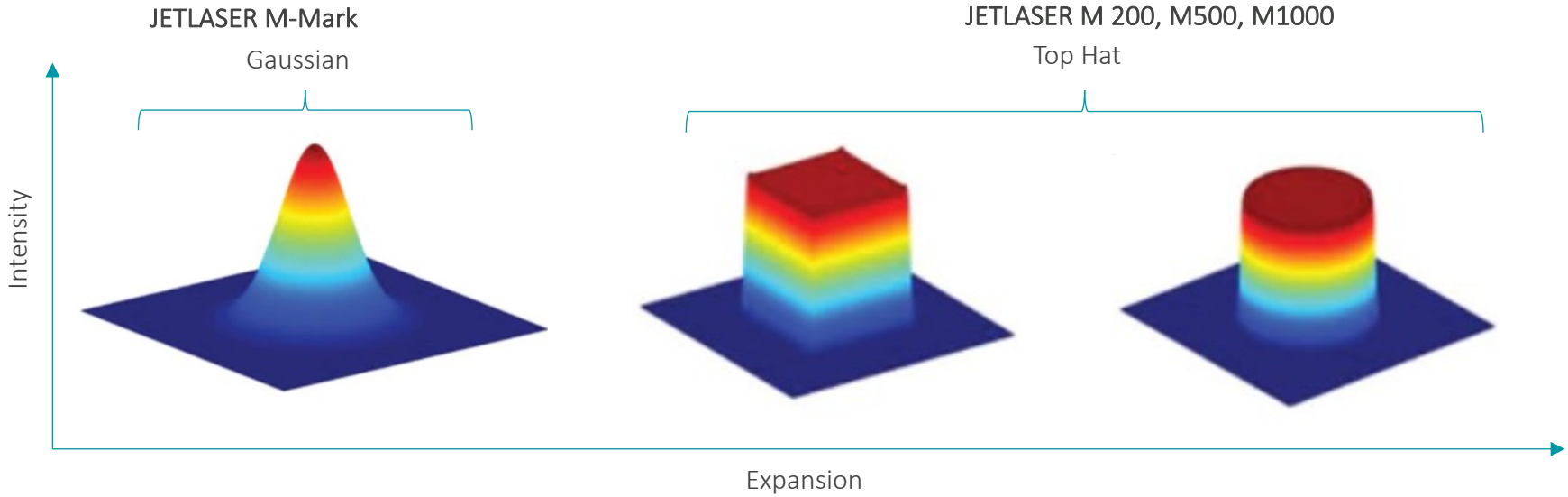
Different Beam Shapes.

