



High power monolithic linearly polarized single-mode Yb-doped fiber laser

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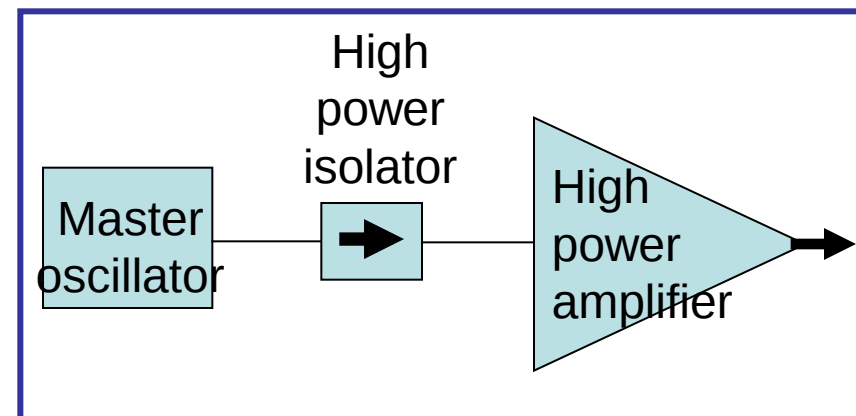
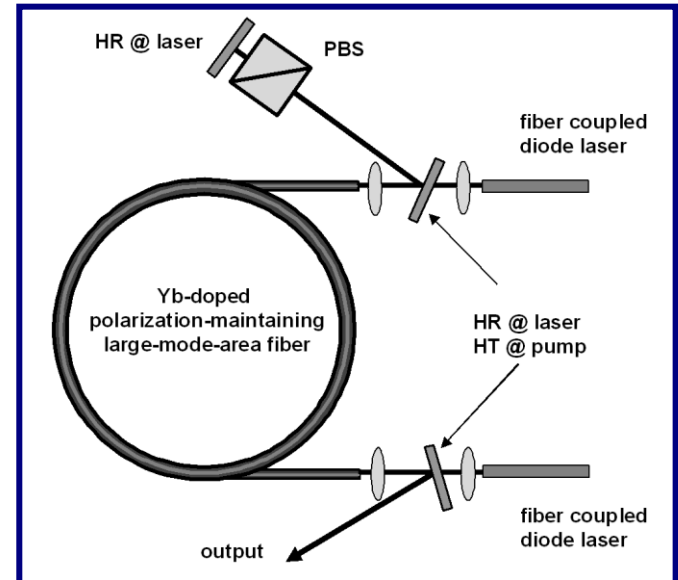
Outline

- Introduction
- Design
- Experimental results
- Summary



Introduction

- Applications for high-power linearly polarized SM fiber lasers:
 - Nonlinear frequency conversion
 - Beam combining
- Previous work:
 - Using external free-space polarizers (Jena)
 - MOPA (Southampton)





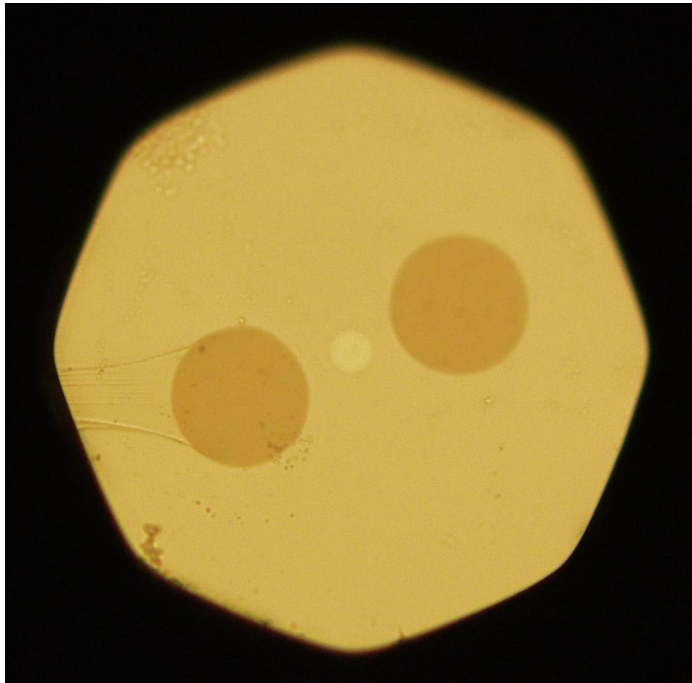
Design Features

- Monolithic linearly polarized
 - No external free-space polarizing components
 - Coiling of Hi-Bi fibers
- Fiber-Bragg grating stabilized wavelength
- Single transverse mode



