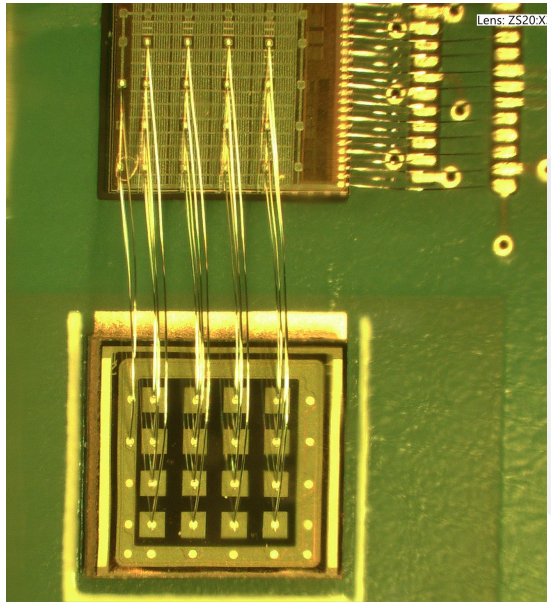
IR Laser test bench status

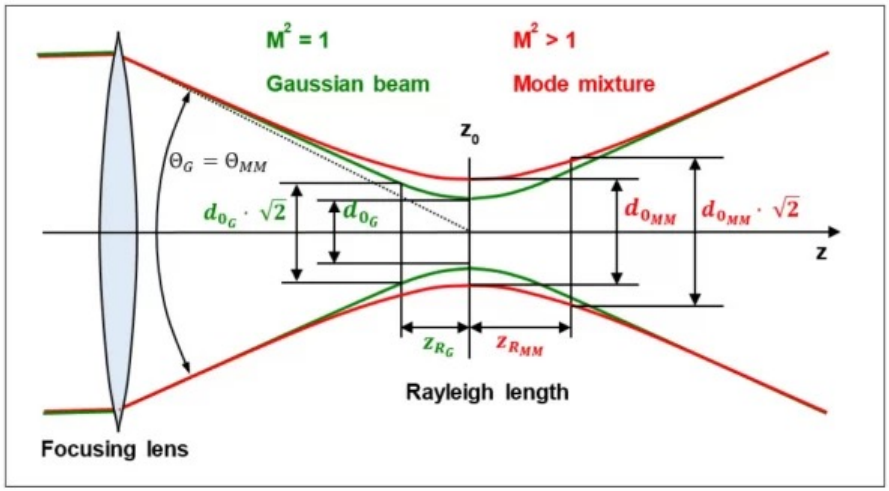


O. Brand-Foissac, V. Chaumat, T. Cornet, D. Marchand,
A. Sharma, L. Serin, A. Torrentó

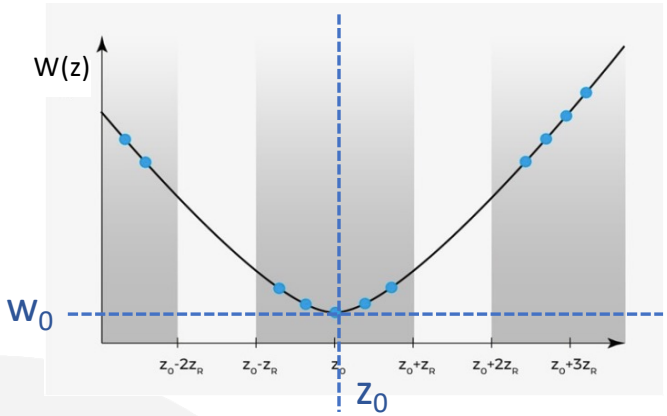
Measurement of laser beam quality M^2

- Ideally, a laser beam has a Gaussian profile (TEM_{00} propagation), but in reality there is a slight non-gaussianity which has to be measured to get the real size of the waist

  → M^2 beam-quality parameter: $M^2 > 1$ ($M^2 = 1$ for a Gaussian beam)



- Waist (w_0) = minimum radius at $1/e^2$ of intensity
- Rayleigh distance (Z_R) = spot surface doubles / radius increases ~ √2

