High-average-power Picosecond Drive Source For Photocathode Injectors

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Achieving High Repetition Rate

High Gain and Short Lifetime are required:
=> Nd:YVO_4 master oscillator and Nd:YVO_4 MOPA ???

Nd:YVO_4 material for the amplifiers:

- Limited size of high-quality crystals
- Large dn/dT:
  - strong, aberrated thermal lensing
  - difficulty with power scaling by adding amplifiers

$\Rightarrow$ *challenges in scaling up to high powers*

- Natural birefringence
  - no depolarization in amplifiers

Our Preferred approach

Develop a frequency-doubled Nd:YVO4 MOPA system:

- Low-power (0.5-1 W), end-pumped, passively mode-locked laser as a master oscillator
- Nd:YVO_4 is a best suited material for high rep.rate mode-locked osc
  - Highest gain
- MO defines almost all critical parameters :
  - Repetition rate
  - Pulsewidth
  - Timing jitter
  - Wavelength
  - Beam pointing
- Power amplifier based on a number of MPV gain modules
- Amplifier chain defines:
  - Max average power
  - Beam quality
  - Beam pointing

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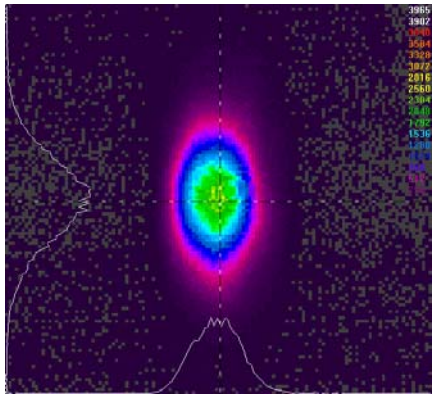
Nd:YVO_4 Master Oscillator (Time-Bandwidth AG)

Laser Model: GE-100-VAN-74.85/748.5-CLX

- Diode pumped solid state laser system
- Passively mode-locked by patented SESAM® technology of Time-Bandwidth Products AG
- Switchable repetition rates:
  - 74.85 MHz or 748.5 MHz
  - Active locking to an external RF source
  - Timing jitter < 400 fs rms.
- Wavelength: 1064 nm
- Output power: >950 mW
- Pulsewidth optionally increased to 30 ps ± 5 ps
- Diffraction limited beam
  - M^2 (X ≤ 1.1, Y ≤ 1.2)



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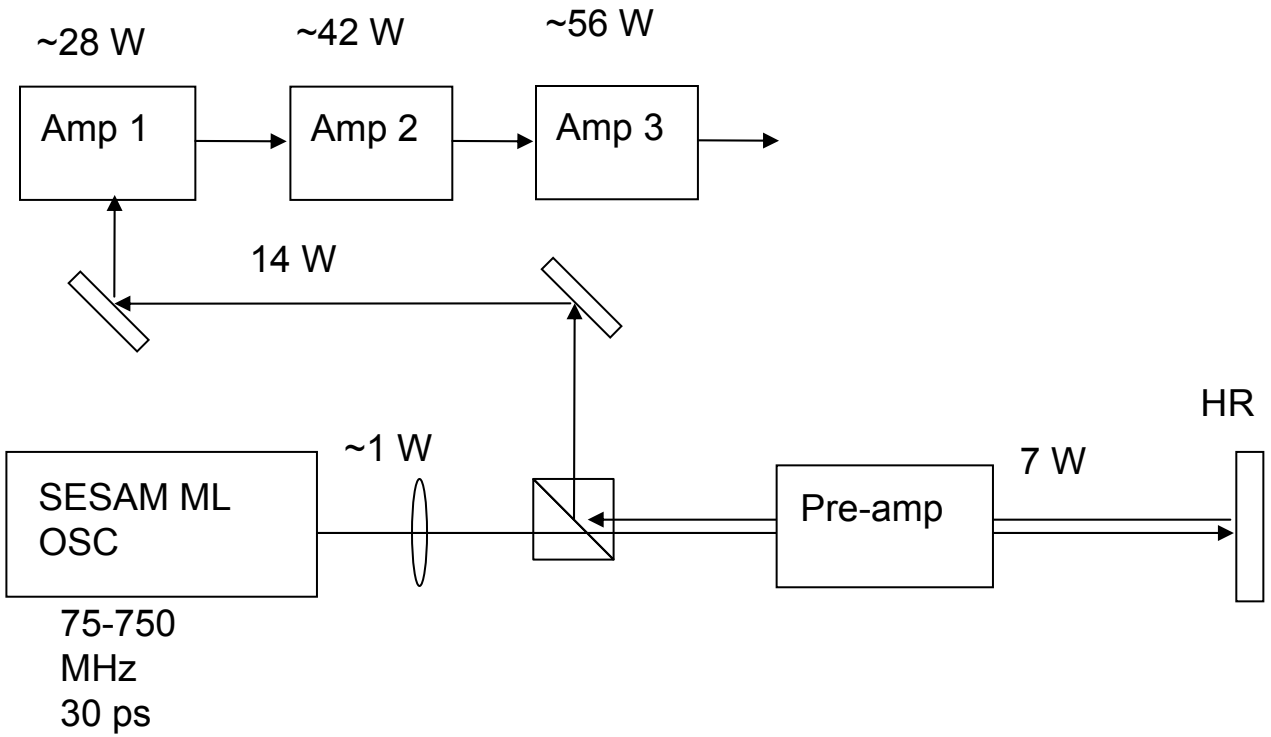
PS High-Repetition Rate Nd:YVO_4 MOPA



