

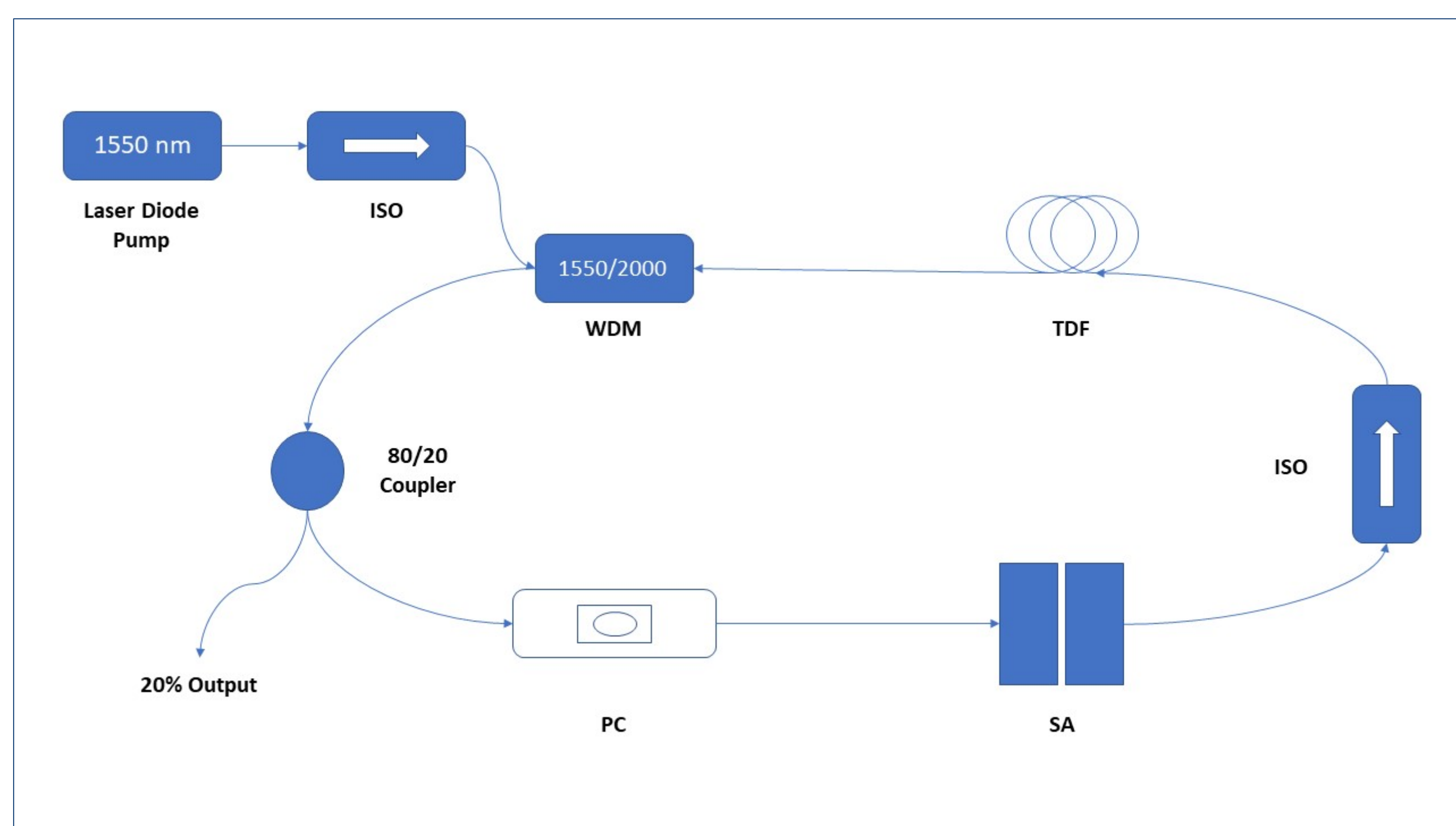
Thulium-doped Fibre Laser Modelocked by Polymer/Carbon Nanomaterials Composite Saturable Absorbers

