Sheet metal cutting with fiber lasers

- About Bystronic
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- Summary

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Bystronic: Key Figures

- **Established in 1985**
- **Field of activity: Sheet Metal Processing Systems**
- **Headquarters: Niederönz (CH)**
- **Since 1994 part of the Conzzeta Group**
- **Sales 500 mio. € (2008)**
- **Employees 1627**

Bystronic: Core Activities

Laser Cutting

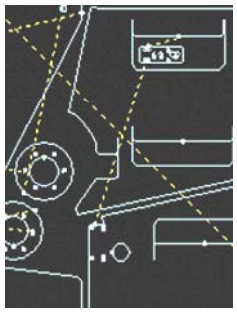
Waterjet Cutting

Bending

- **Process chain: cutting - bending**
- **All from a single source**
- **For all flat materials and all shapes**

Handling & Automation

Software & Control



Services & Support

- **Automation of the complete materials and data flow**
- **For increased productivity and cost efficiency**

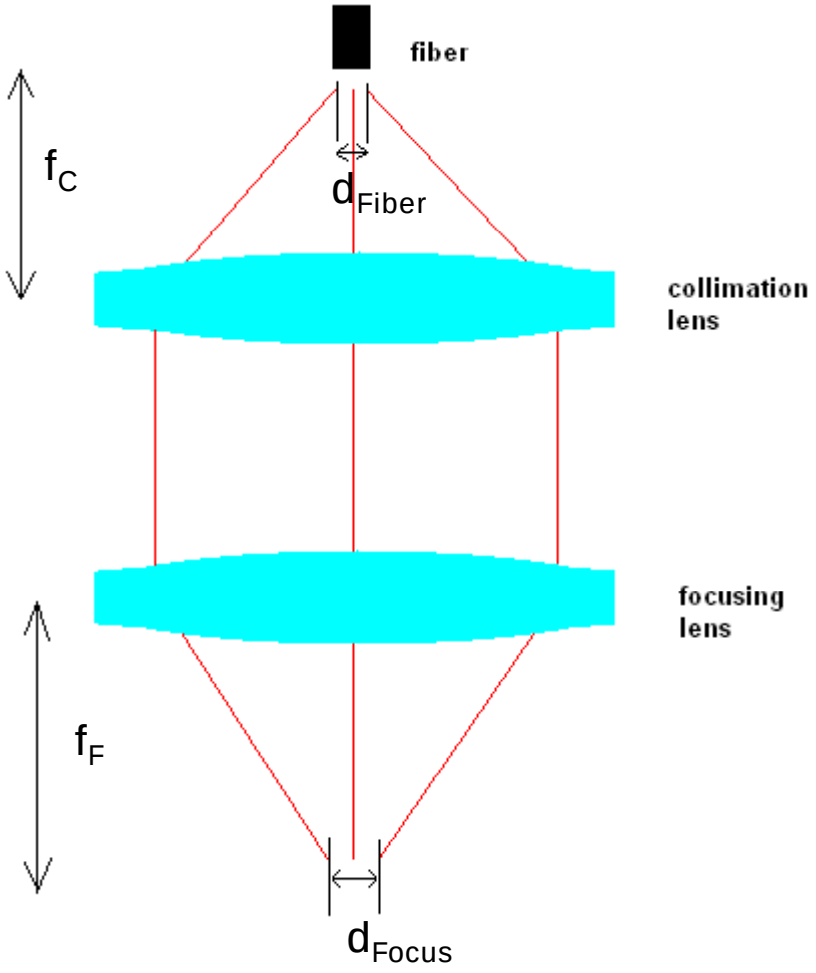
Introduction/Motivation

Wish list for a laser cutting system

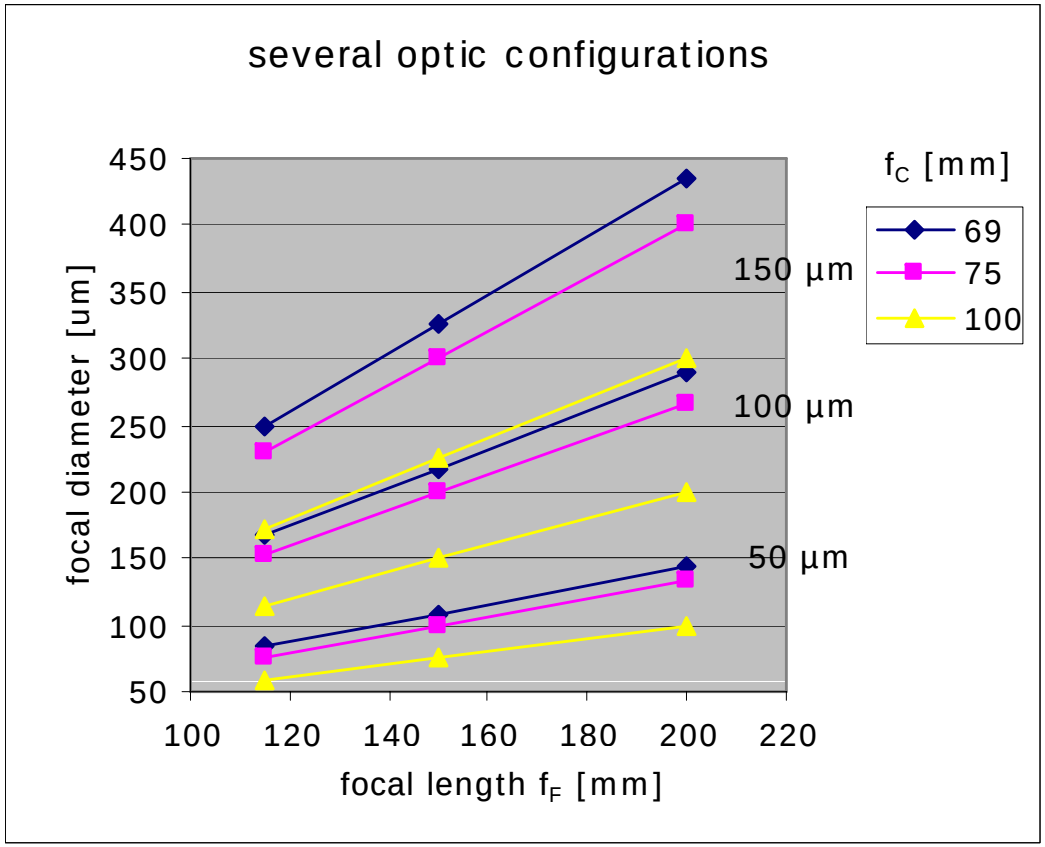
	CO_2	fiber
• Cost-effective	☺	☹
• Reliable autonomous operation	☺	☺
• Energy-efficient	☹	☺
• Compact layout	☹	☺
• Simple operation	☹	☺
• Little maintenance	☹	☺
• Continuous high output	☺	☺
• Good cut quality		

