

Fiber Profile Perturbation and Polarization Sensitivity

- Detailed analysis of transmission behavior of two fiber samples with a special launch condition which applies controlled offset and controlled polarization.

(source: DFB-laser)

- Fiber 1: OM1 “worst case” benchmark fiber
- Fiber 2: OM3 50 μ m fiber with very smooth profile

1. DMD-type measurement for fiber characterization
2. Observation of polarization behavior for selected offsets

Fiber Profile Perturbation and Polarization Sensitivity

Example of "worst case" benchmark Fiber

- We measured an OM1 "worst case" benchmark fiber in the lab with a bandwidth about $500\text{MHz}\cdot\text{km}$ @ 1300nm with controlled offset launch (one piece fiber length of 200m)
 - Strong defects in the area 0 to $10\mu\text{m}$ radius
 - Smooth profile for the outer core larger than $14\mu\text{m}$ radius

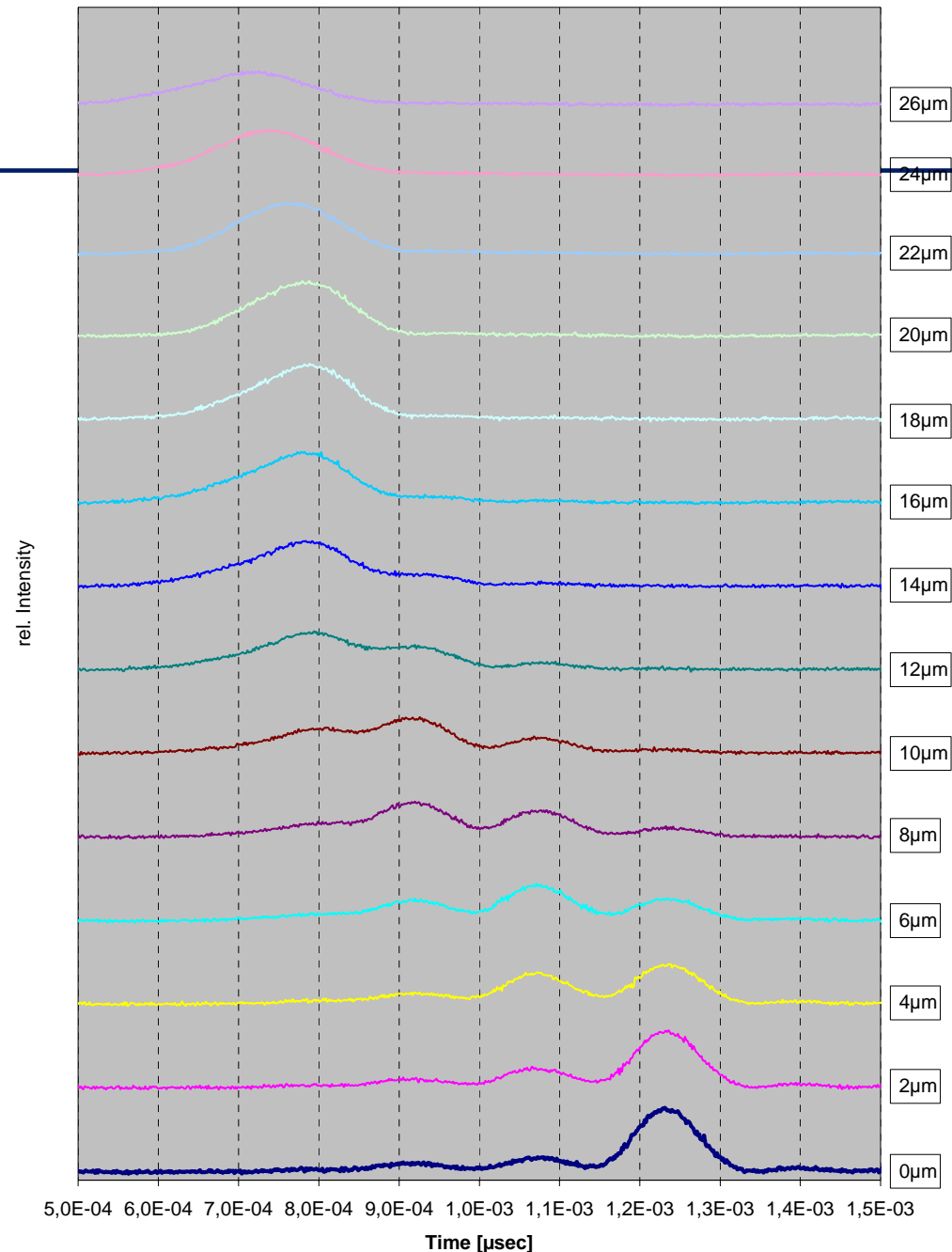
- Observation of polarization sensitivity of the pulse shape at small offsets as well as offsets around $20\mu\text{m}$

