



# Structured Laser Beam

**Amy Bilton**

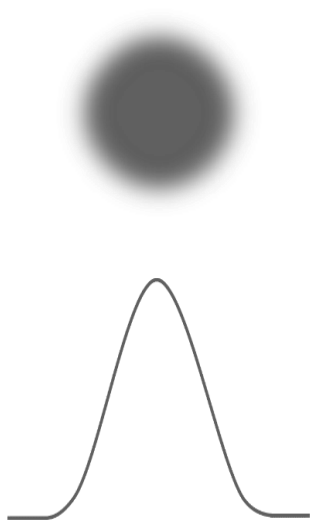
Knowledge Transfer Officer  
CERN Knowledge Transfer

**Miroslav Šulc**

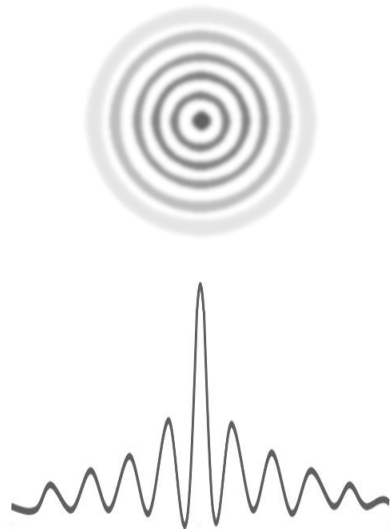
Knowledge Transfer Officer  
Institute of Plasma Physics of the  
Czech Academy of Sciences



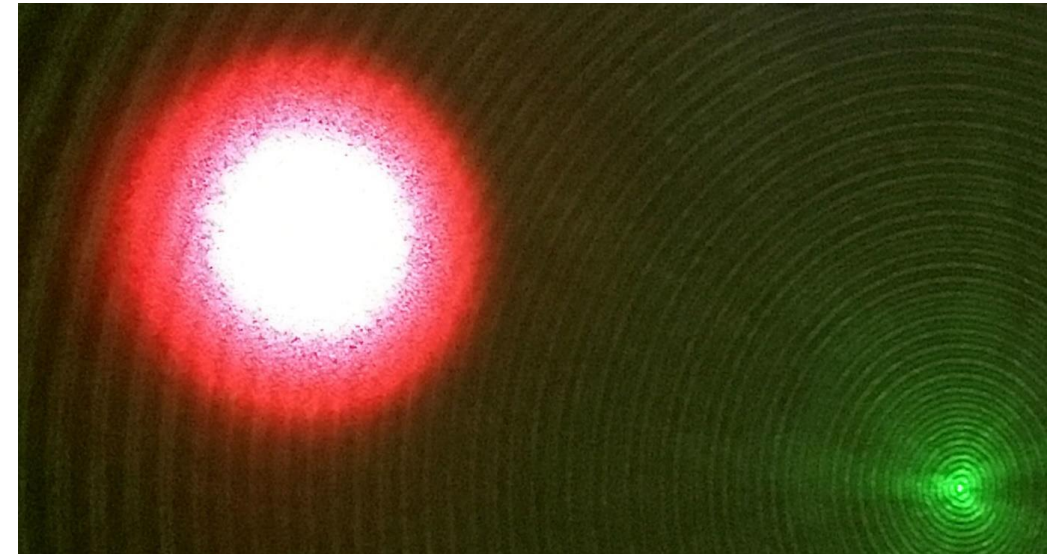
- A simple, low-cost system and method for generating a structured laser beam (SLB) that can propagate over **large distances** while maintaining a **low divergence** and **small central spot size**.



