

Generation of High Order Modes

Sandile Ngcobo^{1,2}, Kamel Ait-Ameur³ and Andrew Forbes^{1,2}

¹*CSIR National Laser Centre, PO Box 395, Pretoria, 0001, South Africa*

²*School of Physics, University of KwaZulu-Natal, Private Bag X54001, Durban, 4000, South Africa 9774*

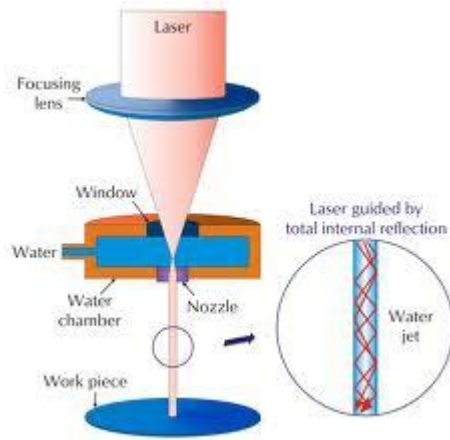
³*de Recherche sur les Ions, Les Matériaux et la Photonique, Université de Caen, ENSICAEN, F1450 Caen, France*

The logo for CSIR (Council for Scientific and Industrial Research) is displayed in a dark blue, stylized font. The letters 'C', 'S', and 'I' are connected, and the 'R' is separate. The 'i' in 'SIR' has a dot above it.