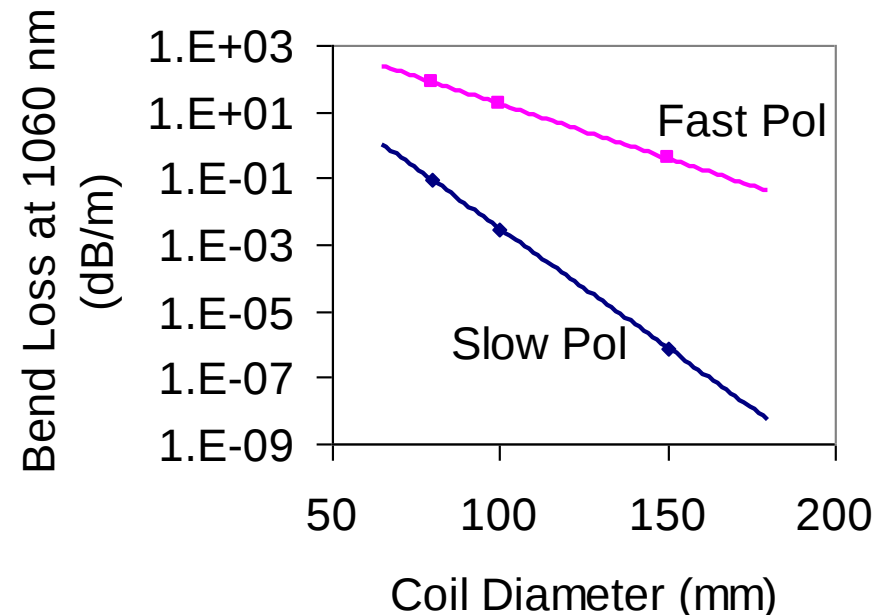
Coiling of Hi-Bi fibers

- 33m 20/400 μ m Yb fiber
- Core/clad-NA: 0.06/0.46
- High birefringence: 3×10^{-4}
- Coiling diameter: 7.5cm and 9cm