Source: PM By

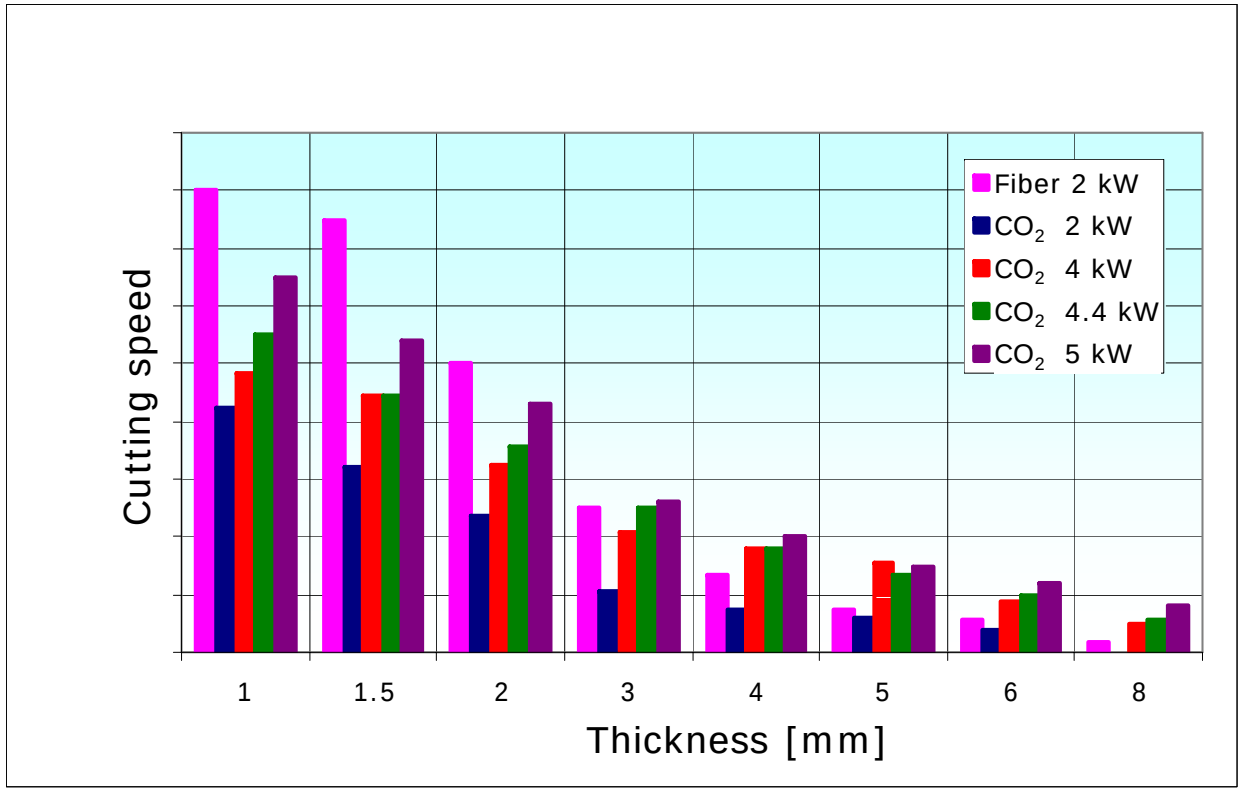
Optic configurations



$$d_{Focus} = (f_F / f_C) \cdot d_{Fiber}$$



Cutting results 2005: Aluminum



Speed

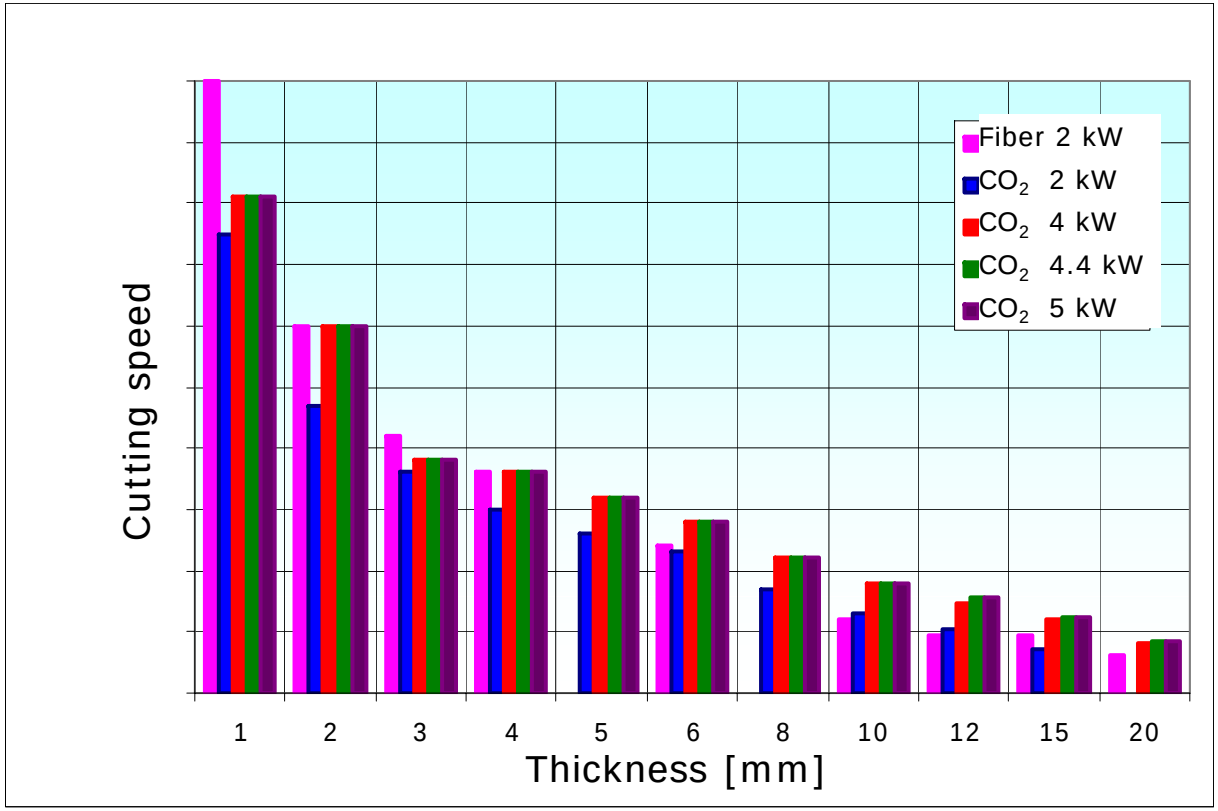
> 4mm similar to 2 kW CO_2

< 4mm faster than 5 kW CO_2

Quality

Similar to CO_2.

