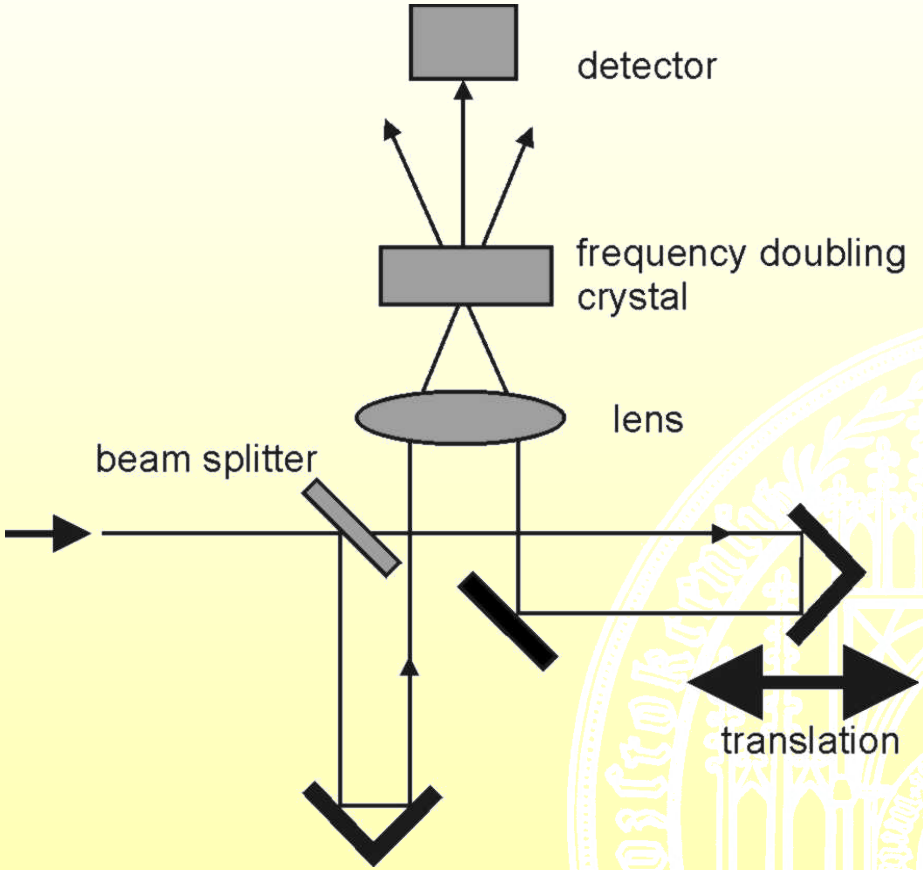
Part III

Various aspects of fiber nonlinearity

Insert: How to measure ultrashort pulses

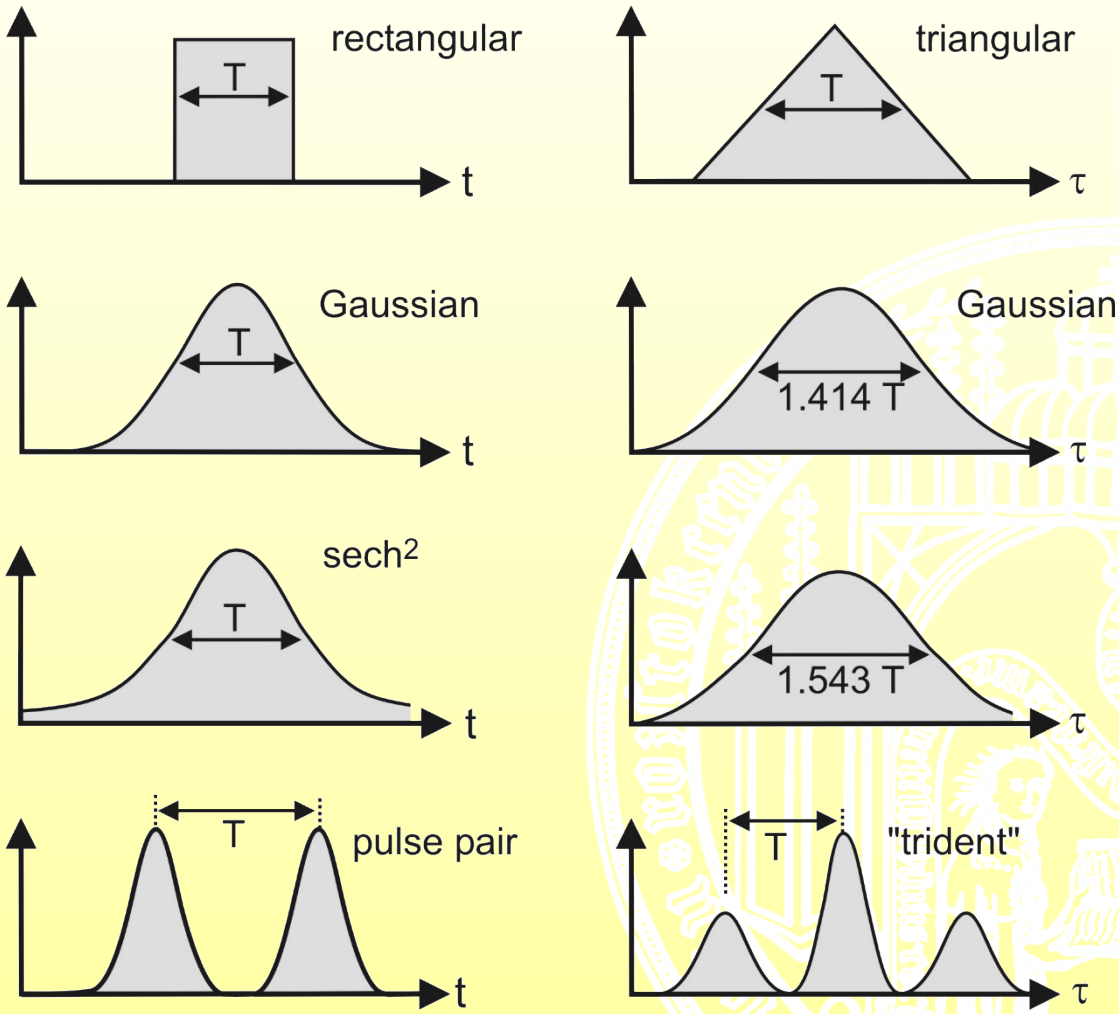


autocorrelator to assess shape and duration of ultrashort light p

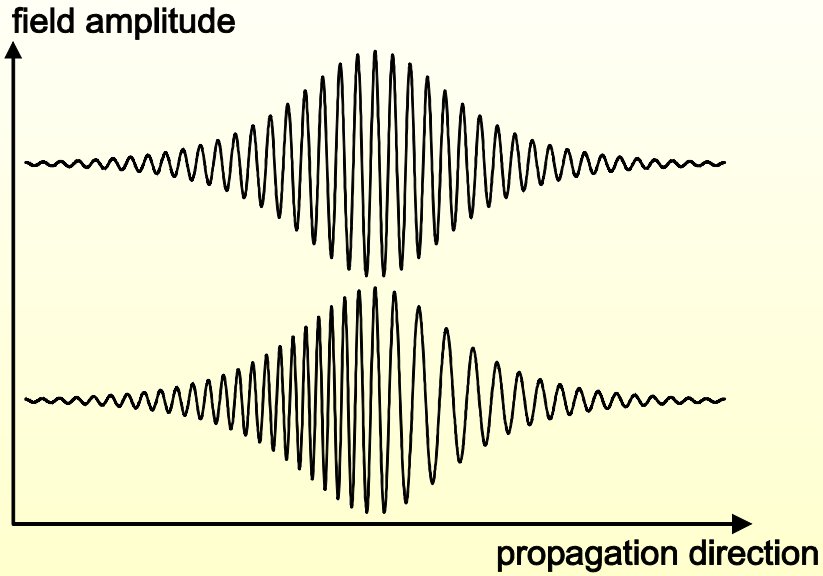
For some function $U(t)$, the autocorrelation function is defined as

