High-efficiency, broadly tunable, tandem optical parametric oscillators

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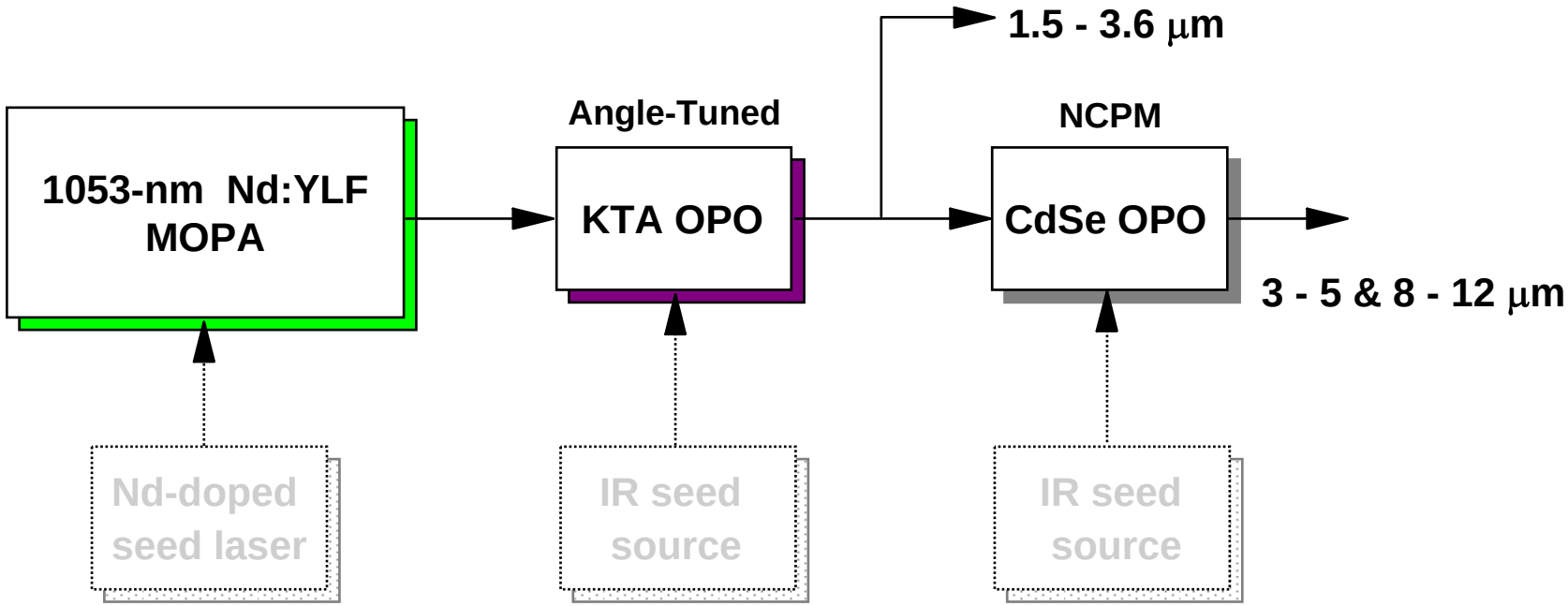
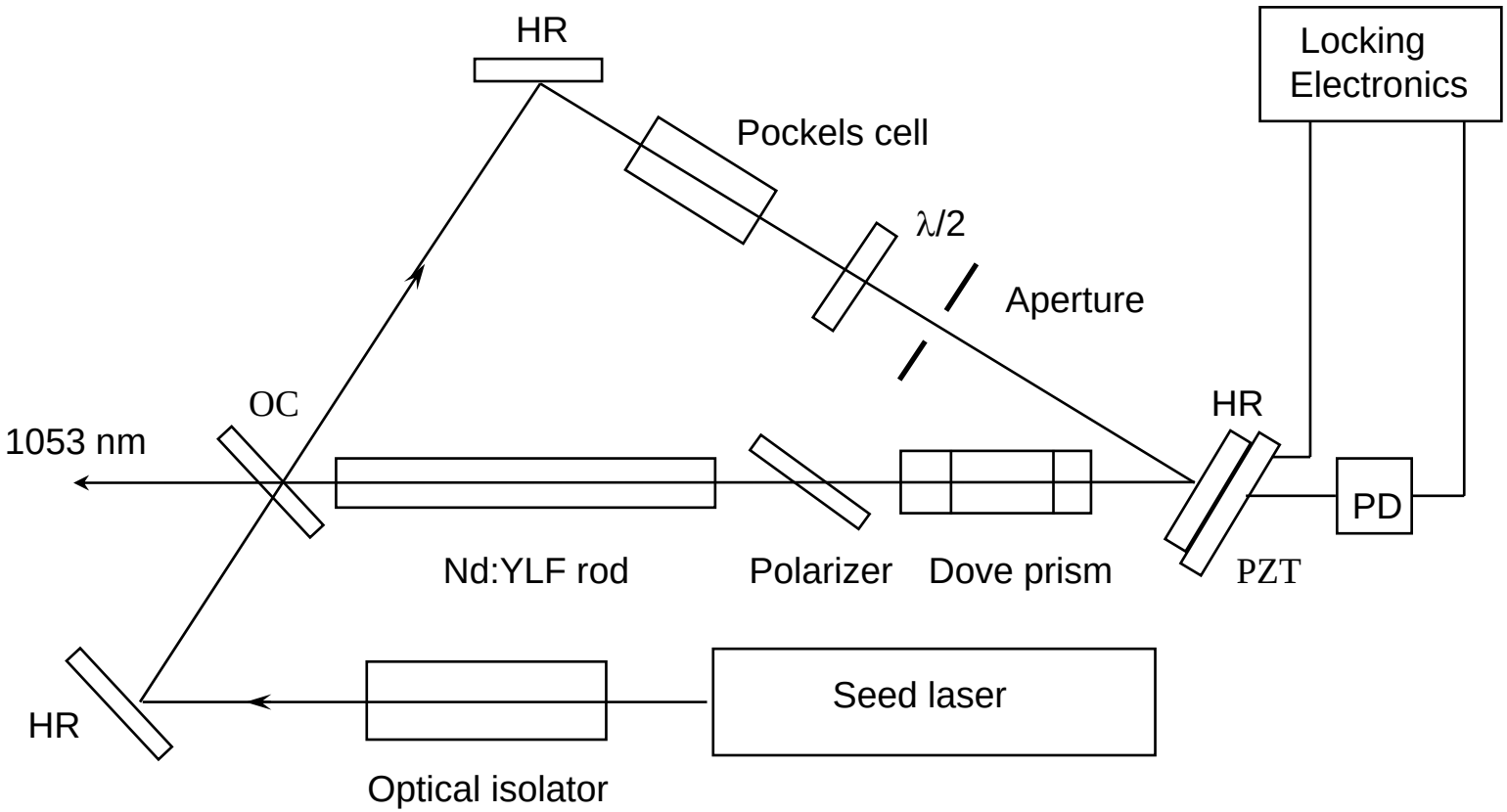
Outline