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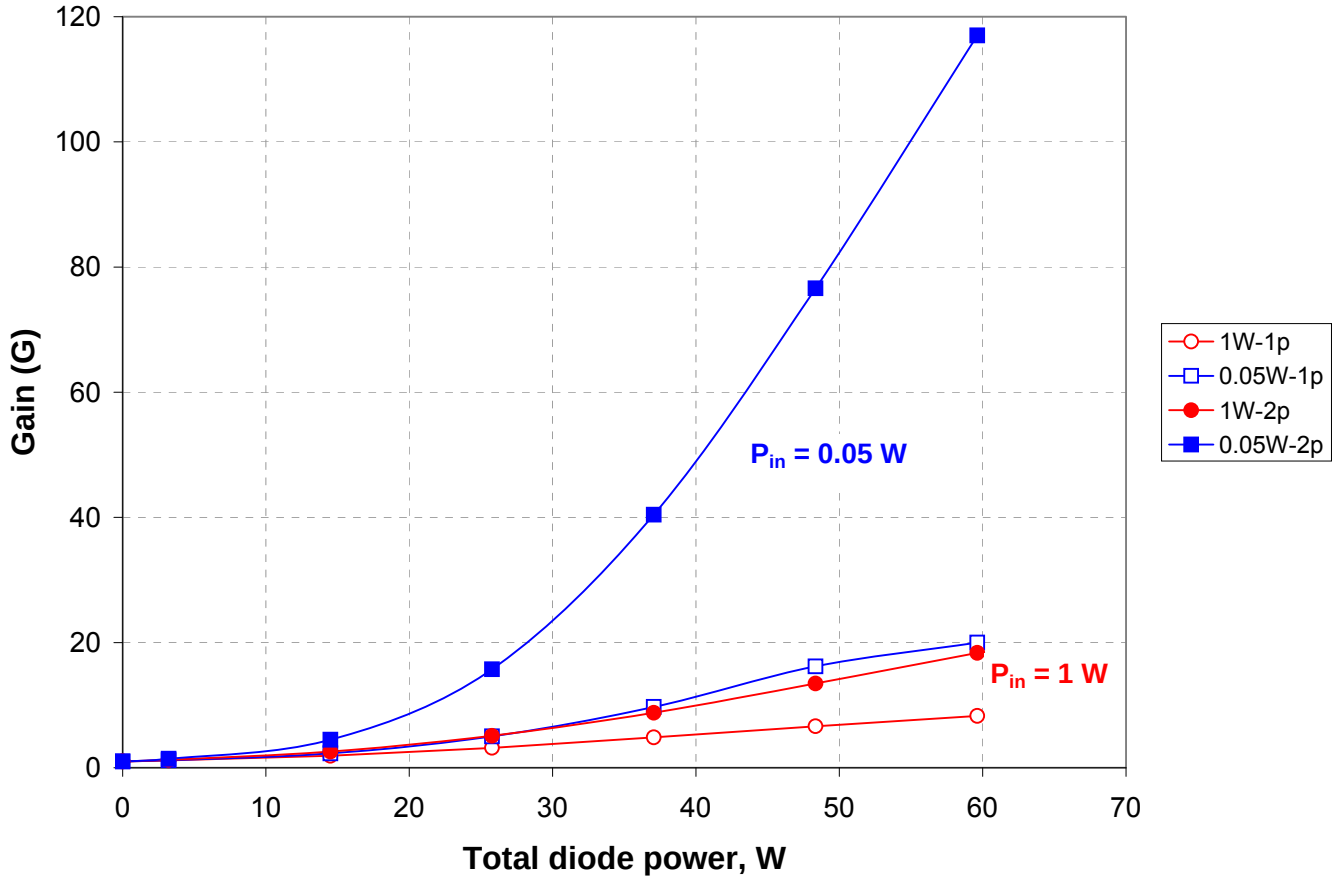
Pre-Amplifier Performance – 1- and 2-Pass Gain