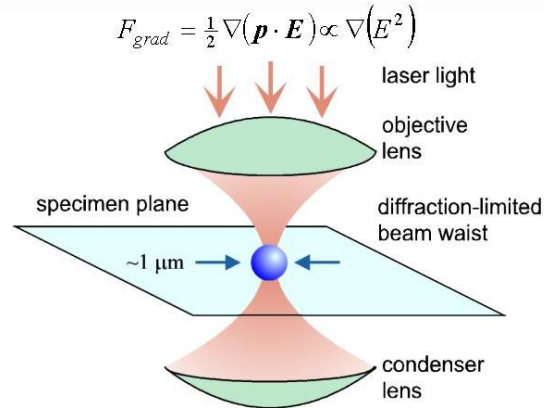
our future through science

Introduction

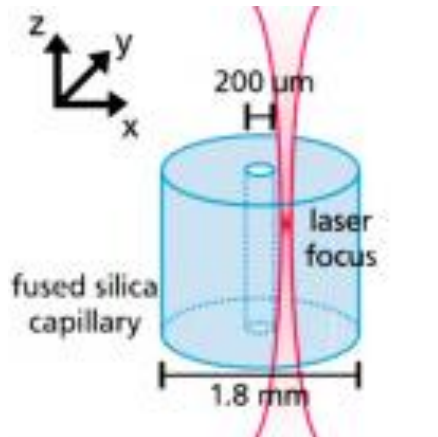
- Laser Cutting



- Optical Tweezers

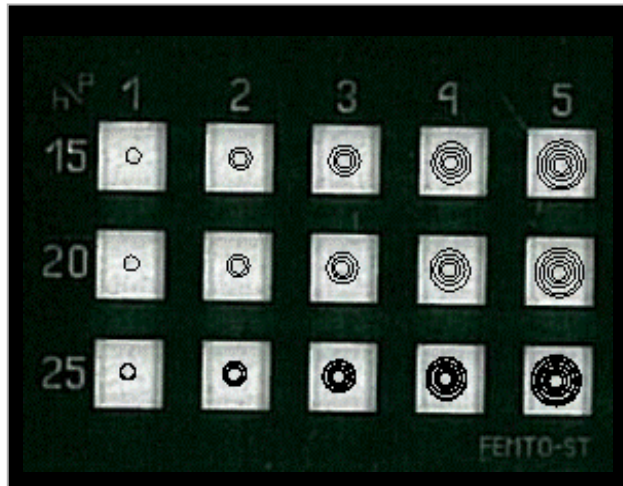


- Nonlinear Microscope