- Experimental layout of the 1-μm Nd:YLF pump laser
- Simultaneous difference-frequency and parametric generation in the KTA OPO
- Injection-seeding of single-frequency radiation
- 4-kHz-repetition-rate Tandem OPO
- Summary

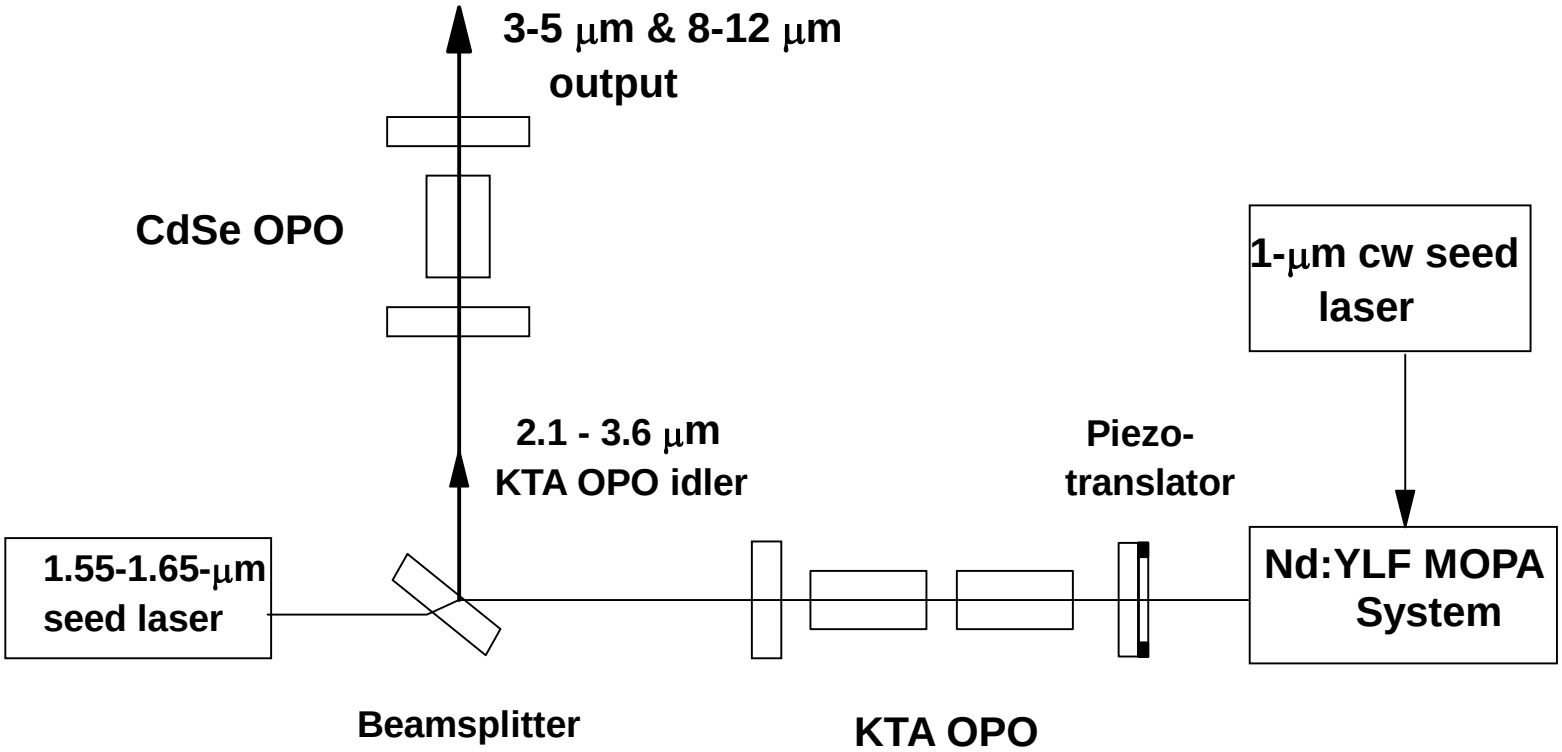
Tandem OPO design



Q-switched Nd:YLF ring laser with image rotation and injection locking

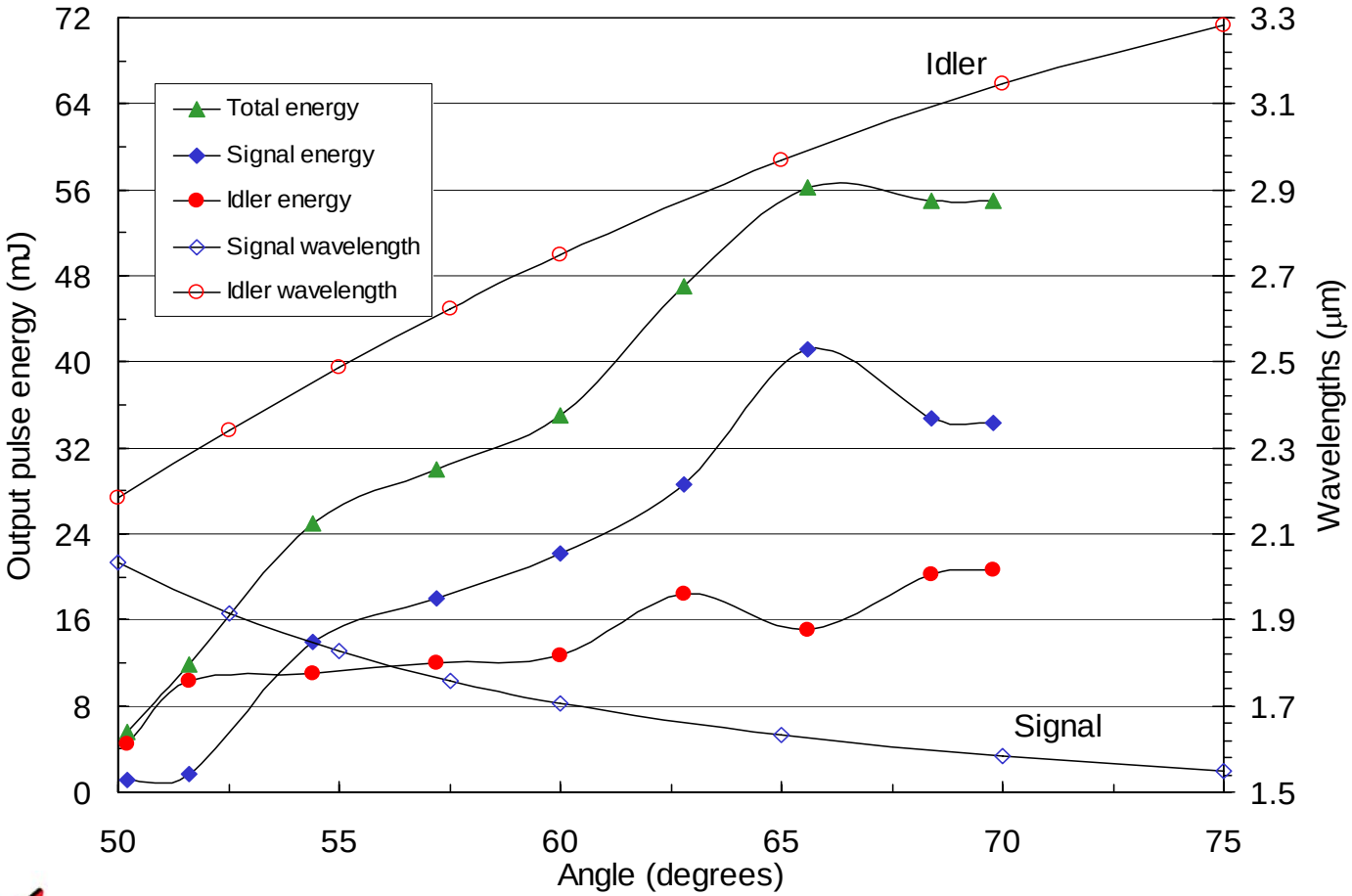


Seeded Tandem OPO experimental setup