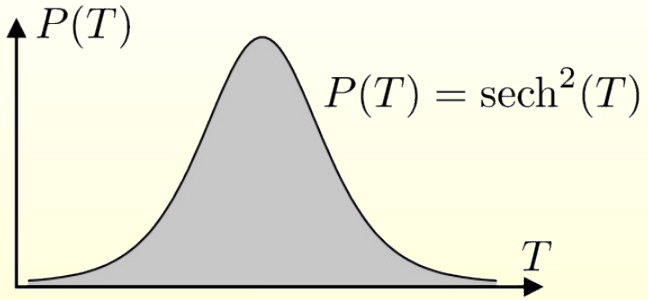
$$\mathrm{ACF}(\tau) = \lim_{T\to\infty} \frac{1}{2T} \int_{-T}^{+T} U^*(t)\, U(t+\tau) dt$$

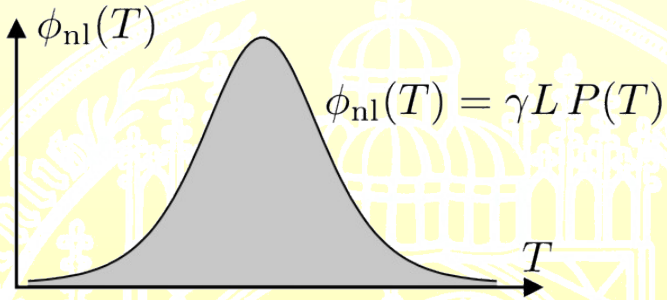
Insert: How to measure ultrashort pulses