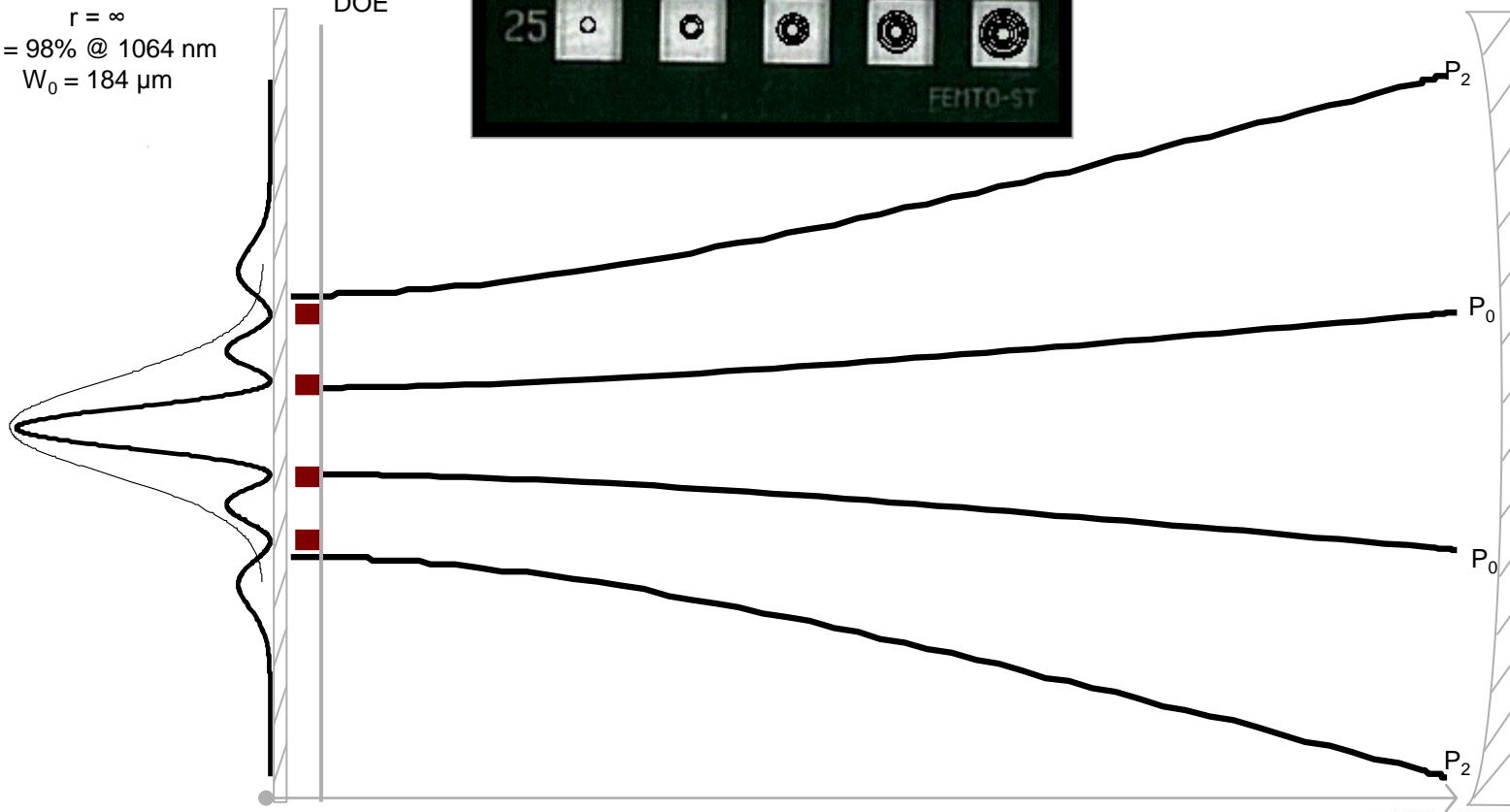
- Laser Ranging





$r = \infty$
 $R = 98\% @ 1064 \text{ nm}$
 $W_0 = 184 \mu\text{m}$

DOE



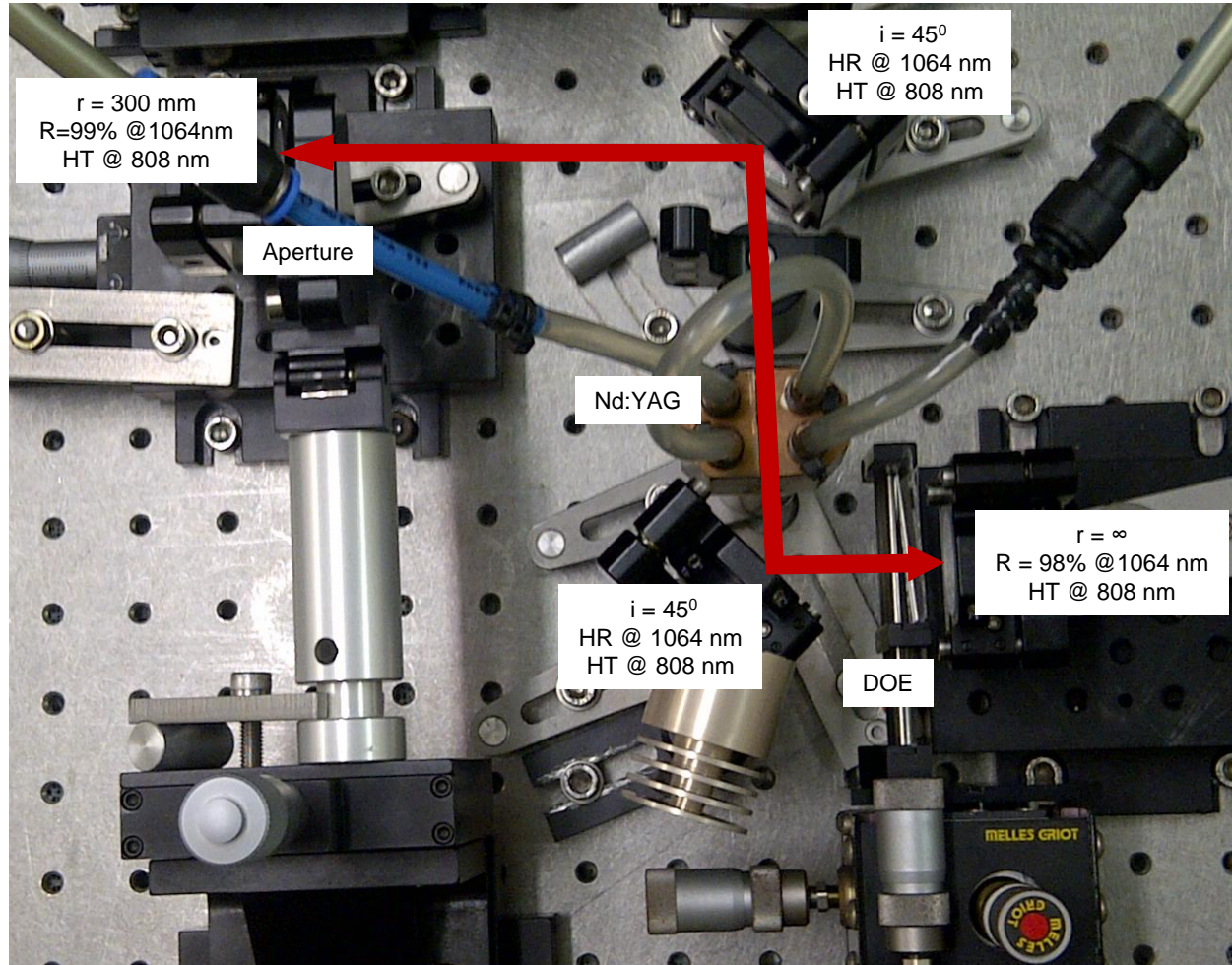
$r = 300 \text{ mm}$
 $R = 99\% @ 1064 \text{ nm}$
 $W_0 = 565 \mu\text{m}$