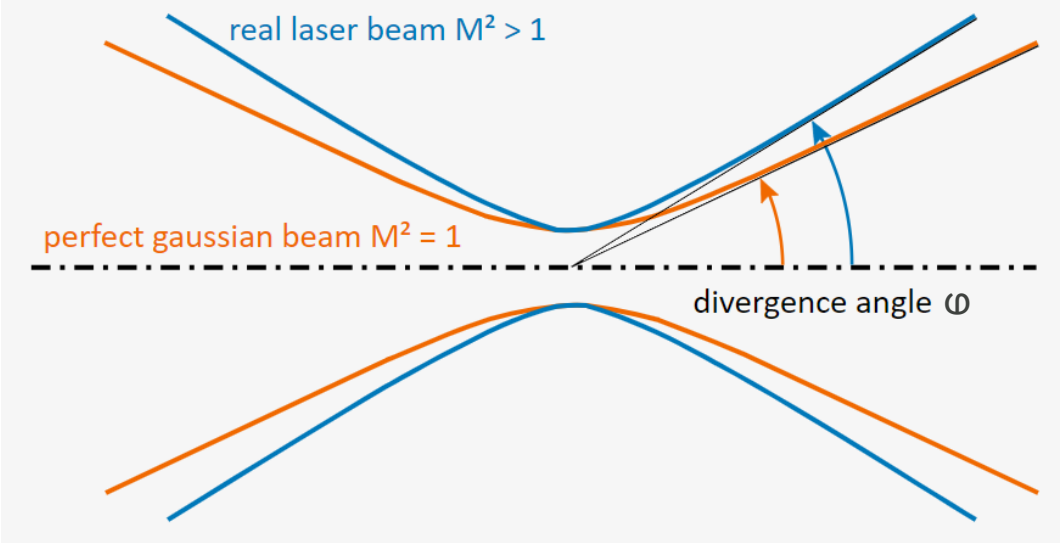


Gaussian Beam:
- perfect beam $M^2=1$
- typically $M^2<2$

Top Hat:
- $M^2>>2$
- typically $M^2>60$

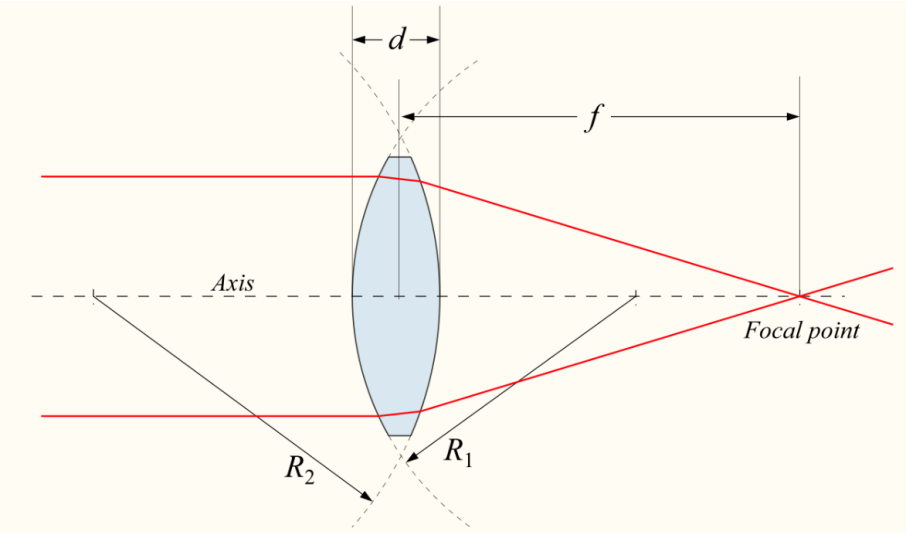
What is M^2?

- $M^2 = \omega_{real} / \omega_{gauss}$
- M^2 describes the ability to focus a beam
- As larger M^2 as worse the ability to focus the beam

