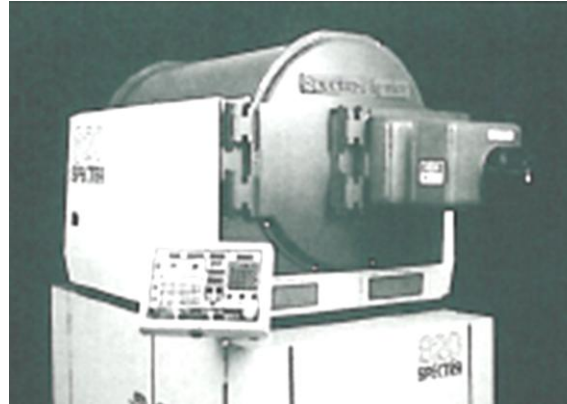
## CO<sub>2</sub> laser manufacturers

---

First manufacturers of CO<sub>2</sub> lasers for material processing

1966/68 in the US:

- Coherent
- GTE-Sylvania
- Photon Sources
- Spectra Physics



*Source: Spectra Physics*

1971/81 in Germany:

- Messer Griesheim
- Sinar Laser Systeme



*Source: Rofin Sinar*

## 1987: CO<sub>2</sub> laser + standard machine

---

Biggest success in laser processing worldwide



First flatbed cutting machine from TRUMPF  
with own laser and flying optics



1979: TRUMPF combined  
punching + laser machine

# BMFT and the laser institutes



1984 ILT, Aachen



1985 BIAS, Bremen



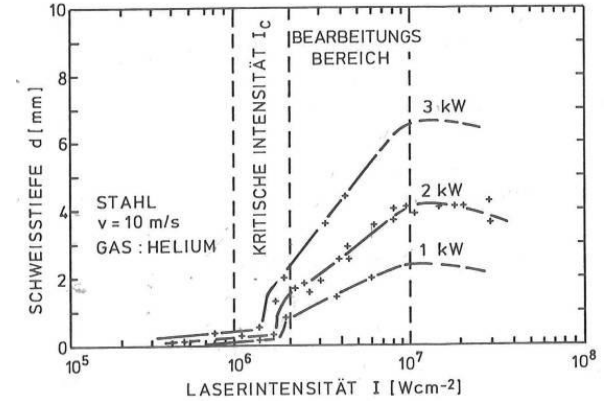
1986 IFSW, Stuttgart



