Alignment of the photonic fiber in the StreakCam lab

2021-11-08

- For all power measurements (except if elsewhere indicated), the power meter (PM) was set to 800 nm.
- I'm not entirely sure if the reported throughputs are with or without the collimating lens.
- The reported throughput powers have to be taken with a grain of salt.
- (The order of) optimizing it with the differential micrometers and/or the 2 mirrors is also something which is unclear. Just try it.

Alignment

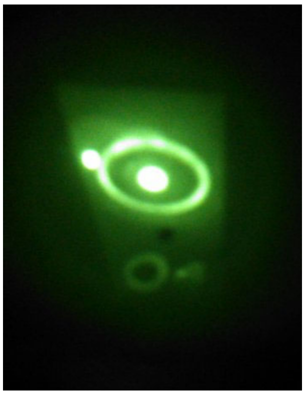
Mira : 4.5 W, 812 nm, monitor 132 ML.
Set the incoming power to fiber at 35 mW, using the variable OD filter.
[NB: alignment should be done with low power, since the fiber gets easier damaged, if the light is not passing the core]

- Align the beam such that it goes horizontal, runs exactly over the line before the fiber and hits the objective in the center (as good as possible).
- The distance between the 20x input objective and the fiber is about 2 mm
- Remove the collimating lens behind the fiber
- Put the power meter directly after the fiber (PM @ 800 nm).
- Using the coarse X&Y micrometers of the input objective, optimize the power. Maybe also use 2 far away mirrors (the top periscope mirror and the closest mirror). Also optimize the focus micrometer.
- Perhaps do this in a cycle : XY, focus, XY, focus etc.
- At the maximum power, make sure the differential micrometers are in the middle.
- Input power : 35 mW : out : ~ 0.8 mW
- The correct position can not be optimized with the power any further. The light now passes through the cladding of the fiber. For white light generation, it should hit the fiber exactly in it's core, which is only 1.8 µm in diameter !

The differential micrometers move less then 0.1 mm in a maximum range of 360 degrees.
[if these numbers are correct, then 7 degrees is ~2 um]
NB: the core of the fiber is only 1.8 µm.

- Change the input power to 50 mW. Throughput is now 1.2 mW
- Remove the power meter, put a white card 10-15 cm behind the fiber and observe the output with an IR viewer.
- At first, a small dot in the center and a ring can be seen (figure 1).
- Change the vertical differential micrometer a bit (5-10 degrees ?) and scan the horizontal differential micrometer. Repeat, repeat etc.
  It's like sampling a NxN grid. Takes some time, but you can always find it.

- At a certain point, the image becomes a bit blurry, and then forms a uniform blob (figure 2).
- The light now passes through the core.



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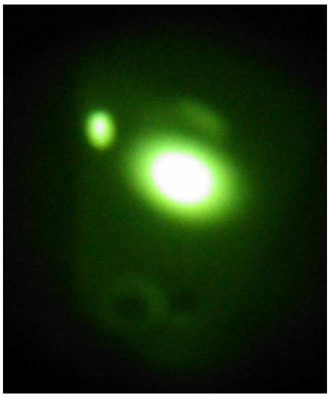

Seen through IR viewer

- NB : the measured throughput power is now only 0.55 mW : less then after the first optimization on measured power !!
- Optimize the power, as seen by the IR viewer by eye, with either the differential micrometers or the top periscope mirror and the closest mirror.
- Also optimize the differential focus micrometer : boom : a lot of light
- Now put a power meter directly behind the fiber, to optimize by power again.
- Optimize with the top periscope mirror.
- The throughput (directly after the fiber, PM@800 nm) is **31 mW**

95 mW 812 nm in -> 35 mW after collimating lens. PM@800 nm
With band pass filter 550/10 nm after the fiber : 0.3 mW (PM@550 mW).