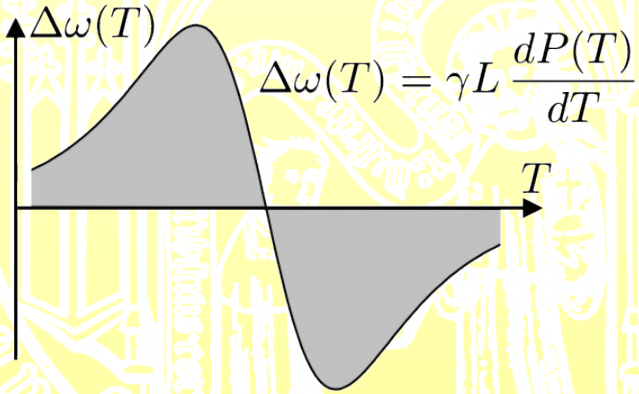


some examples of autocorrelation pulse shapes

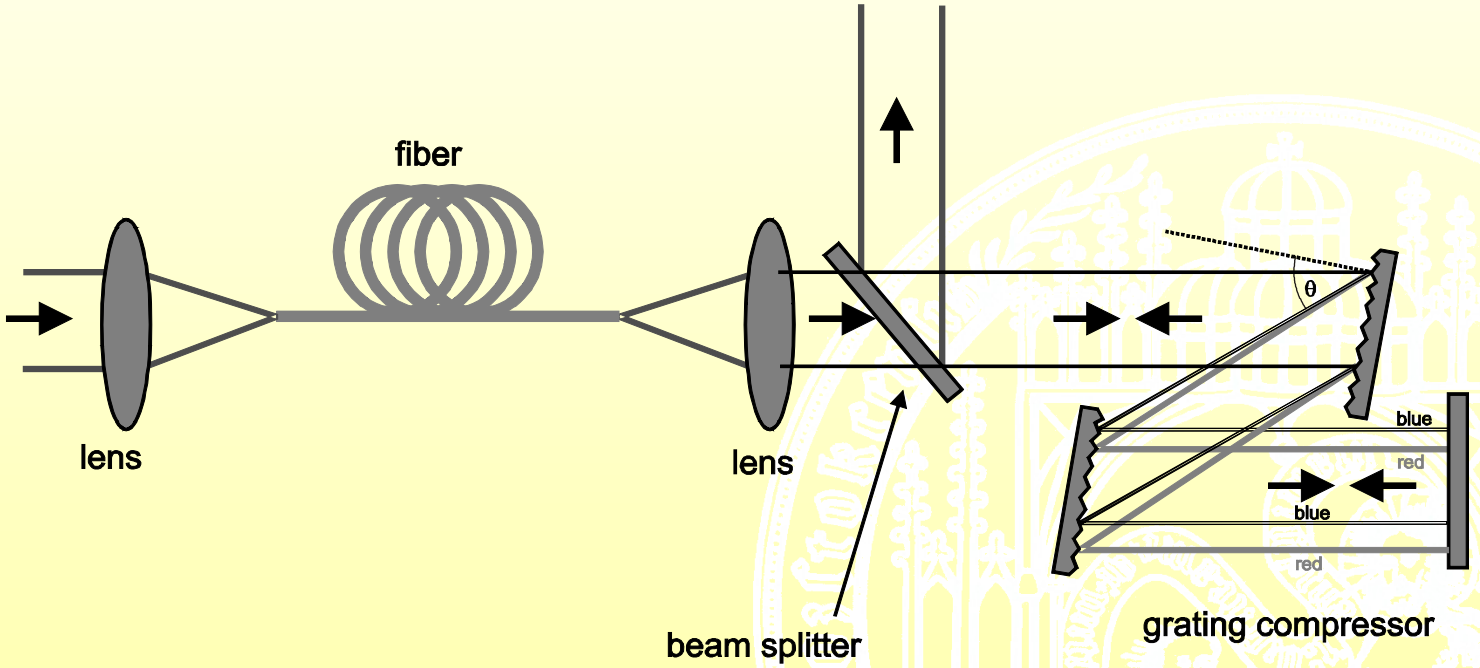




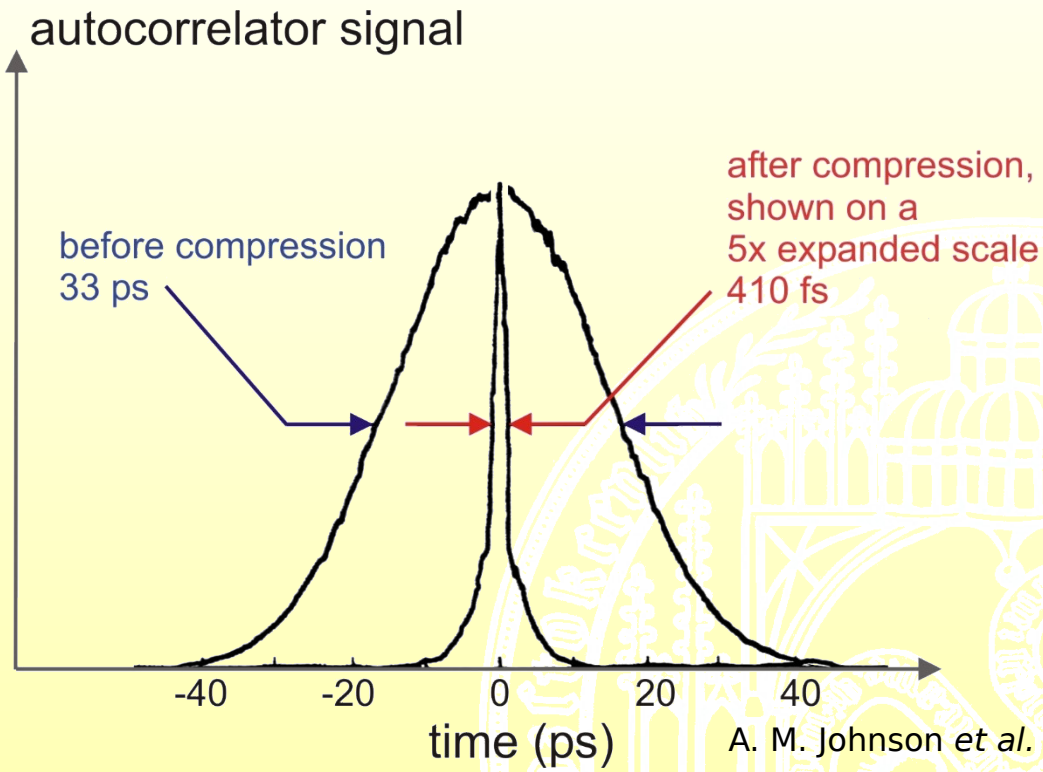




REMINDER:
self phase modulation

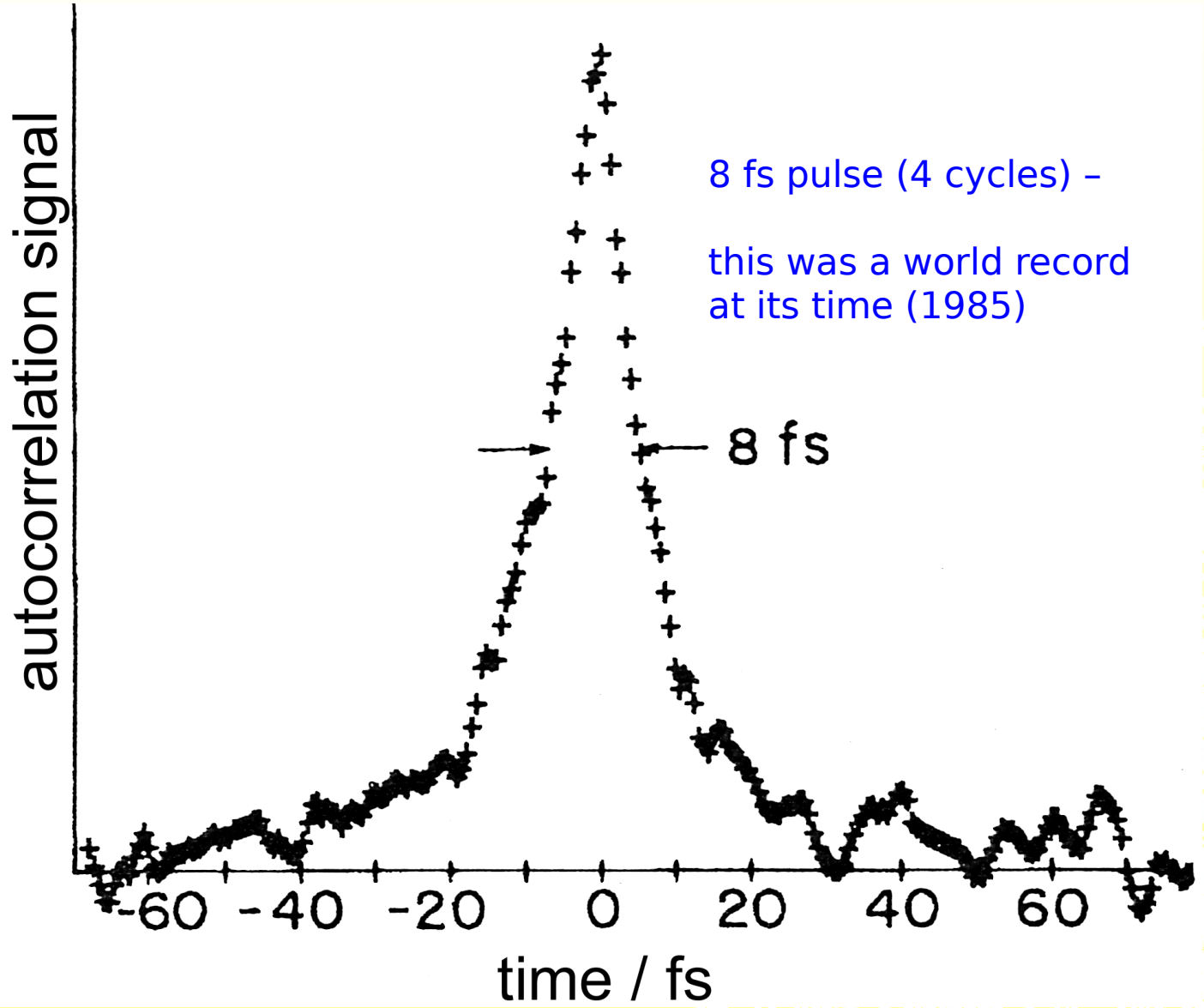


a fiber-grating pulse compressor



A. M. Johnson *et al.* 1984

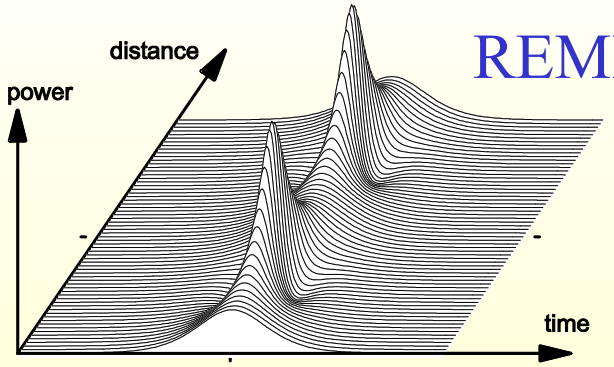
temporal pulse compression



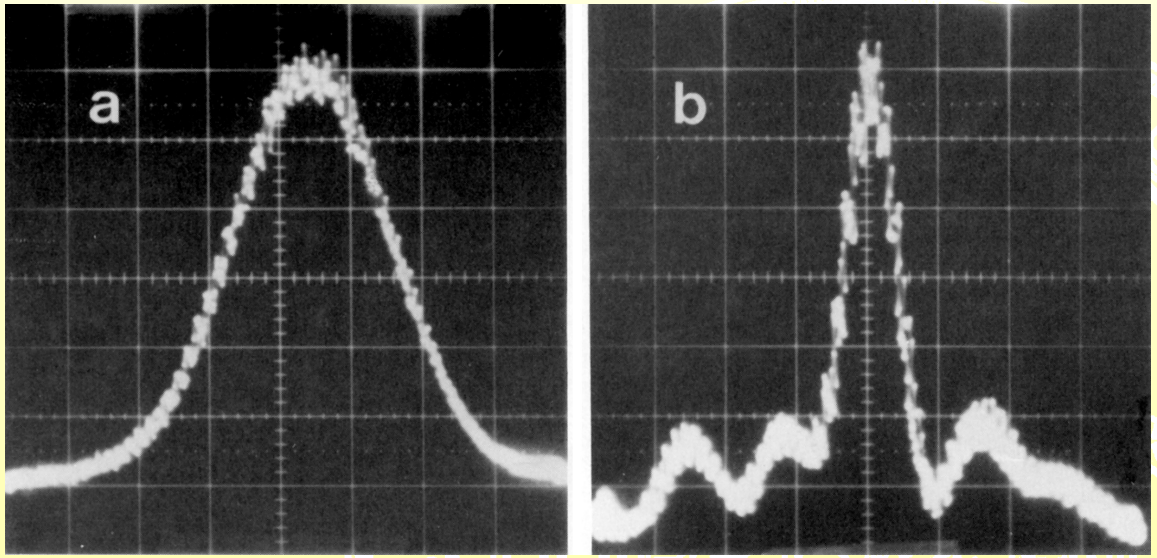
8 fs pulse (4 cycles) –

this was a world record at its time (1985)

