22. Treffen der ITG-FG 5.4.1 "Optische Polymerfasern“

Multiplexverfahren auf optischen Polymerfasern - neueste Entwicklungen und Vergleich

Olaf Ziemann, Hans Poisel, Juri Vinogradov, Stephan Junger, Norbert Weber, Bernd Offenbeck, Wladimir Tschekalinskij, Bernd Weickert, Herbert Bauernschmitt

25. Oktober 2006
Messe München

Multiplexverfahren auf POF

- SDM: Space Division Multiplexing, use of several parallel fibers
- WDM: Wavelength Division Multiplexing: use of different optical wavelengths
- MGDM: Mode Group Division Multiplexing: parallel transmission with different angles in the fiber
- SCM: Sub Carrier Multiplexing: electrical multiplexing on several sub carriers

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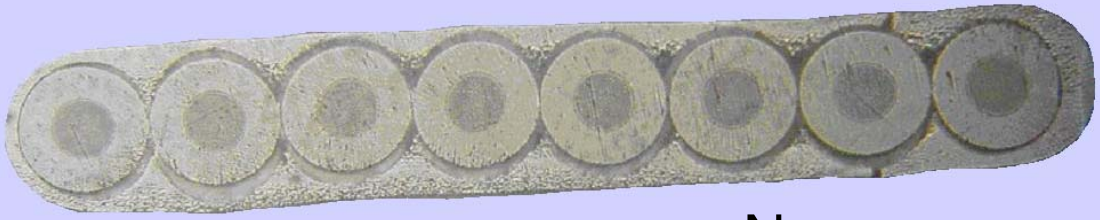
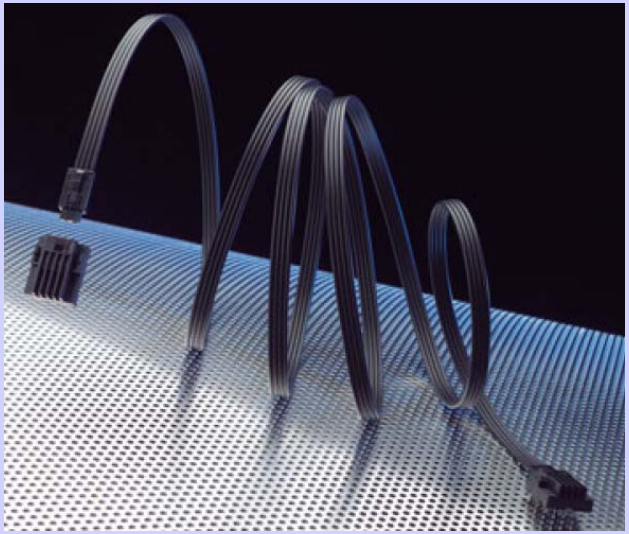
POF-Bändchen für parallele Übertragung

Nexans
4 × 500 µm SI-POF



Nexans
8 × 120 µm GI-POF



Honda Cable
4 × 1 mm SI-POF

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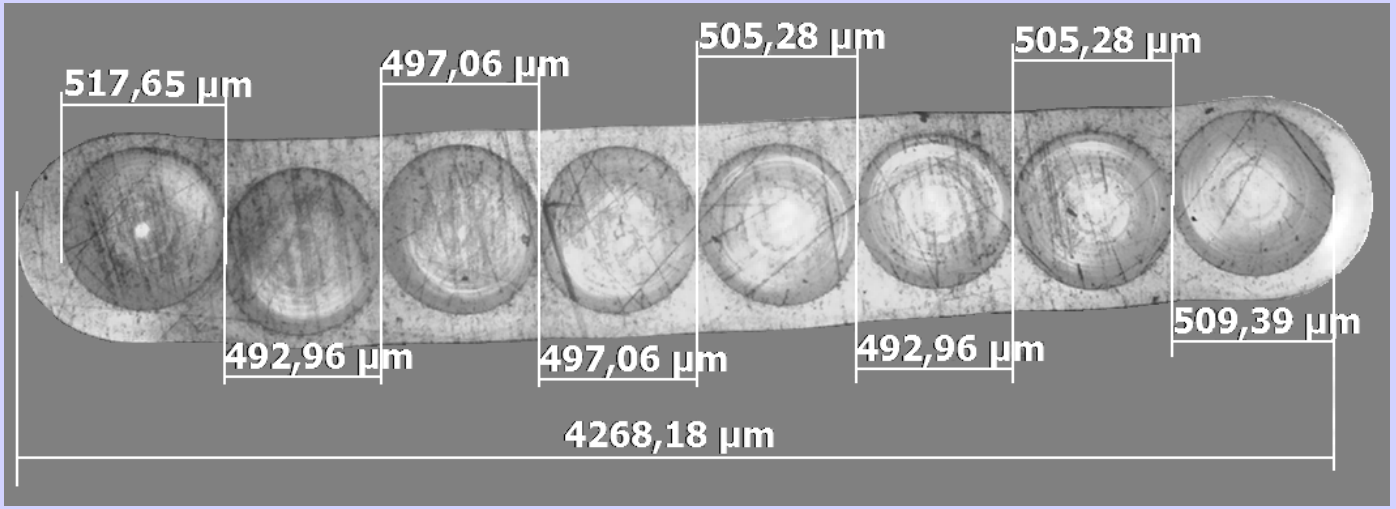
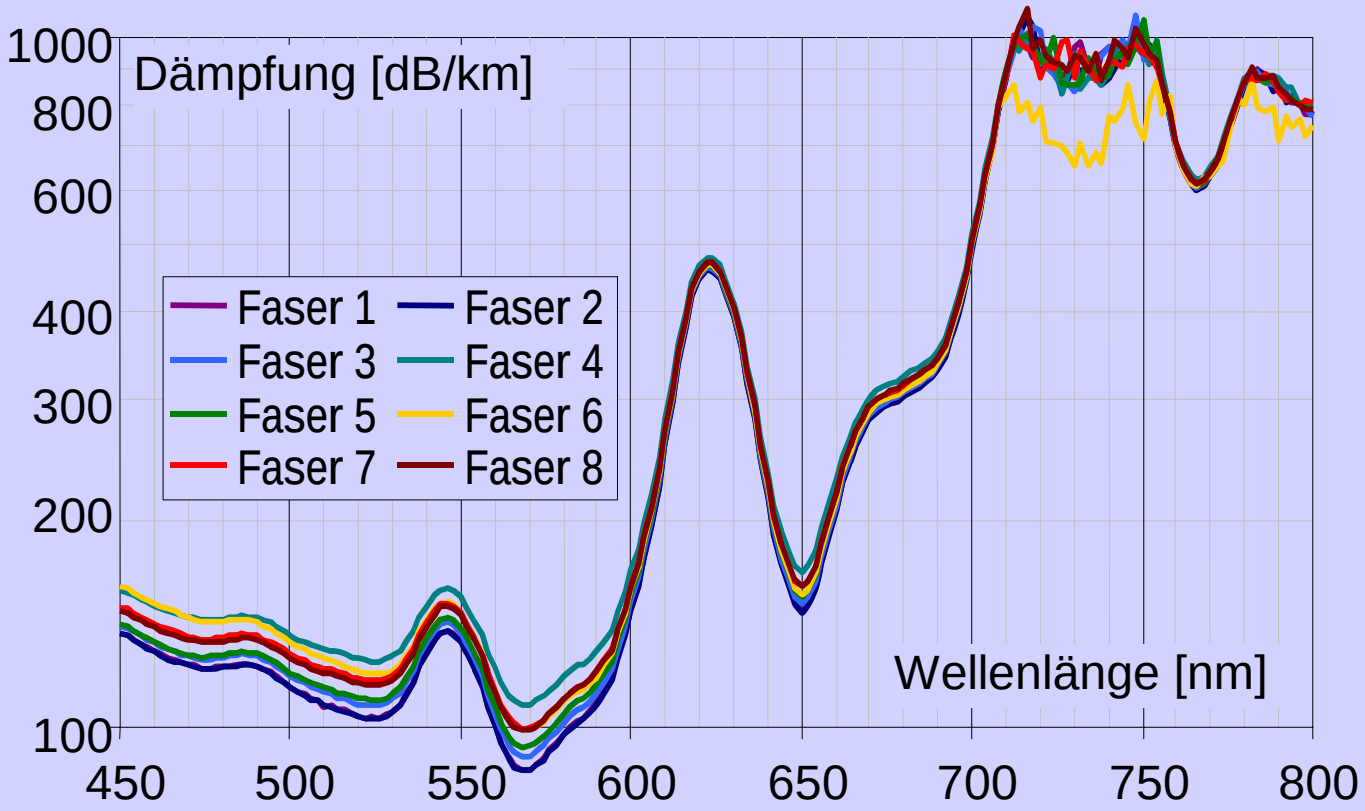


