

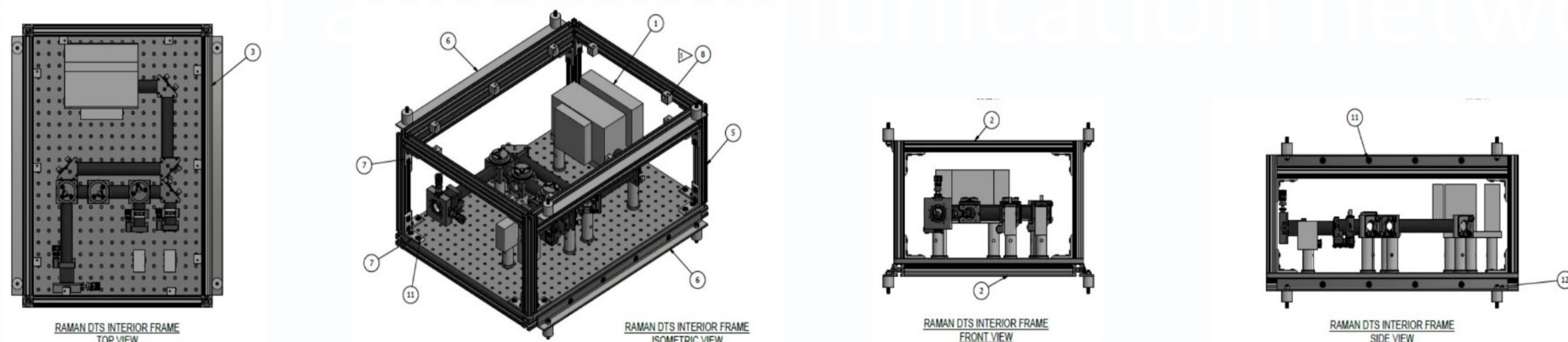
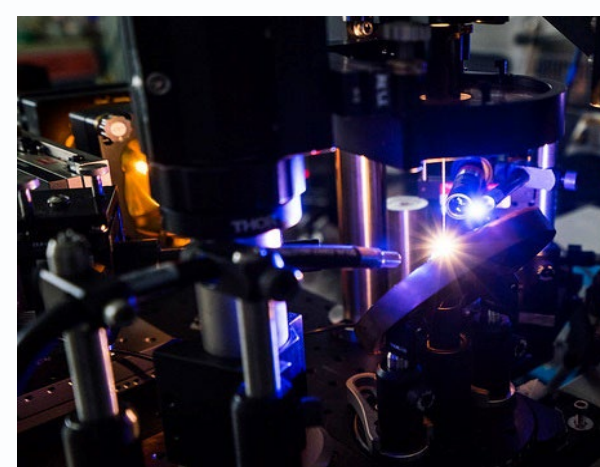
Laser-heated Pedestal Growth and Raman DTS for Harsh-environment Applications