Cutting results 2005: Steel (O_2)



Speed

> 5mm similar to 2 kW CO_2

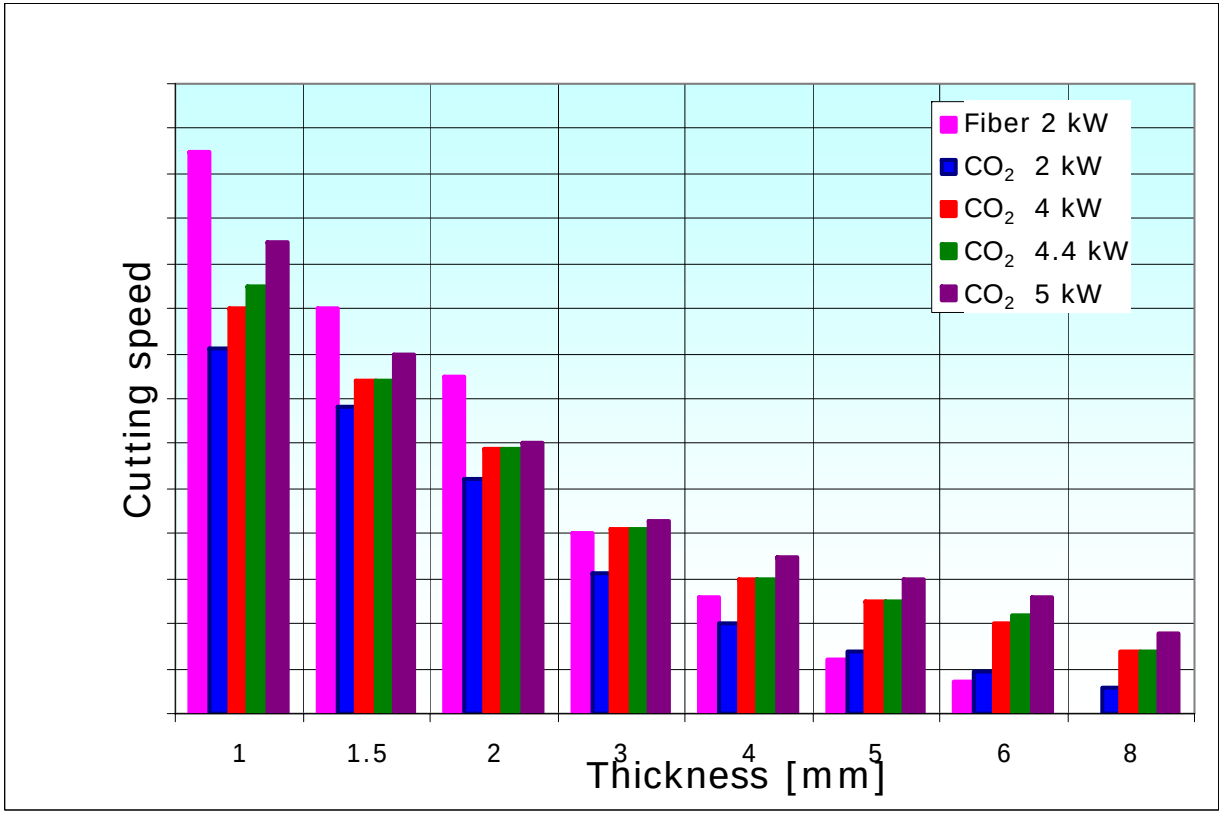
< 5mm similar to 5 kW CO_2

Quality

< 6mm very good

> 6mm good

Cutting results 2005: Stainless steel



Speed

> 4mm similar to 2 kW CO_2

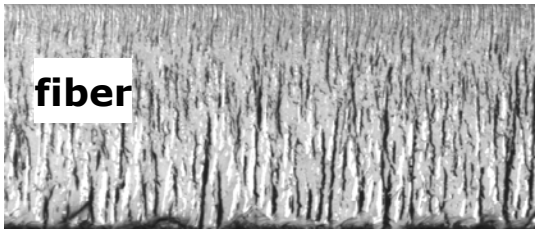
< 4mm faster than 5 kW CO_2

Quality

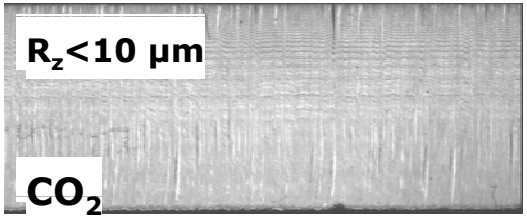
Rather rough cut,

worse than CO_2

Cutting results 2005: Stainless steel



fiber laser: 4mm stainless steel
rough cut; R_z ~ 30 µm (lower region)



CO_2 laser: 4mm stainless steel
smooth surface with R_z < 10 µm

Cutting possibilities: Fiber vs. CO2

	1mm - 5mm	5mm - 20mm
N2	Fiber laser cuts faster Comparable cut quality of fiber- and CO_2-laser	Good cut quality only with CO_2-laser
O2	Comparable cutting speed of CO_2 and fiber laser Comparable cutting quality of CO_2 and fiber laser	