W. H. Knox *et al.* 1985



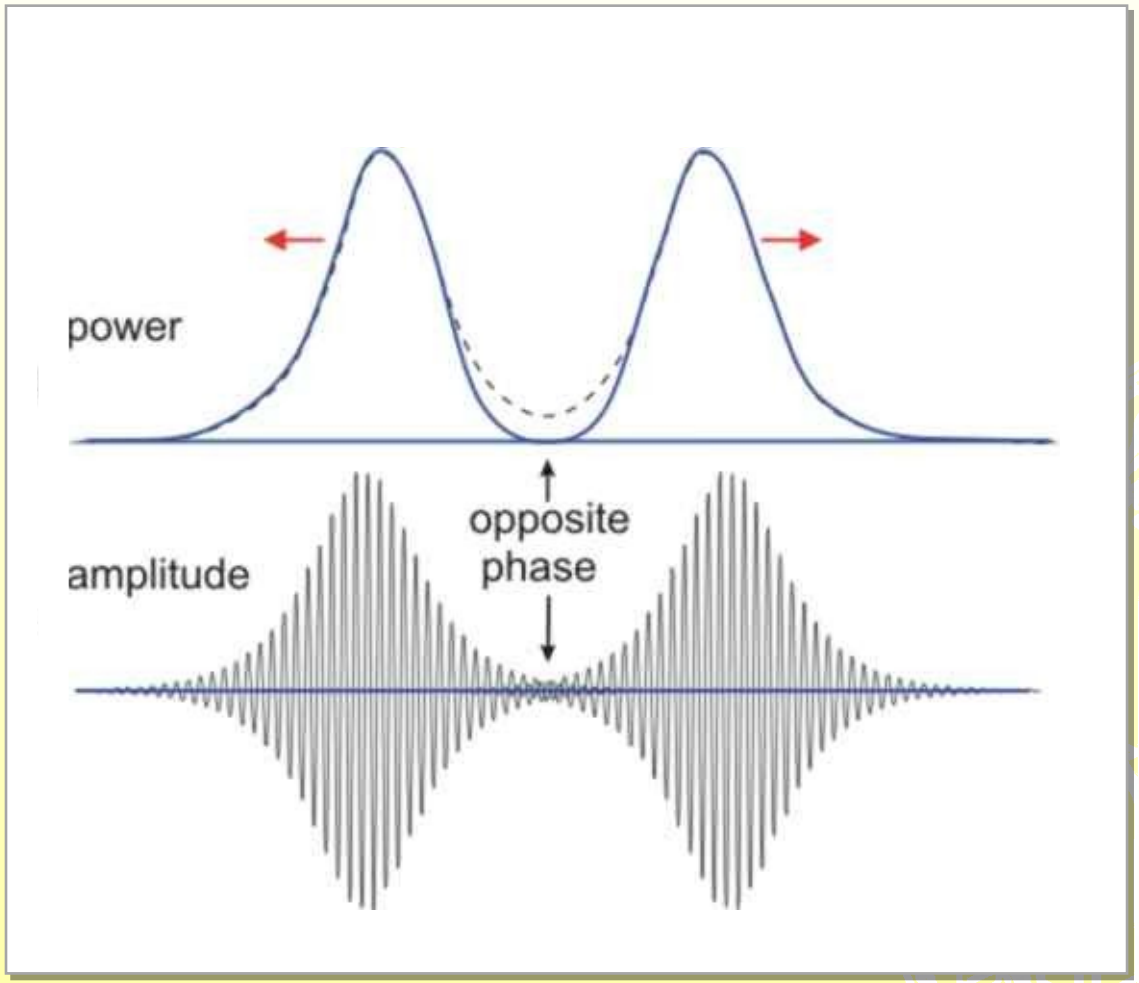
REMINDER: $N = 2$ soliton



19 fs: 3.8 cycles
the infrared world record...

Left: 60 fs pulses (autocorr)
Right: same after soliton compression to 19 fs
(FM, Mollenauer 1985)

Interaction between Solitons

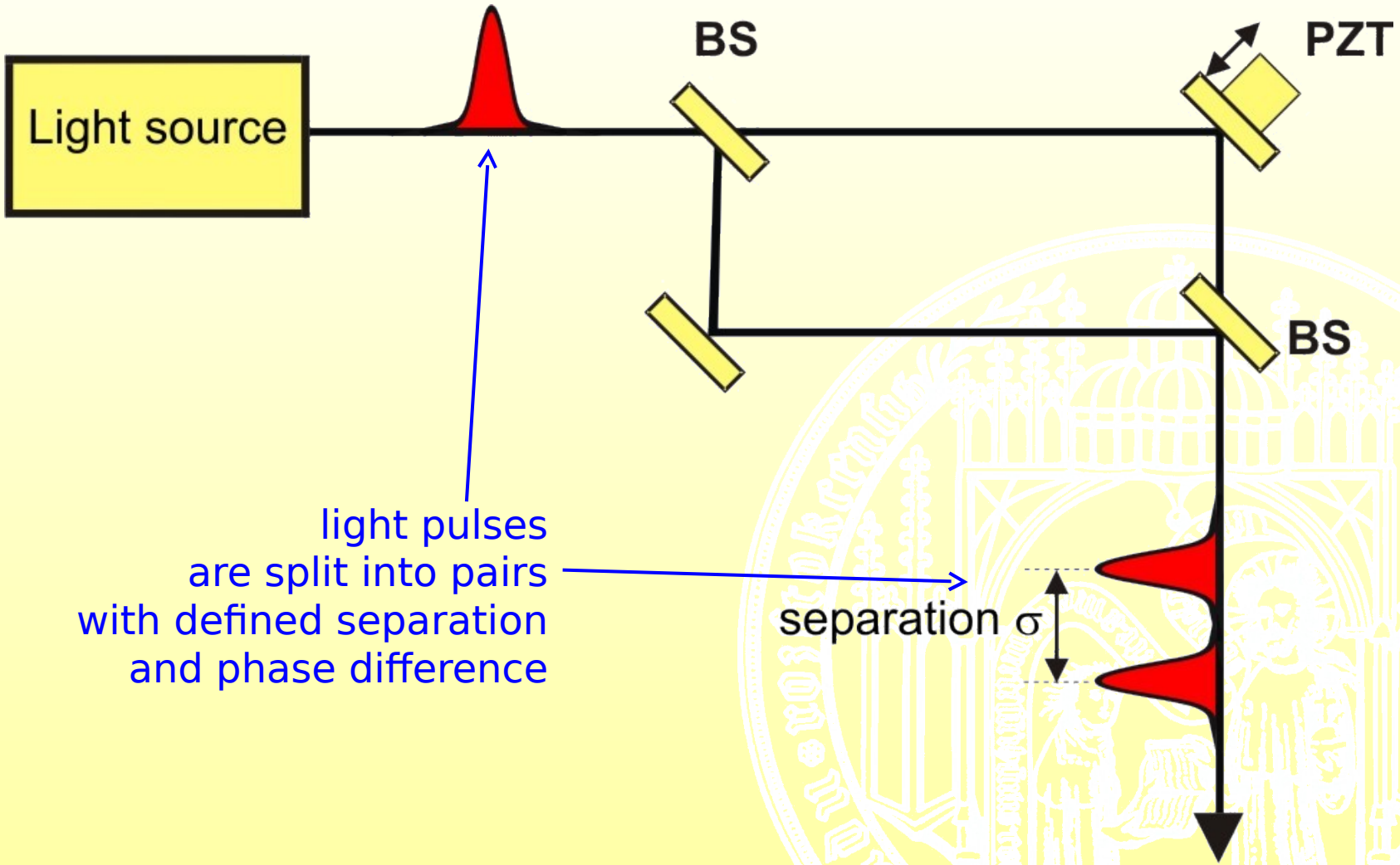


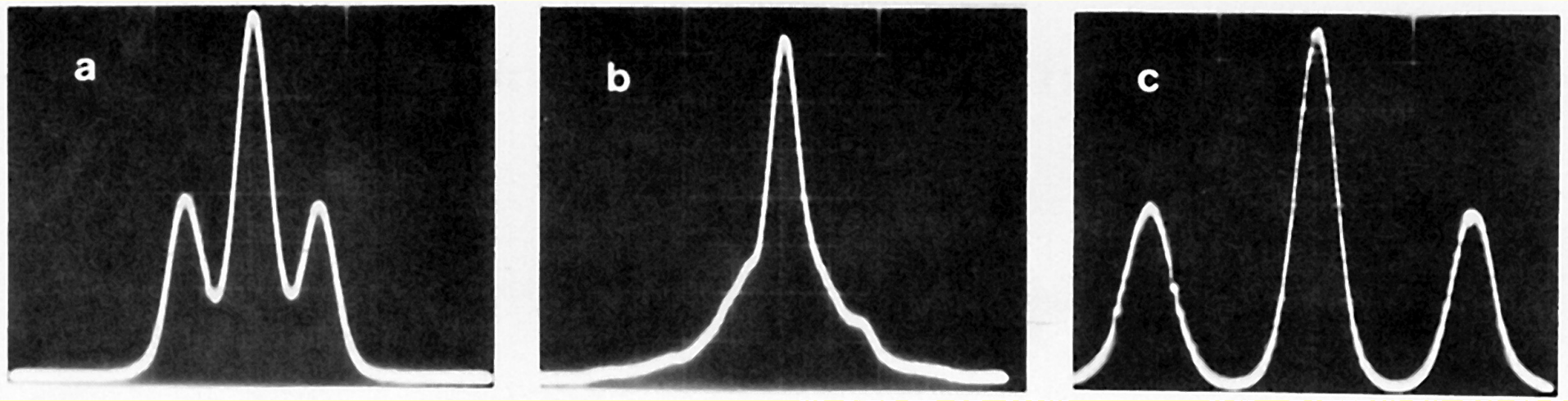
In Phase:
Attraction

Opposite Phase:
Repulsion

prediction: J. P. Gordon, Opt. Lett. 8, 596 (1983)
1st observation: F. Mitschke, L. F. Mollenauer, Opt. Lett. 12, 355 (1987)