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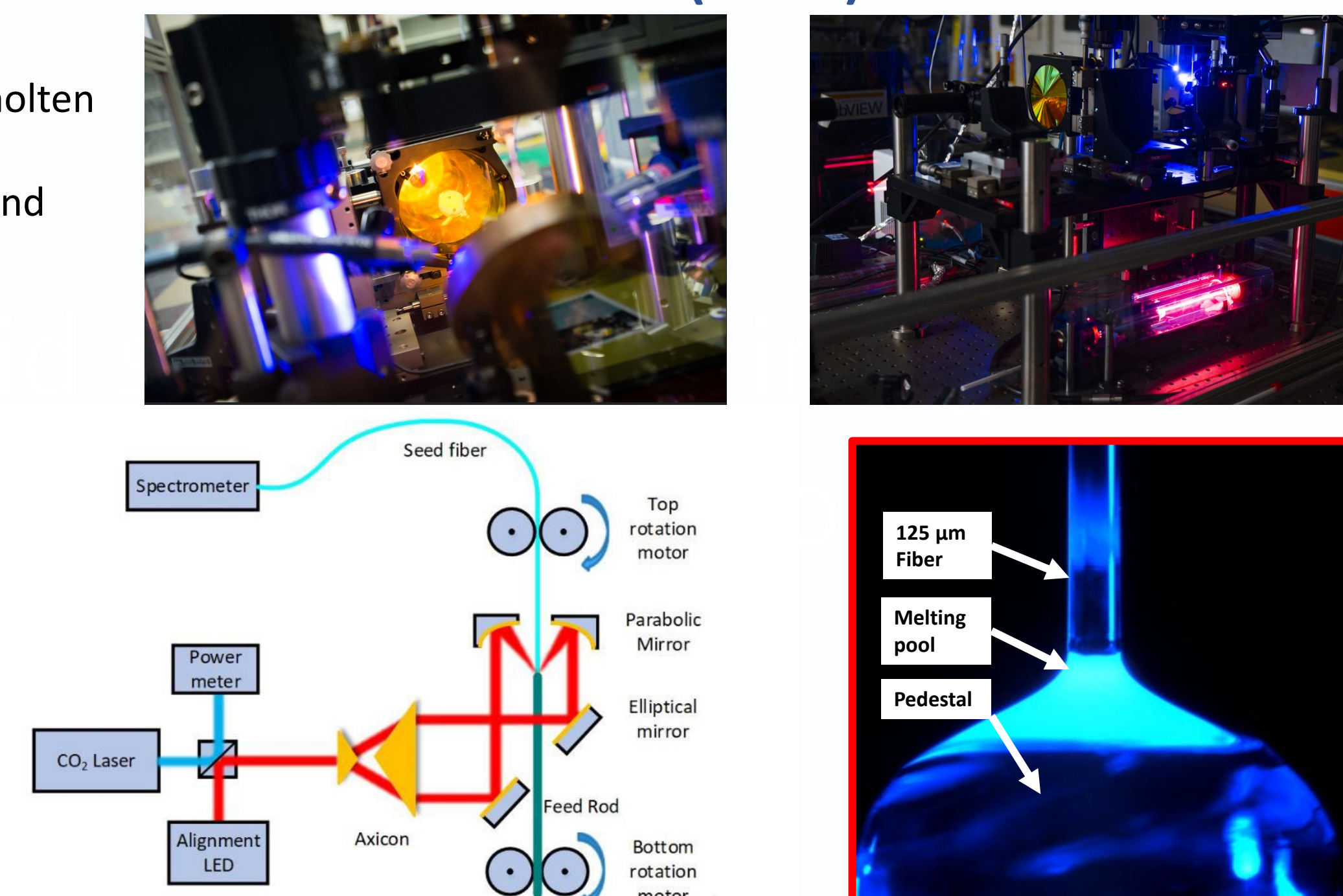
Technology Summary

- New single-crystal fibers withstand harsh conditions
- Distributed optical interrogation enables precise core and coolant control
- Allows measurement of loop temperatures, piping strain, or other important parameters
- Reactor automation accelerates Molten Salt Reactor designs, ushers in a new paradigm of distributed core-monitoring
- Sensor fibers produce thousands of data points to aid reactor designers or improve reactor operational awareness

