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Fiber-array-based detection scheme for single-shot pulse contrast characterization

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Outline

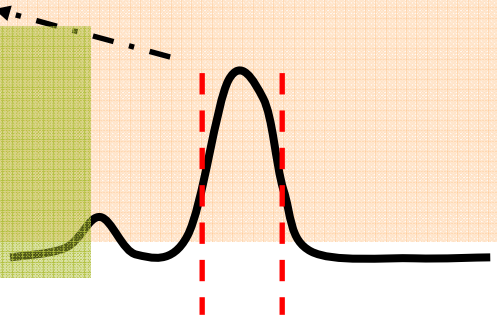
- Background
- The structure of our system
- Summary

Pulse contrast measurement

Time-Scanning: Repetition rate ⟶

- Repetitive pulses
- Dynamic range: ~10^{11}:1

- **Single-shot:**
- Dynamic range: 10^6~10^7:1
- Noise: Neutral density filter (NDF)



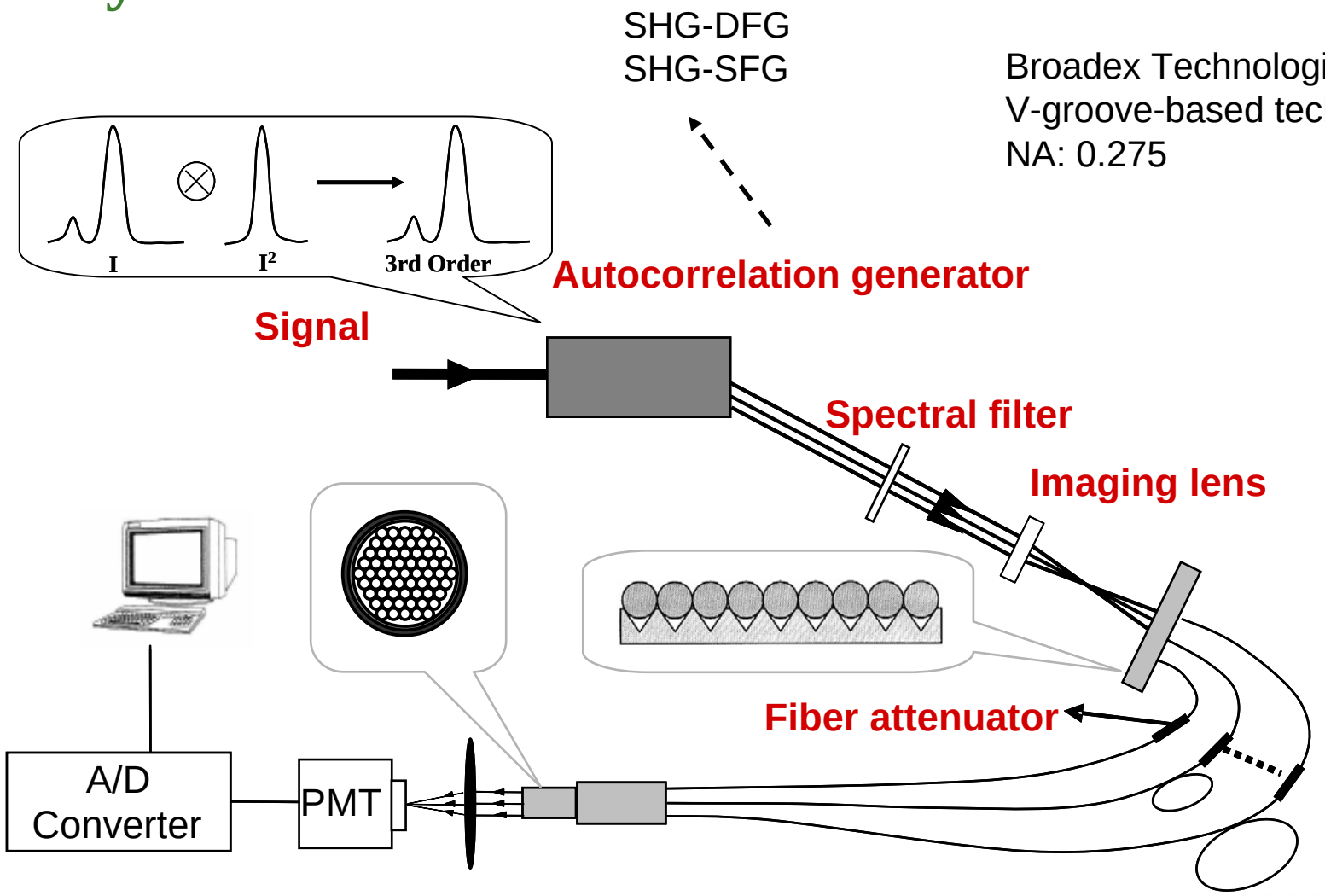
High-power laser system: low repetition rate