Interaction between Solitons



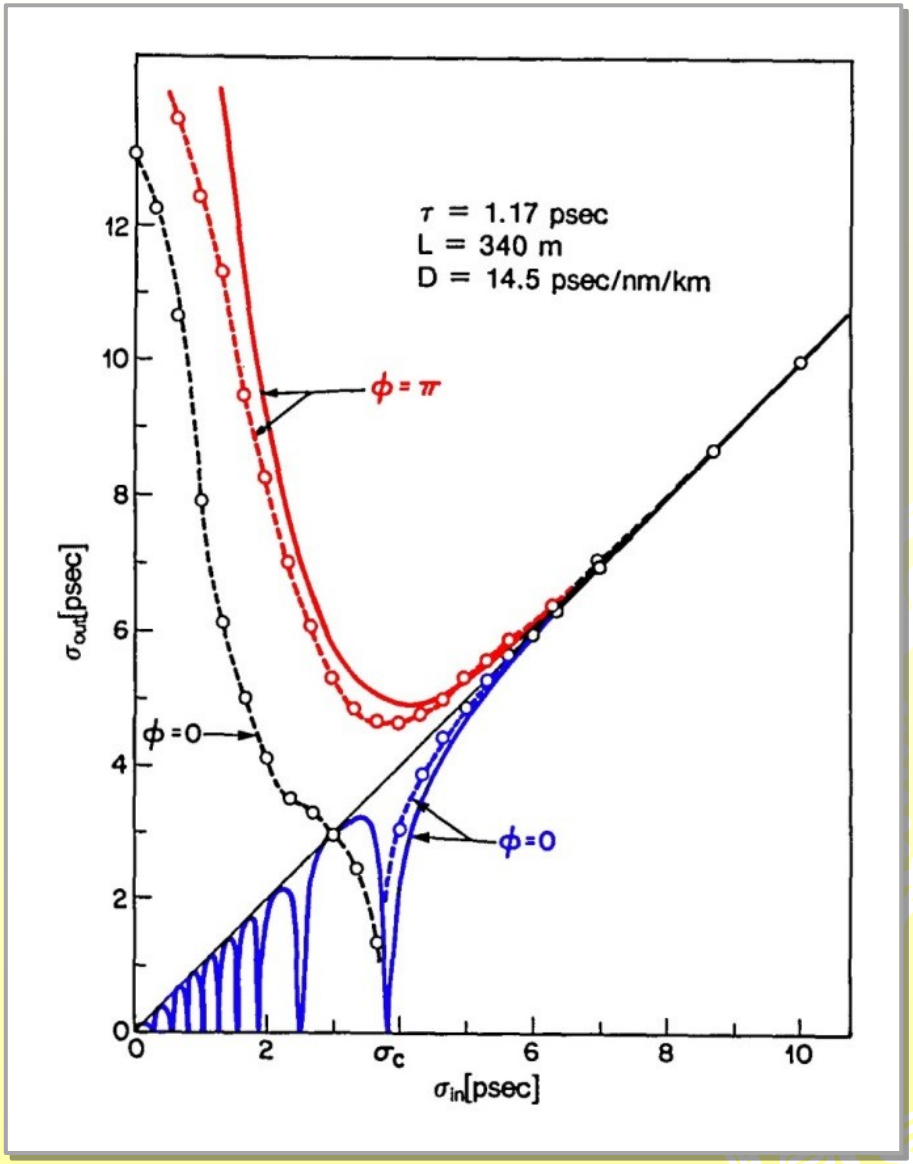


launch in phase opposite phase

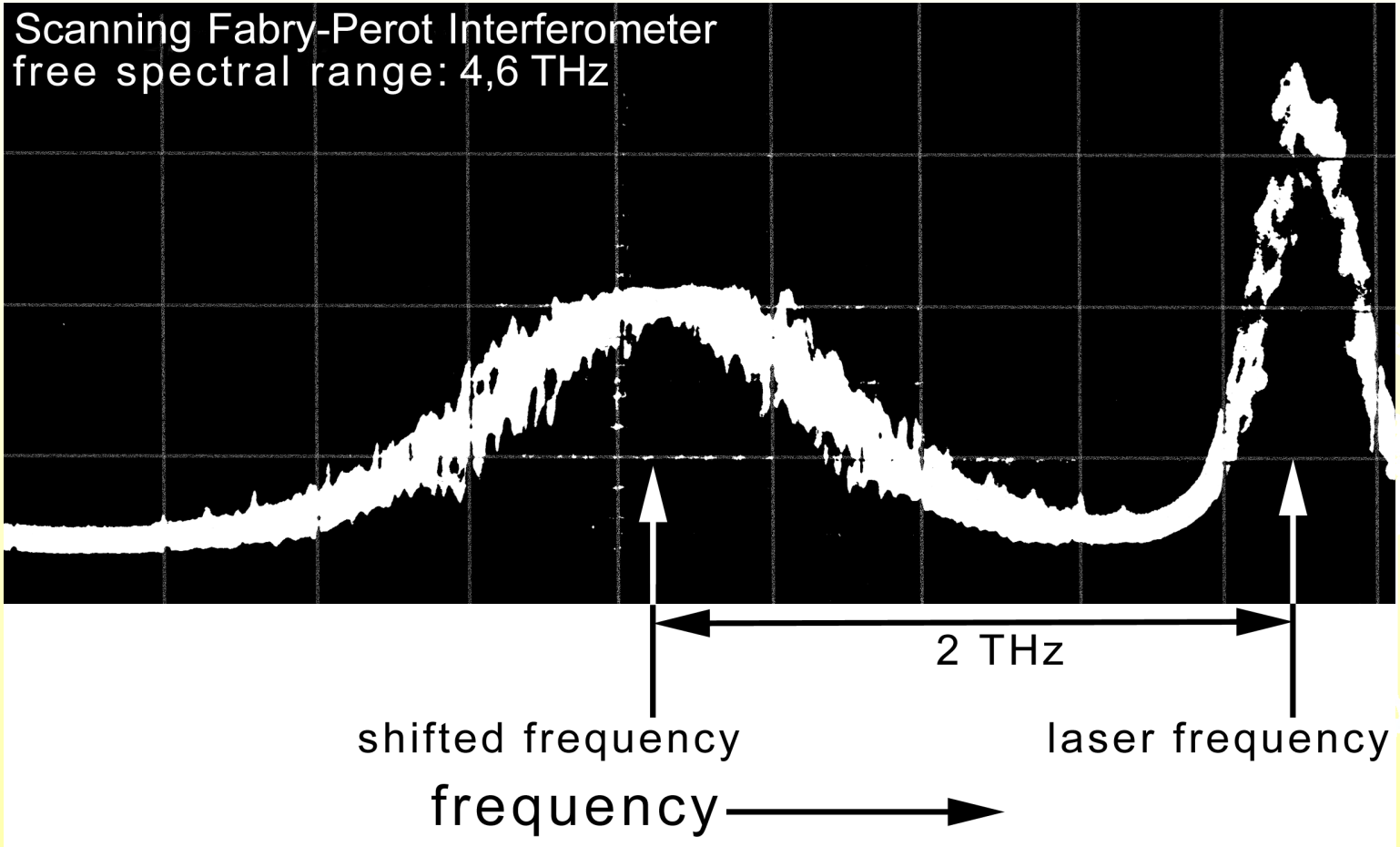
First experiment showing soliton interaction: autocorrelation traces

(FM, Mollenauer 1986)