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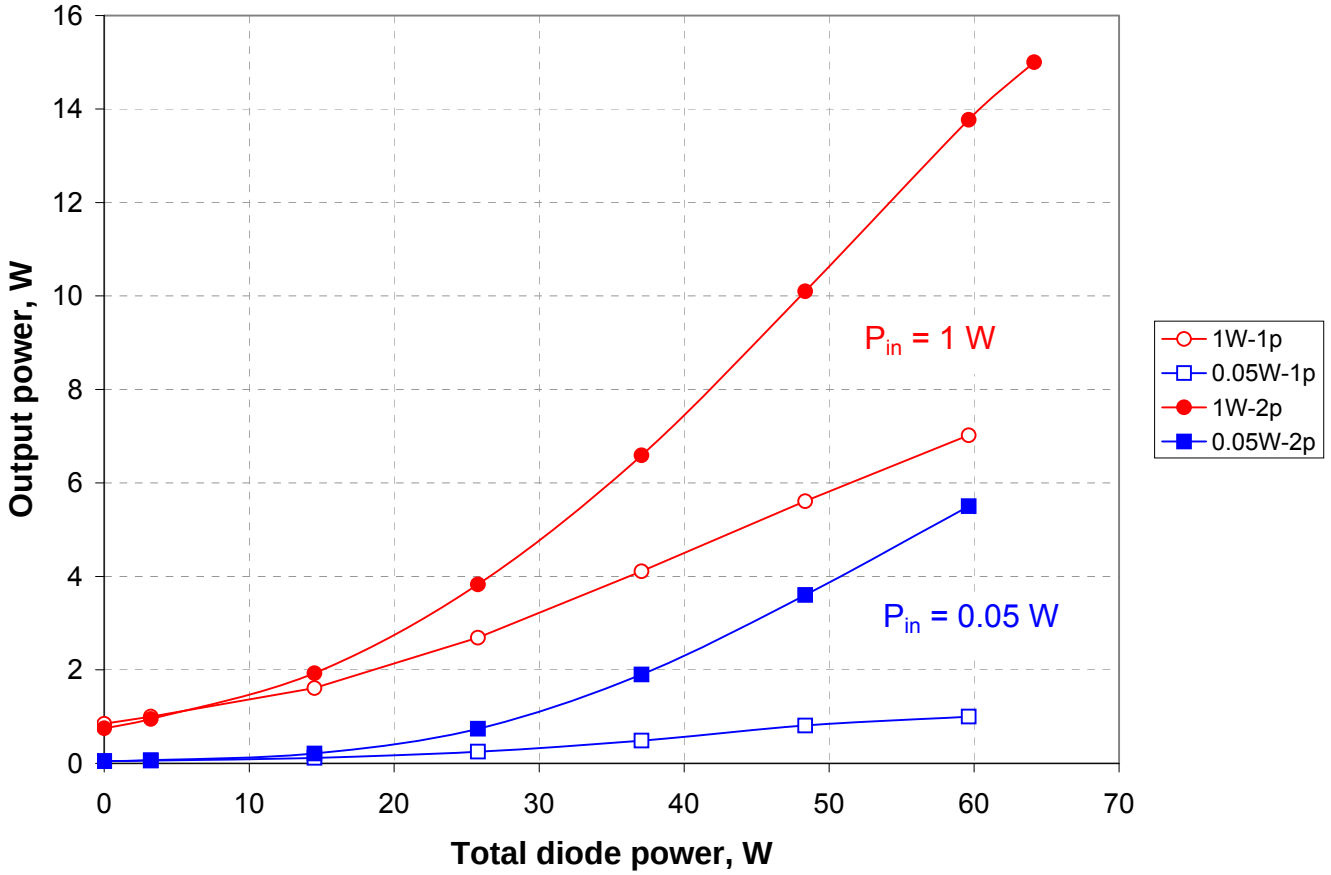
Pre-Amplifier Performance –1- and 2-Pass Power Output