large shot-to-shot variations

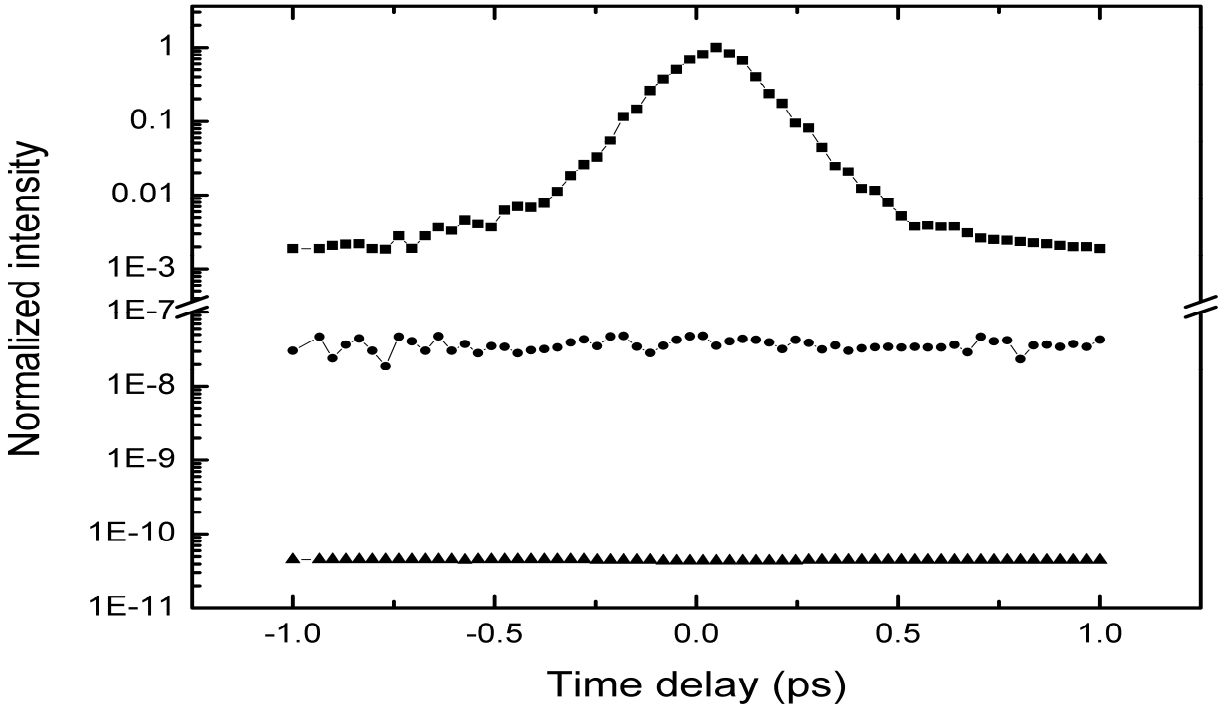
Pulse contrast is more important.

- ✓ P. Pax et al, **SPIE** (1990)
- ✓ V. Sirutkaitis et al, **J. Phys.** (1998)
- ✓ J. Collier **Laser Part. Beams** (2001)
- ✓ E. Divall et al, **OL** (2004)
- ✓ C. Dorrer et al, **OE** (2008)