$Z = 260 \text{ mm}$

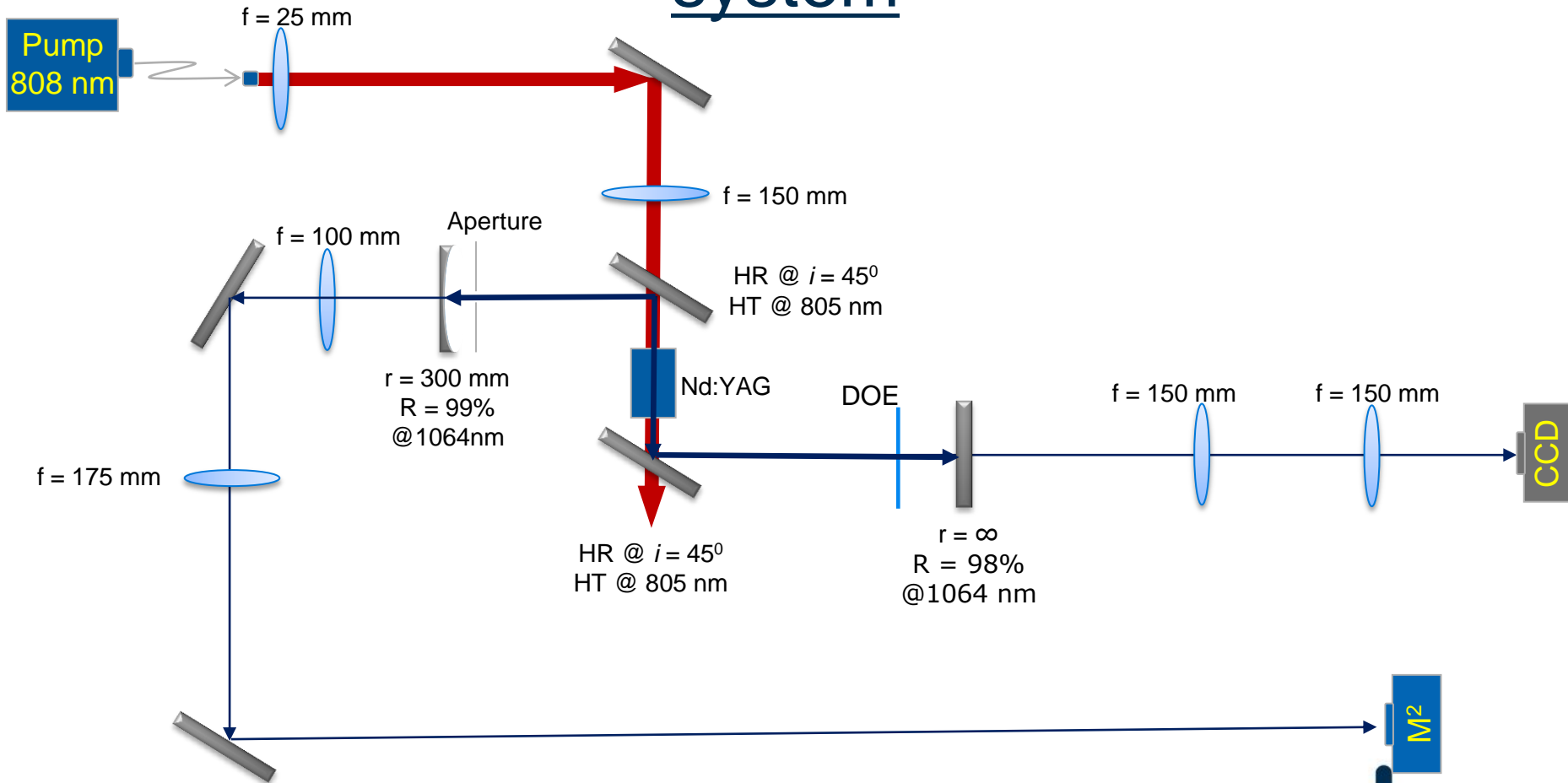


our future through science

Part 1 - Tested the concept on an Nd:YAG system

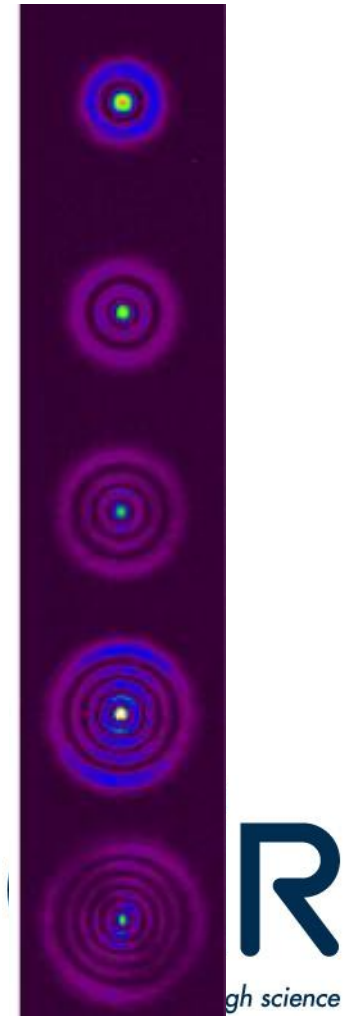
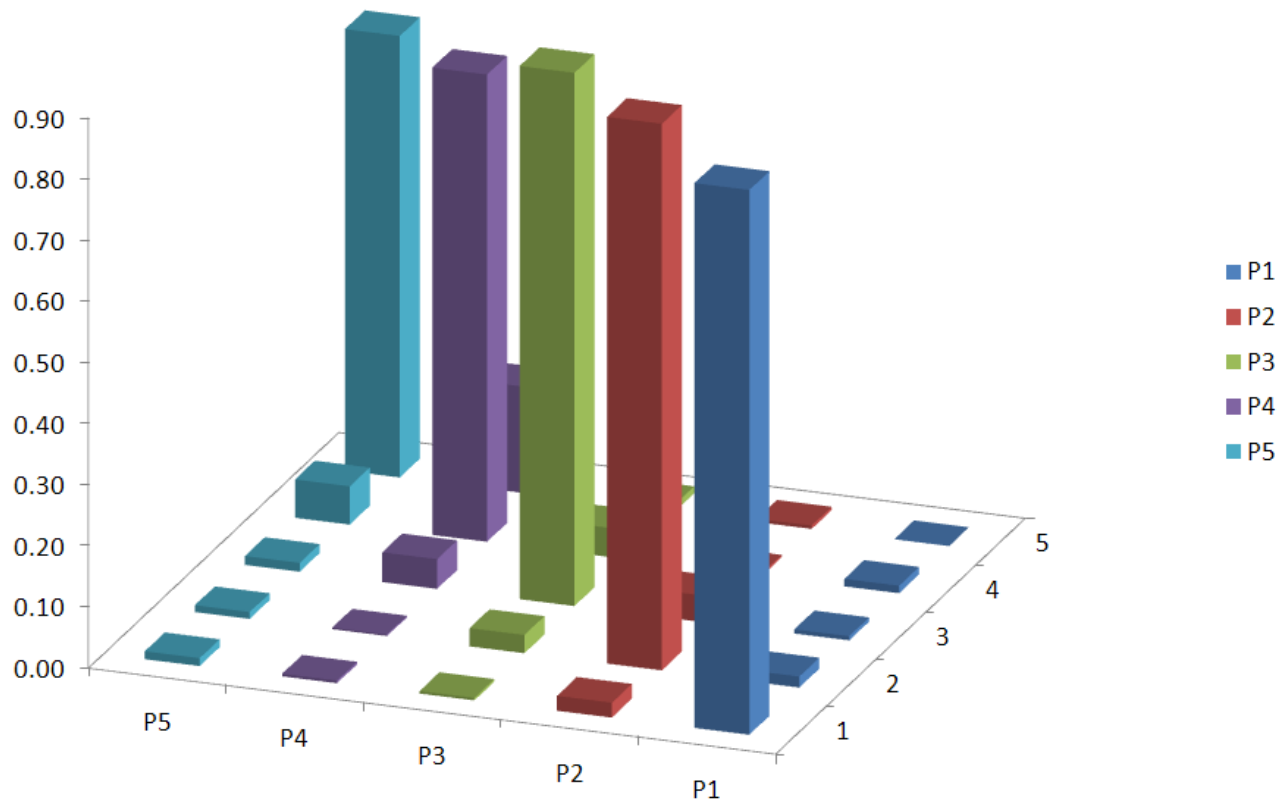