After beam walking the top periscope mirror and the closest mirror:
100 mW in (PM@812nm) -> **43 mW out** [throughput = 43 %]

Notes

- NB: no modelocking, no fiber output !!! Check this first.
- Normal use is : 70-90 mW input power (alignment : 30-50 mW)
- Daily alignment :
  Optimize it with the top periscope mirror. If the white light is not visible at first, use an IR-viewer.
- Maybe more throughput can be achieved with a 40X input objective, but alignment becomes (much) more difficult (see also Application note 28).
- According to NKT Photonics (the manufacturer) [email 2018-7-11 on max power] :
"For these short pulses (76 MHz, ~100fs, 800 nm) it will be a combination of peak power and pulse energy. We would be comfortable with up to ~5nJ/pulse with these parameters. However, the facet conditions are rather important; keep the facet clean from any debris/contamination/dust etc as that otherwise may act as a hotspot."
[FdH : this boils down to 350 mW input @ 76MHz, But please stick to < 100 mW]

Spectra

The generated spectrum depends heavily on the input power and the input wavelength.
The 2 examples below come from [Application Note 28] (also see this document for more information).
https://www.newport.com/medias/sys_master/images/images/ha8/ha9/8797285449758/Supercontinuum-Generation-in-SCG-800-App-Note-28.pdf
[can also be found on the OCMP shared google drive in
G:\Shared drives\OCMP Team Drive\Manuals\StreakCam\Photonic fiber - Application note.pdf]