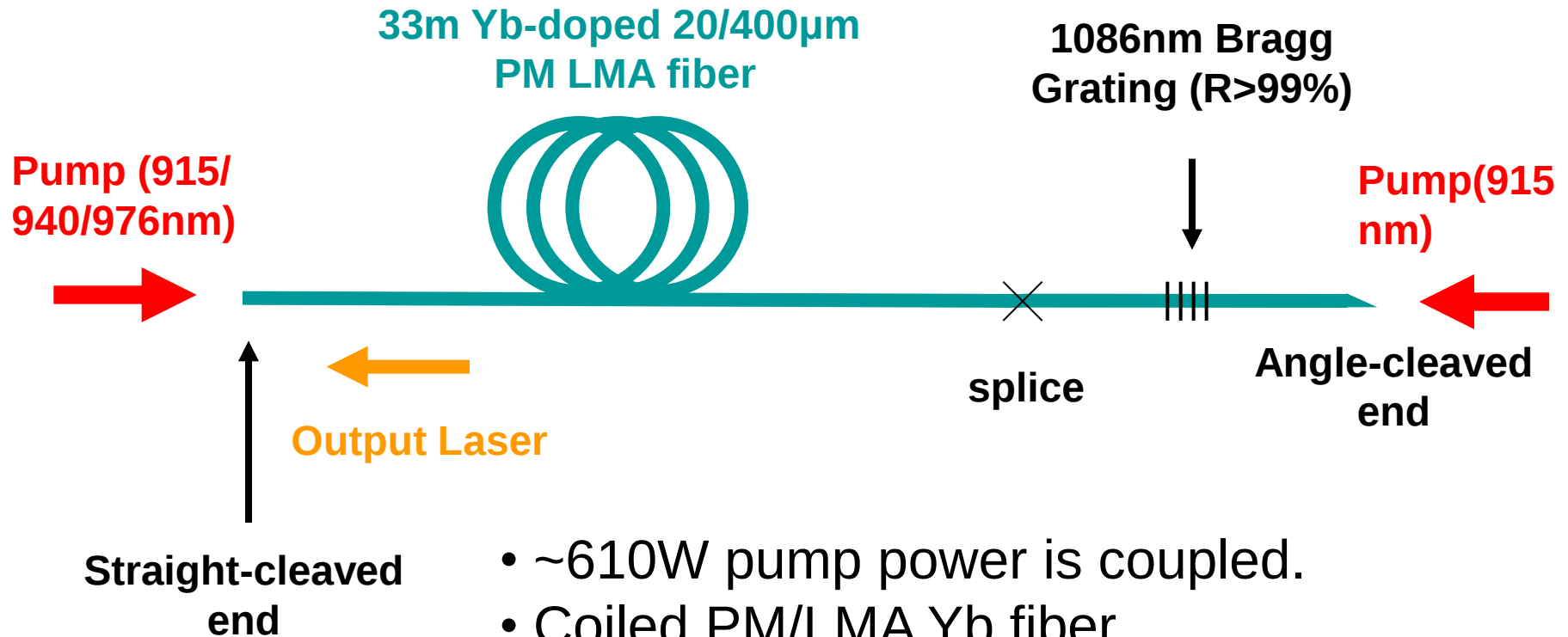
Polarizing coiling technique

- Separate slow and fast Pol. by coiling
- High birefringence required
- No external polarizing components





Experimental set-up

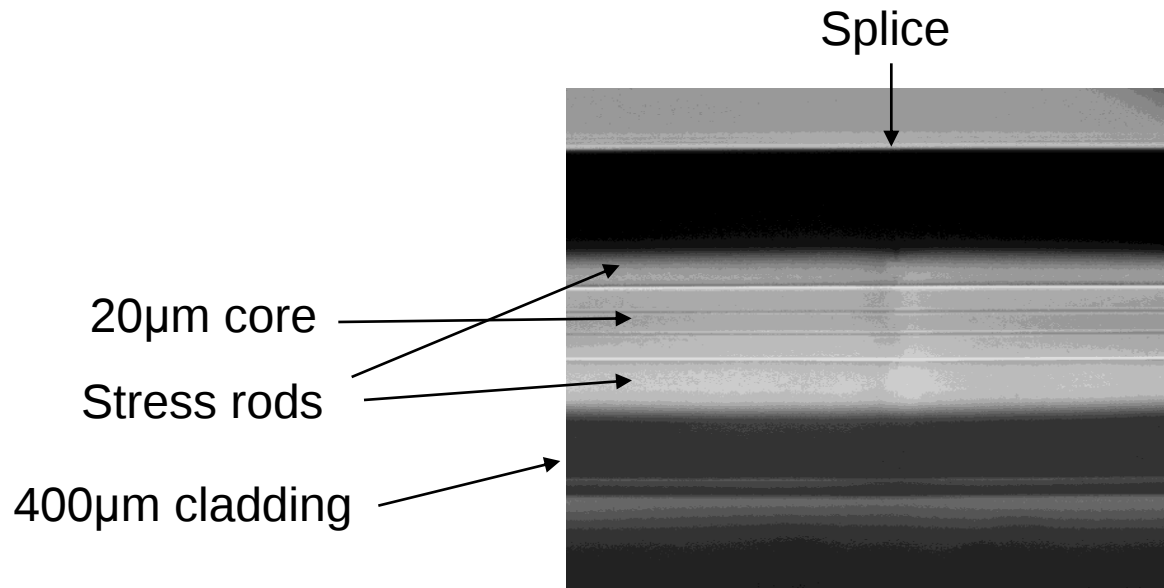


- ~610W pump power is coupled.
- Coiled PM/LMA Yb fiber
- 7.5cm and 9cm diameter used