Part 1 - Tested the concept on an Nd:YAG system

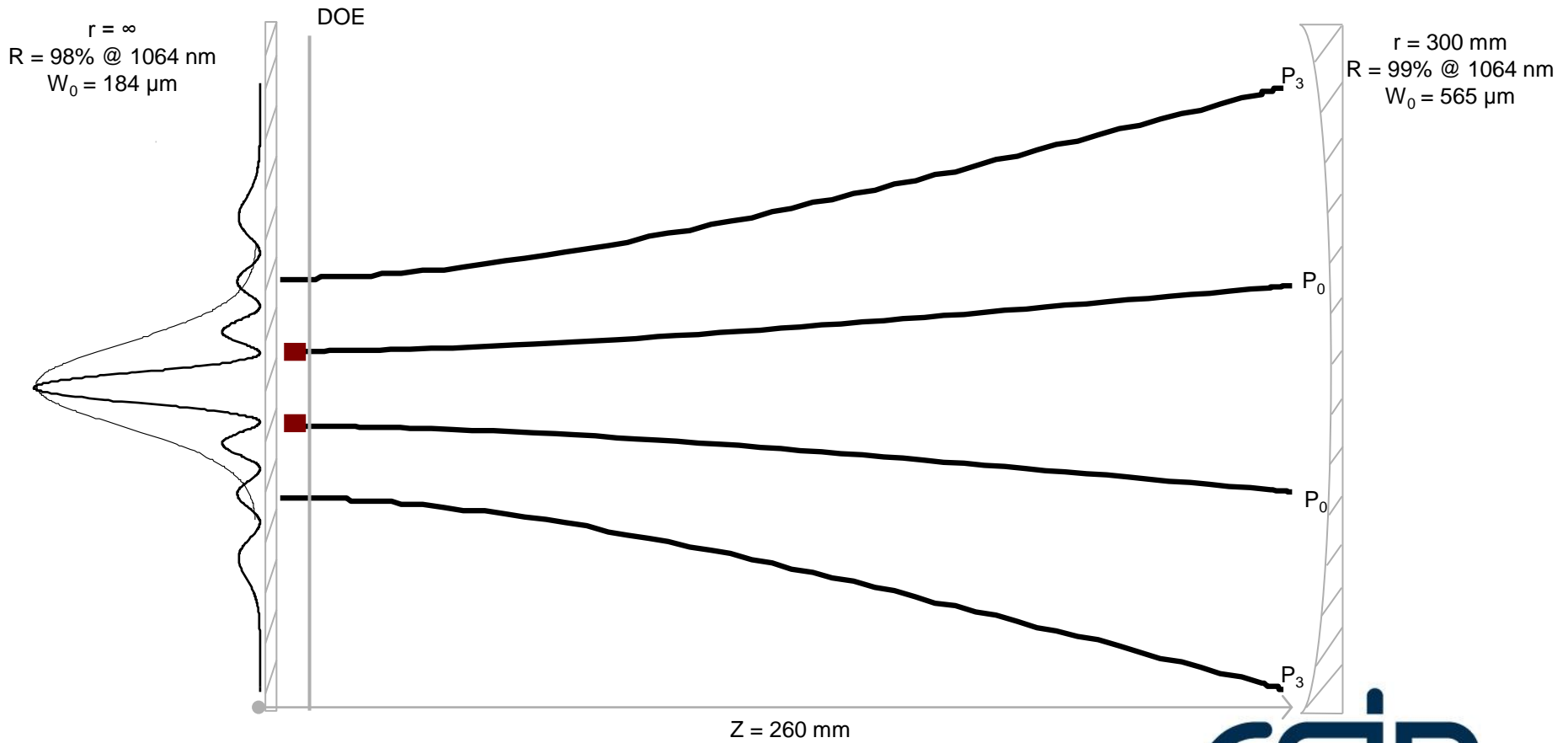


Part 1 - Results

- Modal Decomposition of LG_{p0}

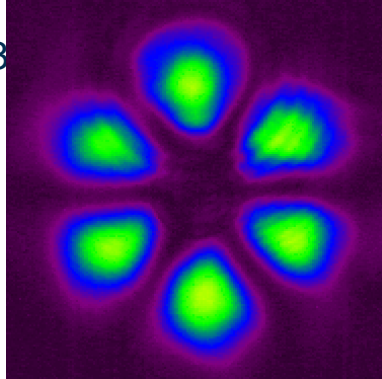


Part 2 – Concept

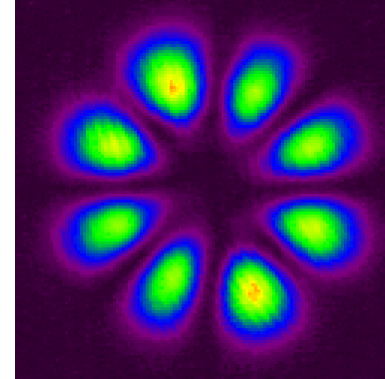


Part 2 - Results

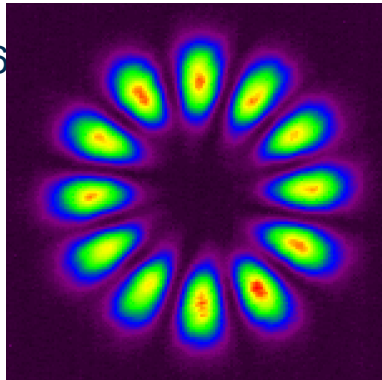
• $LG_{0\pm3}$



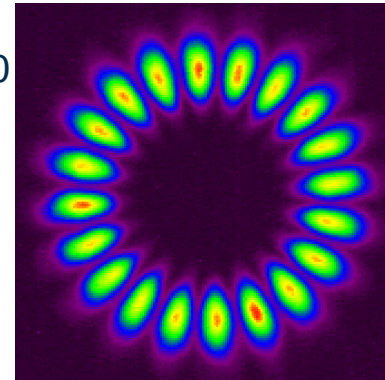
• $LG_{0\pm4}$