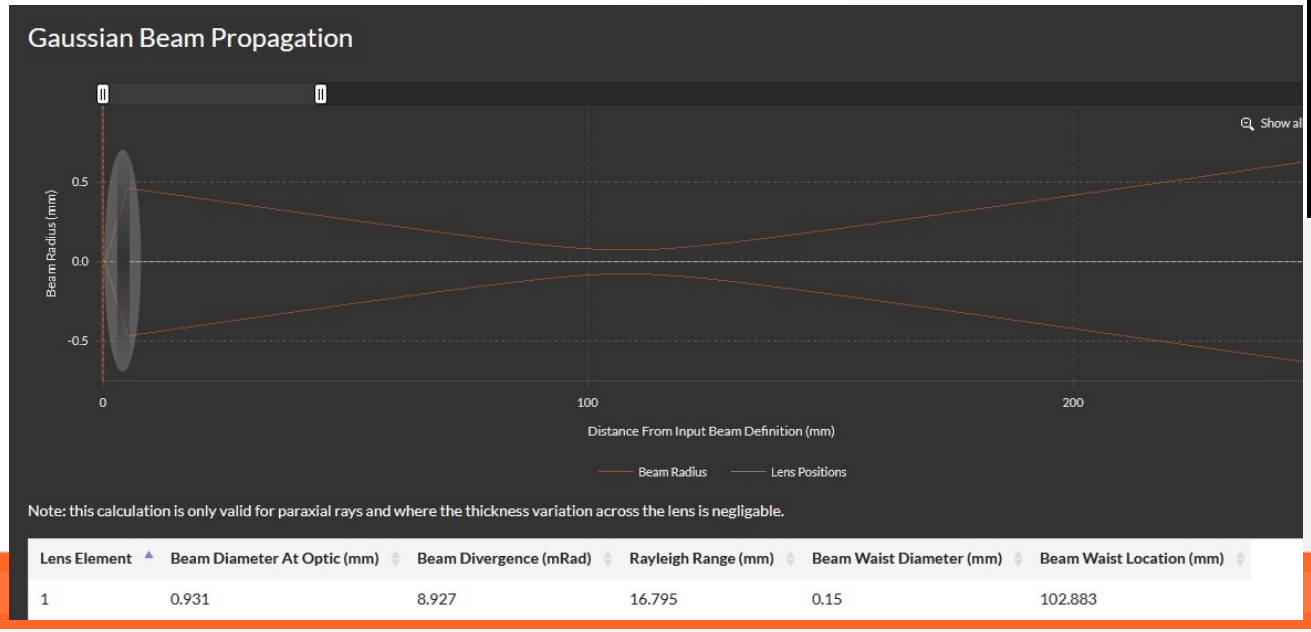


- Measure spot size at ± 5 Z_R from waist then fit a hyperbolic function (ISO11146-1)

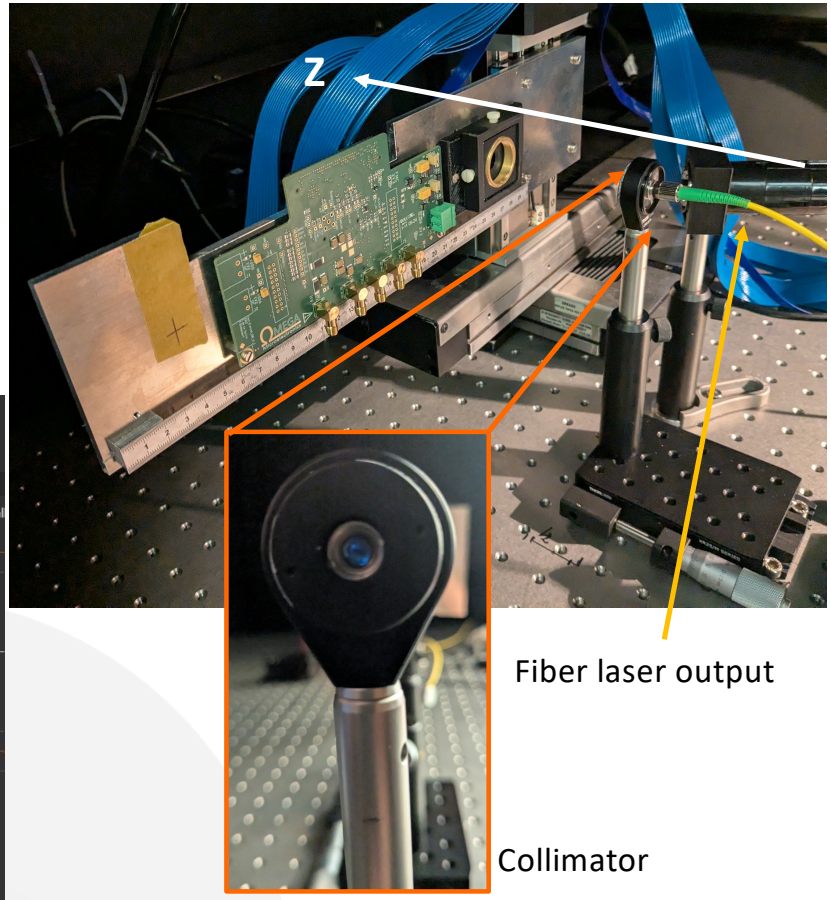
$$w^2(z) = w_0^2 + \left(\frac{\lambda M^2}{\pi w_0^2}\right)^2 (z - z_0)^2$$