FM, Mollenauer, Opt. Lett. **12**, 355 (1987

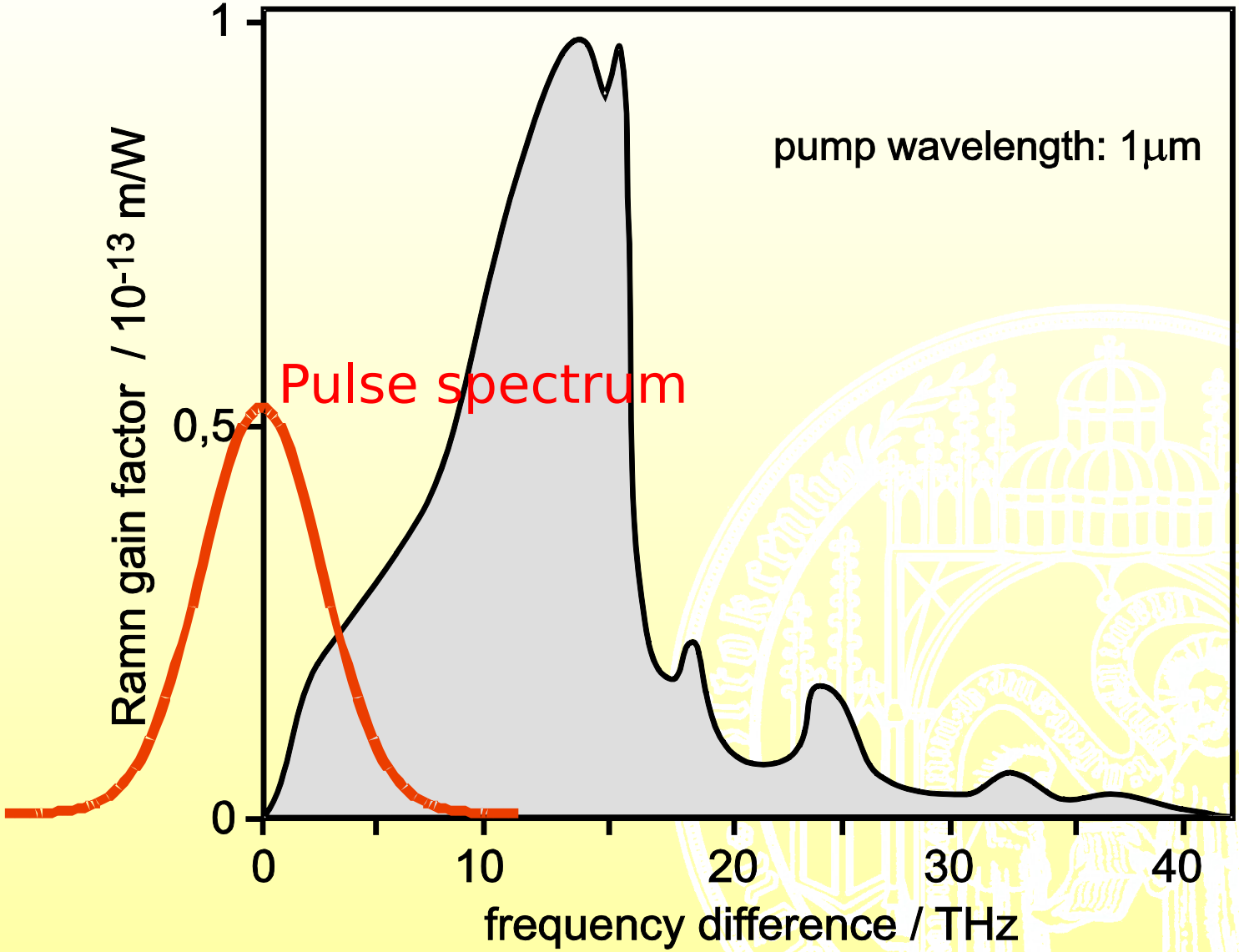


Interaction between two solitons initially separated by σ_{in}



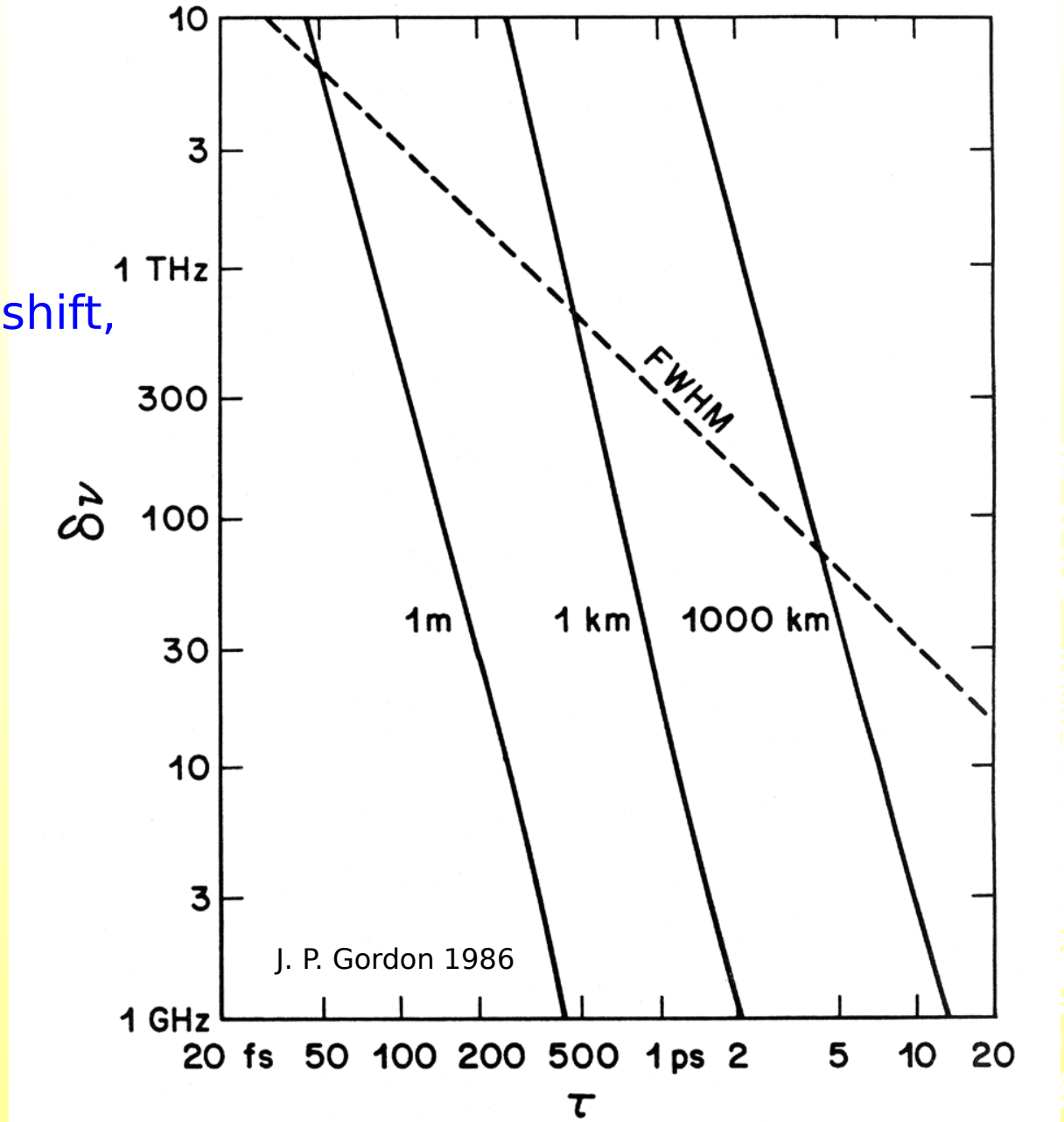
soliton self frequency shift

FM, Mollenauer 1986