• $LG_{0\pm6}$

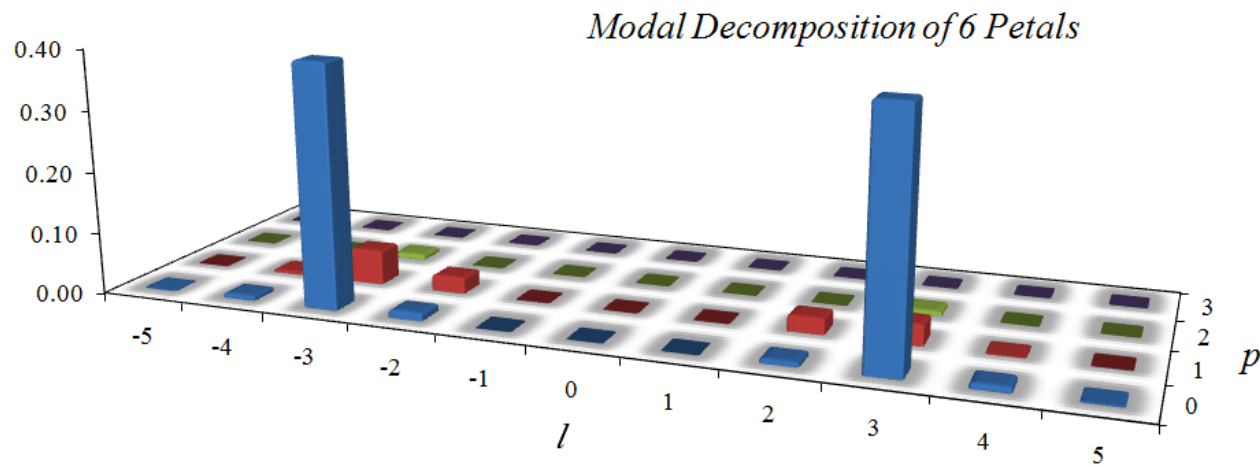


• $LG_{0\pm10}$



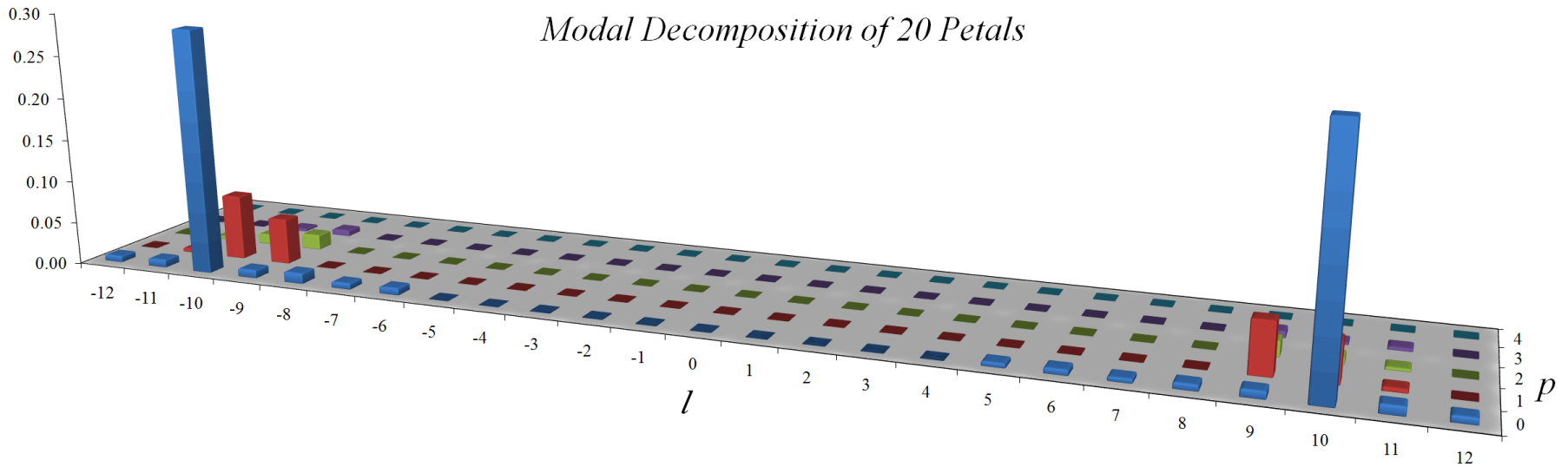
Part 2 - Results

- Modal Decomposition of 6 petals $LG_{0\pm 3}$



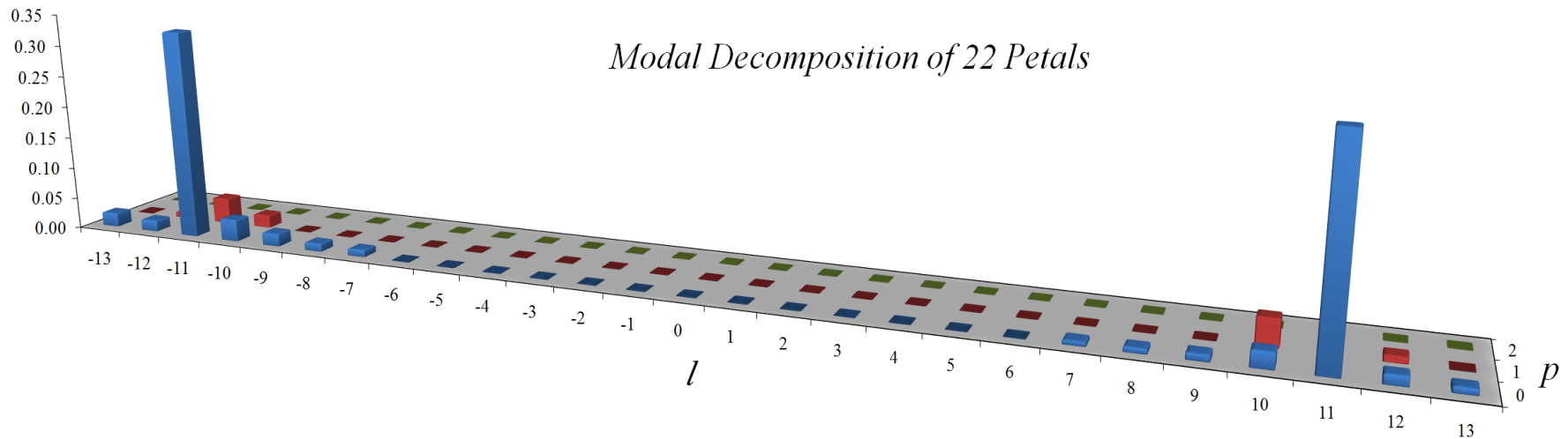
Part 2 - Results

- Modal Decomposition of 20 petals $LG_{0\pm 10}$

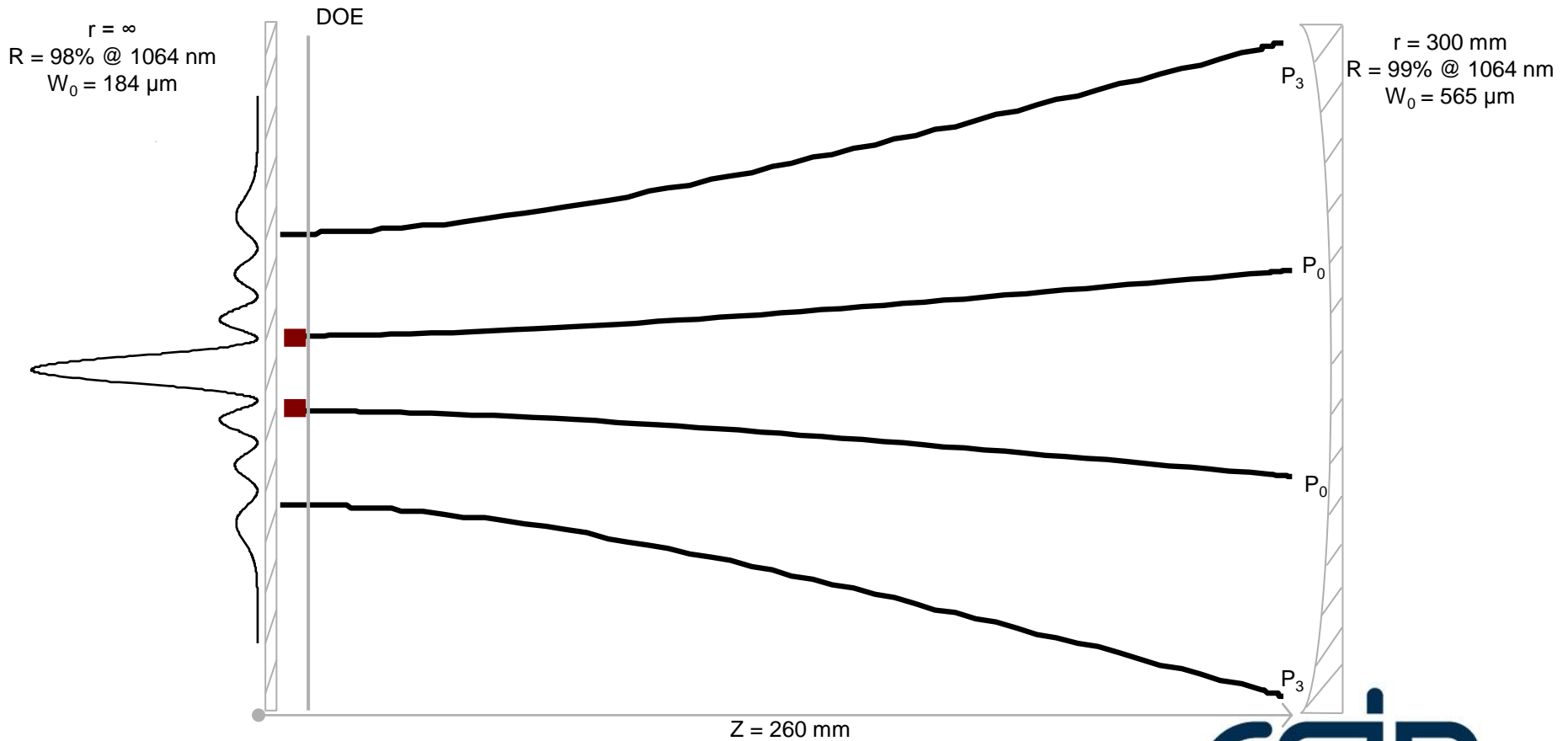


Part 2 - Results

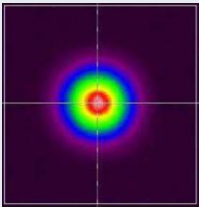