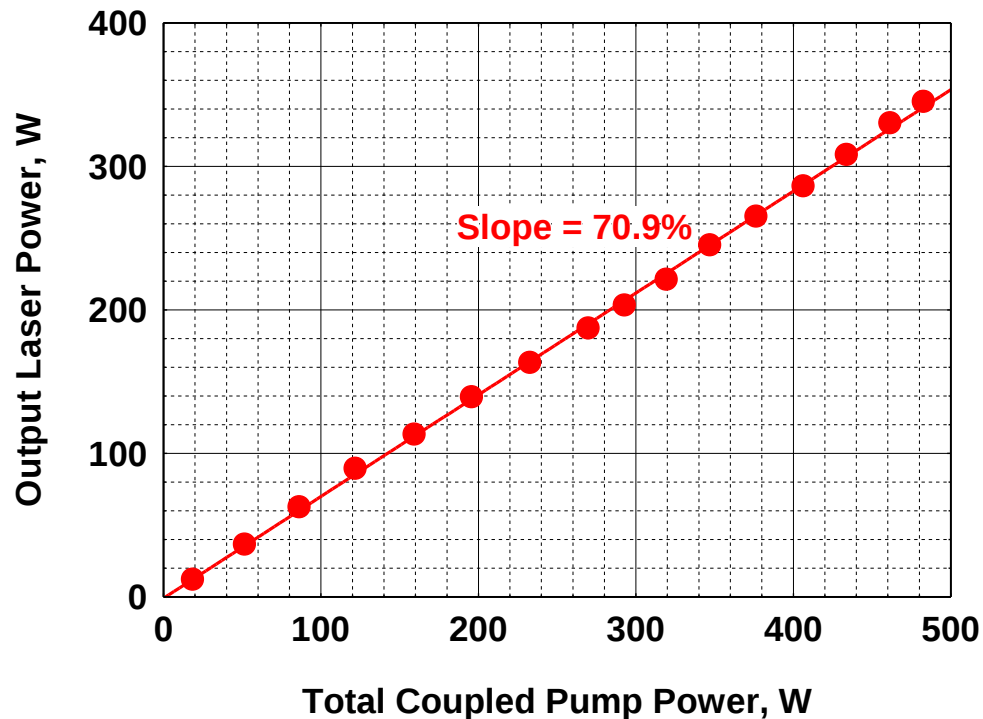
Splicing

- Low loss ($<0.1\text{dB}$)
- Low coupling between polarizations
- Low coupling into higher order modes