Measurement of laser beam quality M^2

- In LGAD scan configuration (2 lenses), the spot is too small *o*(10µm) to make a good measurement (pixel size CMOS = 3.75 µm)
- We use a onfiguration with only a collimator lens (f = 4.5 mm) to have a bigger waist (r = 75 µm ~ 20 pixels), at a distance that allows us to scan ~ 5 Z_R (distance CMOS – lens & table range 17*5 mm = 85 mm, ok)

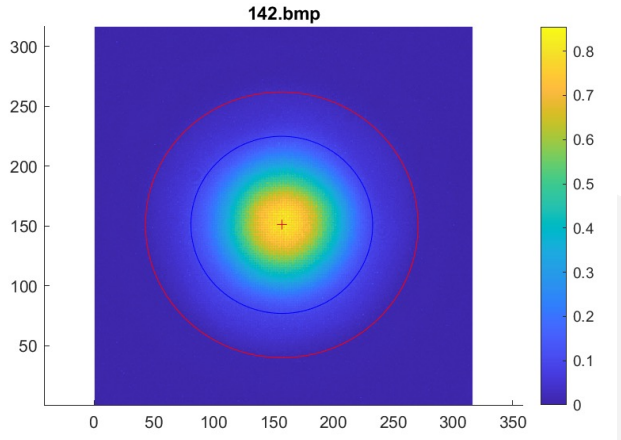


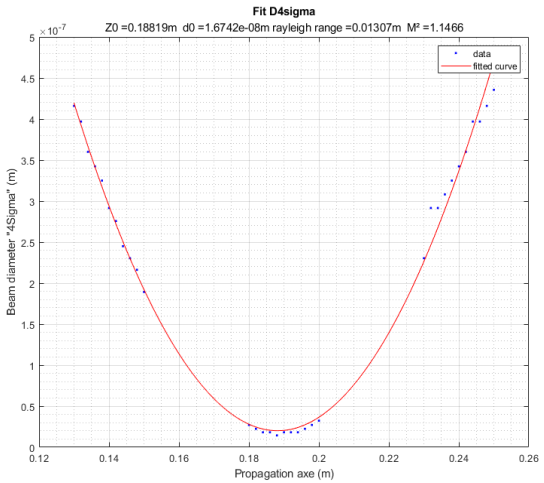
Lens Element	Beam Diameter At Optic (mm)	Beam Divergence (mRad)	Rayleigh Range (mm)	Beam Waist Diameter (mm)	Beam Waist Location (mm)
1	0.931	8.927	16.795	0.15	102.883



Measurement of laser beam quality M^2

- 33 images, 3 zones in range z = 130 – 250 mm, with Δz = 2 mm (waist around 180 mm)
- Image treatment and analysis with Matlab (V. Chaumat)
  - Try different intensity thresholds
  - ROI at ±5σ from barycenter
  - Determination of spot diameter D4sigma (ISO 11146-1) for X and Y (spot not perfectly circular)
  - Plot radius vs. Z hyperbolic function to obtain waist diameter (d_0) and position (z_0), M^2 and Rayleigh (z_R) distance
  - Analysis ongoing !!!





D_0 = 167 µm, M^2 = 1.14

Future work

- Still some issues to solve:
  - Get rid of aberrations / diffraction effects that distort the beam image, making it difficult to well determine the 4Dsigma diameter.
  - Fix the analysis procedure (esp. threshold)
- DAQ software:
  - Ongoing work to have a state machine for acquisition: save configurations, record data, …
    - Gather all relevant variables : XYZ, timestamp, photodiode power, AC-LGAD + EICROC signals
    - Save ACQ configuration (to recall later), record data in a file
    - Define measurement sequence
  - To be done:
    - Include photodiode, ACQ chain
    - Vertical translation table : fix IP problem, home definition