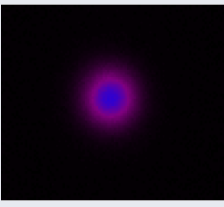
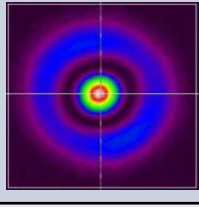
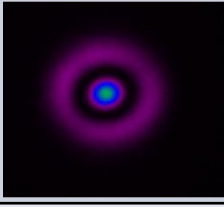
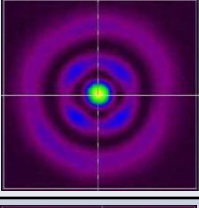
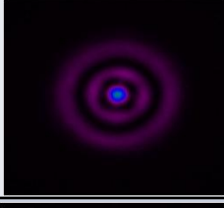
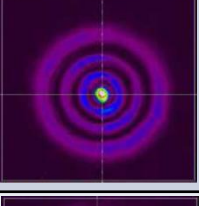

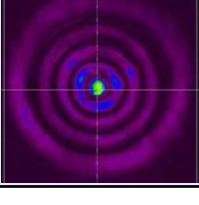
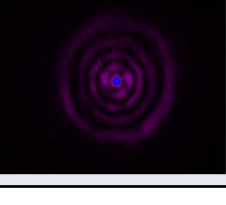
- Modal Decomposition of 22 petals $LG_{0\pm 11}$