- The polarization variations are observed also for the unspooled fiber lying loosely on the ground

DMD Measurement of "worst case" OM1 fiber

- Measurement of transmission behavior over length of 200m with controlled offset launch.
- Strong perturbation of profile in the center up to 12 μm radius
- better profile at larger core radii beyond 14 μm

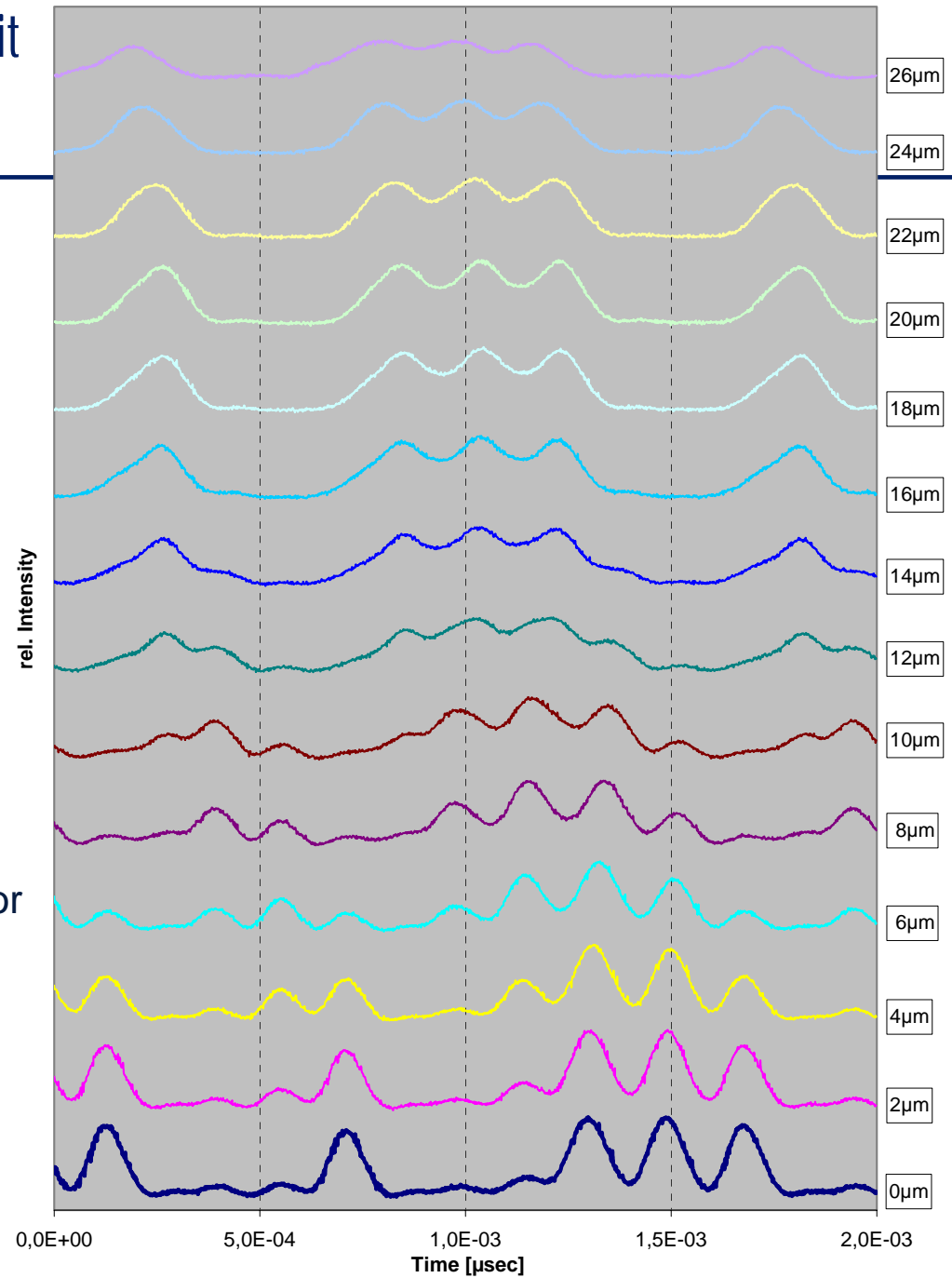
Pulse Response of benchmark OM1 Fiber



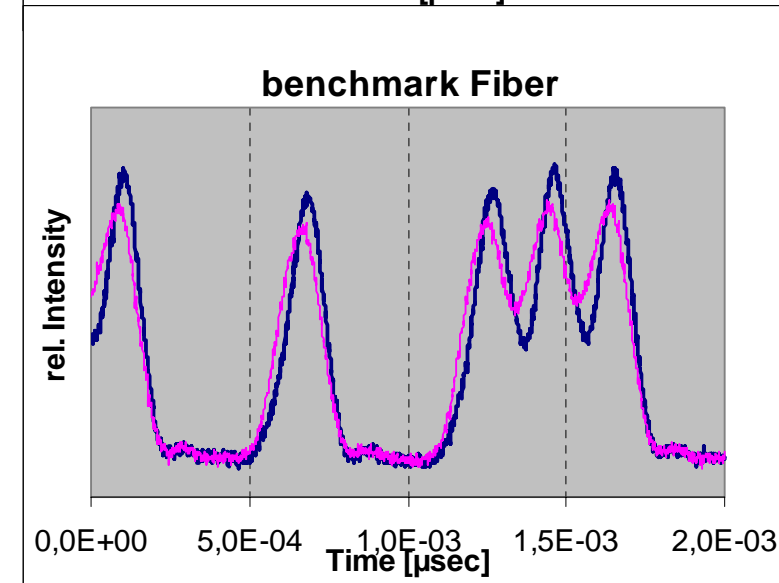
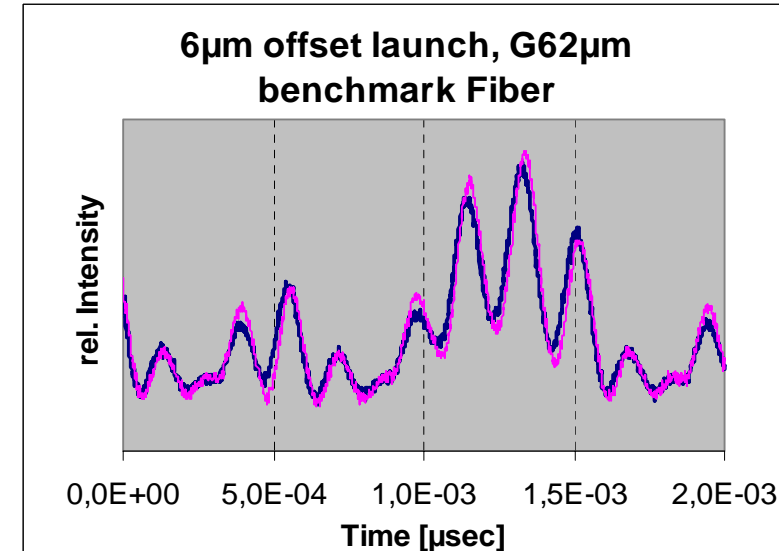
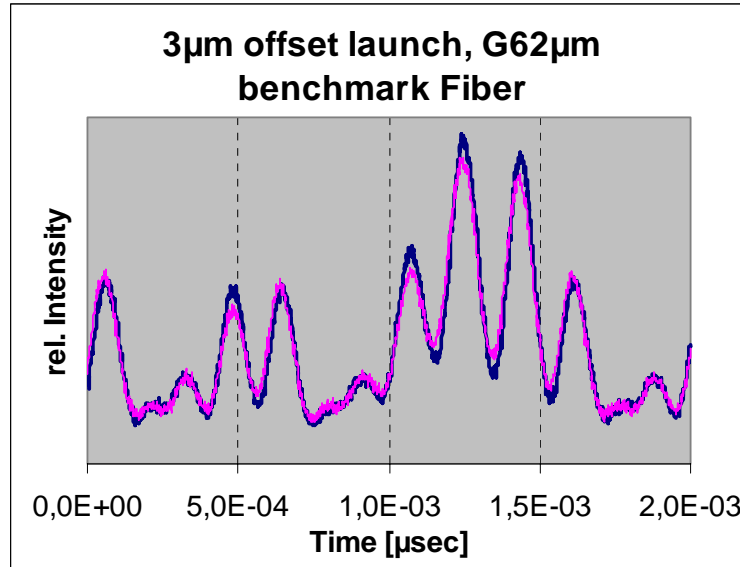
"DMD" Measurement with Bit Pattern