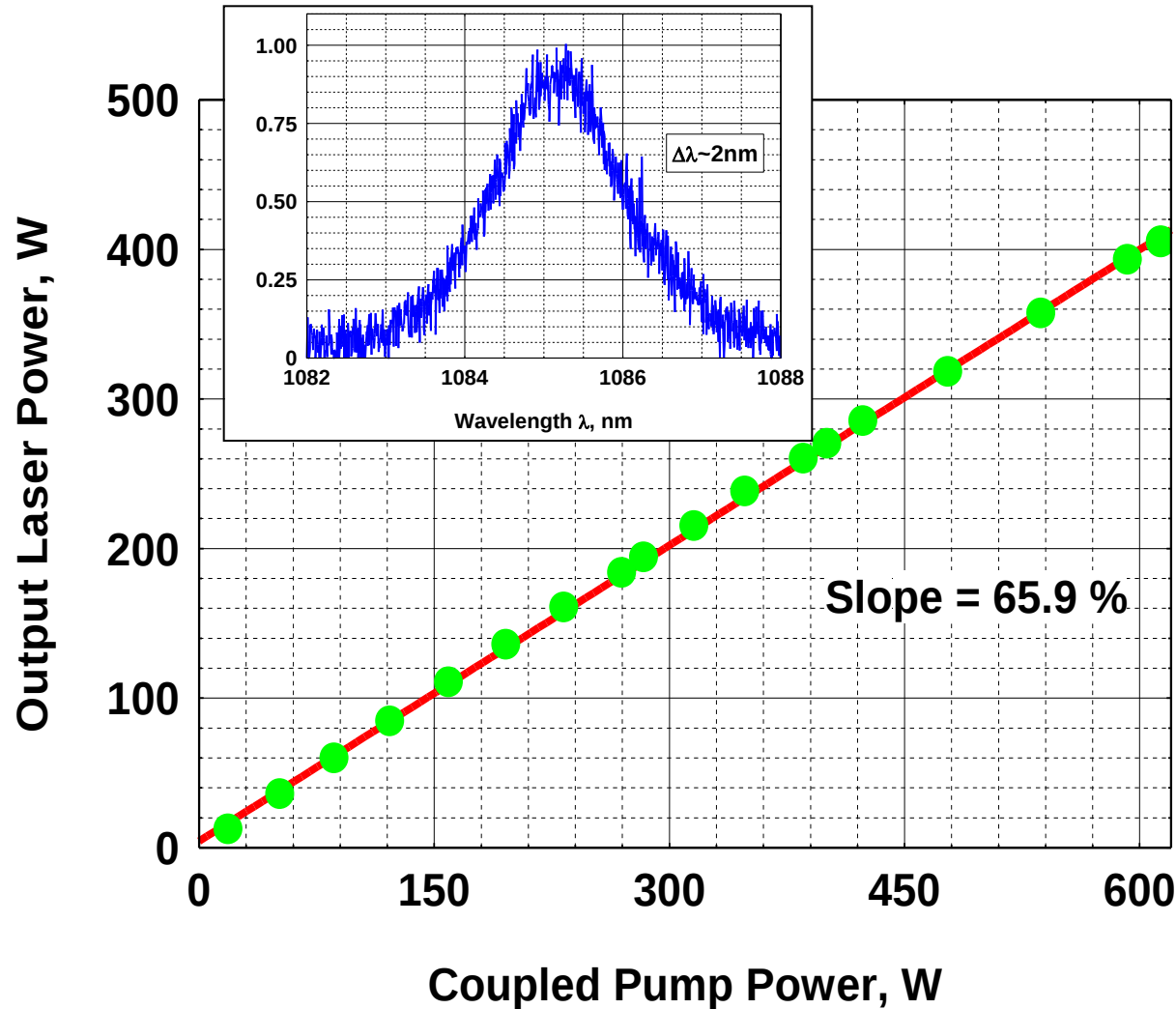
Power: Laser #1



- 9cm coiling
- 345W cw power
- PER 19dB
- No SRS or SBS observed



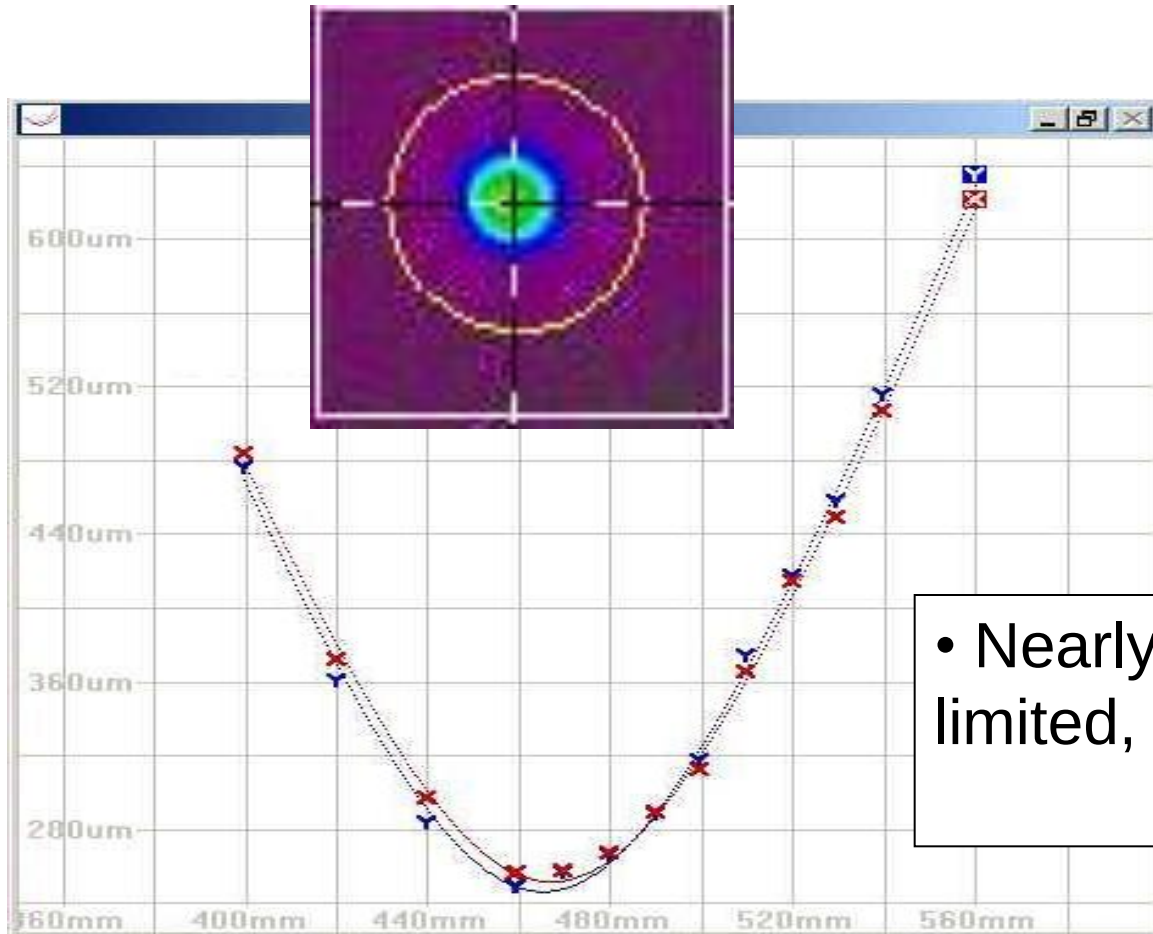
Power and Spectrum: Laser #2



- 7.5cm coiling
- 405W cw power