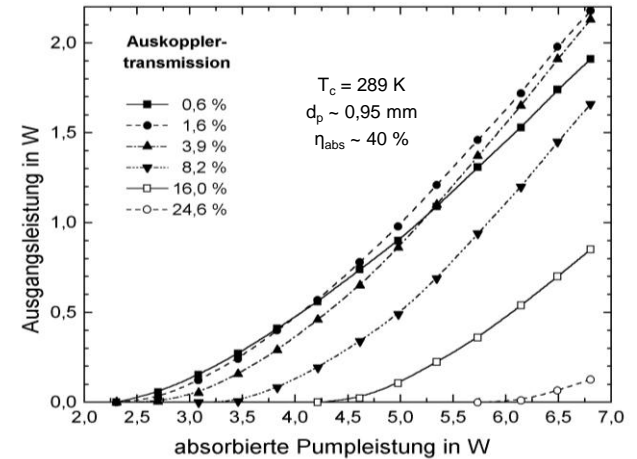
1986 LZH, Hannover



1987 FLI, Berlin



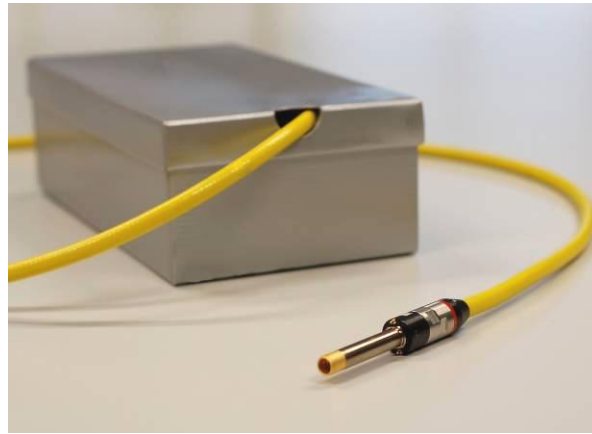
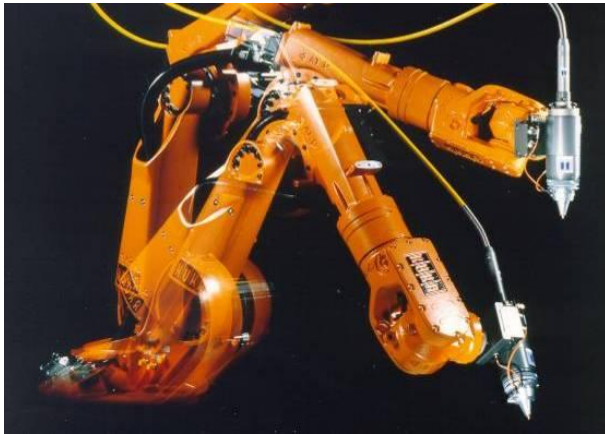
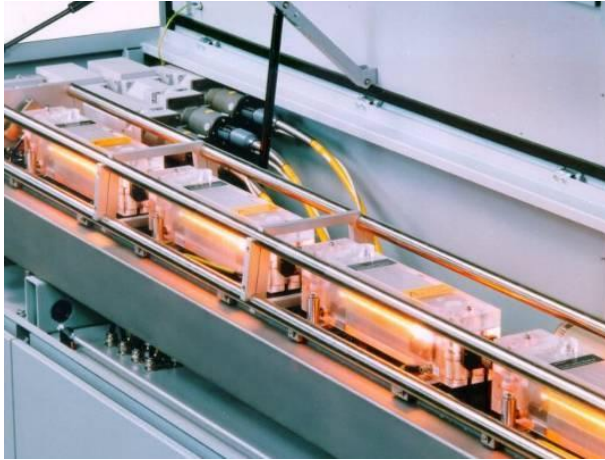
Source: VDI Handbuch



Source: IFSW

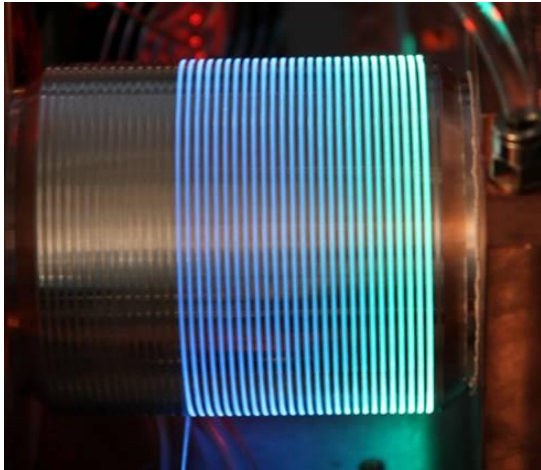
# The 90s: solid-state and diode lasers are moving

---

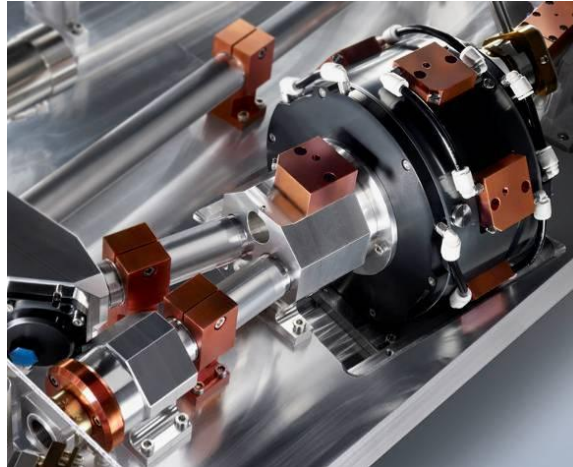


## Current decade: driven by diode lasers

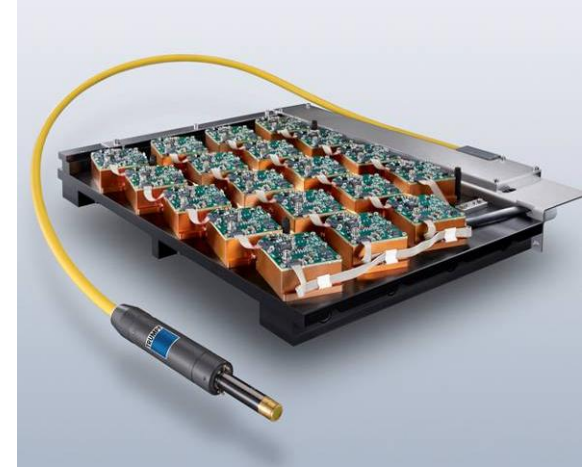
---



Fiber laser



Disk laser



Diode laser

New applications in precision processing with shorter wavelengths and ultra-short pulses.



I would like to thank Prof. Hügel and TRUMPF  
for supporting this presentation.

Dr.-Ing. E.h. Paul Seiler