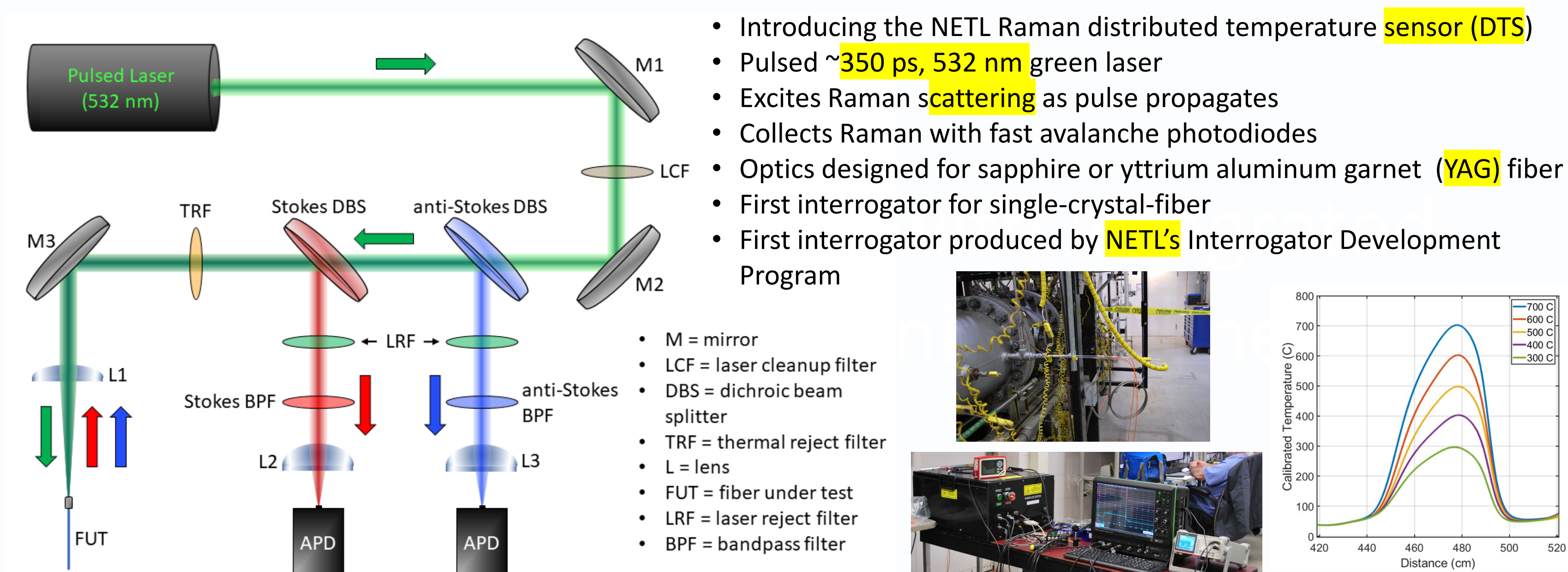


Laser-heated Pedestal Growth (LHPG)

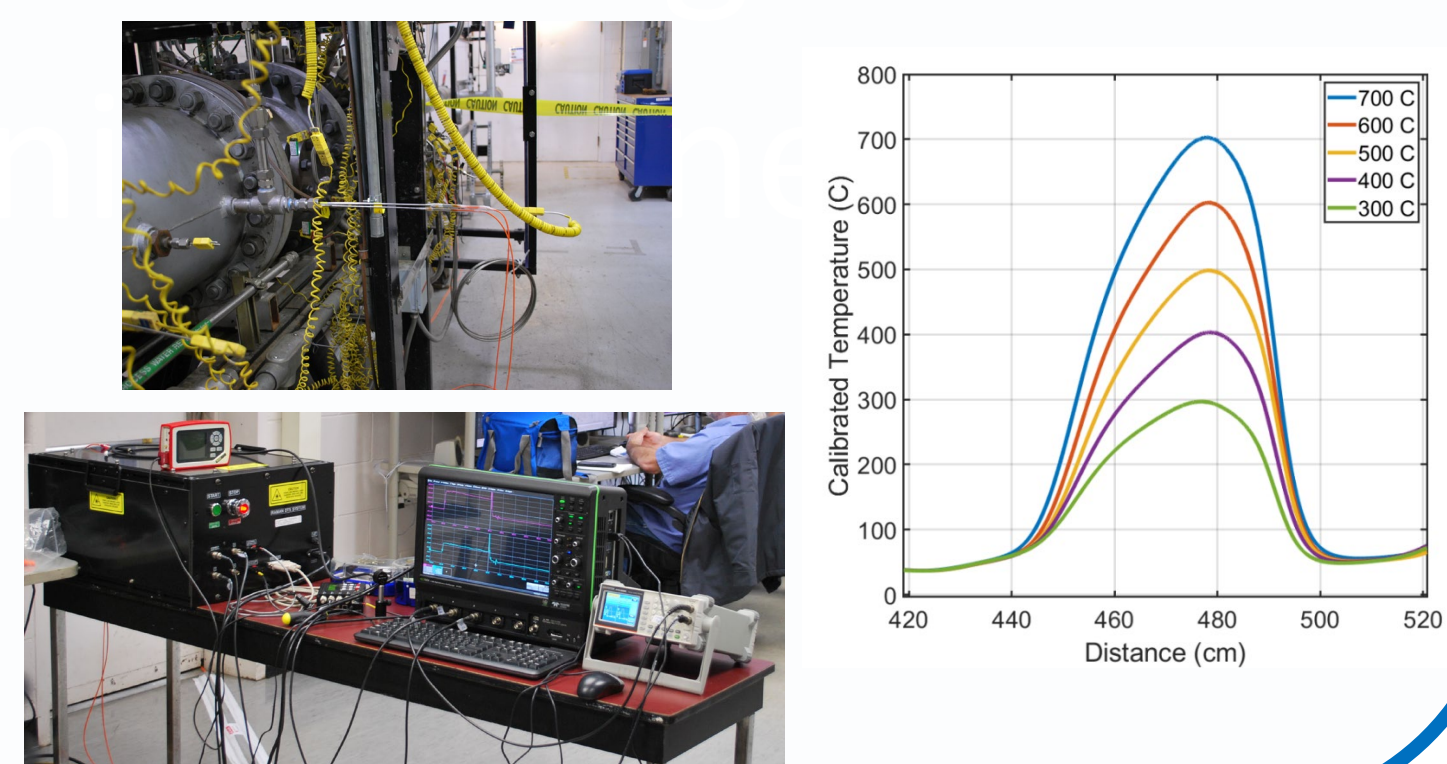
- CO₂ laser source for heating
- “Doughnut” beam shaper surrounds molten zone with light
- Motors advance feedstock (pedestal) and fiber
- Slow process (mm/min)
- Grows pure crystals (no cladding)