*Gaussian laser beam and its intensity distribution*



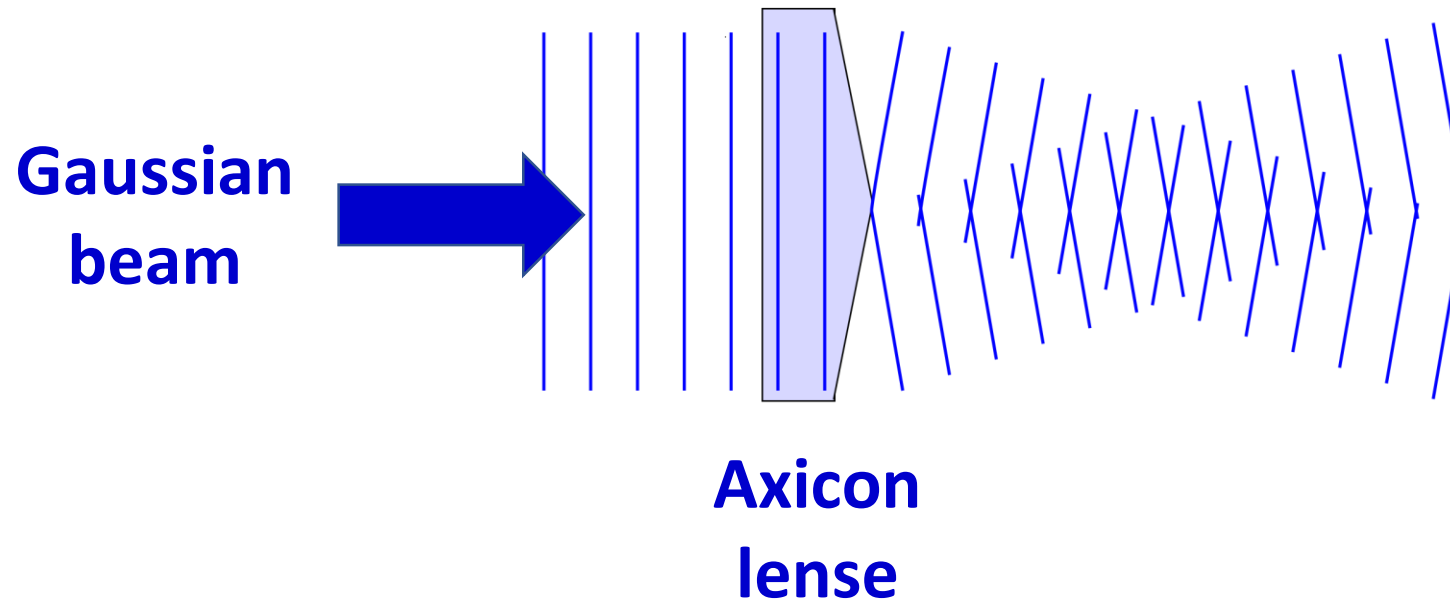
*Structured laser beam and its intensity distribution*



*Comparison of the SLB (Green) and a Gaussian beam (Red). The Central spot of the SLB is much smaller than the Gaussian at the same distance from the electromagnetic radiation source.*



- Bessel beam generation on short distances

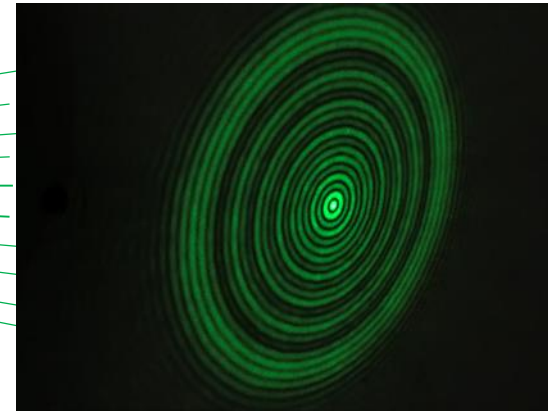
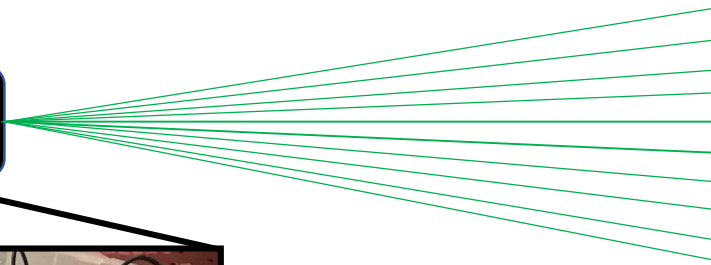
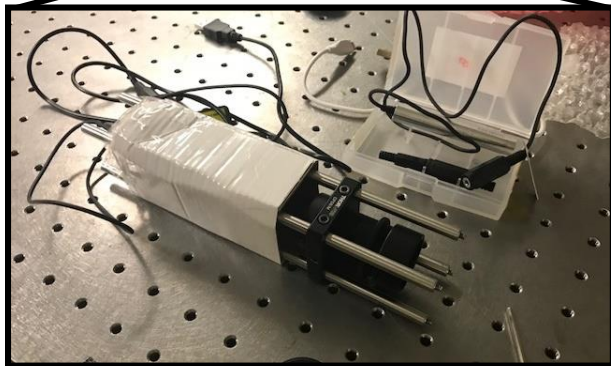
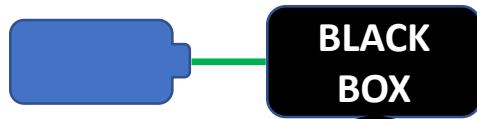


- Only for distances up to 100 mm



- A coherent beam of electromagnetic radiation is illuminated on an optical system in such a way as to produce a structured beam.
- The parameters of the system can be easily adjusted to modify the focus, the divergence of the beam, and the number and thickness of the rings.