- 18dB extinction ratio
- 2nm linewidth
- No SRS or SBS



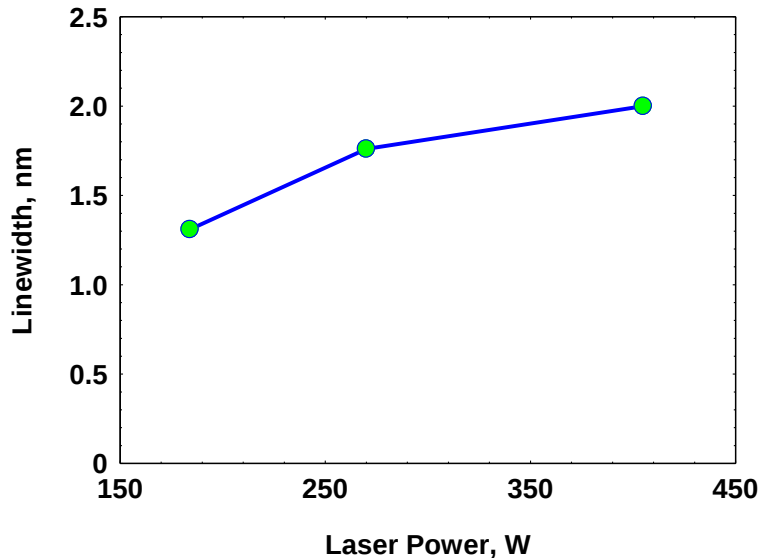
Beam profile and M^2 Measurement



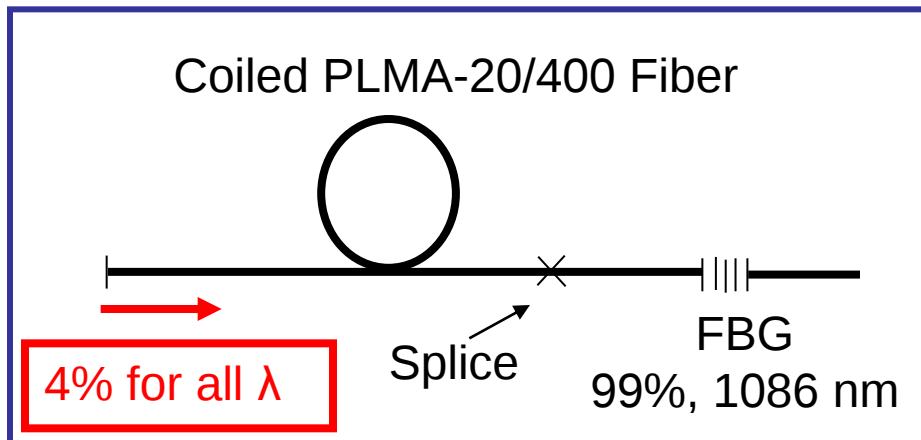
- Nearly diffraction-limited, $M^2 \sim 1.1$