Integrated Raman DTS System

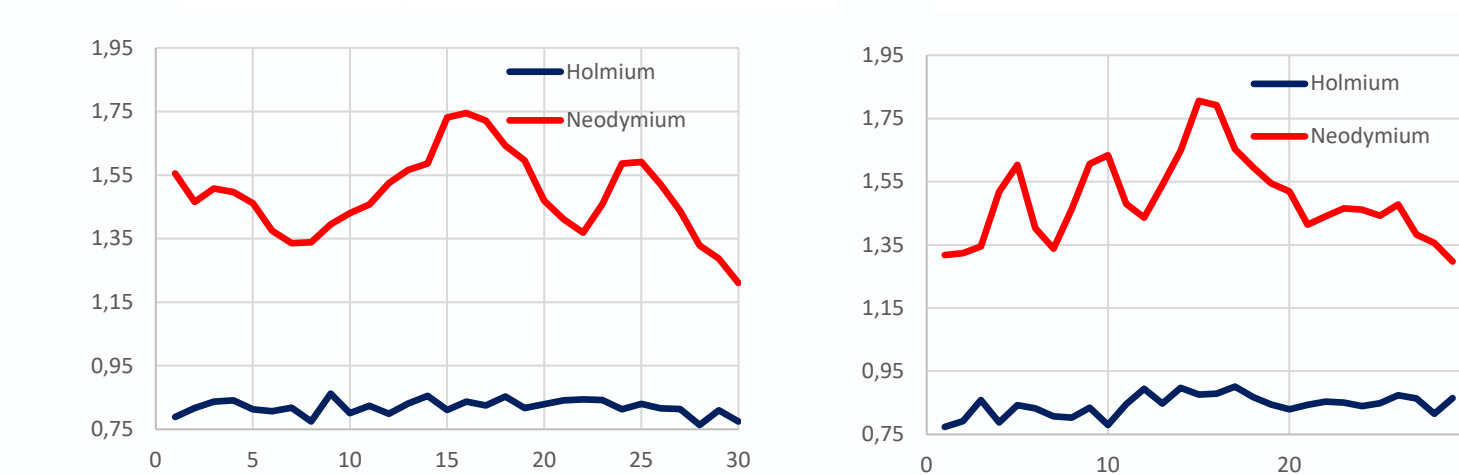
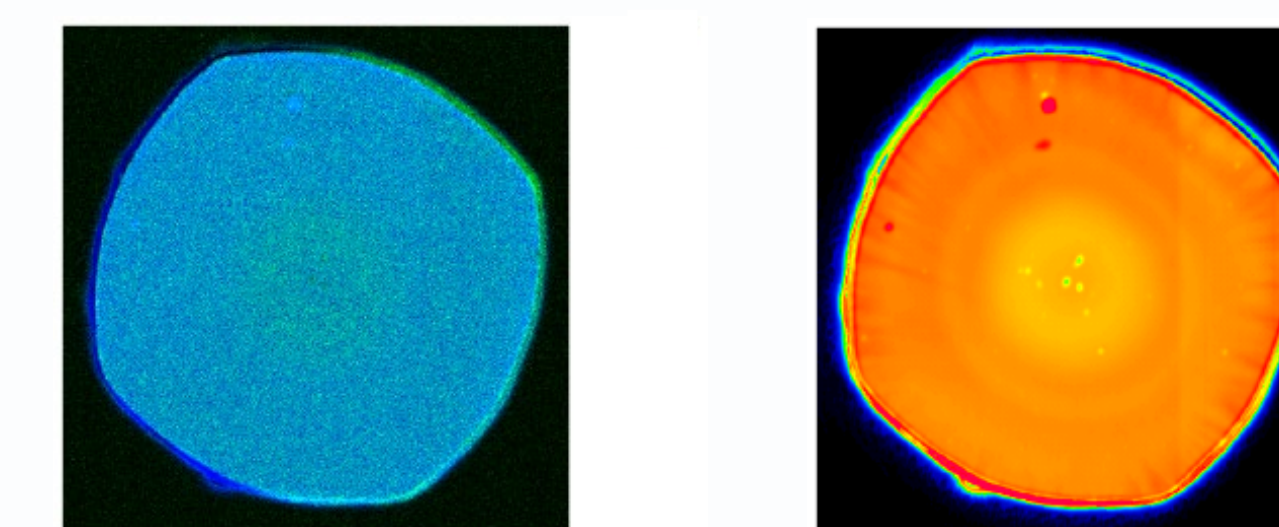
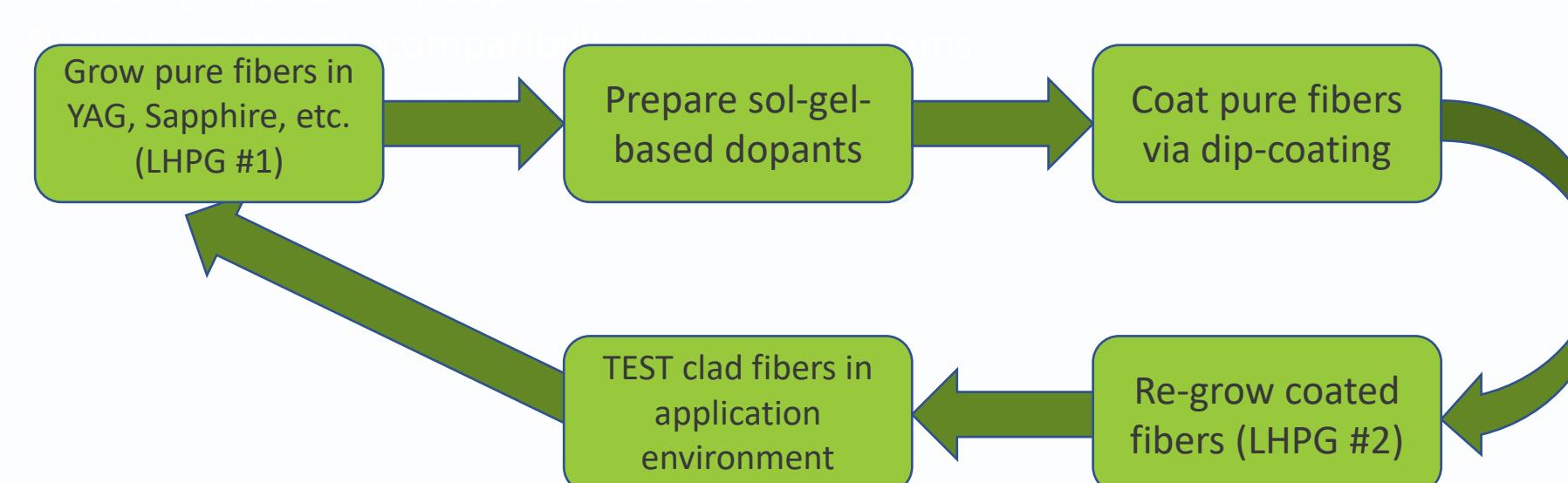


- Introducing the NETL Raman distributed temperature **sensor (DTS)**
- Pulsed **~350 ps, 532 nm** green laser
- Excites Raman **scattering** as pulse propagates
- Collects Raman with fast avalanche photodiodes
- Optics designed for sapphire or yttrium aluminum garnet (**YAG**) fiber
- First interrogator for single-crystal-fiber
- First interrogator produced by **NETL's** Interrogator Development Program



Dopant Additions via Regrowth of Sol-gel Coated Fiber

- Grow cladded fibers with two-stage LHPG
 - Sapphire or yttrium aluminum garnet (YAG)
 - Sol-gel (or other) dopant additions
- Evaluate **materials'** compatibility in energy systems
- Improve fiber performance



Automatic Dopant Segregation through LHPG: Top left: Visible light guiding in GRIN YAG fiber; Top right: EMPA map of Nd concentration in a GRIN YAG fiber; Bottom plots: Co-doped Nd and Ho: YAG fiber dopant concentrations in X (left) and Y (right)