8-POF Bändchen (hergestellt von Nexans)

- 500 µm SI-POF
- 500 µm GI-POF (Optimedia)

Dämpfung der Fasern im Bändchen



650 nm: Dämpfungsunterschiede:
1 dB @ 50 m (im Bereich des Meßfehlers)

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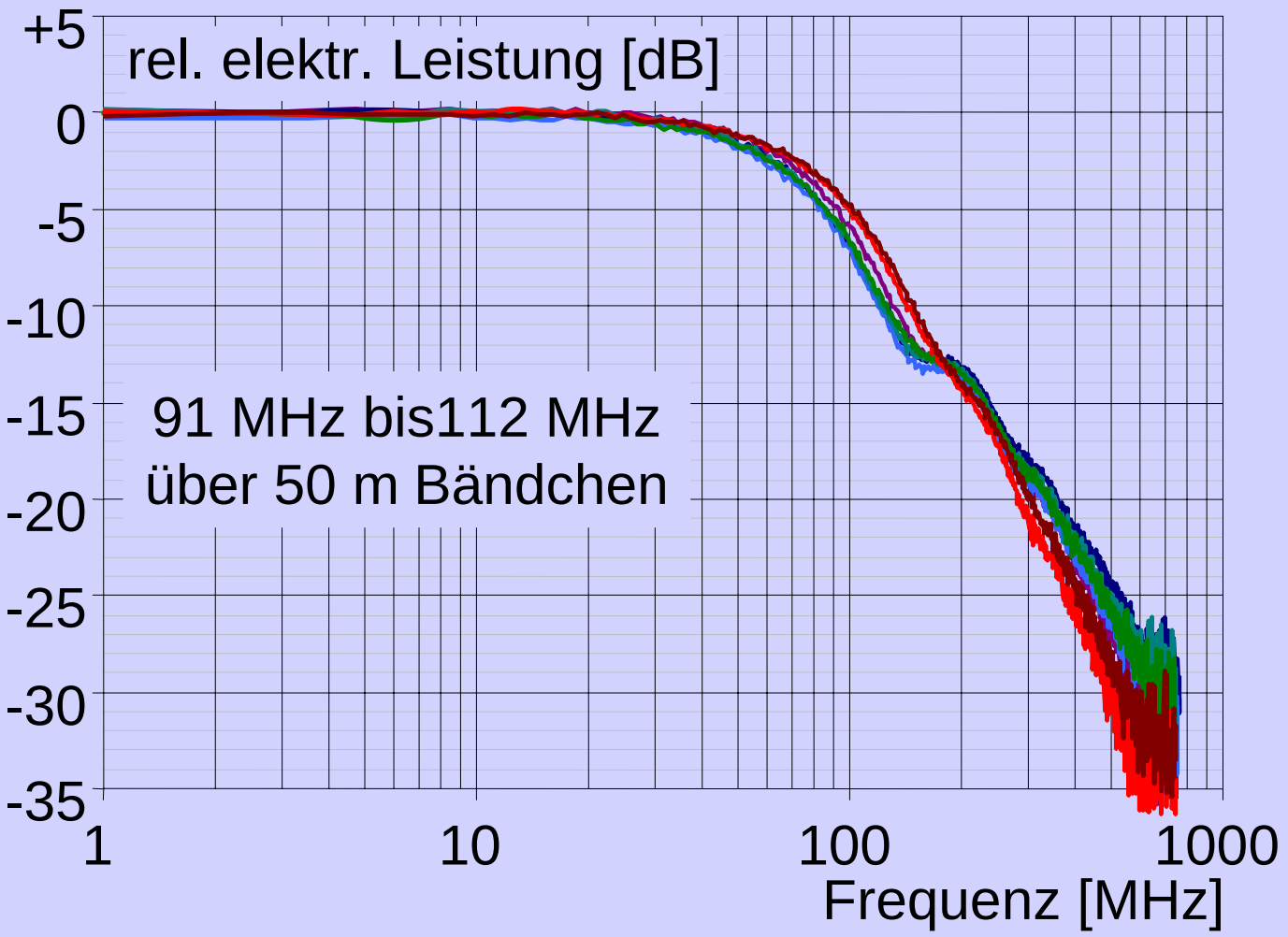
Bandbreite der Faser im Bändchen