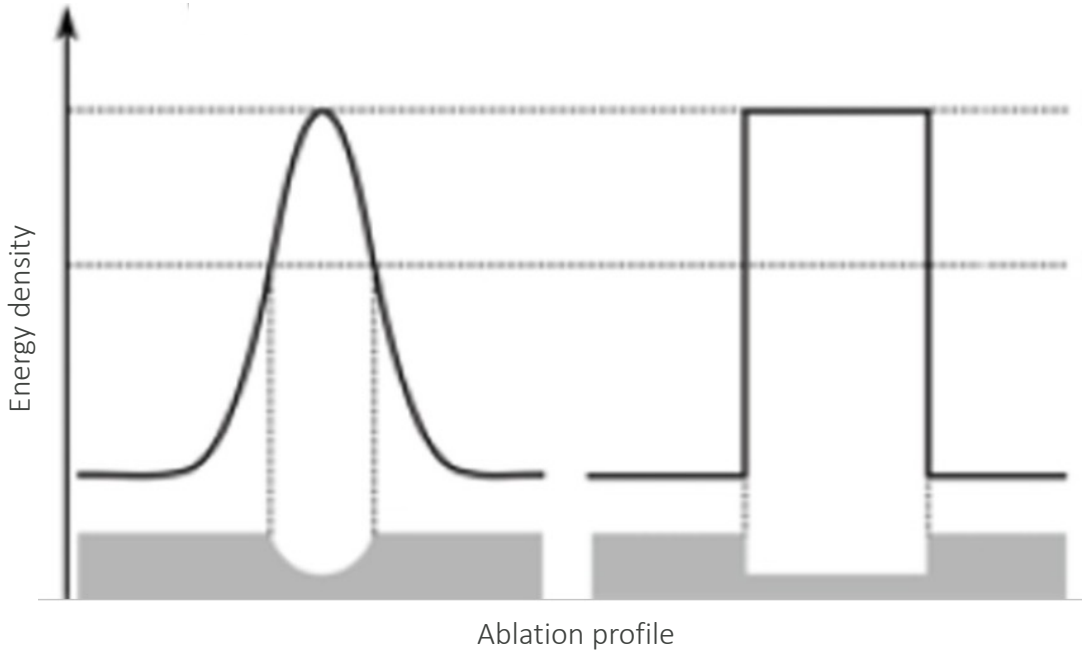


What does that mean?

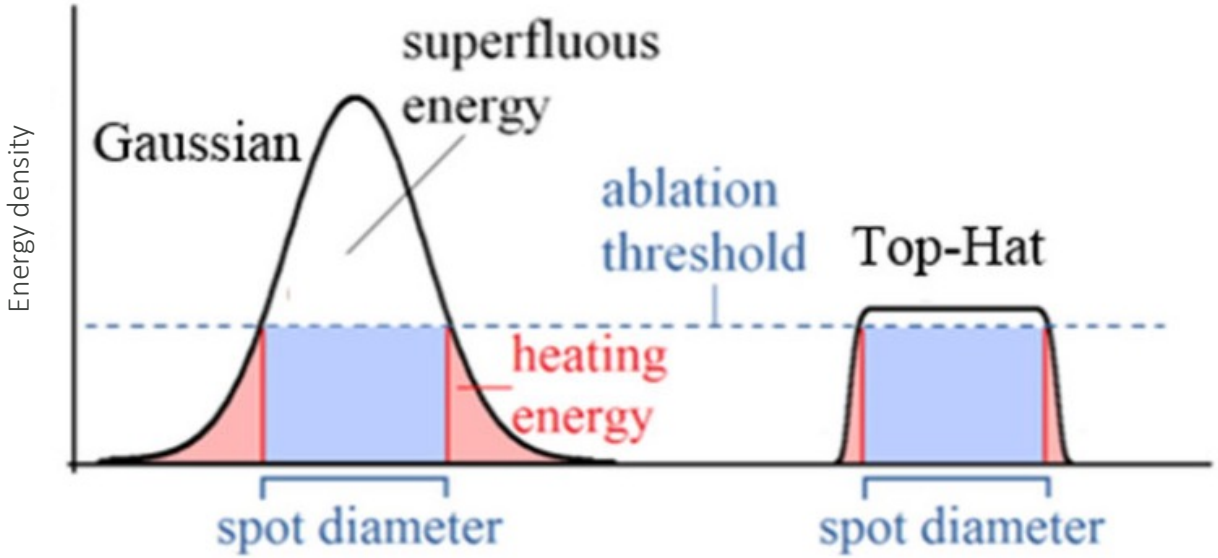
- Focussing a beam (10mm diameter) with a 300mm lens:
  - Ideal Gauss:
  - $M^2 = 1$ → spot size = 40µm
  - Jetlaser 200W:
  - $M^2 = 14$ → spot size = 570µm
  - Jetlaser 500W:
  - $M^2 = 70$ → spot size = 2800µm



Fluence profile and corresponding ablation topography.