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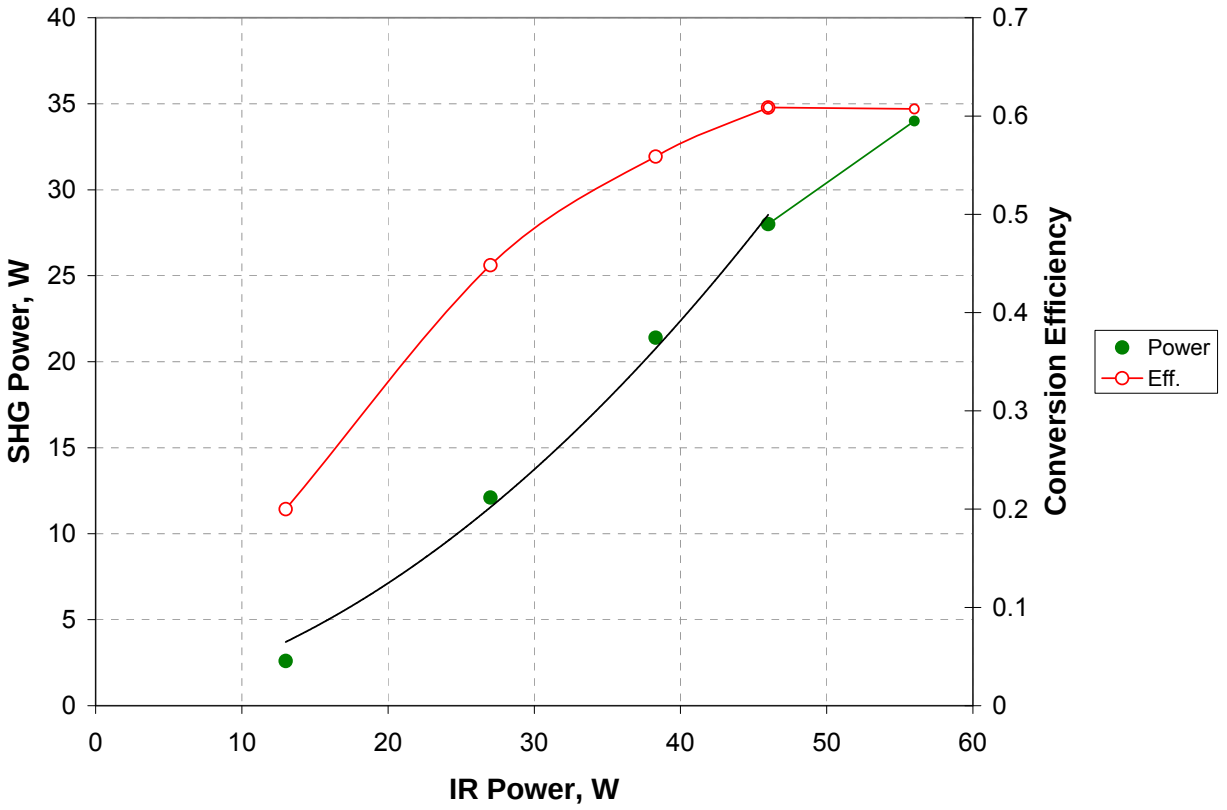
SHG in LBO

- ≤ 34 W at 532 nm
- ≥ 60% eff.
- 75 MHz
- TEM_{00}

- ≤ 10 W at 532 nm
- ≤ 18% eff.
- 750 MHz
- TEM_{00}



Typical performance at 75 MHz

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