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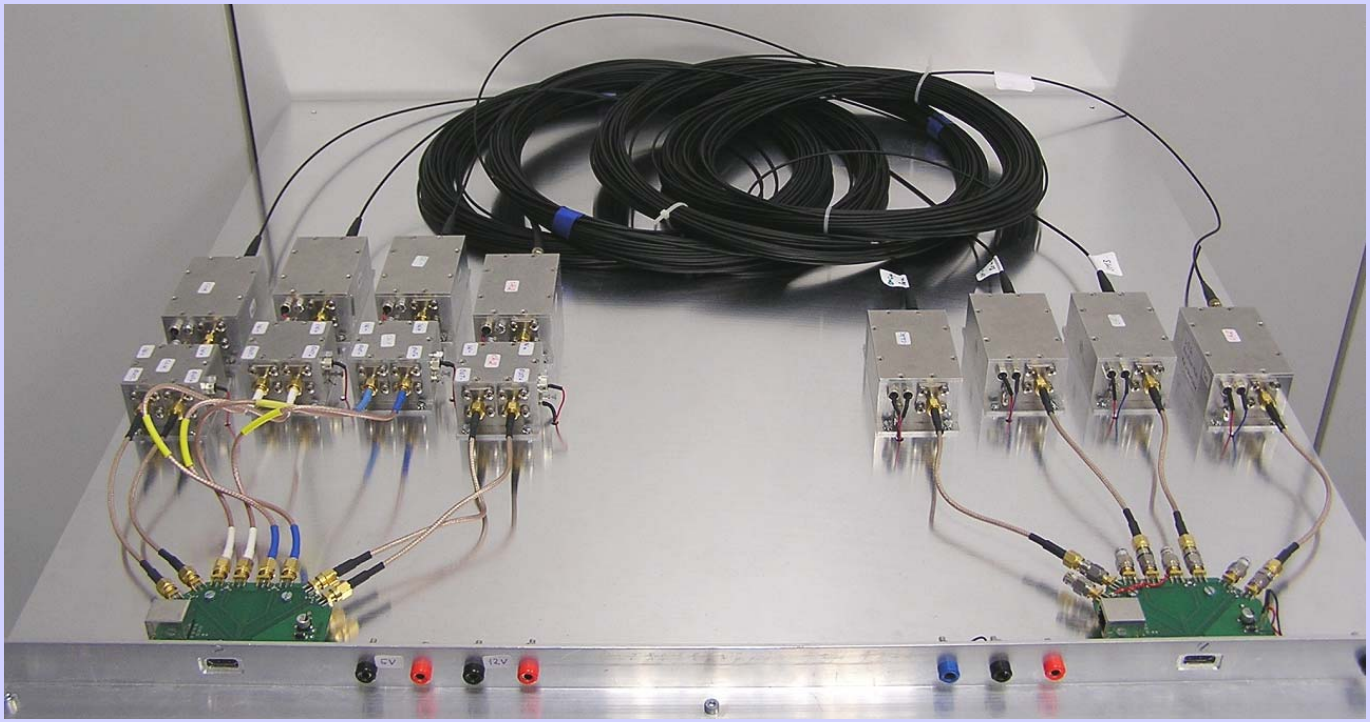
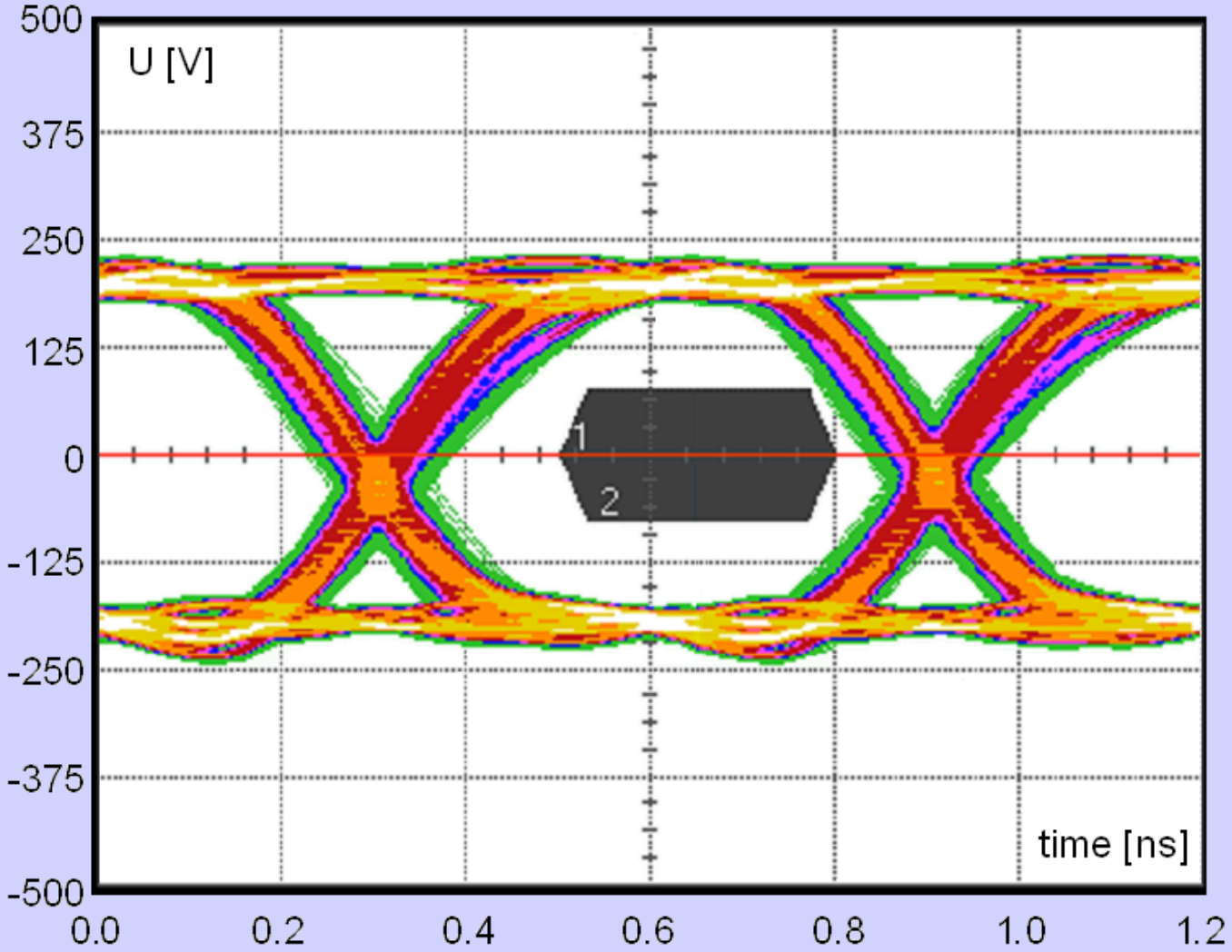
Digitales Video über POF



- Cooperation of FhG and POF-AC (project OVAL)
- 650 nm LD transmitter, Si-pin-PD receivers
- 4 channels with 1,600 Mbit/s each
- 50 m PMMA-GI-POF (900 µm, Optimedia)
- tested also with 50 m of 500 µm GI-POF-ribbon