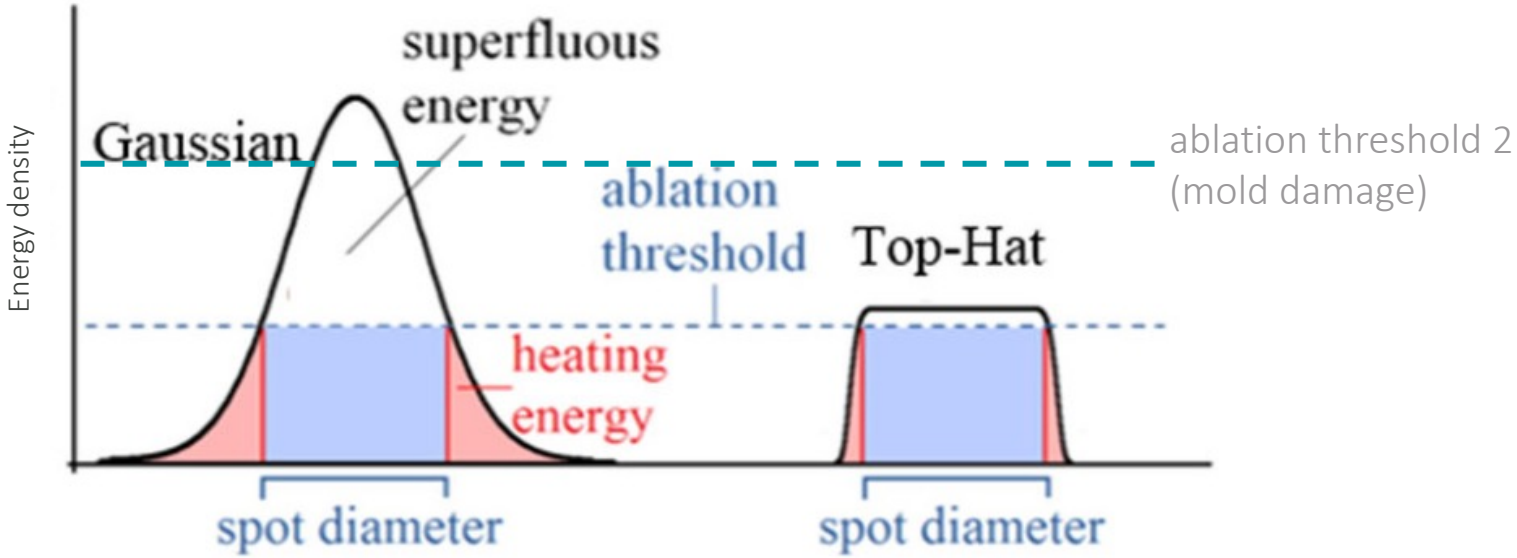


Which beam profile suits your application?



- If the application is having a ablation threshold (e.g. cleaning of injection molds), the top hat beam profile is the mean of choice!

Which beam profile suits your application?



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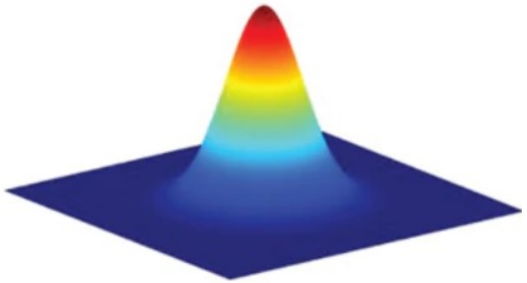
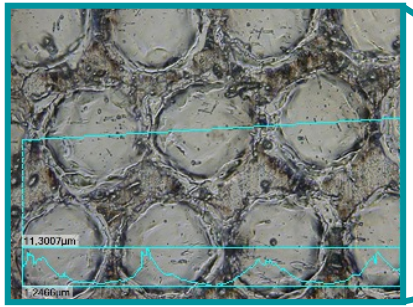
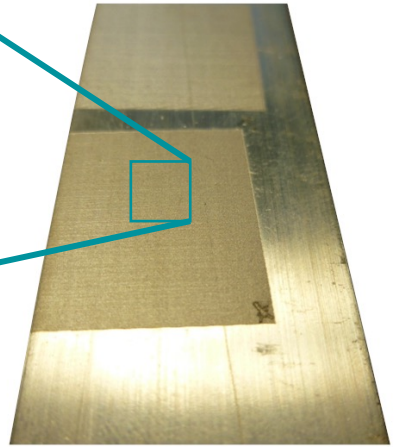
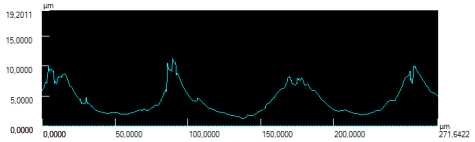
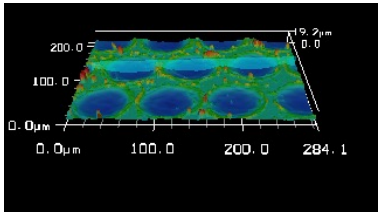
Laser treatment with gauissian beam profile.