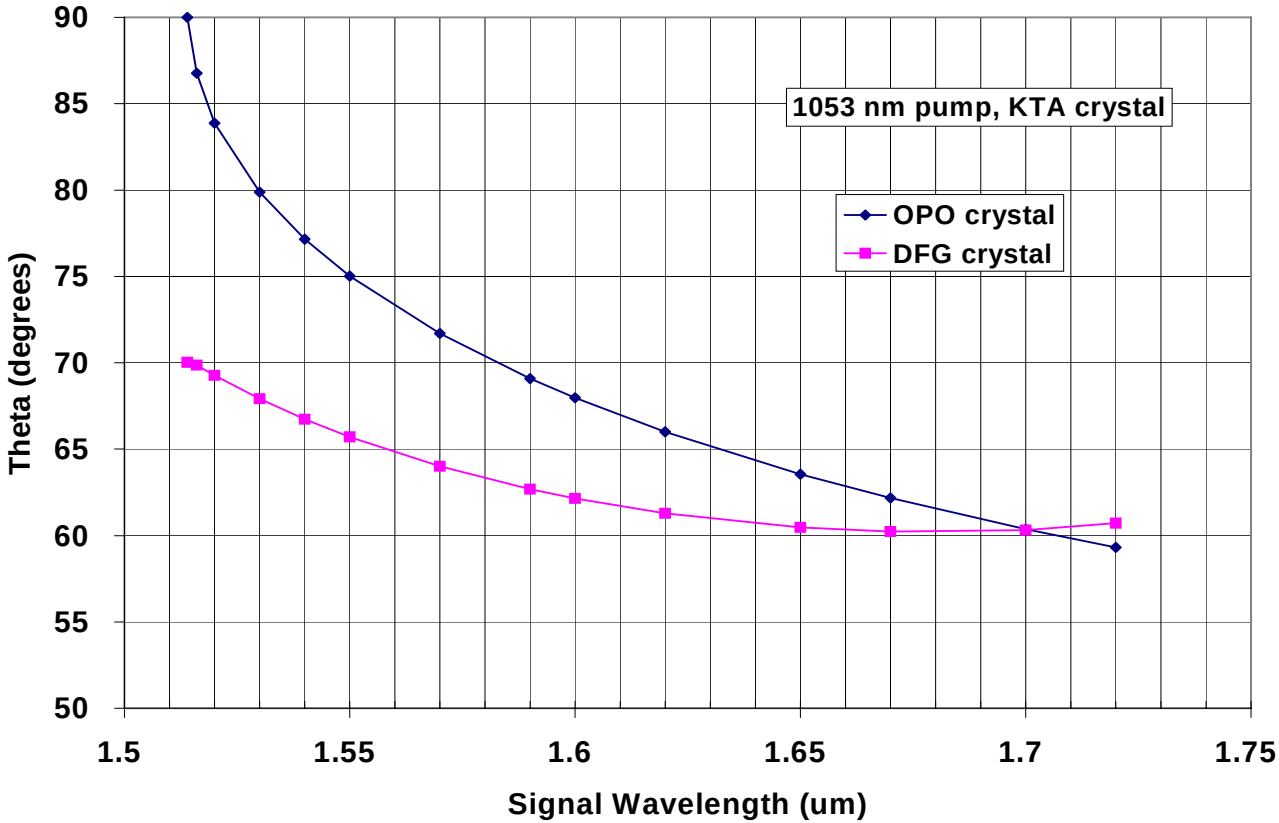


KTA OPO wavelengths and output energies at 200-mJ pump

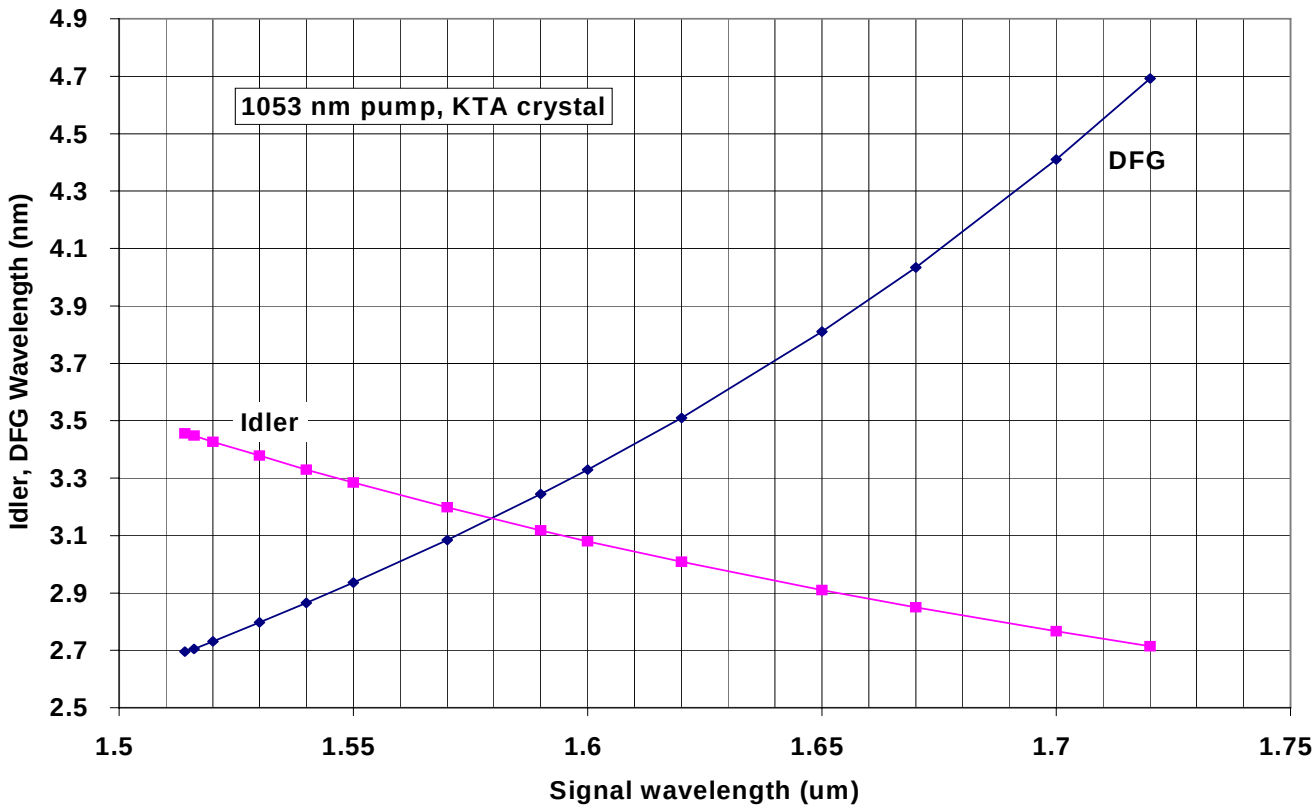
Signal range 1573 - 2066 nm
Idler range 2167 - 3184 nm