Linewidth



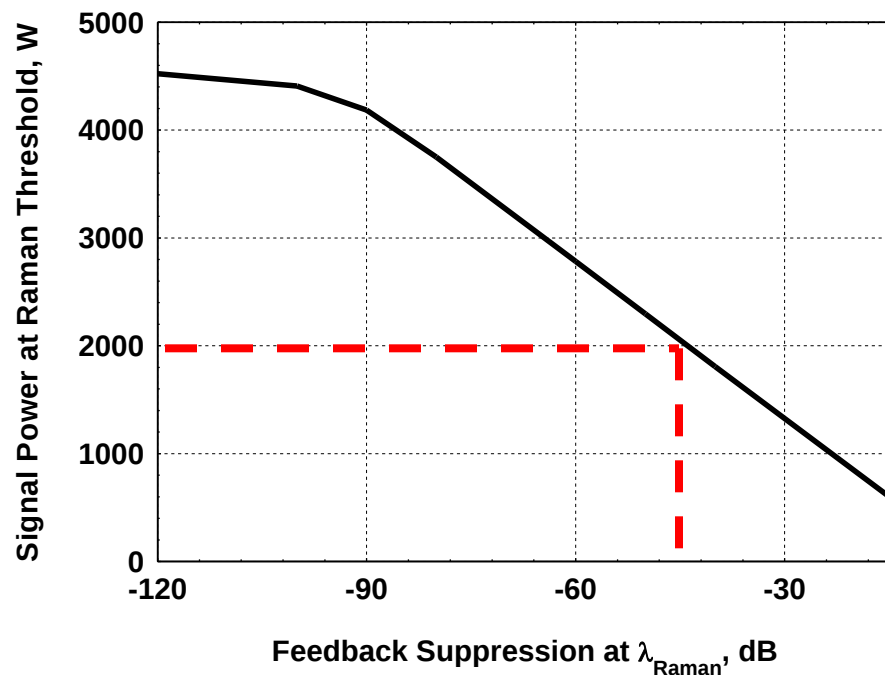
- $\Delta\lambda$ increases with laser power
- Straight-cleaved end is not λ -selective
- 2 FBGs designs for narrow linewidth laser



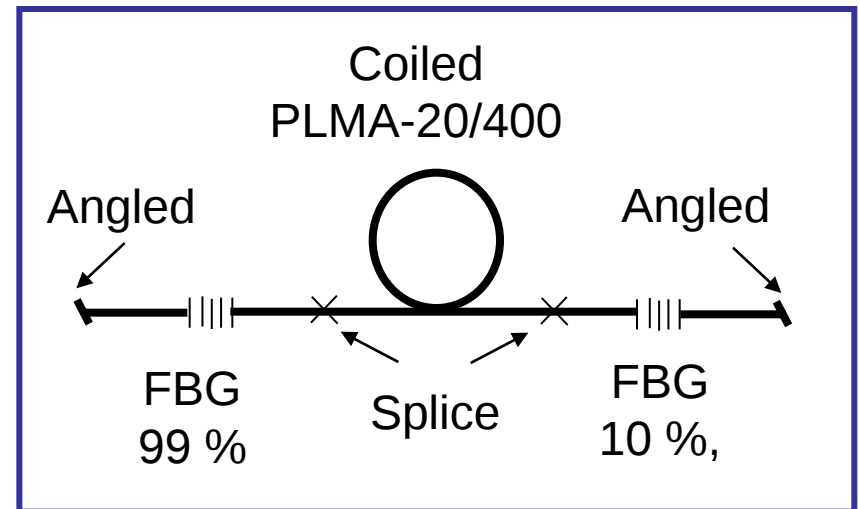


Power is scalable

- 2-FBG design:
 - Power scalable up to $> 2\text{kW}$
 - Reduce Raman feedback
 - Reduce linewidth



Monolithic module with low feedback





Summary

- All-fiber cavity linearly polarized high-power fiber laser:
 - Linear polarization by coiling HiBi LMA fiber
 - FBG stabilized spectrum
 - 405-W cw power
- Perspective:
 - Scalable into kW range
 - Linewidth <0.1 nm
- Applications:
 - beam combining
 - nonlinear frequency conversion