comparison with equal optical power / Source: Optech Consulting, 2009

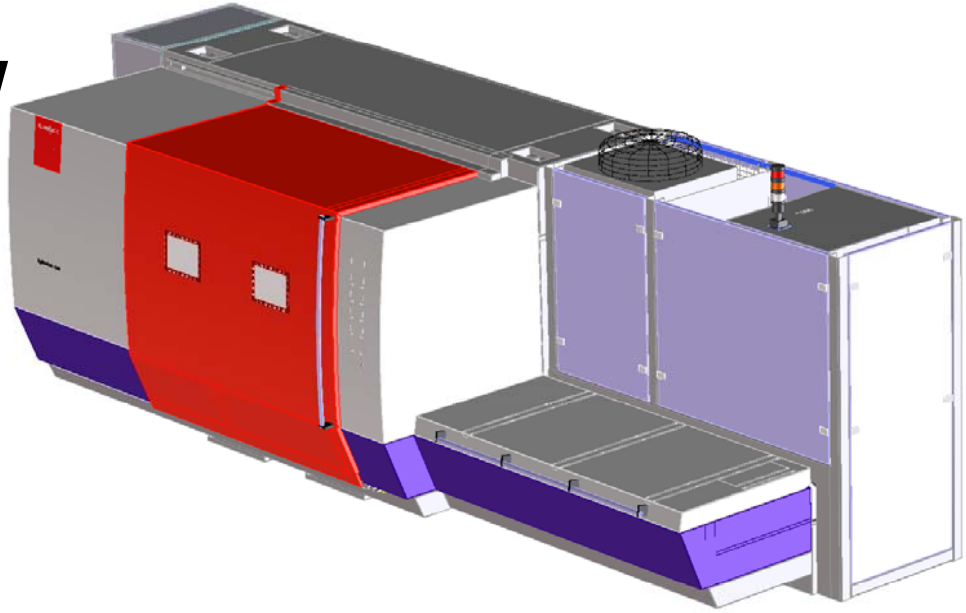
Situation today

➡ **Today, most fiber laser cutting machines are used for thin sheets.**

-ByVention Fiber 2 kW 2007 Munich

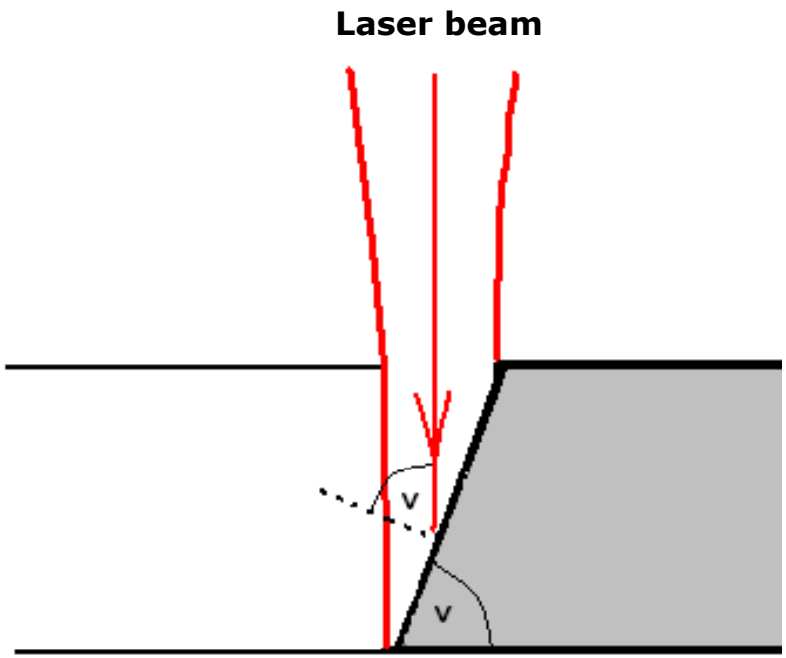
(presented on Laser 2007 WORLD

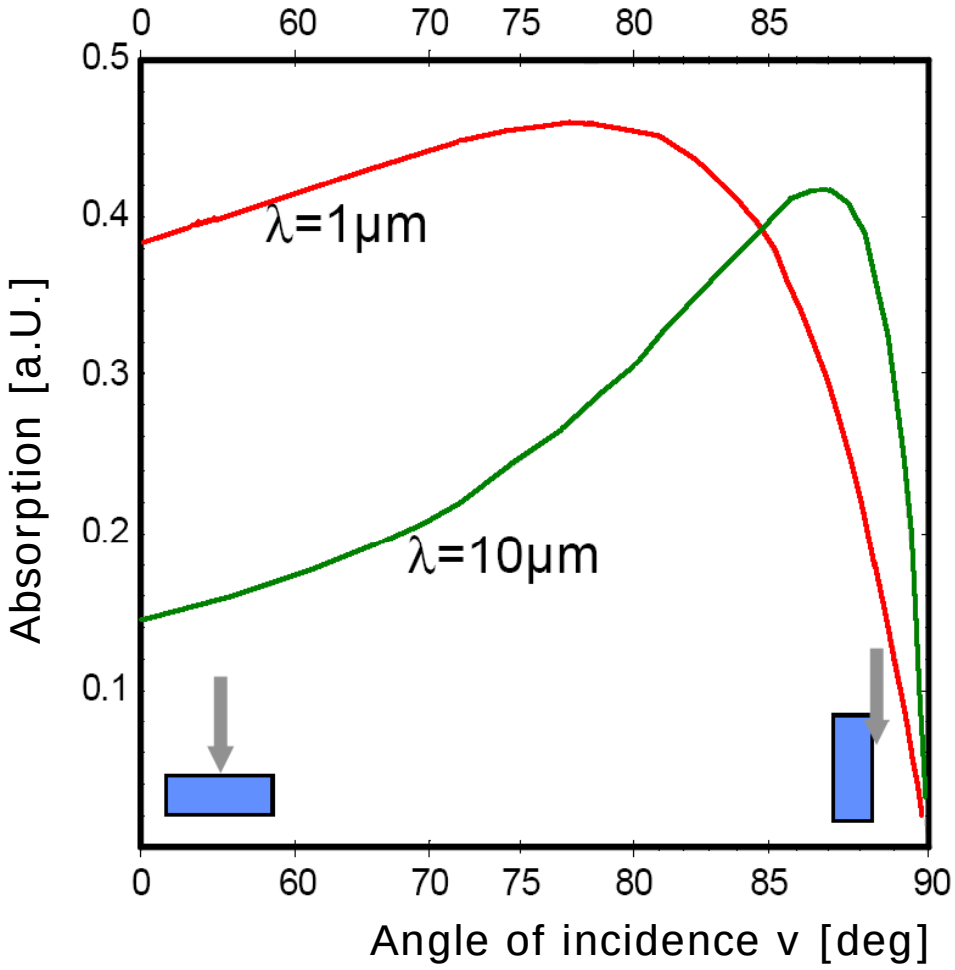
OF PHOTONICS, Munich)