Augendiagramm bei 1,6 Gbit/s



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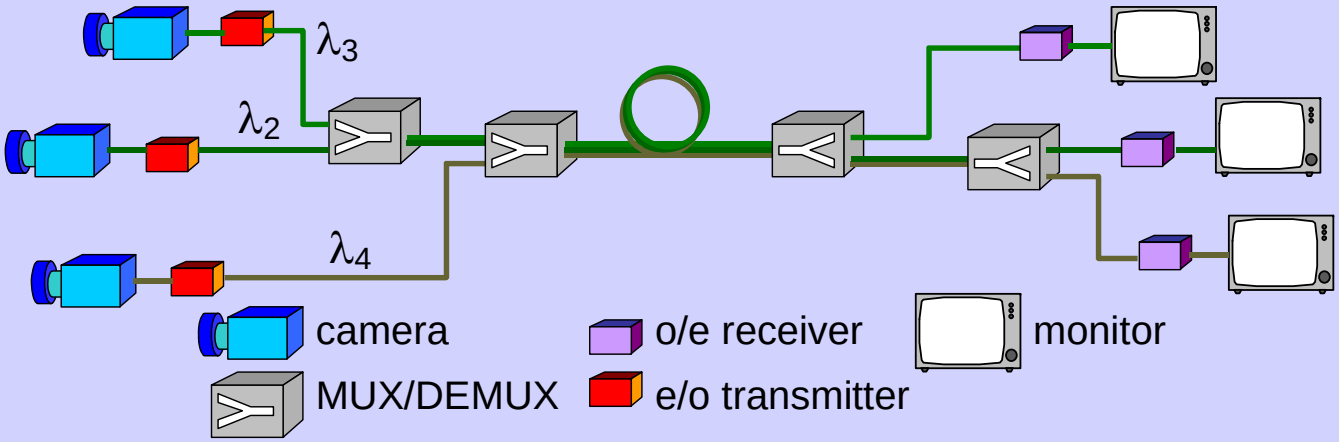
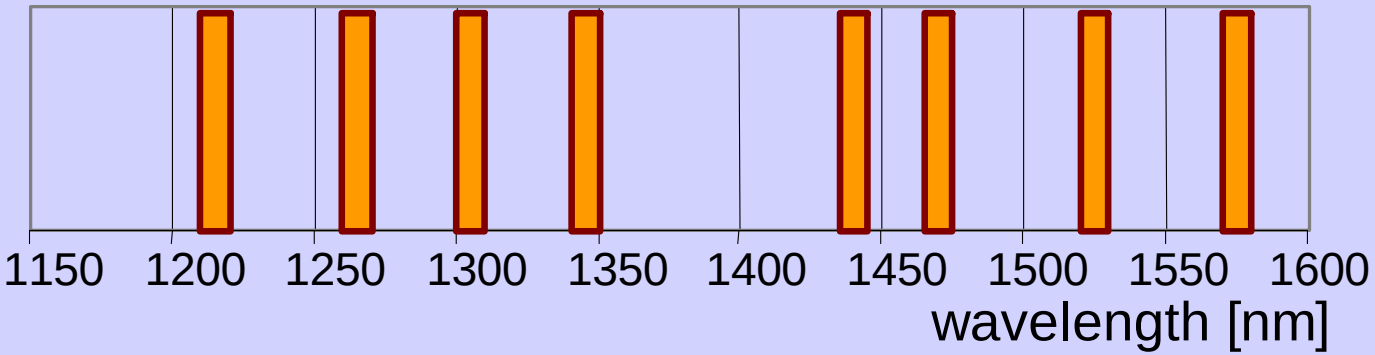
Beispiel für WDM system

WDM Video System (Uehara 1998)



Channels acc. to “Eight λ



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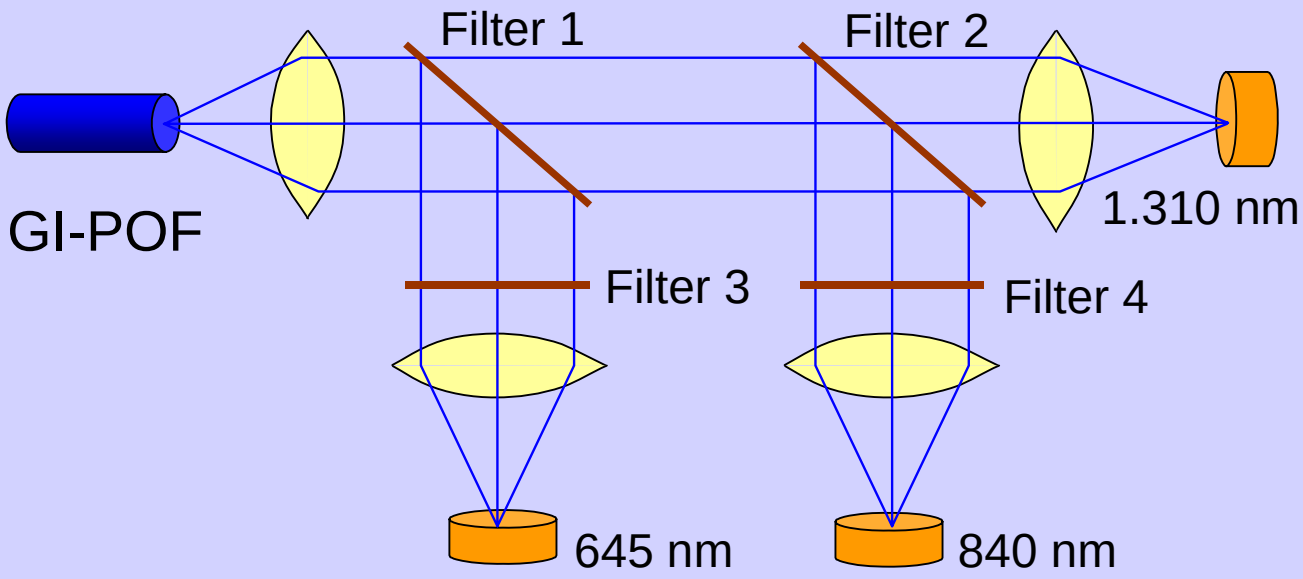
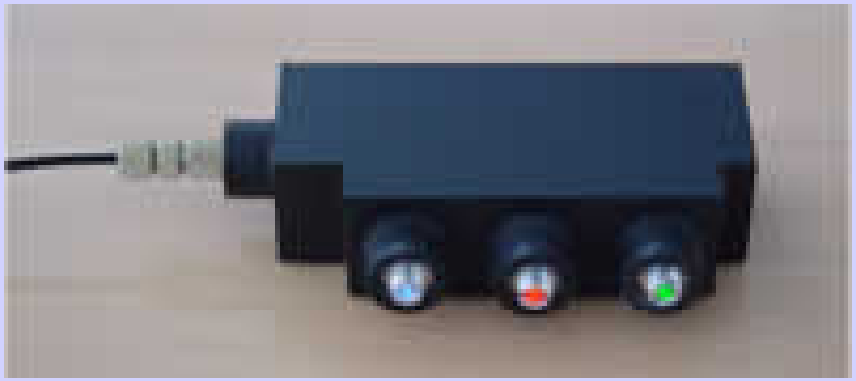
3-Kanal WDM mit GI-PF-POF