Our system



- Fiber attenuator replace NDF (without noise)
- Parallel to serial

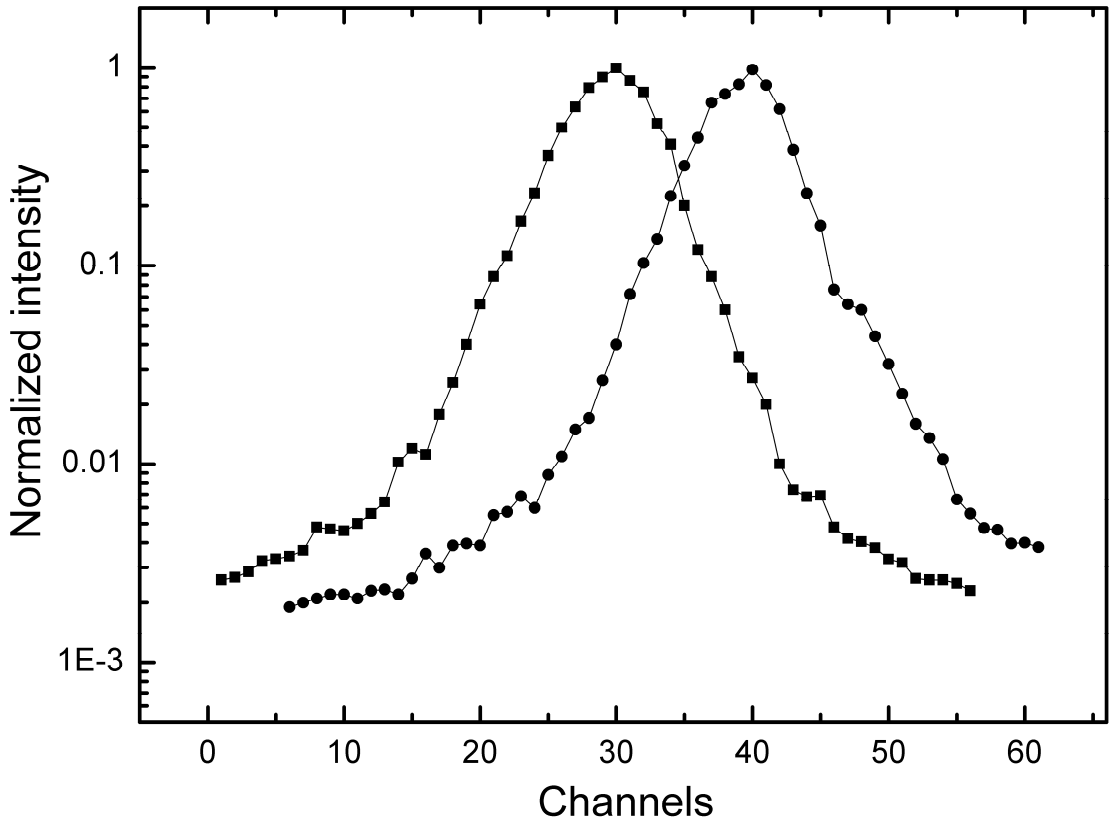


DFG (Degenerate)： ~ **2×10^7:1**

THG (Non-degenerate): Higher

Recent result (DFG): ~ 10^8:1 (50 μJ: high sensitivity)

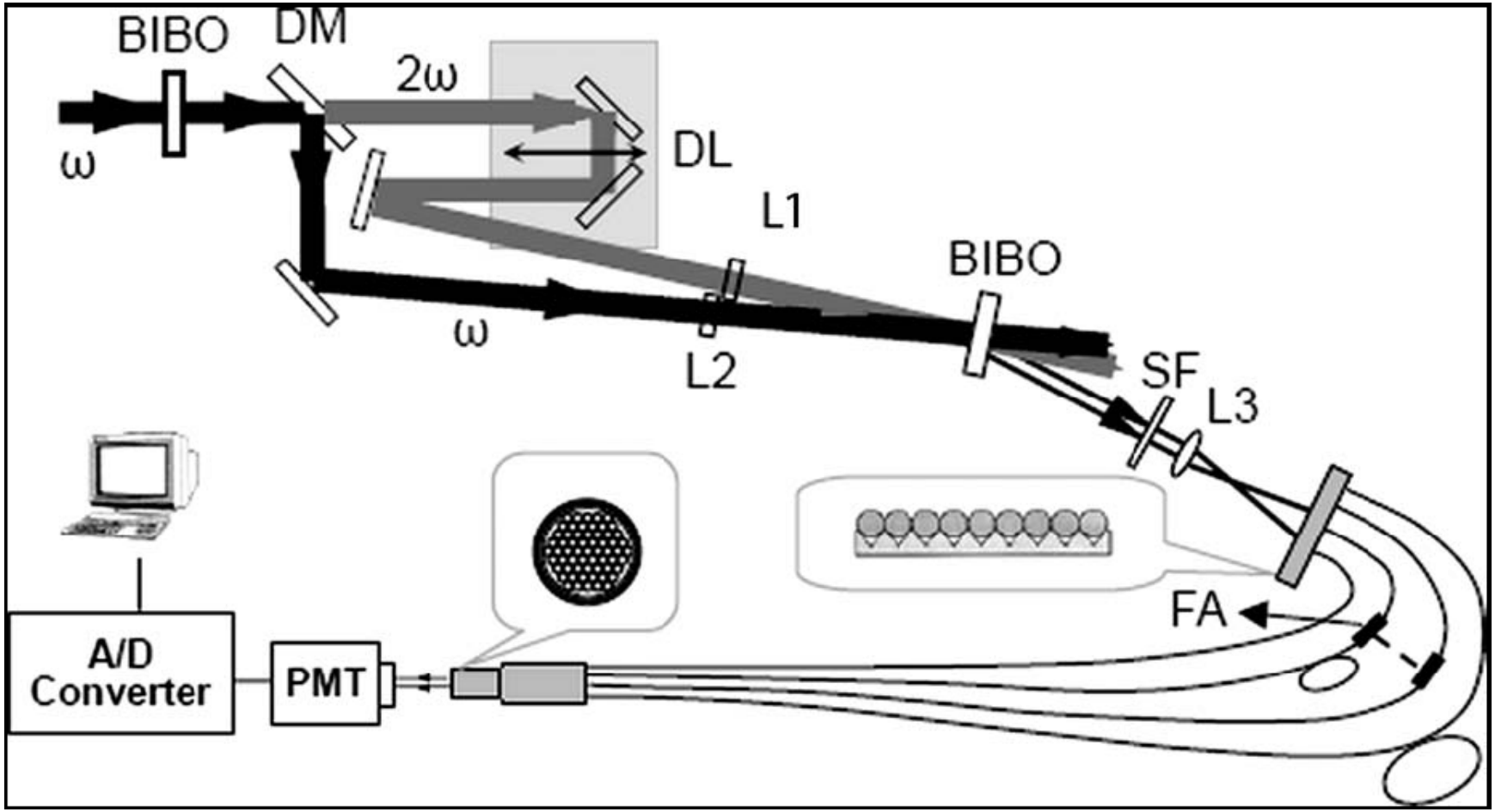
Zhang et al, Opt. Lett. 33, 1969 (2008)