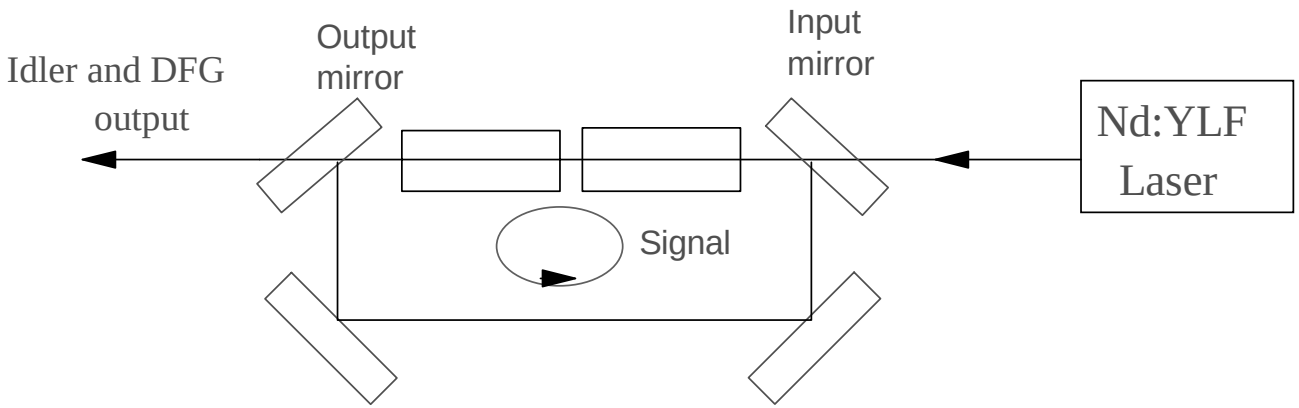
Phase-Matching Angles of OPO and DF crystals