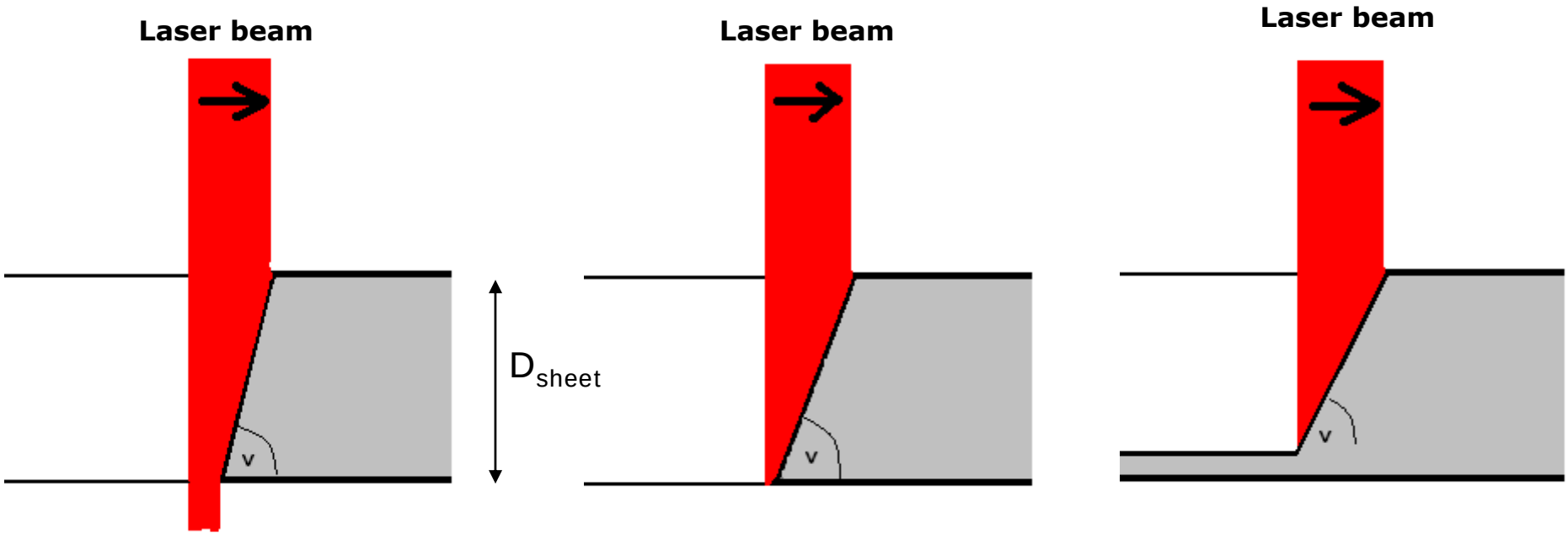
-several fiber laser cutting machines have been presented on Euroblech 08, Hannover.

