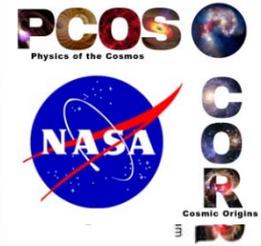


Demonstration of a TRL 5 Laser System for LISA

PI: Jordan Camp/GSFC



Objectives and Key Challenges:

- Develop 2.5W light source for the LISA gravitational wave mission using a Master Oscillator Power Amplifier design with a novel diode laser oscillator (External Cavity Laser, ECL) followed by a 2.5W Yb fiber amplifier, providing a highly stable, compact, and reliable system
- Test the laser system for reliability, and for amplitude and frequency stability, achieving the required noise performance
- Demonstrate system TRL 5

Significance of Work:

- Development, with industrial partner (Redfern Integrated Optics), of space qualified, ultra low-noise oscillator
- Demonstration of low-noise power amplifier with servo controls
- Noise and reliability tests of full laser system

Approach:

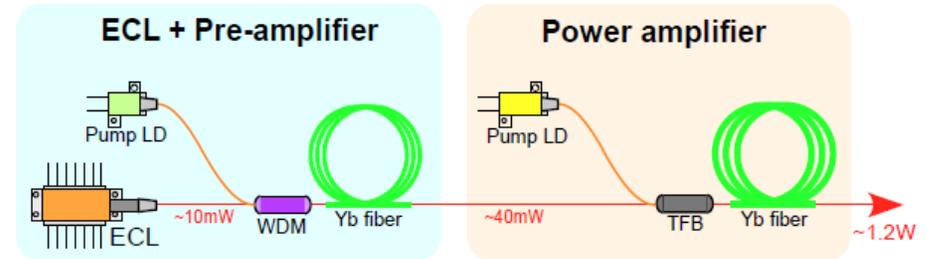
- Noise optimization of 1064 nm External Cavity Laser (RIO)
- Reliability study of External Cavity Laser
- Implementation of amplitude and frequency servo controls on full laser system, achieving $RIN=10^{-4}$ at 10^{-3} Hz, frequency noise = 300 Hz / $\text{Hz}^{1/2}$ at 10^{-2} Hz, and differential phase noise = 6×10^{-4} rad/ $\text{Hz}^{1/2}$ at 10^{-2} Hz

Key Collaborators:

- Kenj Numata, Mike Krainak (NASA/GSFC)
- Lew Stolpner (Redfern Integrated Optics)

Current Funded Period of Performance:

- April 2014 – April 2016



Master Oscillator / Power Amplifier (MOPA) configuration of LISA laser, including ECL, preamp, and diode pumped Ytterbium (Yb) fiber amplifier

Accomplishments and Next Milestones:

- ✓ Fabricated world's first butterfly package layout 1064 nm ECL
- ✓ Procurement of long lead items: fiber splicers and coaters
- ✓ Developed and constructed 2.5 W laser amplifier
- ✓ Preliminary laser system test with External Cavity Laser (ECL)
- Noise optimization of ECL optical cavity Mar 2016
- ECL reliability tests Mar 2016
- Amplifier reliability tests June 2016
- Full laser system reliability testing Oct 2016

Applications:

- Laser source for LISA Gravitational Wave mission
- Oscillator for ground-based GW LIGO project
- Oscillator for GRACE-II mission

$TRL_{In} = 3$ $TRL_{Current} = 3$ $TRL_{Target} = 5$