Laser

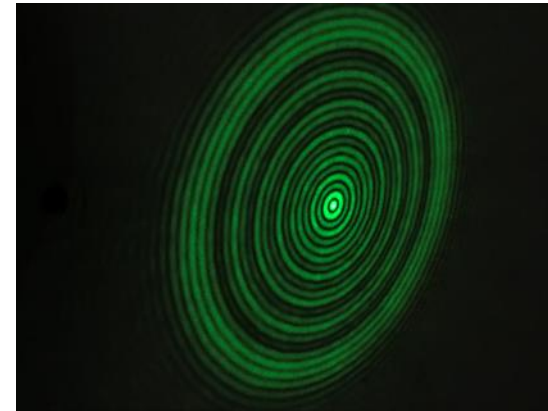
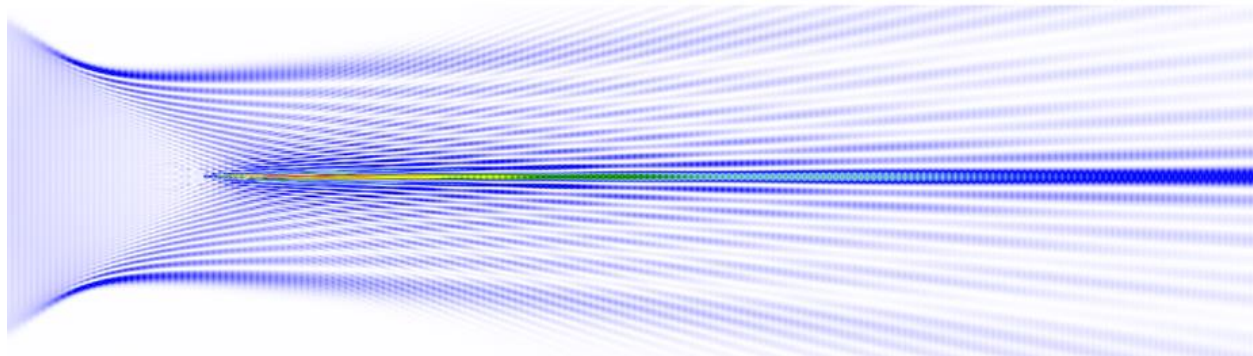




**CESP**  
CERN Entrepreneurship  
Student Programme

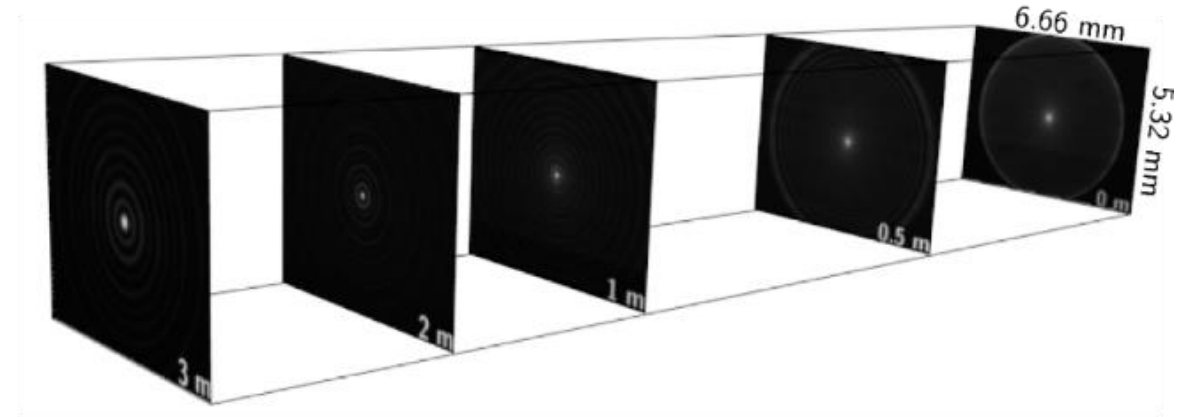
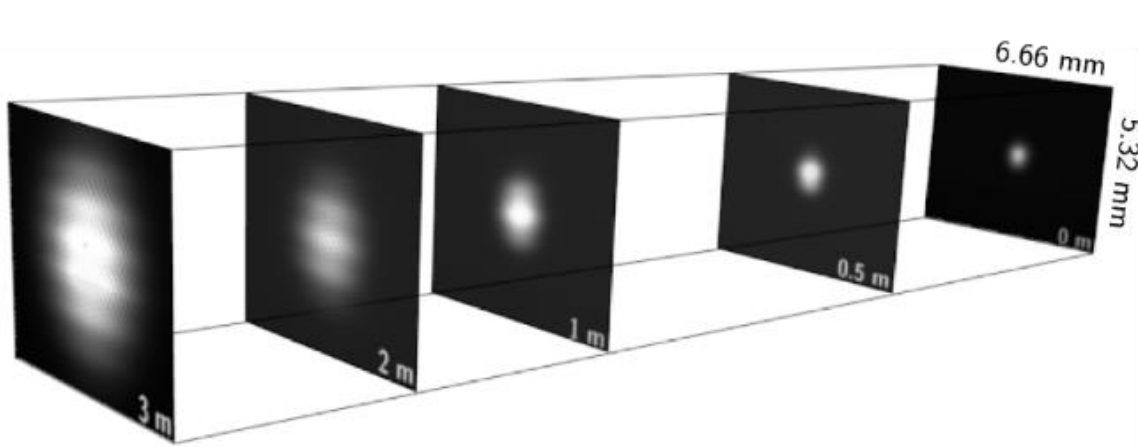
# HOW IT WORKS