an approach to improve cut quality



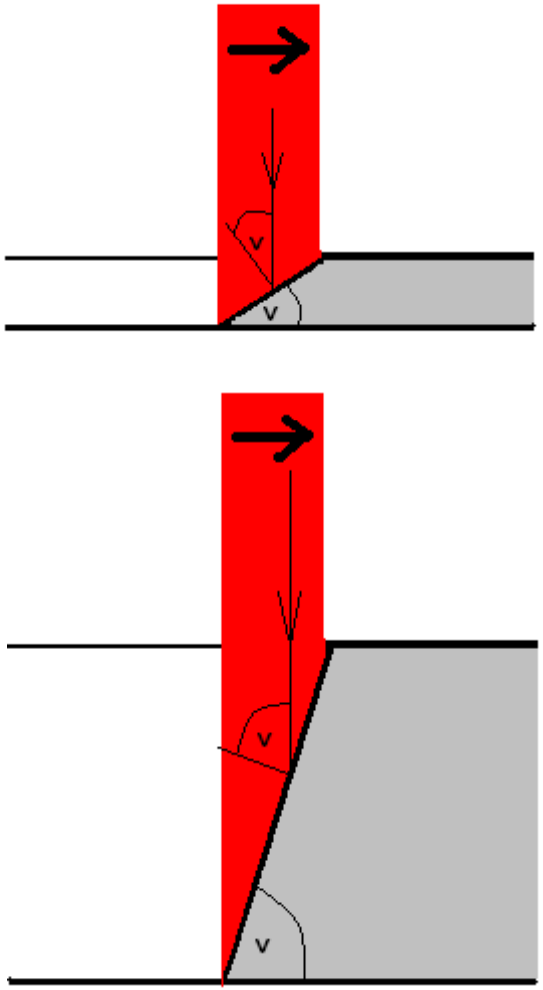


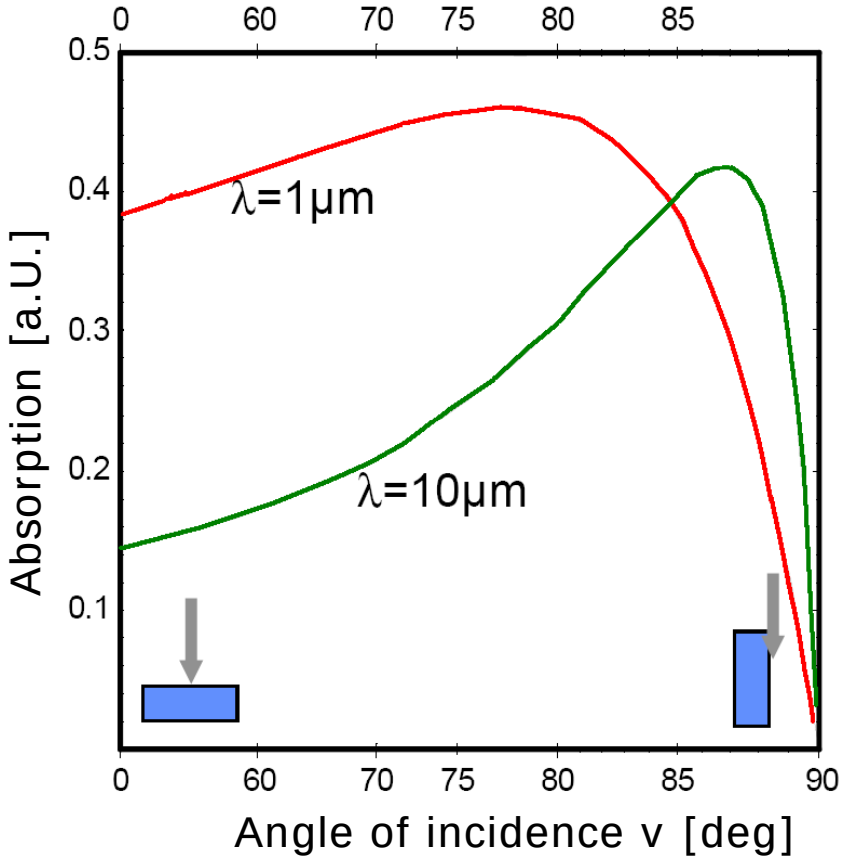
Angle of incidence



$$\mathbf{v_{min}} = \tan^{-1}\left(\frac{D_{sheet}}{D_{Laser\ beam}}\right)$$

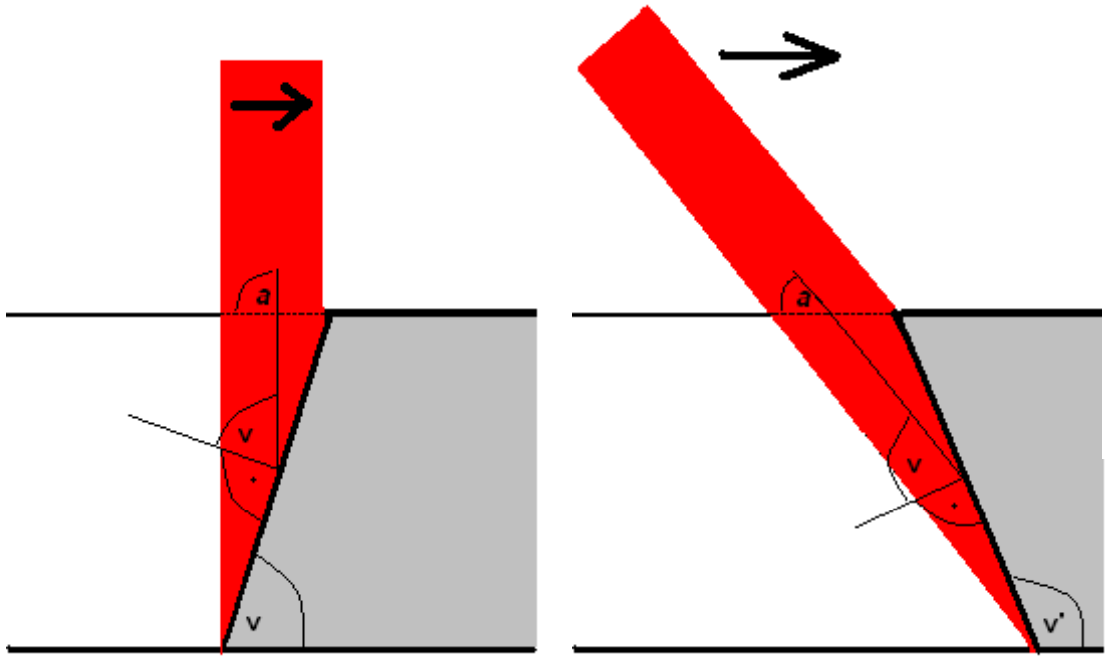
Angle of incidence: sheet thickness

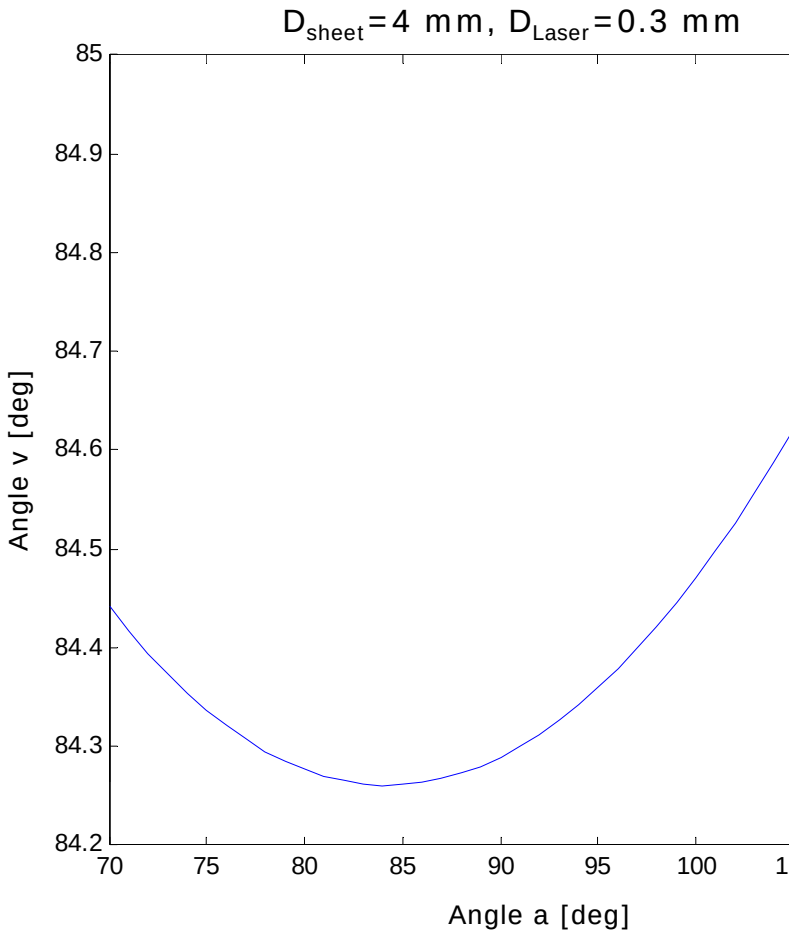




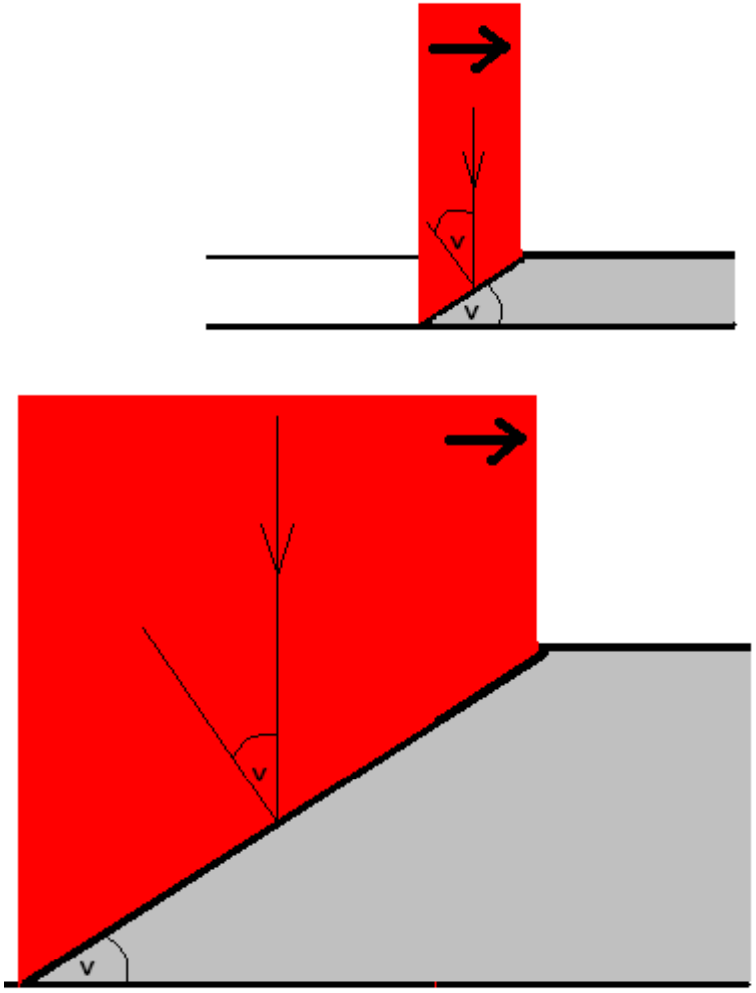
$$\mathbf{v_{min}} = \tan^{-1}\left(\frac{D_{sheet}}{D_{Laser\ beam}}\right)$$