- Measurement of transmission behavior over length of 200m with controlled offset launch.
- Traces for a 16 bit word "1000001010100000" for various offsets.
- Open eyes can be observed for center launch (0 +/-2μm offset)
- Some eye opening is observed for offset launch 17 to 24μm

Pattern response of benchmark OM1 fiber



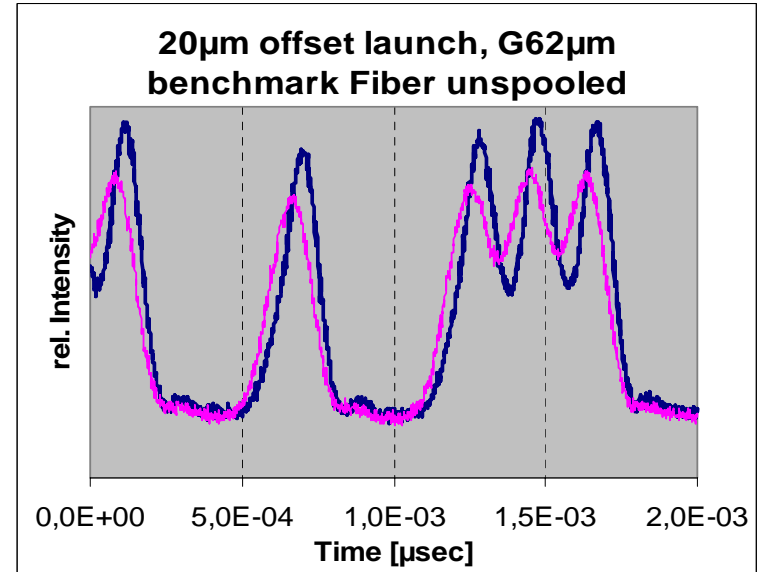
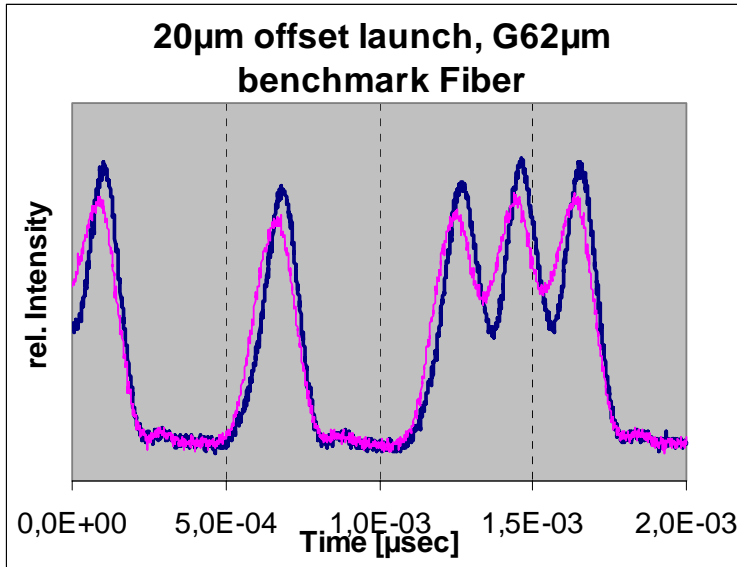
"worst case" benchmark Fiber Polarization Effect



Change of bit pattern with the controlled change of polarization is observed for all offset launch conditions

Polarization Effect: "worst case" benchmark Fiber

Influence of fiber spool



- Similar sensitivity of the signal to polarization direction in the comparison of the spooled fiber and the loose lying fiber. No influence of spooling to the general transmission behavior.