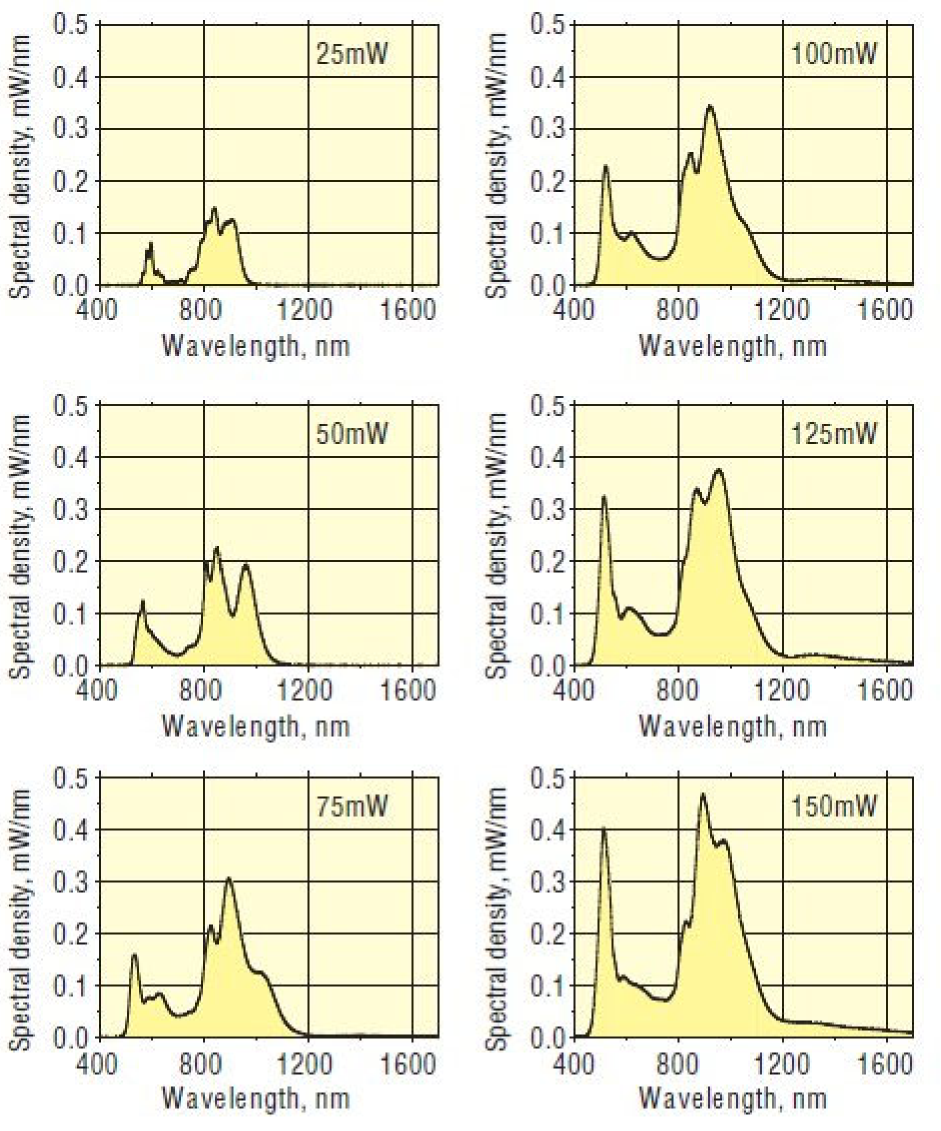

Fig. 6c Dependence on coupled power at 800 nm pump power

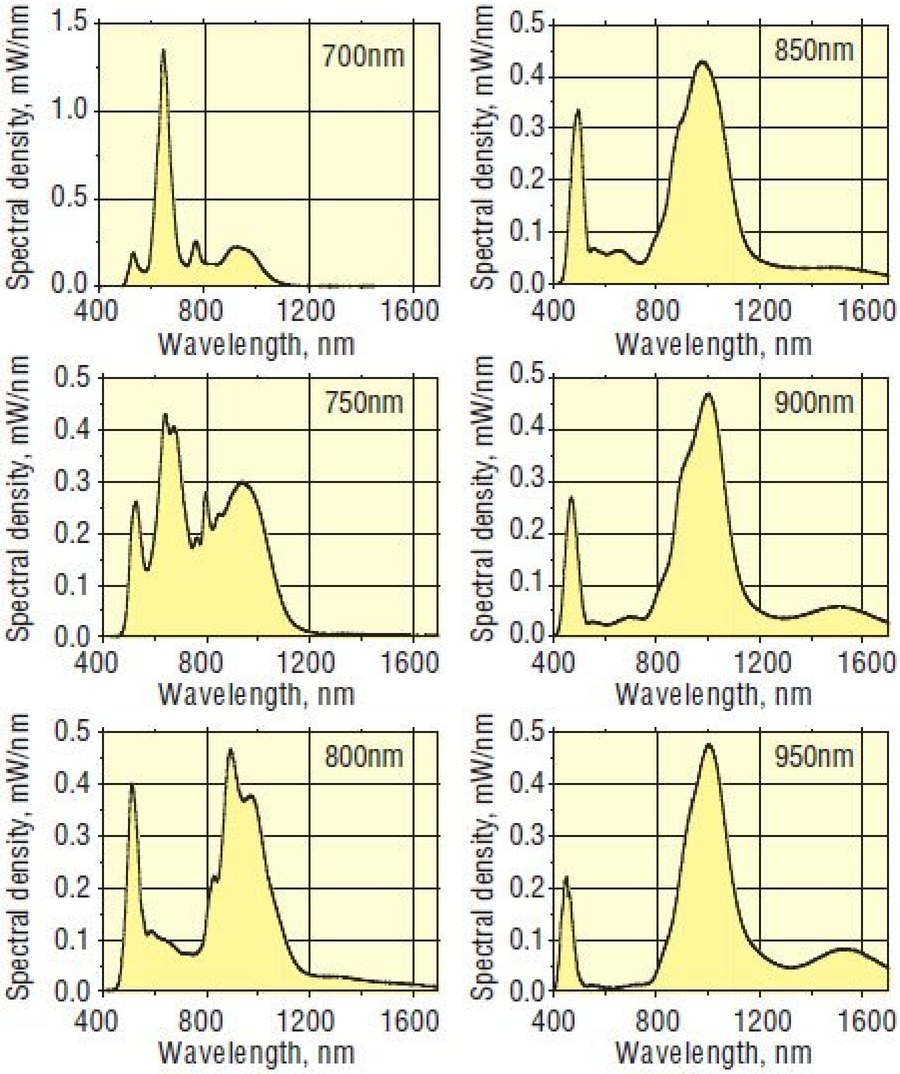

Fig. 7 Dependence on wavelength at 150mW coupled power