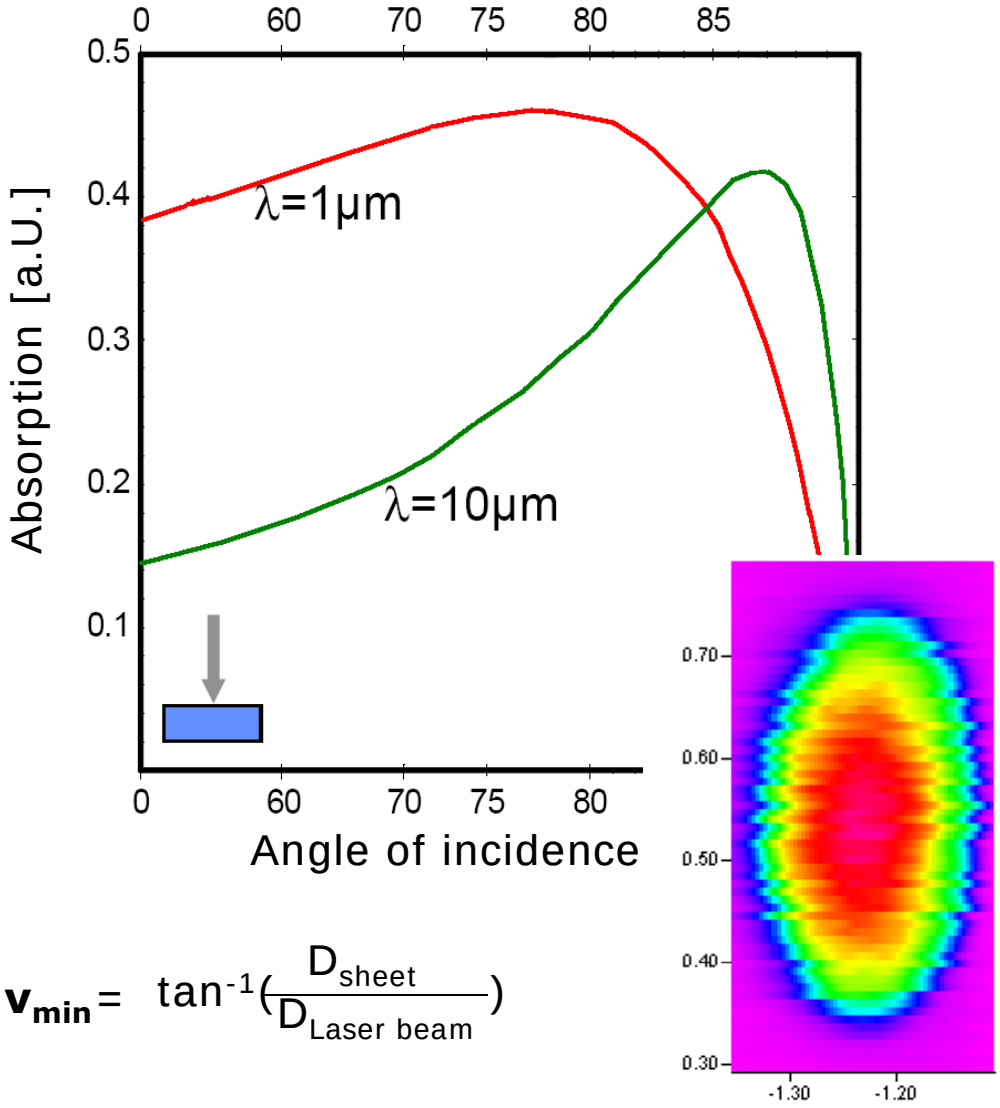
Angle of incidence: beam tilting





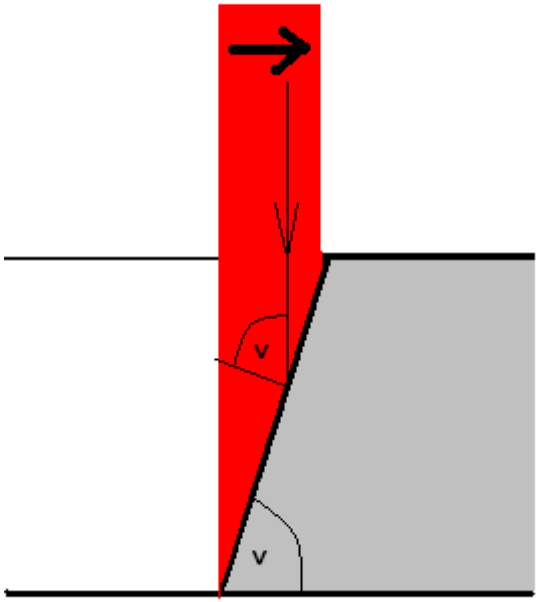
Angle of incidence: elongated beam

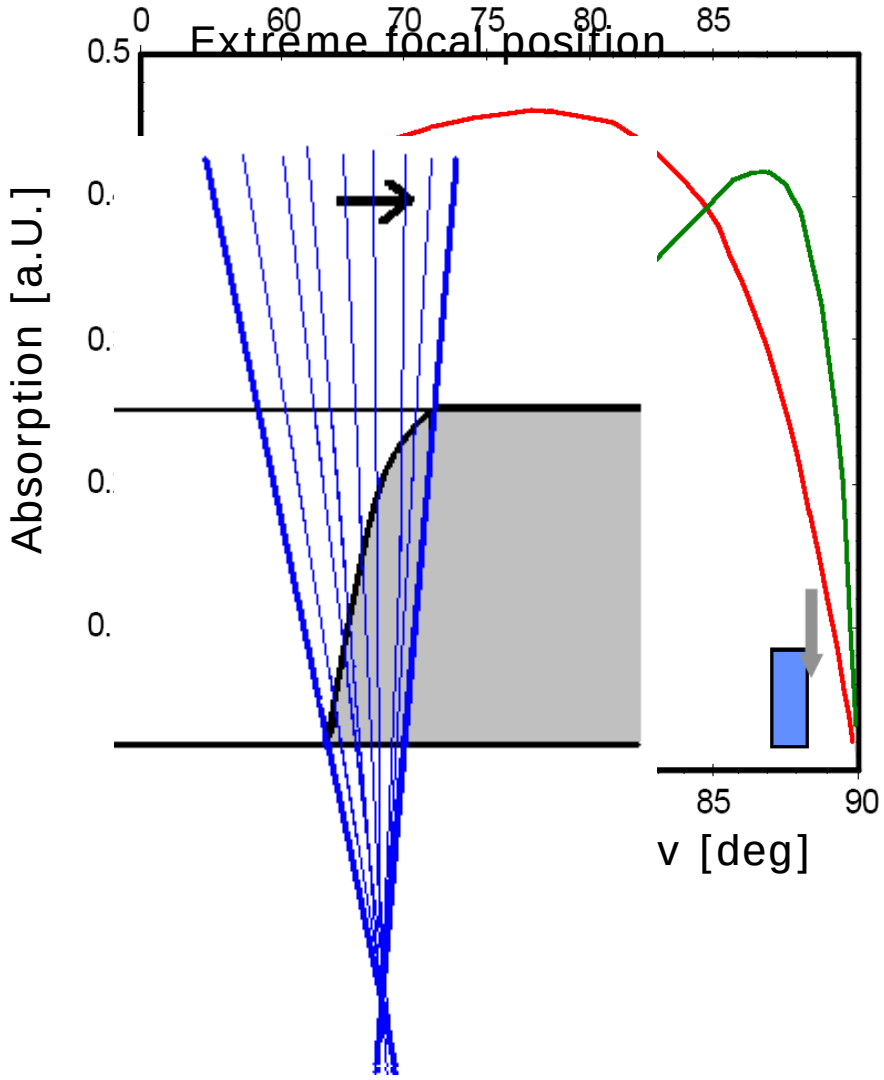




$$\mathbf{v_{min}} = \tan^{-1}\left(\frac{D_{sheet}}{D_{Laser\ beam}}\right)$$

Angle of incidence: focal position

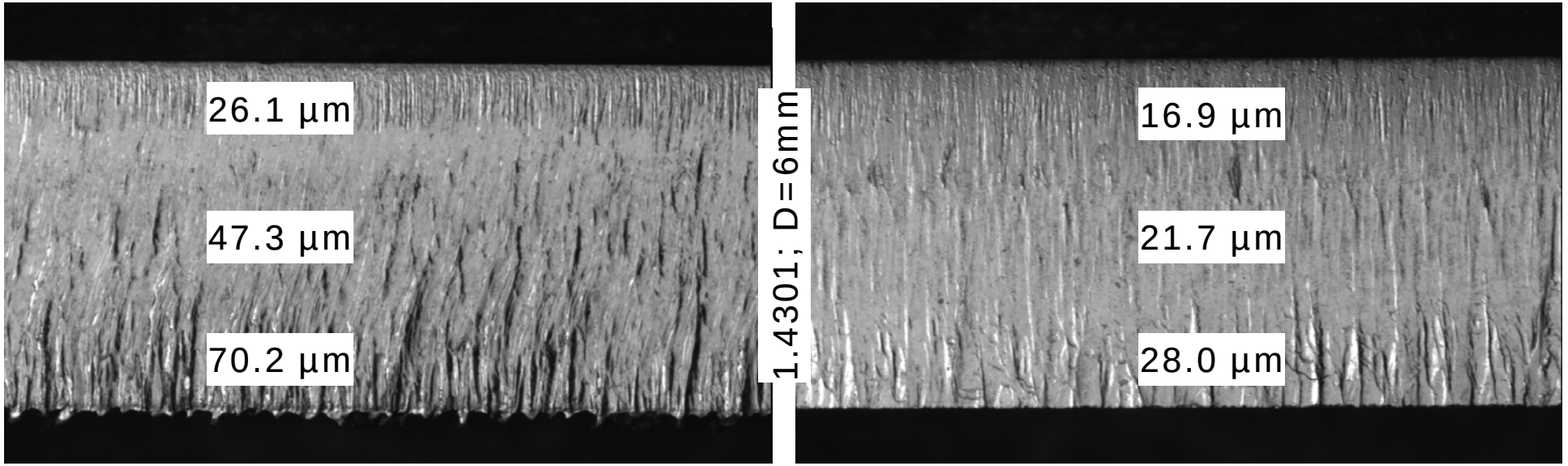




Cut quality improvements