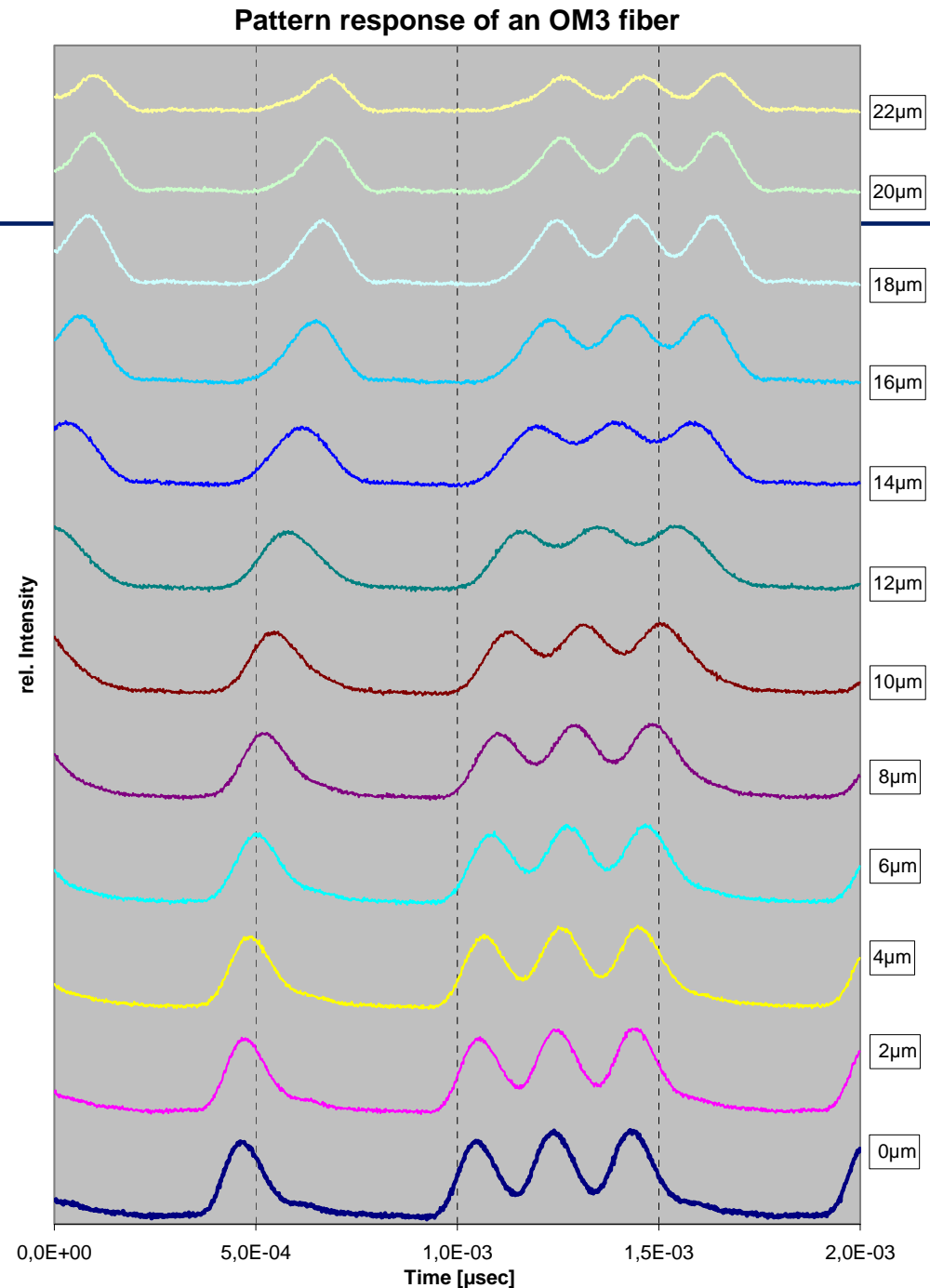
Fiber Profile Perturbation and Polarization Sensitivity Performance of OM3 Fiber (50 μ m core)

- We measured an OM3 fiber with a bandwidth about 900MHz*km @ 1300nm with controlled offset launch (one piece fiber length of 300m)
 - Small profile distortions