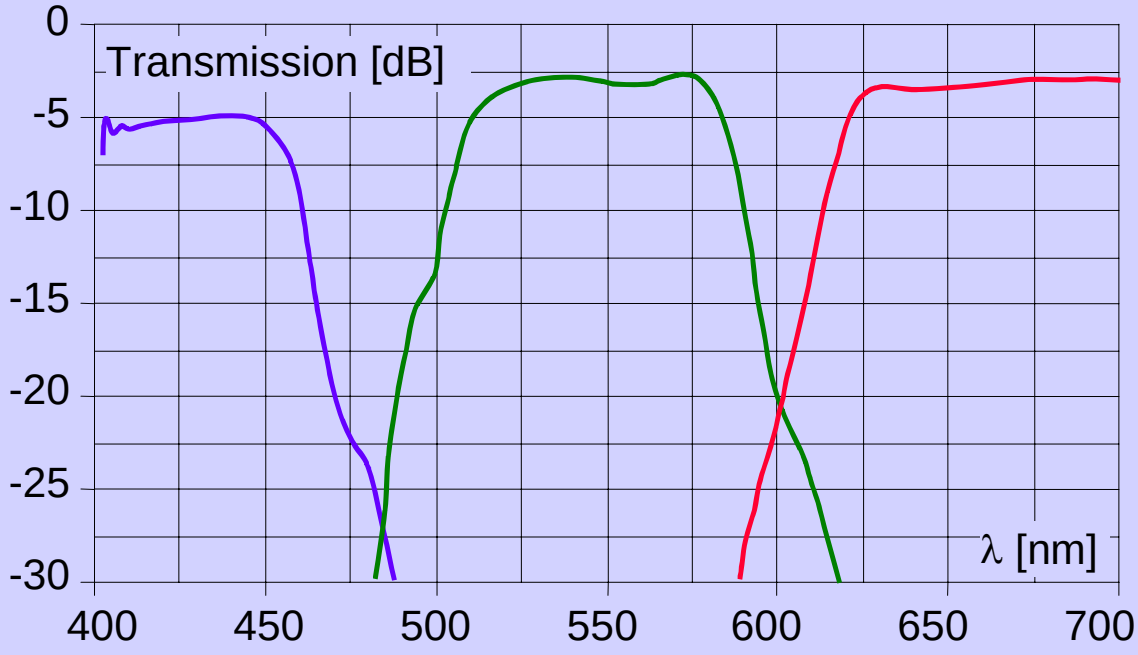
[Khoe99]

- Si-APD mit 230 µm Durchmesser
- LD: 645 nm, 1.310 nm; VCSEL 840 nm (2.5 Gbit/s)
- 328 m mit 3 Kanälen
- 456 m mit 2 Kanälen

3-Kanal WDM am FhG IIS



[Jun02]



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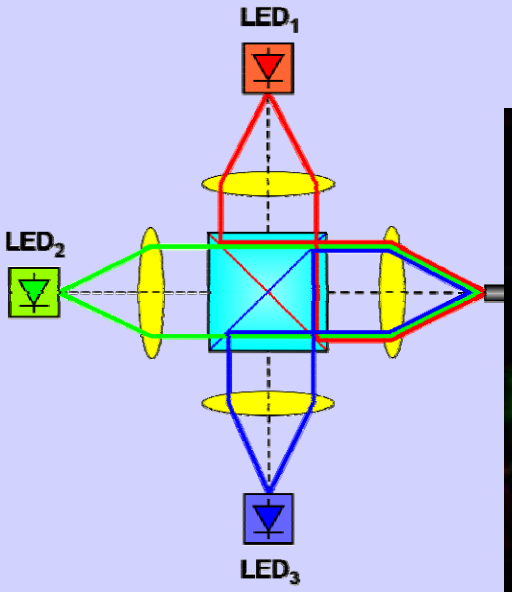
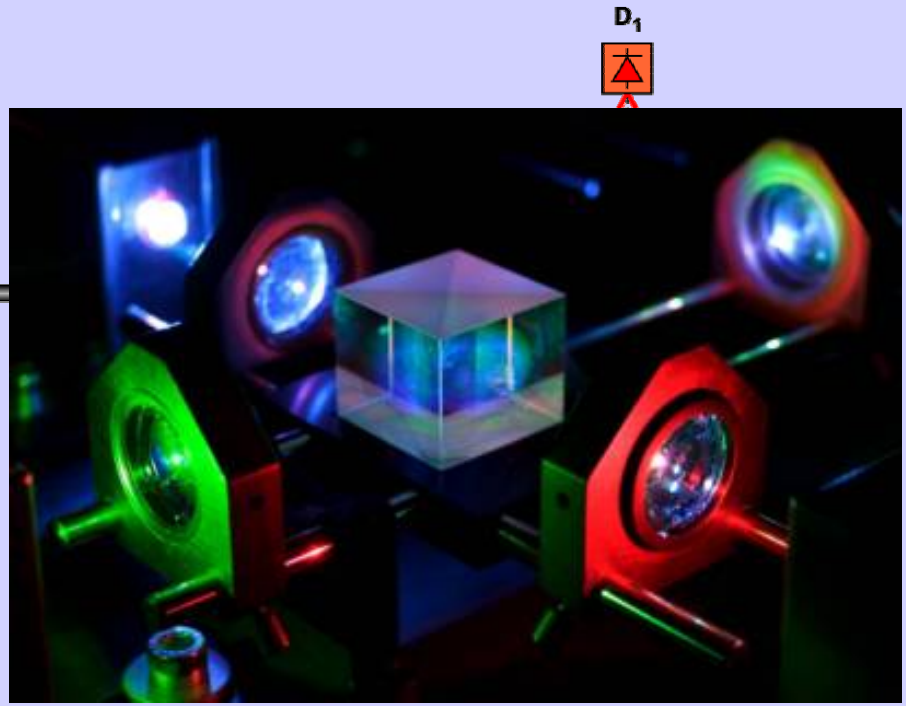
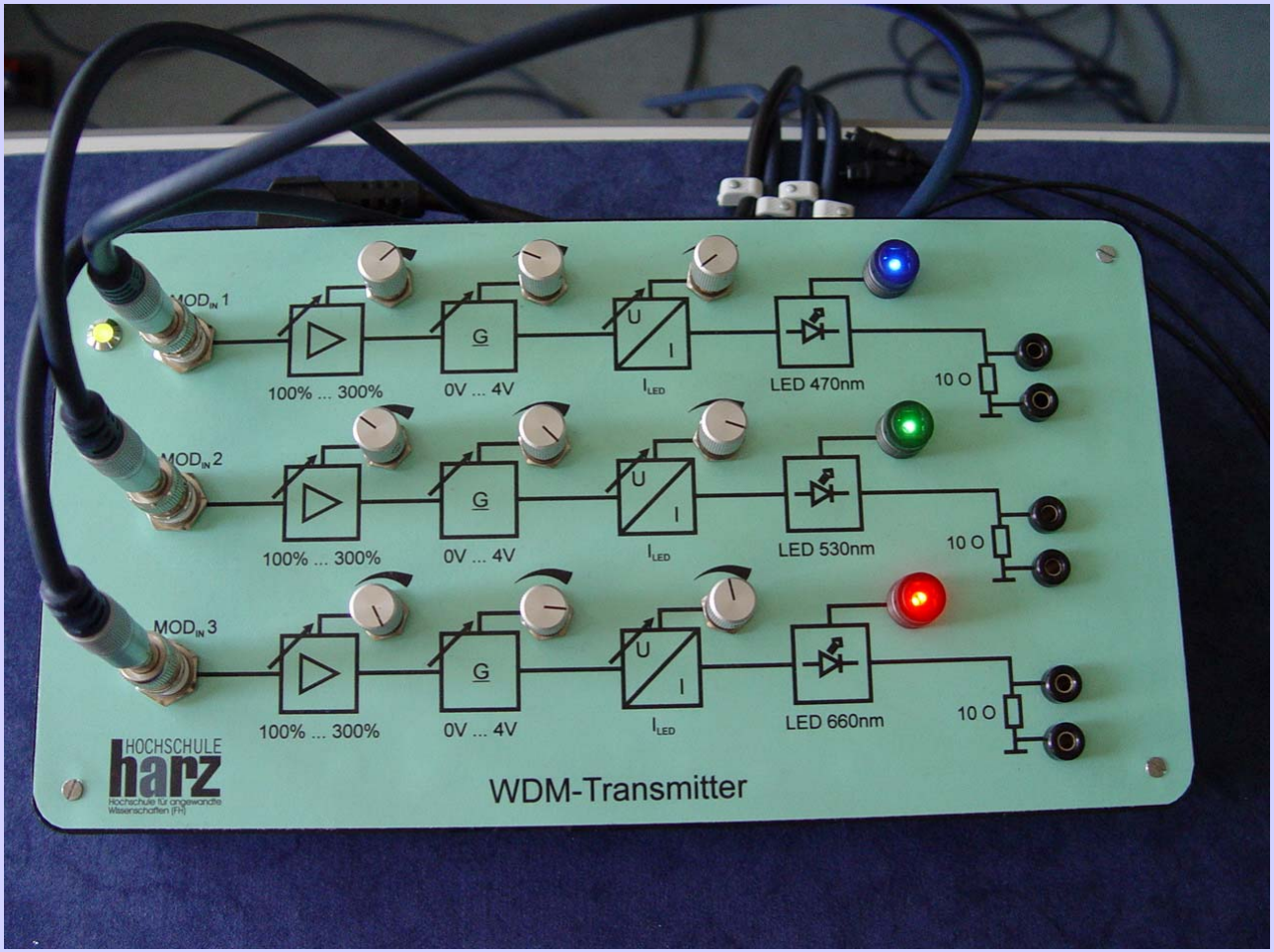
WDM -Demo mit SI-POF (POF-AC)