Application:

- cleaning the surface
- increase roughness
- patterning a defined structure
- marking

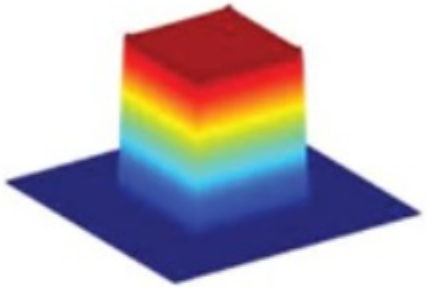
Advantage

- very high fluence (even with low laser power)
- small features writable

Disadvantage

- short Rayleight length (focus tolerance)
- slow processing speed
- inefficient if ablation threshold is low

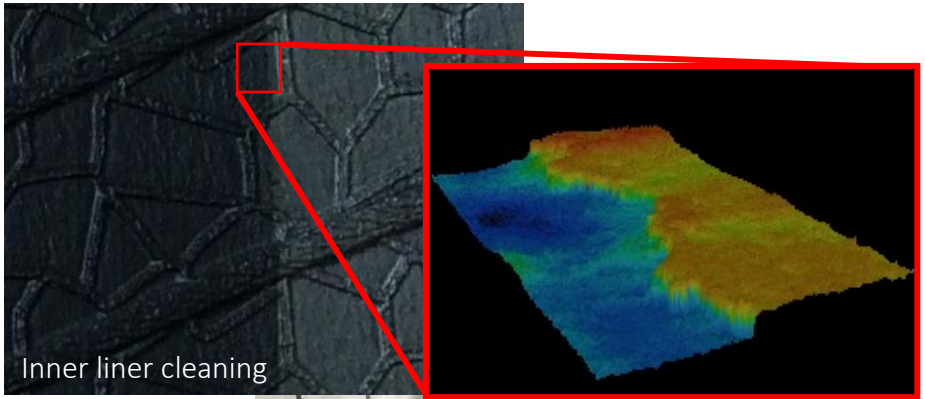
Laser treatment with top hat beam profile.



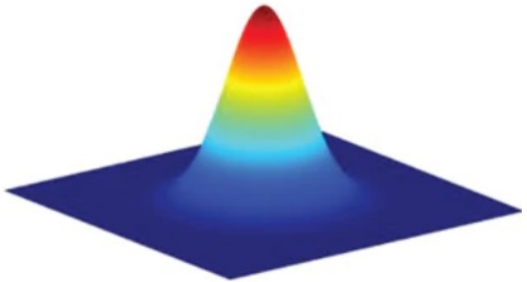
Application:
- cleaning the surface
- homogeneous ablation
- ablation w/o damage to substrate

Advantage
- rectangular spot possible
- high process rates
- High Rayleigh length (focusing tolerance)

Disadvantage
- low energy density
- no small features writable



Gauß vs. Top Hat



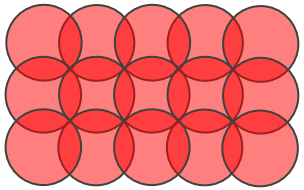
Gauß beam beneficial if:

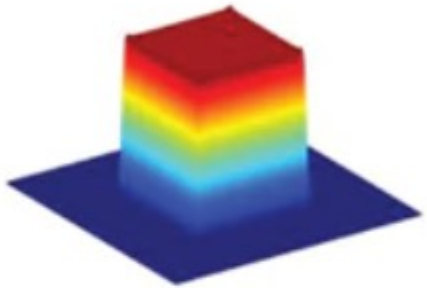
- high energy density is needed
- (sand-) blasting is an alternative

Typical applications:

- cleaning of stone,
- cleaning of ceramic,
- removal of cinder,
- pre-treatment for bonding or welding
- marking

Ideal pattern





Top Hat beam beneficial if:

- high process rate needed
- damage to surface must be avoided

Typical applications:

- mold cleaning,
- innerliner cleaning.

Ideal pattern