Idler and DFG wavelengths vs signal wavelengths



Layout of the OPO - DFG Experiment



2-xtal KTA OPO-DFG

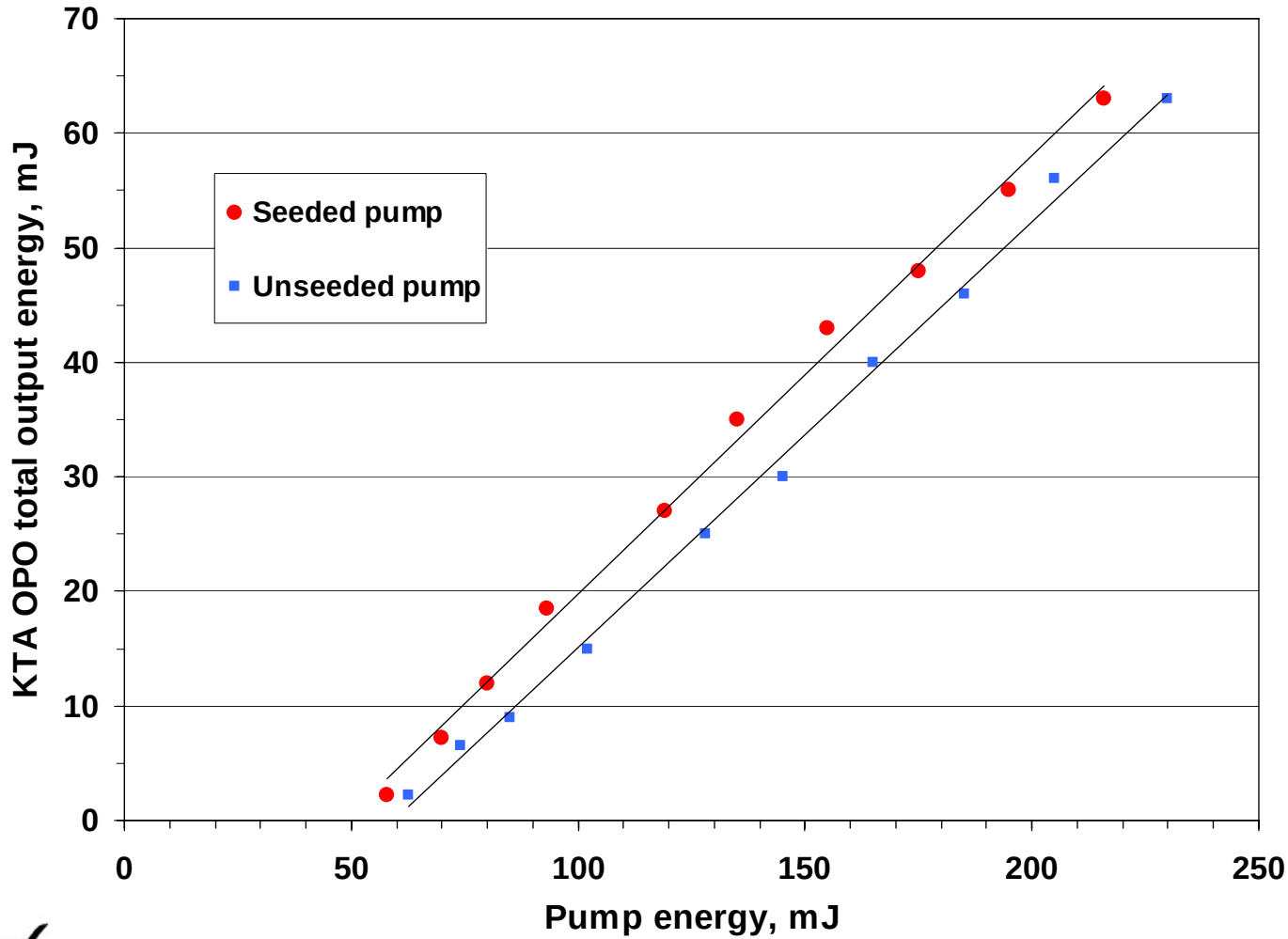
Idler pulse energy w/t DFG: 12.5 mJ

@ Degenerate Angle $\Theta = 61^0$

Idler and DFG pulse energies: 15 mJ and 1.25 mJ, respectively.

Signal wavelength	*1688 nm*
DFG wavelength	*2800 nm*
Idler wavelength	*4255 nm*

KTA OPO Pumped by seeded and unseeded MOPA

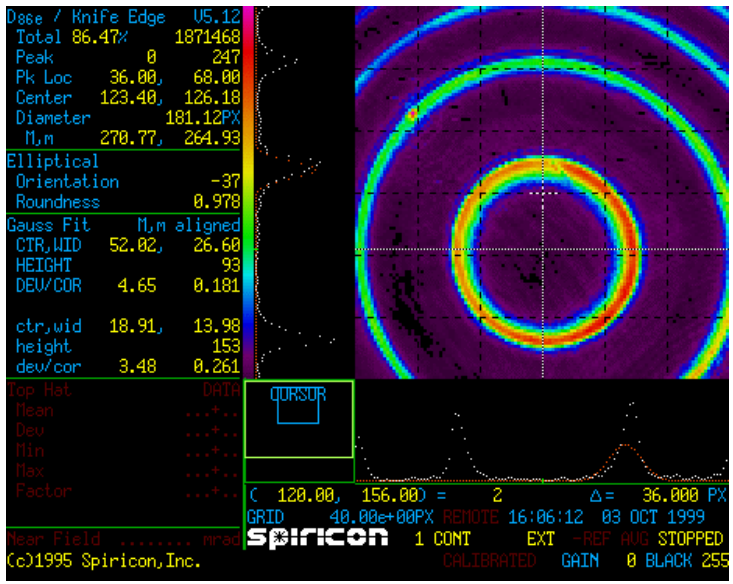


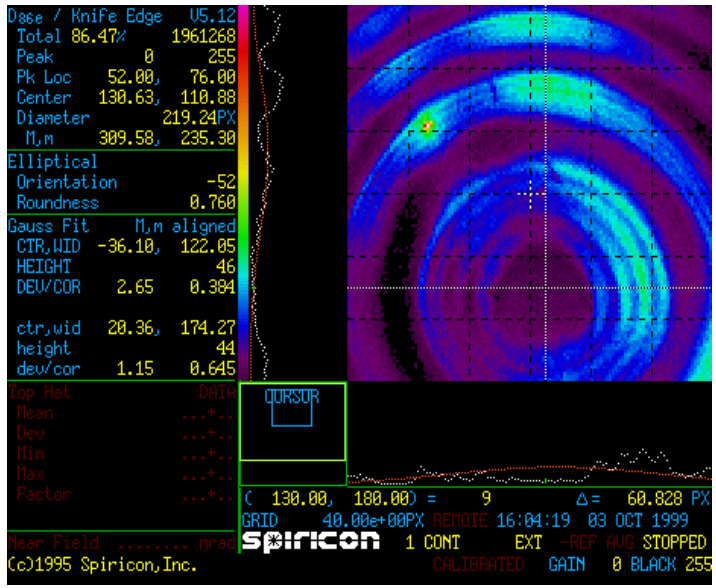
Inteferograms of the KTA OPO signal beam

KTA OPO cavity mode spacing 3.75 GHz
Signal 1557.68 nm
Idler 3250.24 nm

Fabry-Perot interferometer:

Resolution	**0.75 GHz**
Free Spectral Range	**21.5 GHz**

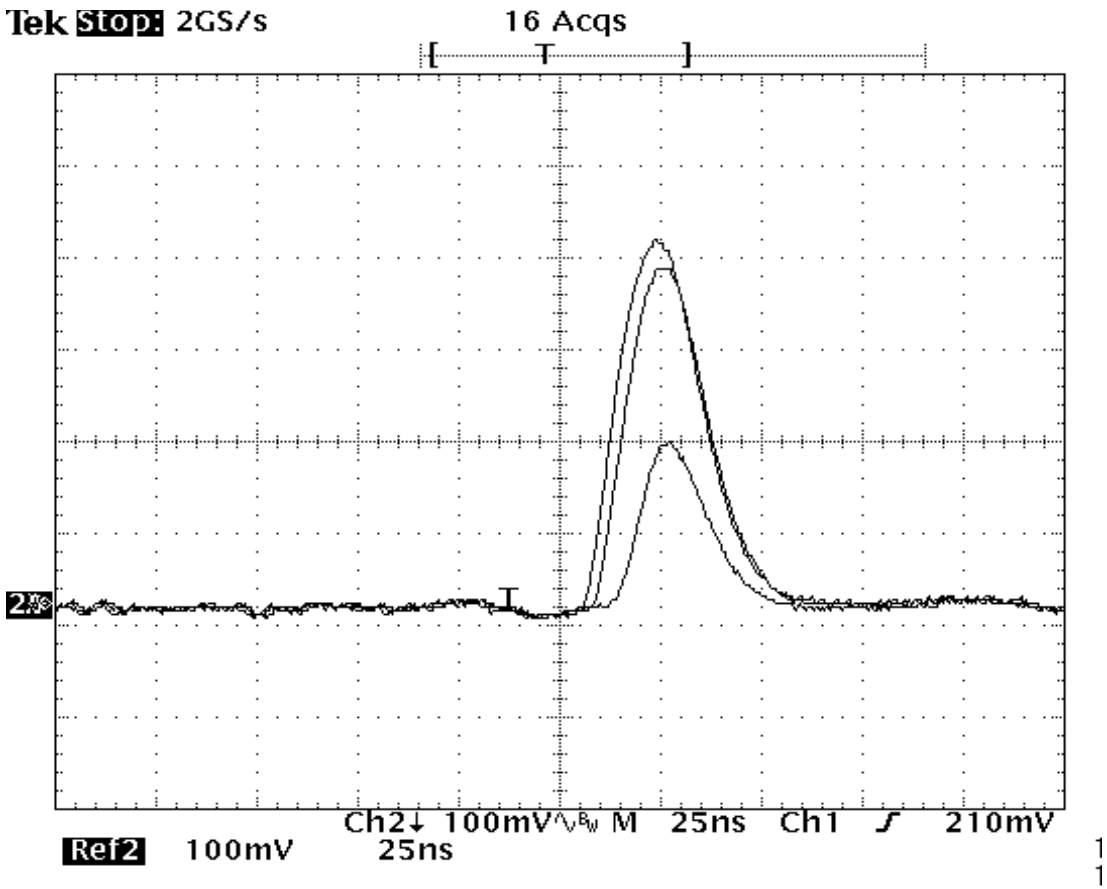




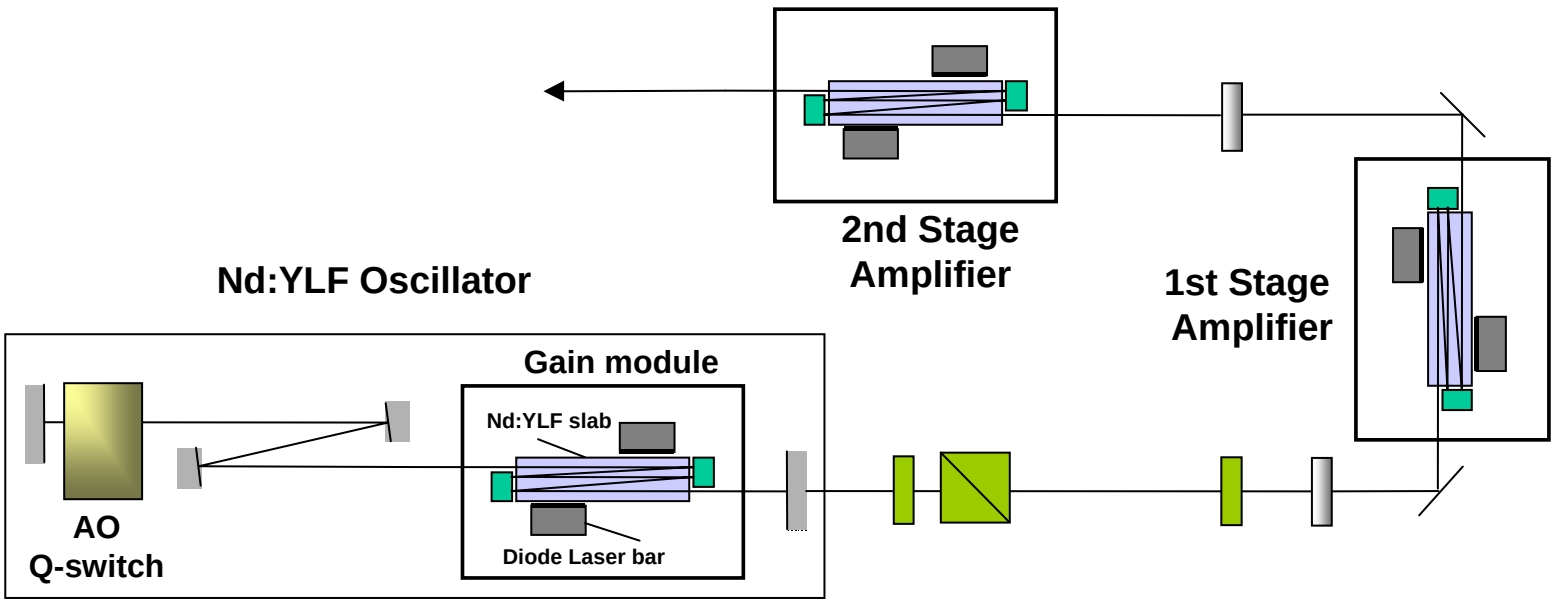
KTA OPO seeded
$\delta\nu$ < 0.75 GHz

KTA OPO unseeded
$\delta\nu$ ~ 10 GHz

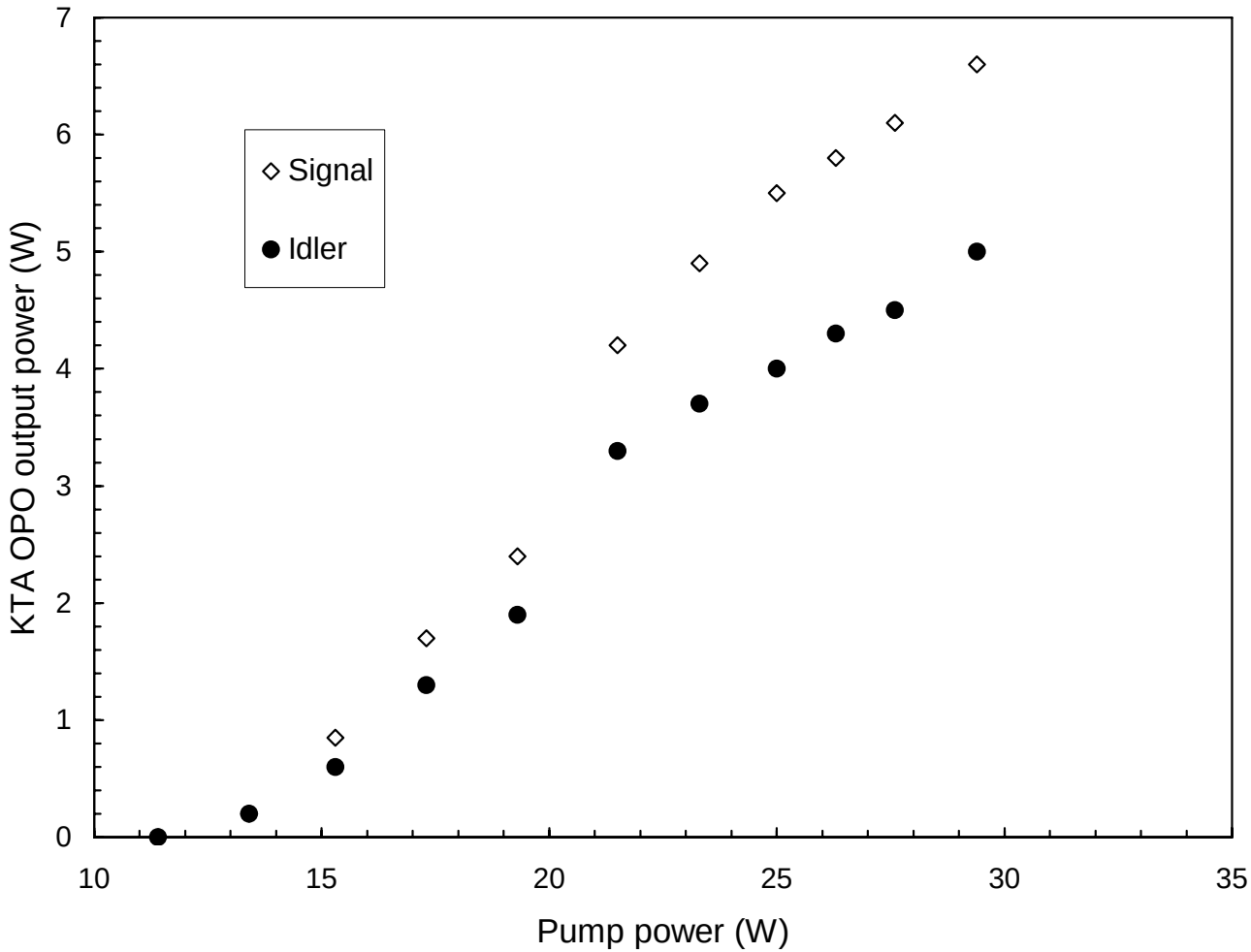
Oscilloscope traces of idler output pulses



4 kHz Diode-Pumped Nd:YLF MOPA design



KTA OPO output vs 1-μ pump power at 4 kHz PRF



Summary

- We have demonstrated a single-frequency, broadly tunable OPO source.
- Difference-frequency generation between the KTA signal and idler provided a 20% increase of the idler.
- Injection seeding of the laser source provided a 10% increase of the OPO efficiency.
- A 50% enhancement was achieved when the pump wavelength was resonant for the OPO cavity.
- We have demonstrated a highest-pulse-rate CdSe OPO ever operated.