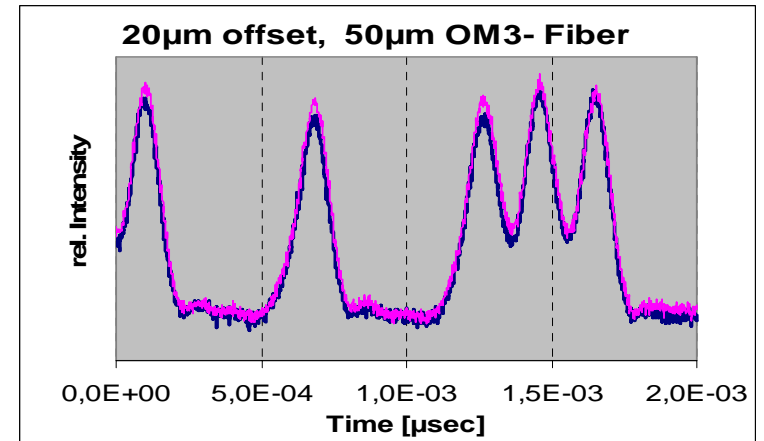
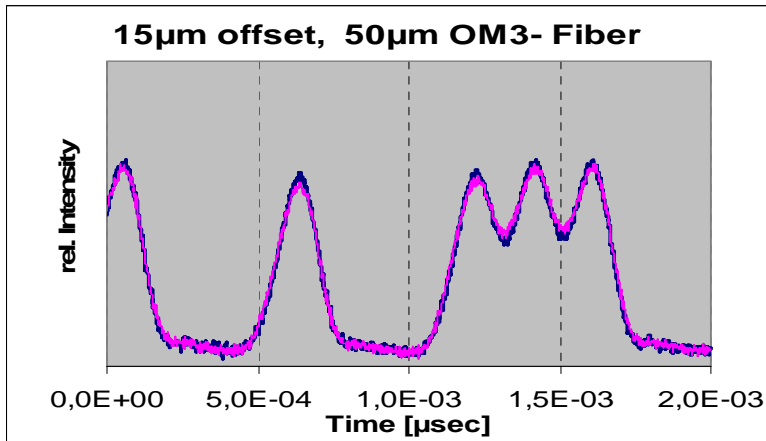
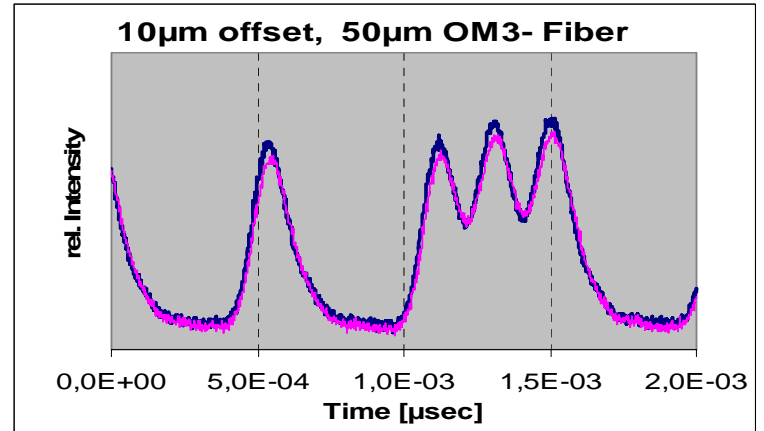
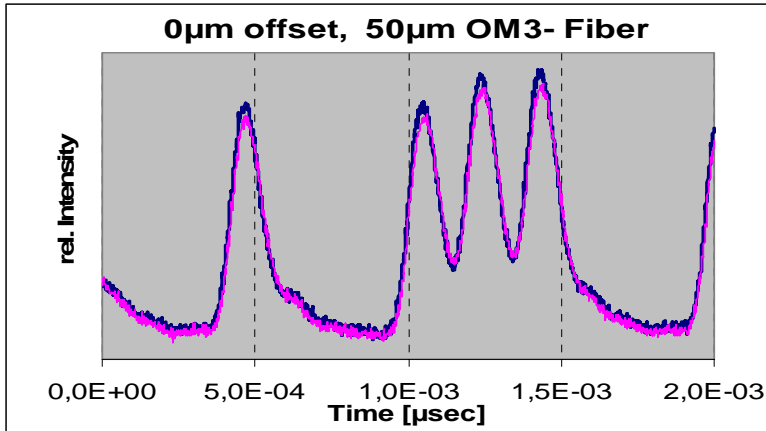
- Small polarization sensitivity of the pulse shape is observed for all measured offset launch positions

"DMD" Measurement with Bit Pattern with OM3 Fiber

- Measurement of transmission behavior over length of 300m with controlled offset launch.
- Traces for a 16 bit word "1000001010100000" for various offsets.



Performance of OM3 Fiber Polarization Effect



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- Small influence of polarization orientation on the transmission for all offset launch conditions.

Conclusion

1. Polarization effects are very small in fibers with low profile distortions.
2. Polarization effects are very small if the excited mode groups have the same velocity and no significant pulse broadening is observed.
3. Polarization effects can occur if two or more mode groups with different velocities are excited which results in a pulse broadening. Different polarizations excite a different power distribution between the modes which changes the pulse profile and influence the transmission quality.
4. Fiber manipulation influences the transmitted signal (by changing the polarization state in the fiber) but seems not to influence the size of the polarization effect significantly.