Lyubomyr Bartkiv (NULP, Lviv)

Optoteach POF-WDM-Lehrsystem HS Harz



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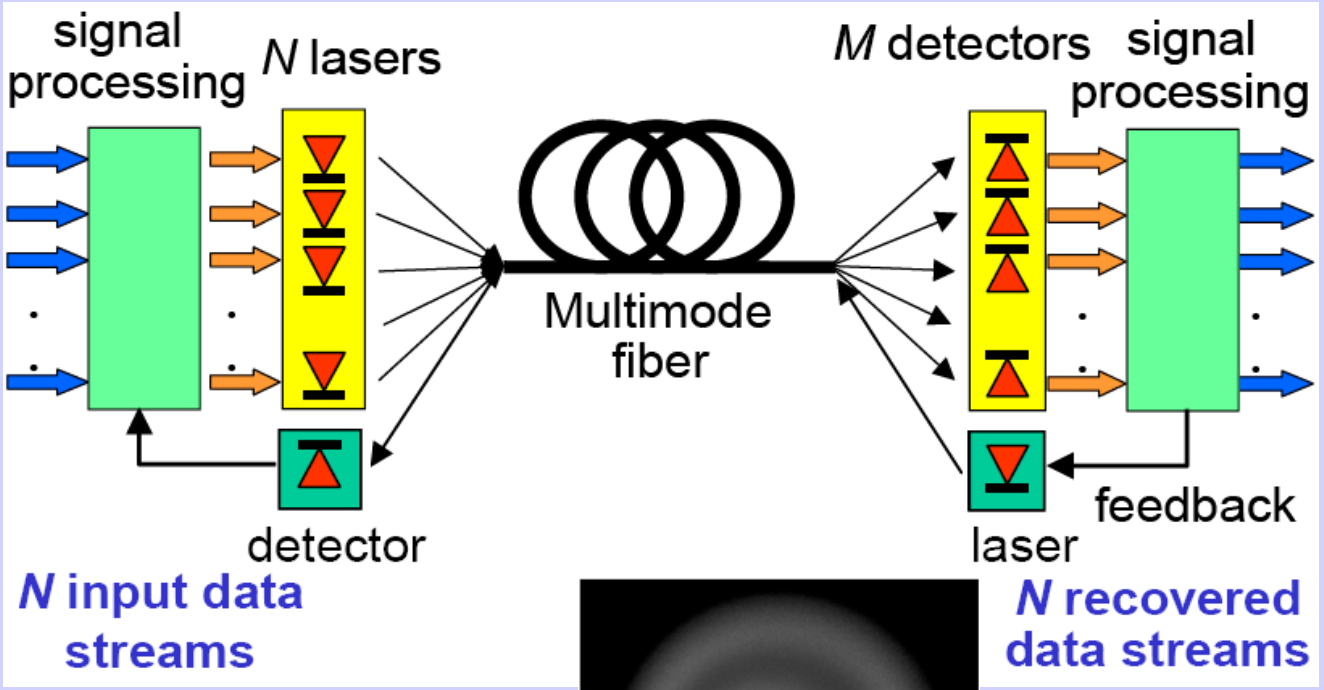
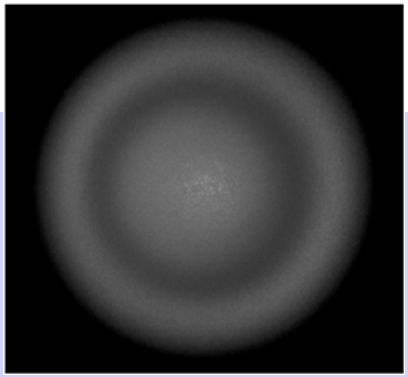
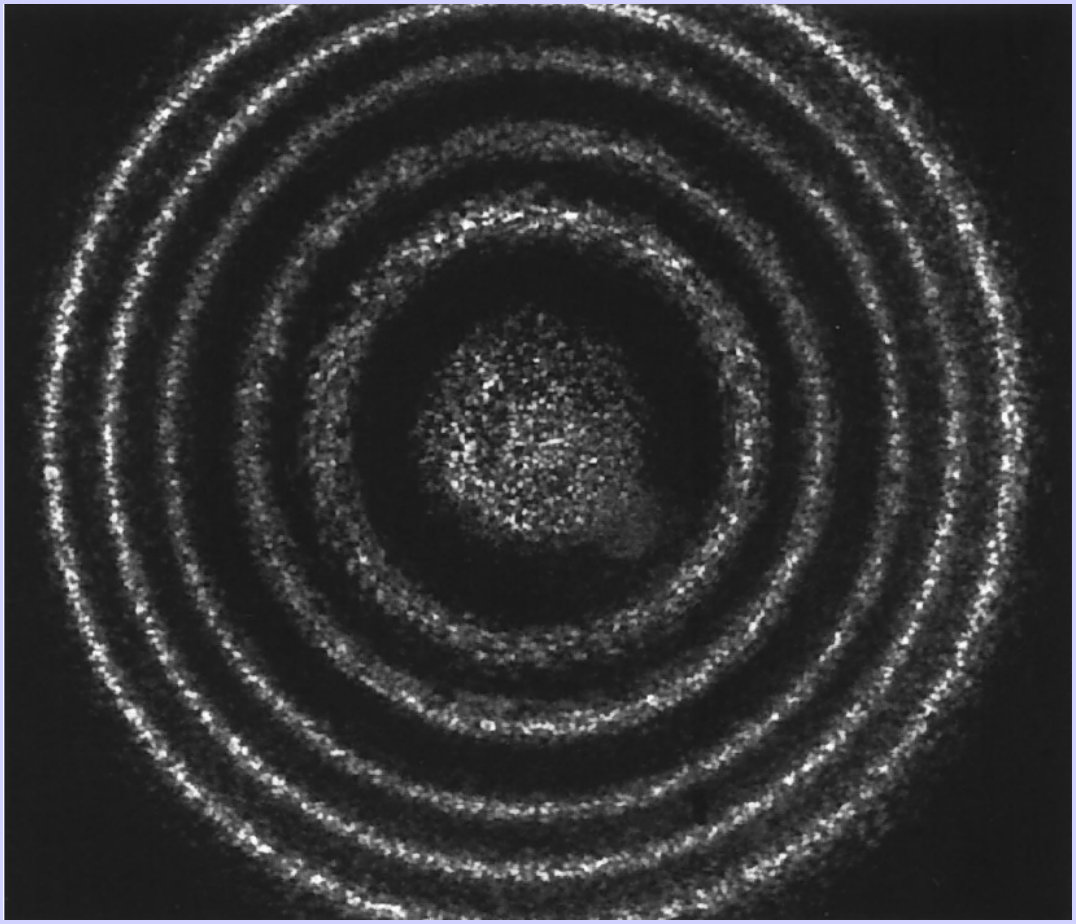
Modengruppen-Multiplex