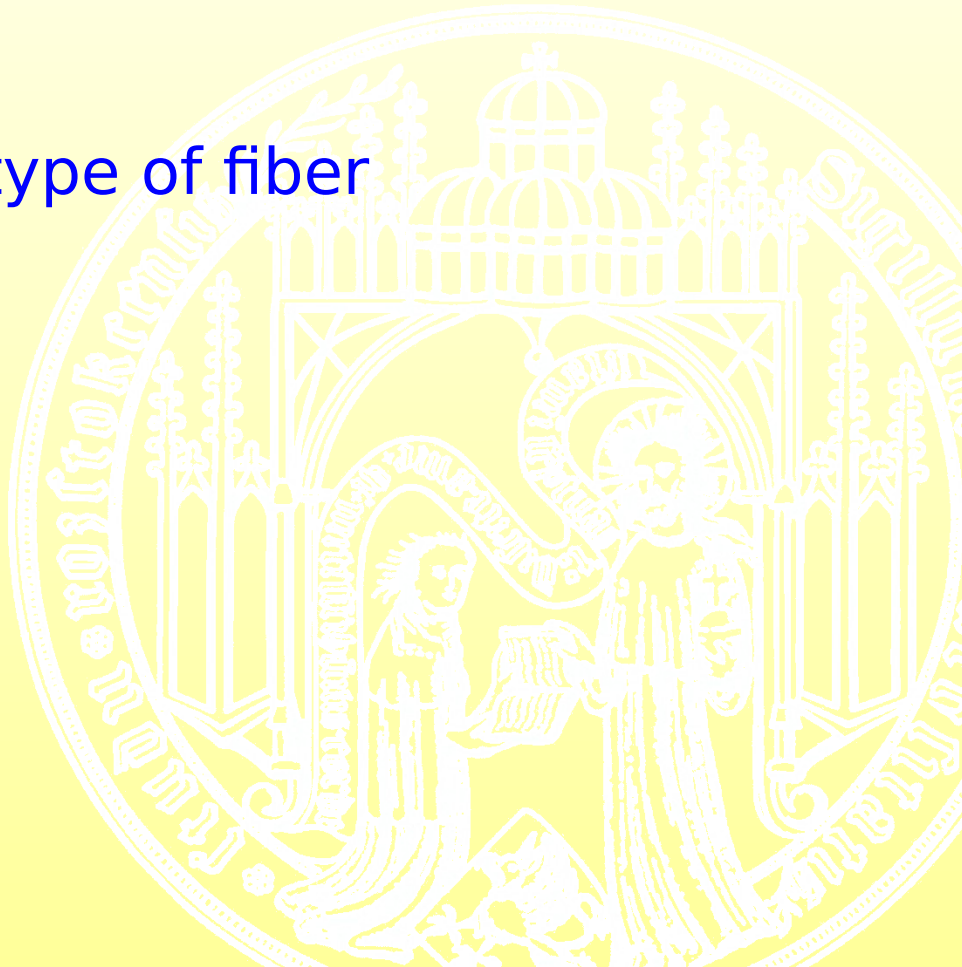
Reminder: frequency response of Raman gain in optical fiber

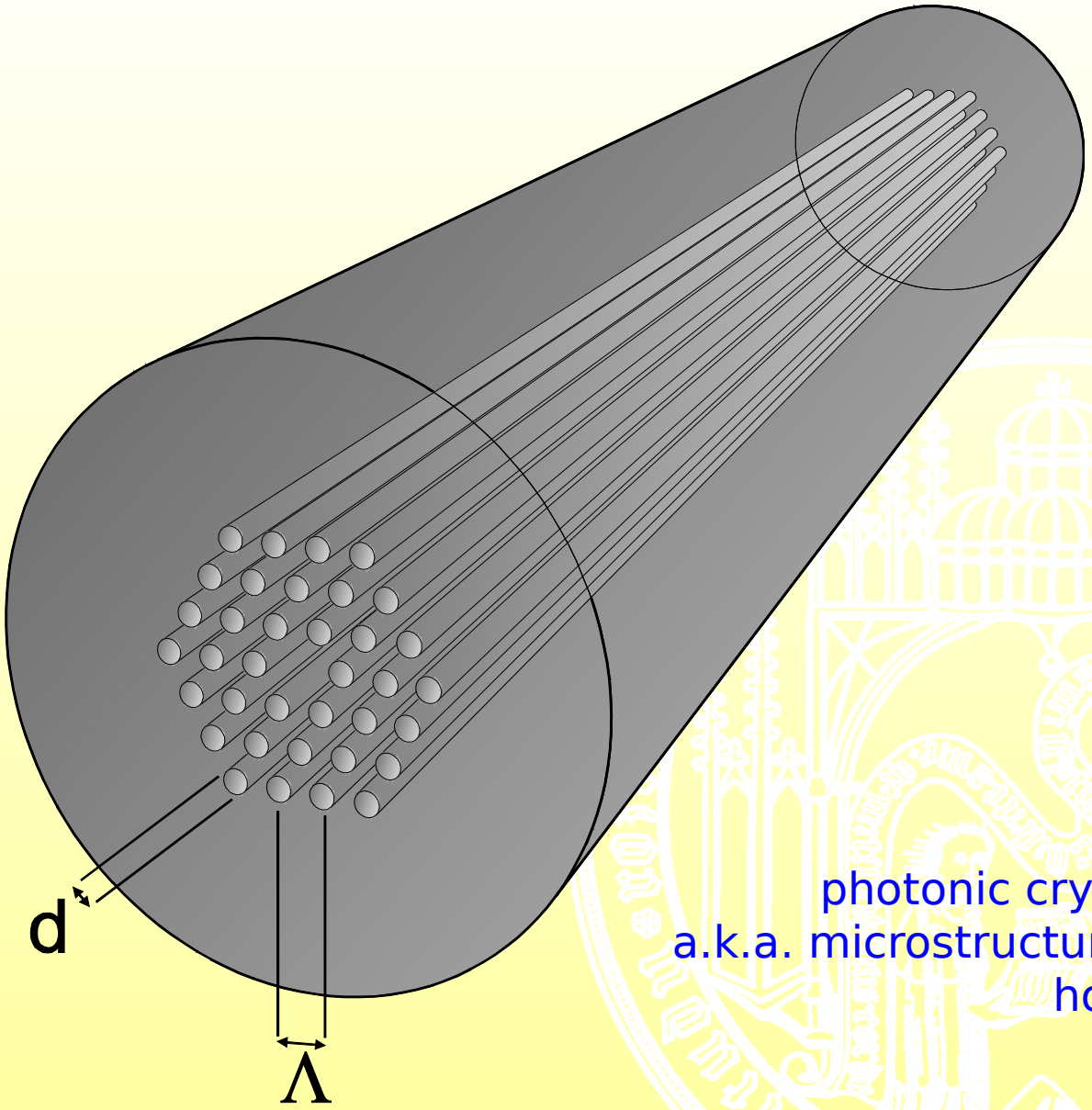
soliton self frquency shift, quantitatively



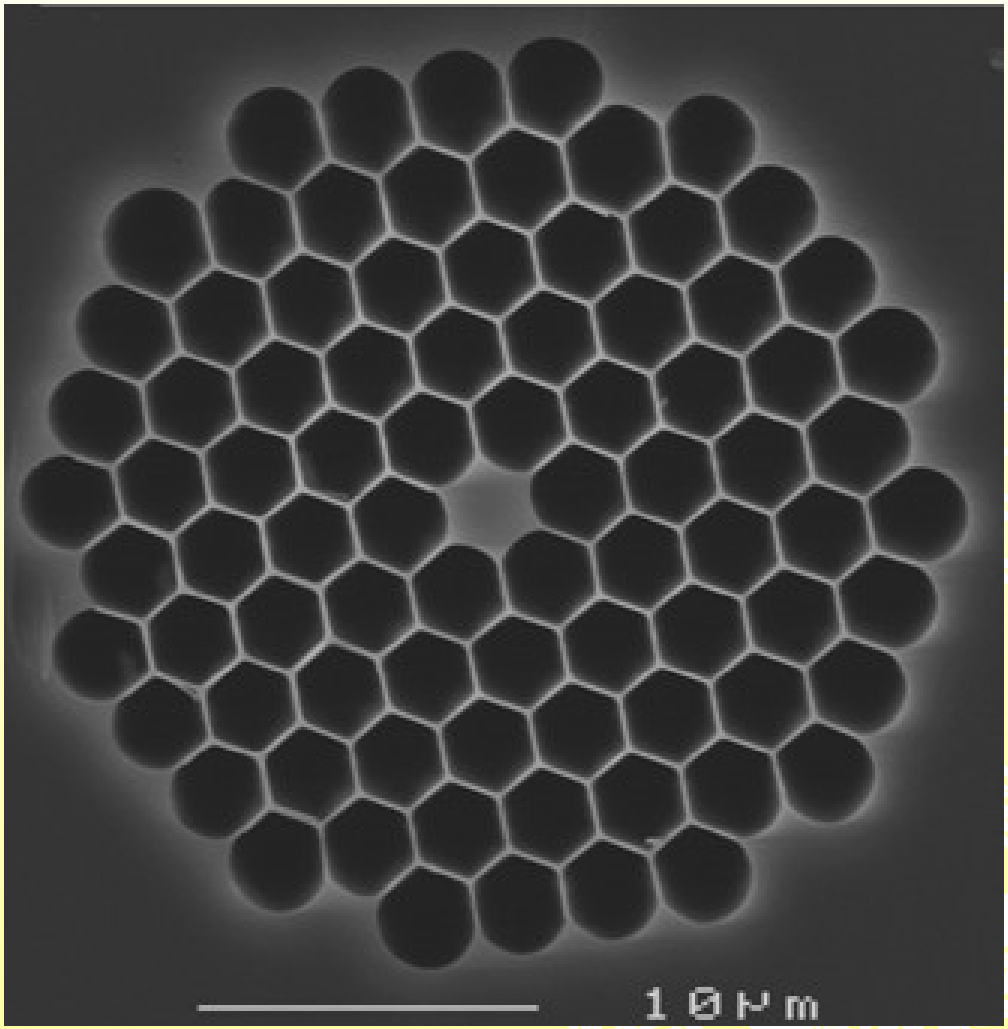
Now enter:

a radically different type of fiber

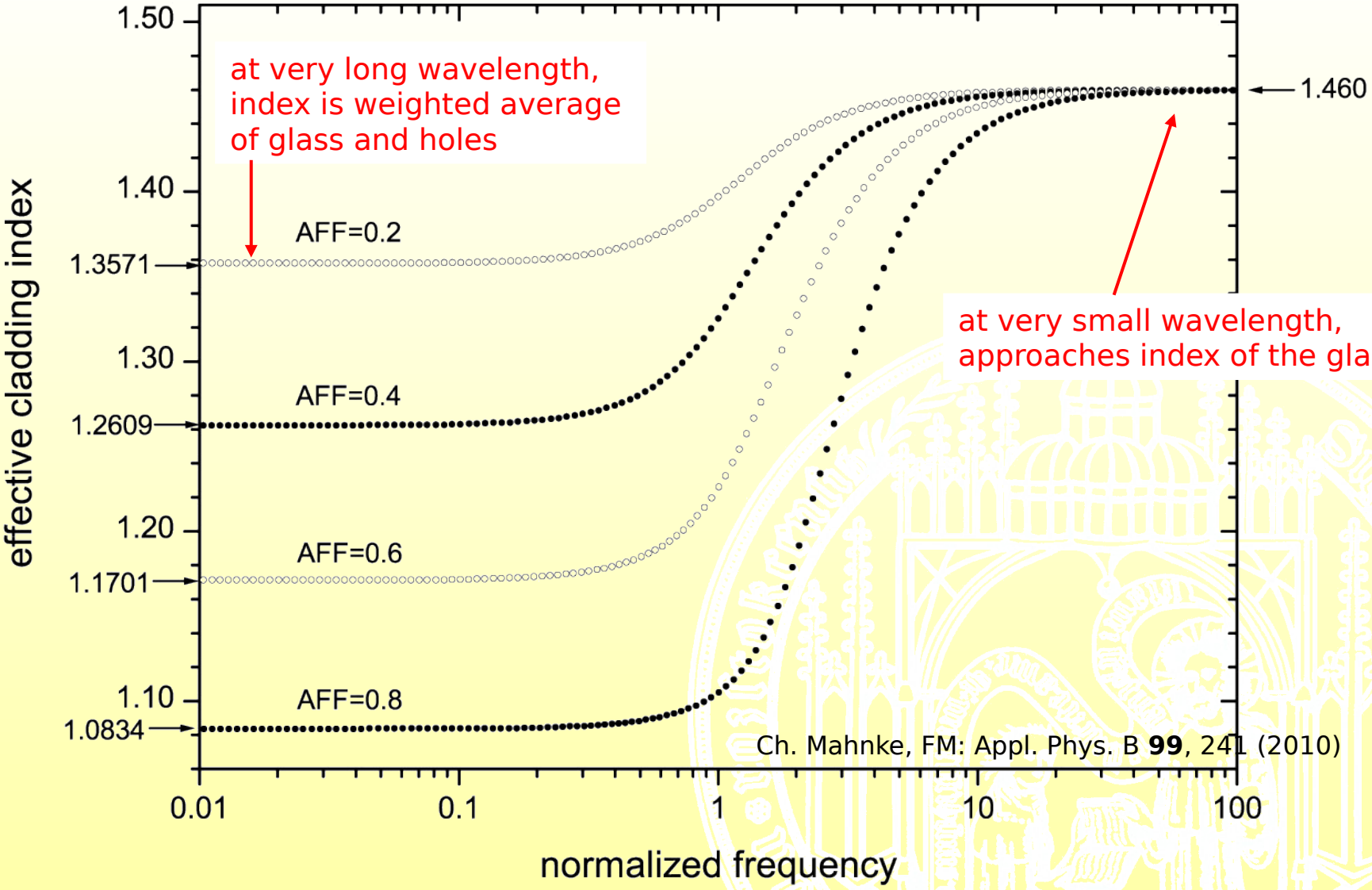




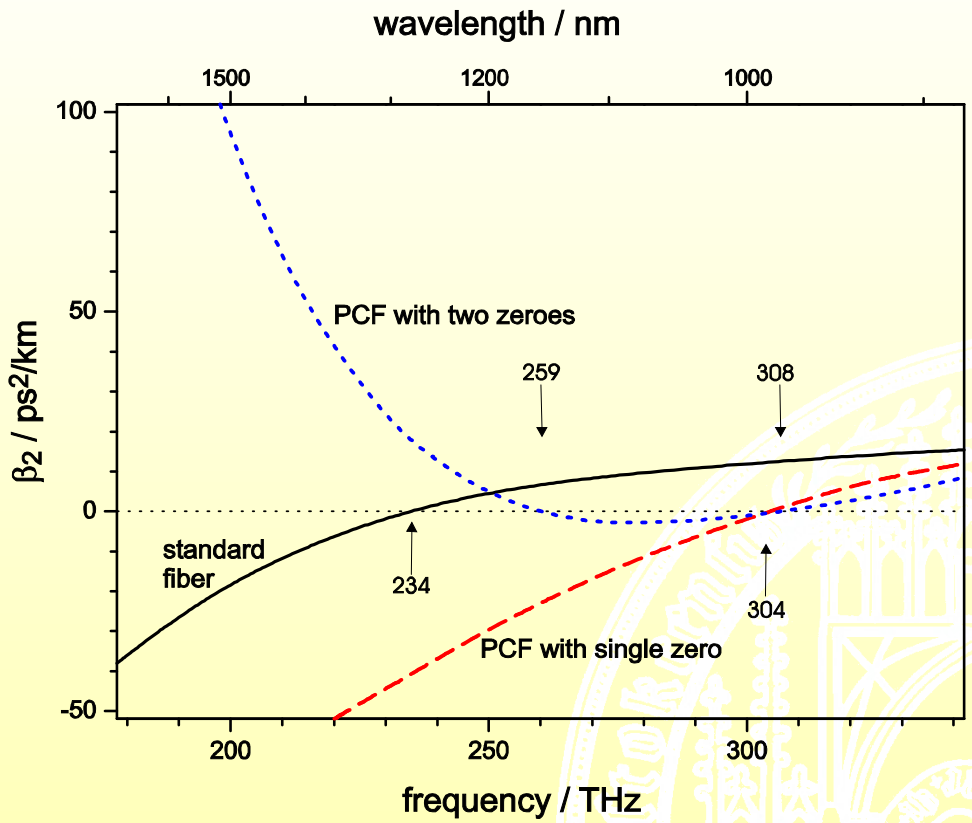
photonic crystal fiber
a.k.a. microstructured fiber,
holey fiber



PCF with massive core and „holey“ cladding



Calculated effective cladding index of holey fiber over a wide frequency range
AFF: air fill fraction



In PCF, the dispersion curve can be tailored within much wider range than in conventional fiber