The packaging uniformity and alignment of the proximal ends of the fibers

Translate the fiber array transversely by ten channels

The consistency of the two traces clearly manifests the satisfactory uniformity of the fiber array and the shot-to-shot stability of the laser source as well.



Zhang et al, Opt. Lett. 33, 1969 (2008)

Summary

- Advantage:
  - single-shot, high sensitivity, high dynamic rang
- Fiber:
  - Parallel to serial mapping: PMT (Low-noise high-sensitivity detector)
  - Similar to Time-scanning mode except for pulse averaging
  - Spatial filter
- Fiber attenuator:
  - This eliminates the external NDF and the introduced Noise

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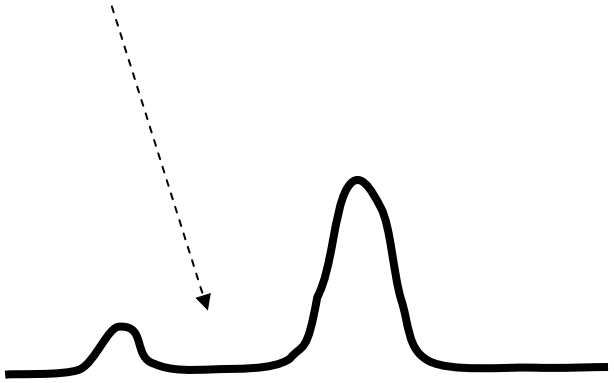
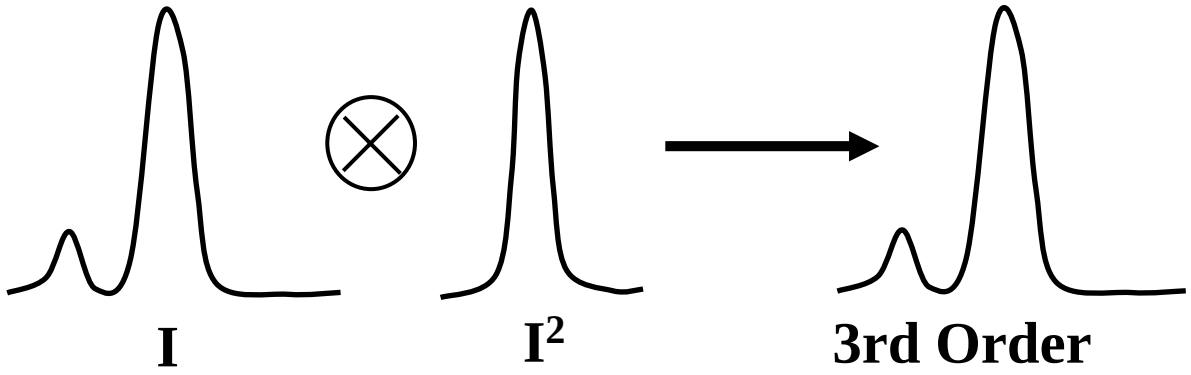
Thank you !



- **Parameters**

- 400 μJ　SHG-DFG : 2×10^{7}:1　Ti: sapphire: 800nm
- 50 μJ　SHG-DFG : 10^{8}:1　OPA: 1054nm
- Widths of the interacting beams or pulse tilting.
- 1.5 ⟶ 7.5ns



Third-order autocorrelation

- **SHG-DFG**
- **SHG-SFG**