📖 T. Koonen, Univ. Eindhoven
S. Schöllmann, Univ. Kiel

MGDM auf 200 µm SI-GOF

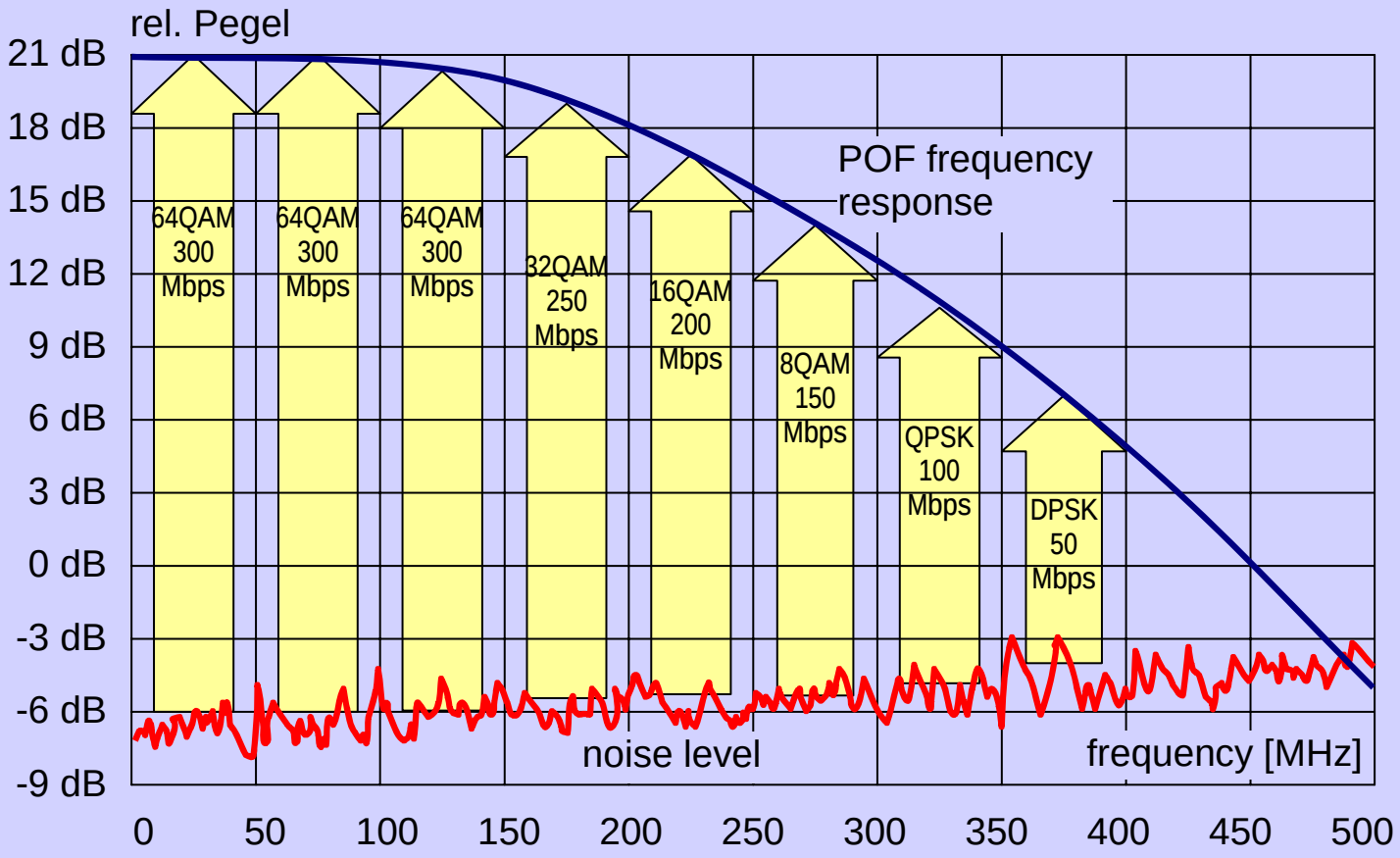


12 Channel
8 m
632 nm
Ø: 200 µm
NA = 0,39

UNI Mannheim

W. Krackhard et. al. “Broadband parallel-fiber optical link for short-distance interconnection with multimode fibers”, Appl. Optics 2000

Subträger-Multiplexing



Optimal use of the transmission capacity requires low noise reveivers for high SNR