Standard cut (@2kW)

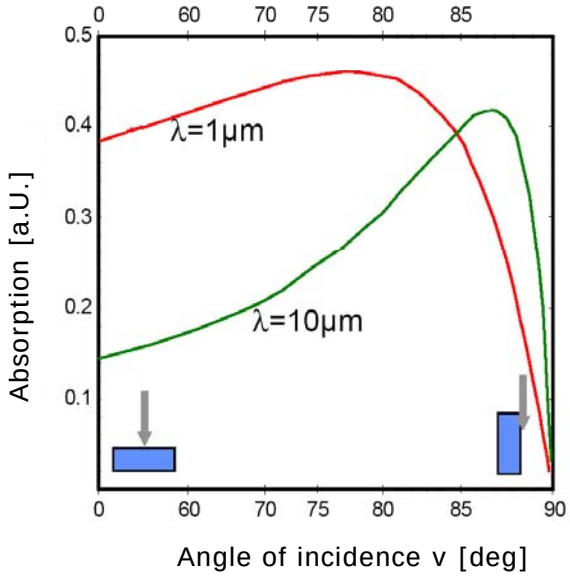
Cut with extreme focal position (@2kW)



➡ Reduced burrs
Reduced roughness

Summary

- 1µm lasers have inherent disadvantage concerning fusion cutting of thick sheet metals (and v.v. concerning thin sheet metals)



- Improvements of cut quality can be achieved by improved incoupling of laser radiation

Thank you for your attention