- The SLB consists of a central part with surrounding fringes.
- After the generator, only the central part is a continuous line.





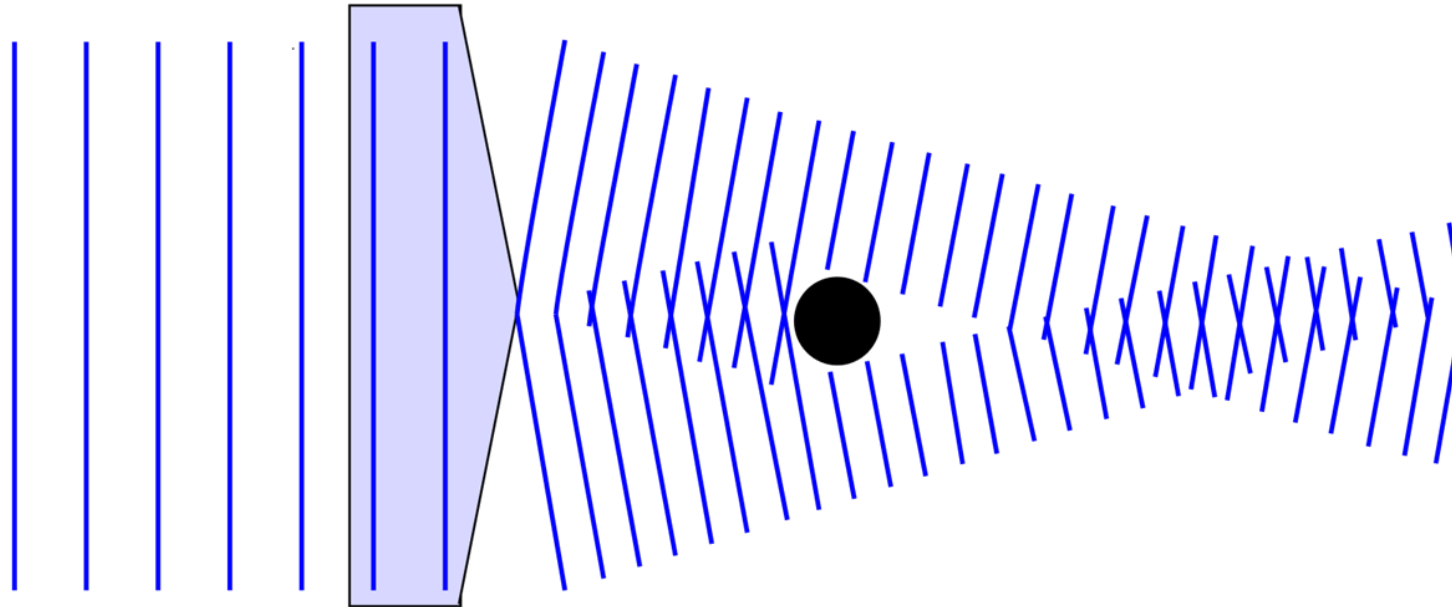
Experimental comparison of divergence of the Gaussian and the Bessel beam



	Size at 3 m	Size at 100 m
Gaussian	0.8 mm	240 mm
<b>SLB</b>	<b>0.01 mm</b>	<b>1.2 mm</b>



- The SLB can self-reconstruct after obstacles.





**CESP**  
CERN Entrepreneurship  
Student Programme

# ADVANTAGES

- Compact spot size and very low divergence.
- Self-reconstruction after obstacles.
- Simple, low-cost, lightweight system.
- Very robust to jitter, vibrations, and variations in the angle of the input beam; it also shows some robustness to fluctuations in air temperature.
- The SLB can be produced for any wavelength and potentially for any power.





**CESP**  
CERN Entrepreneurship  
Student Programme

# APPLICATIONS

Alignment

Metrology

Communication

Gas detection

Laser shows

Others?