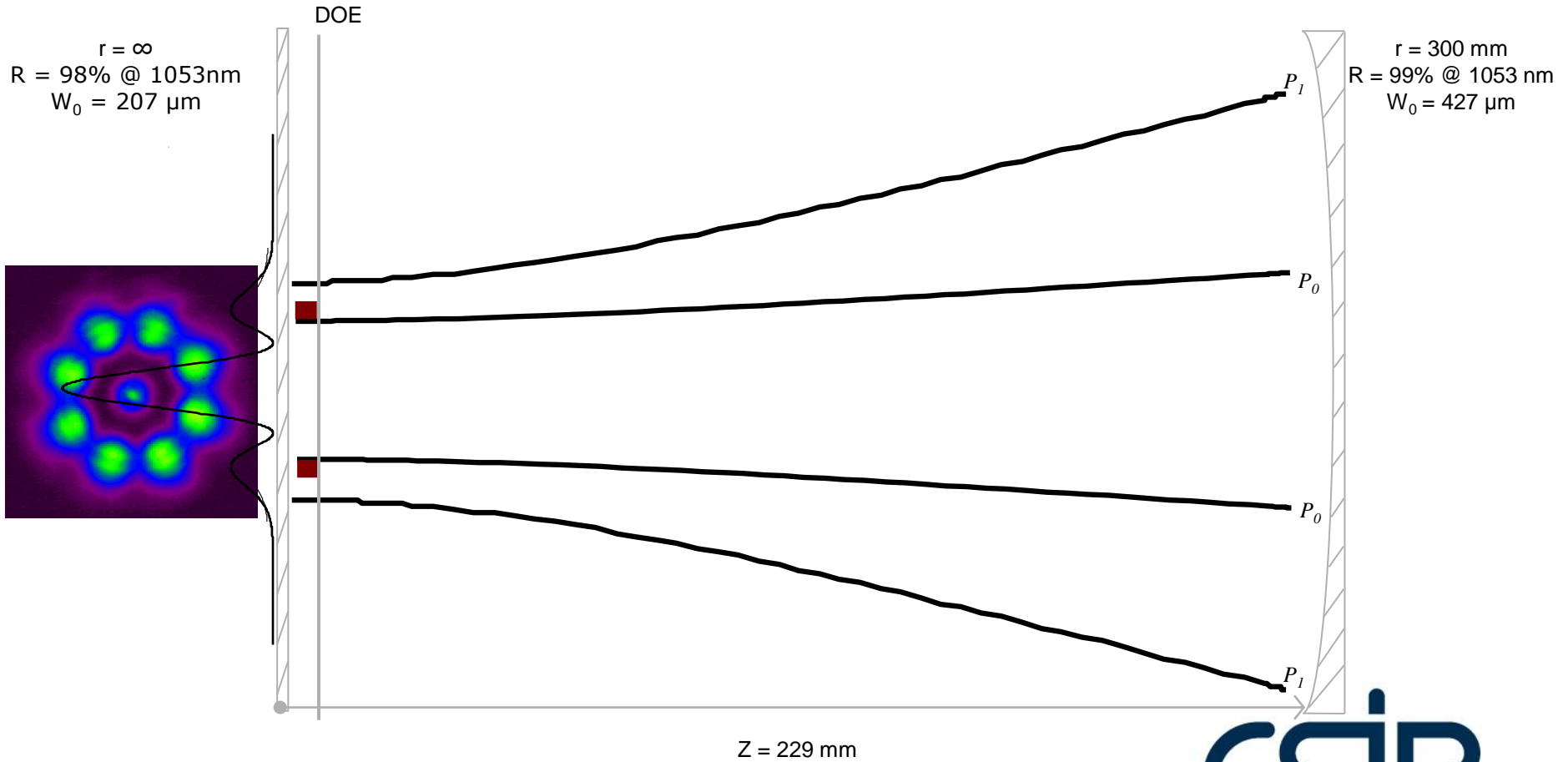
Part 3 - Concept



Part 3 - Results

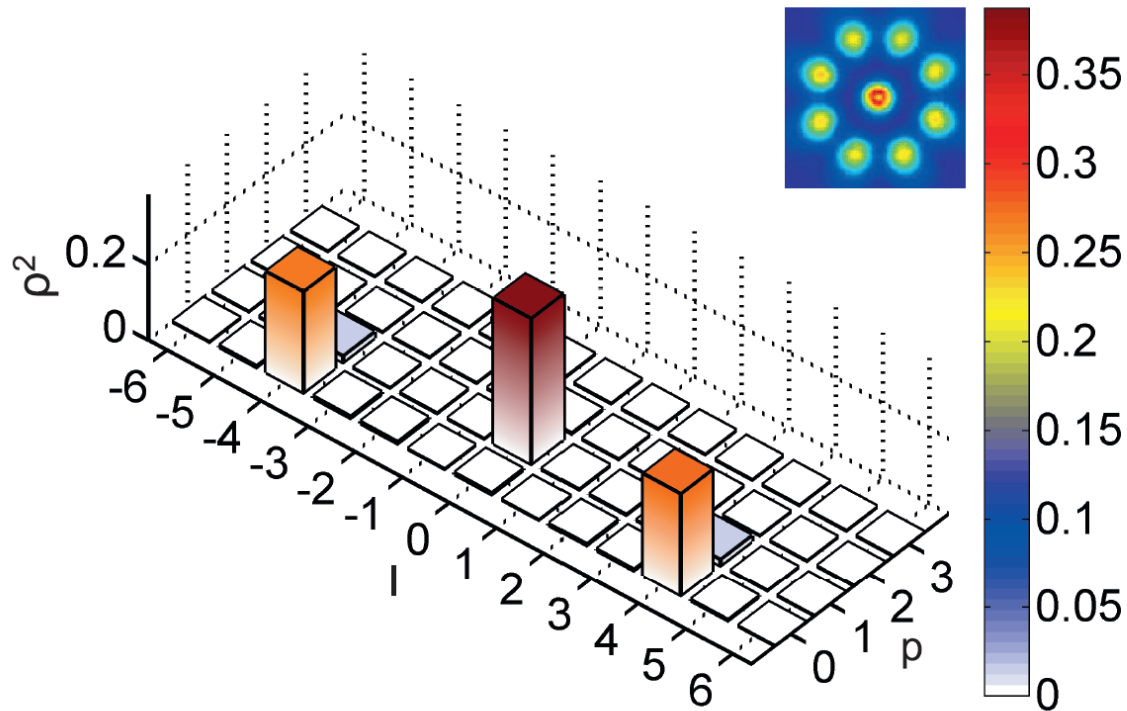
P	Near Field Beam Shape	Cavity Length (mm)	Beam Diameter on Flat Mirror			M ²			Far Field Beam Shape
			Measured (um)	Calculated (um)	Difference (%)	Measured	Calculated	Difference (%)	
0		277	331	328	1	1.0	1.1	10	
1		220	1450	1420	2	3.0	3.2	5	
2		185	992	993	0.1	5.0	5.3	5	
3		277	911	868	5	7.0	7.2	3	
4		290	801	804	0.4	9.0	9.0	0	

Part 4 – Concept



Part 4 - Results

- Modal Decomposition of petals shows three modes of LG_{0+4} , LG_{0-4} and LG_{10}



Conclusion

- Generation of high-order LG modes of different p and l combination is possible using a single ring method.
- High-order LG_{pl} modes are of high purity.

Future Work

- Investigate further the reasons for the unexpected modes.

THANK YOU

THE END