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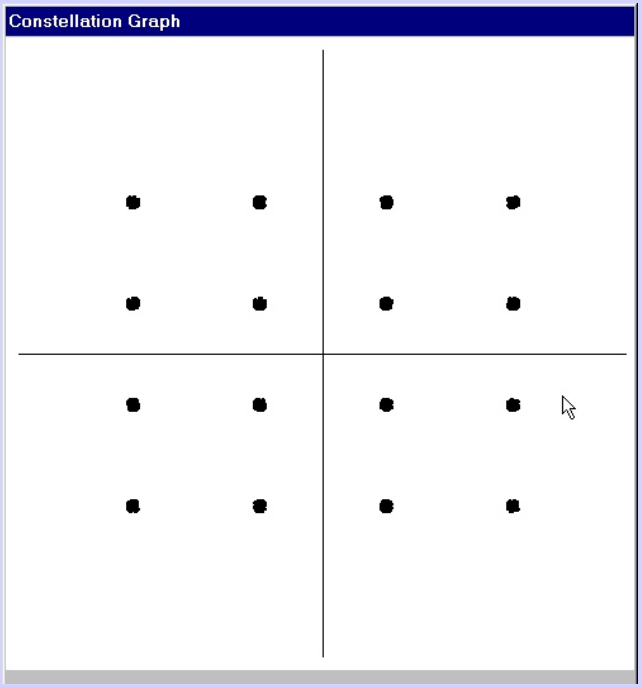
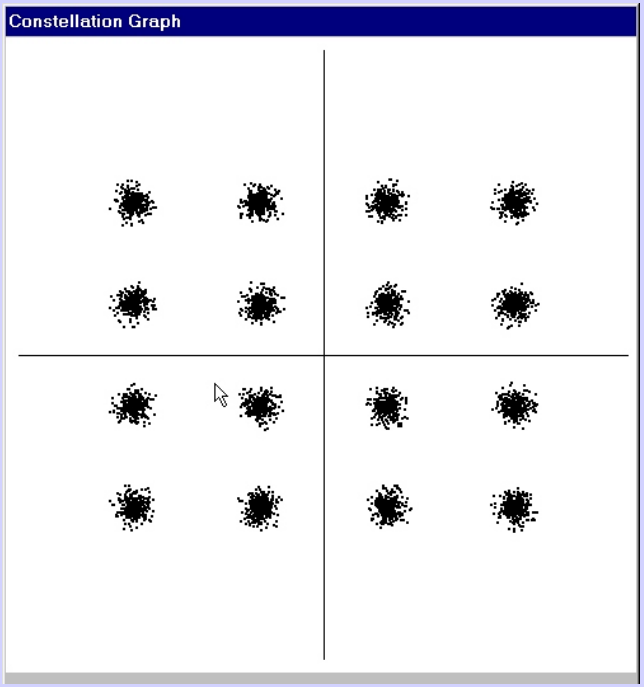
Beispiel: VDSL-Übertragung

Prof. Pollakowski, FH Gelsenkirchen (Germ.)
10 MHz bandwidth @ 50 m SI-POF



Constellation Graph
upstream signal



Constellation Graph
downstream signal

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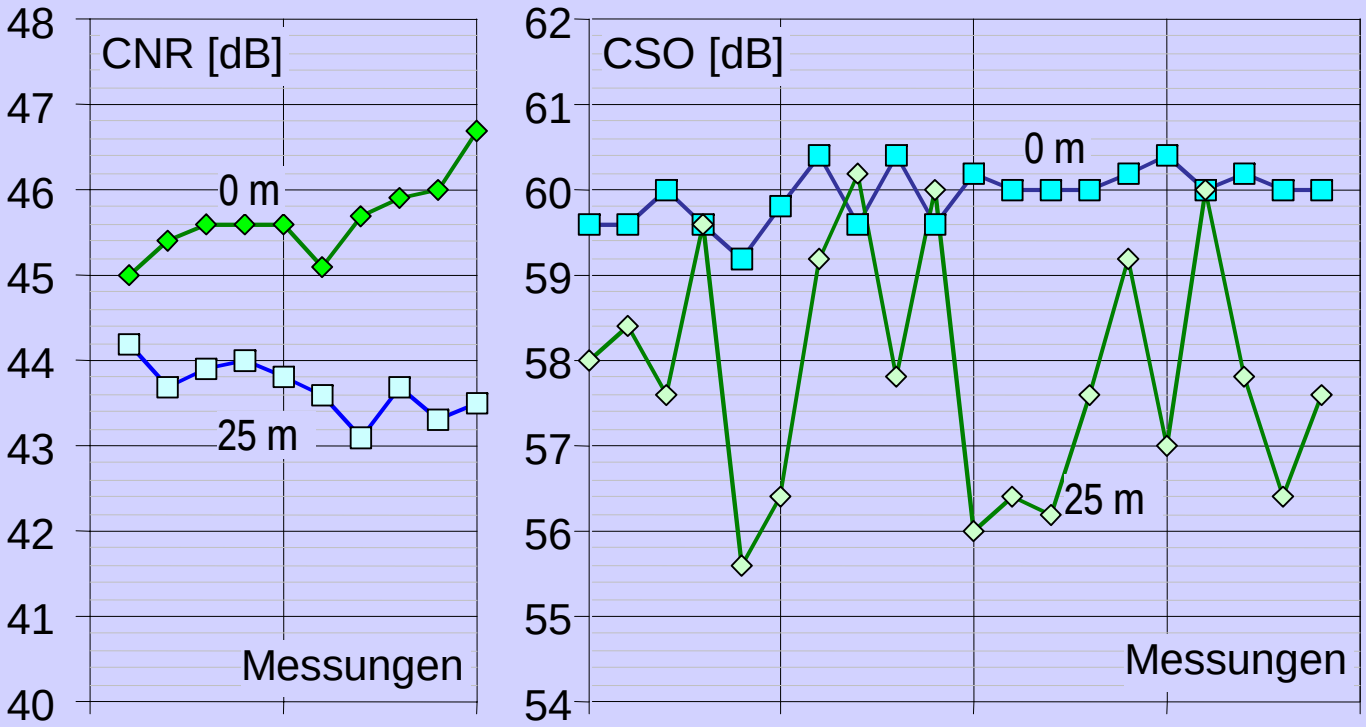
Videosystem mit GI-POF



Y. H. Kim, Y. C. Kim, H. D. Kim: „Multi-channel Analog CATV Transmission over a Perfluorinated GI-POF“, POF'2006, Seoul 11.-14.09.2006, pp. 399-402

Vergleich der Multiplexverfahren

	SDM	WDM	MGDM	SCM
Zahl der Fasern	N	1	1	1
mögliche Bitrate (bei einer Faserbandbreite von B)	≈ 2·B·N	≈ 2·B·N	≈ 6..8·B	≈ 4..6·B
notwendige Wellenlängen	1	N	1	1
verfügbare Sender für PMMA-POF	650 nm LD	650 nm LD alle λ LED	650 nm LD	650 nm LD
verfügbare Sender für PF-POF und SiO_2 Fasern	850 nm - 1300 nm LD	850 nm - 1300 nm LD	850 nm - 1300 nm LD	850 nm - 1300 nm LD
notwendige spezielle Komponenten	Bändchen LD/PD-Zeilen	Mux/ Demux	kleiner TX modensel. RX	linear LD low noise RX
Vorteile	Verwendung verfügbarer Komponenten	einfacher Aufbau opt. Filterung	nur eine Wellenlänge nötig	nur 1 TX/RX nötig verf. Komp.
Nachteile	dickere Kabel	große MUX für PMMA-POF	unbekannter Einfluß der Modenkoppl.	nicht stabile Übertra-gungsfunkt.?