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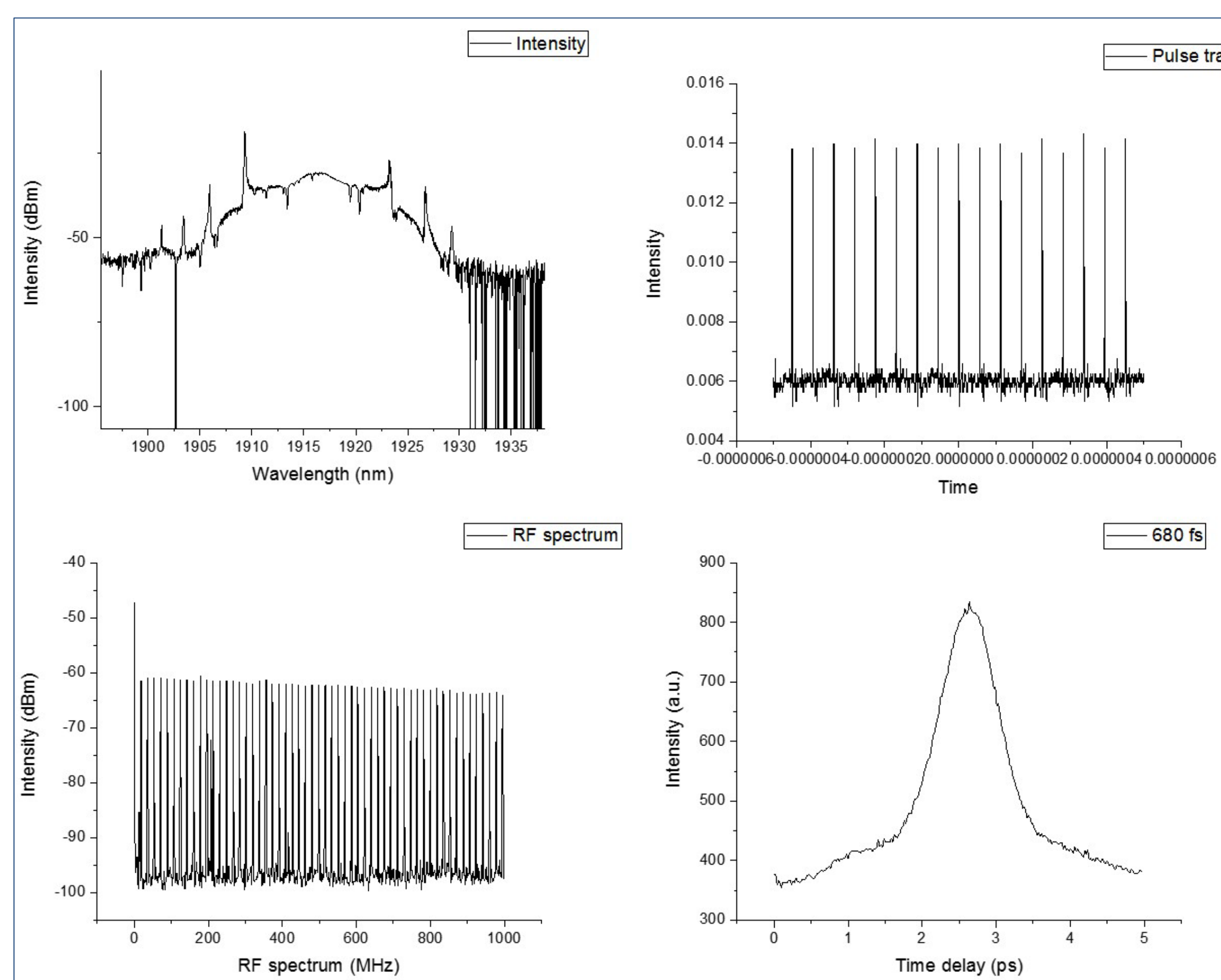
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Introduction

- Thulium-doped fibre laser cavities built to optimise laser operation for graphene/polymer saturable absorbers (SA).
- 2 μm laser applications:
 - Gas detection
 - Surgery
 - Supercontinuum
- Graphene SA:
 - Wideband tunability [1]
 - High modulation depth [2]
 - Fast carrier dynamic [2]



Modelocking: Graphene



- SA support: PMMA
 - >95 % transmission around 2 μm
 - Moisture resistance [3]
 - $T_g > 100^\circ\text{C}$, improved stability [4]
- Modelocking:
 - Wavelength
 - 1.916 μm
 - Pulse duration
 - 680 fs
 - Time-bandwidth product
 - 0.35

Future Work

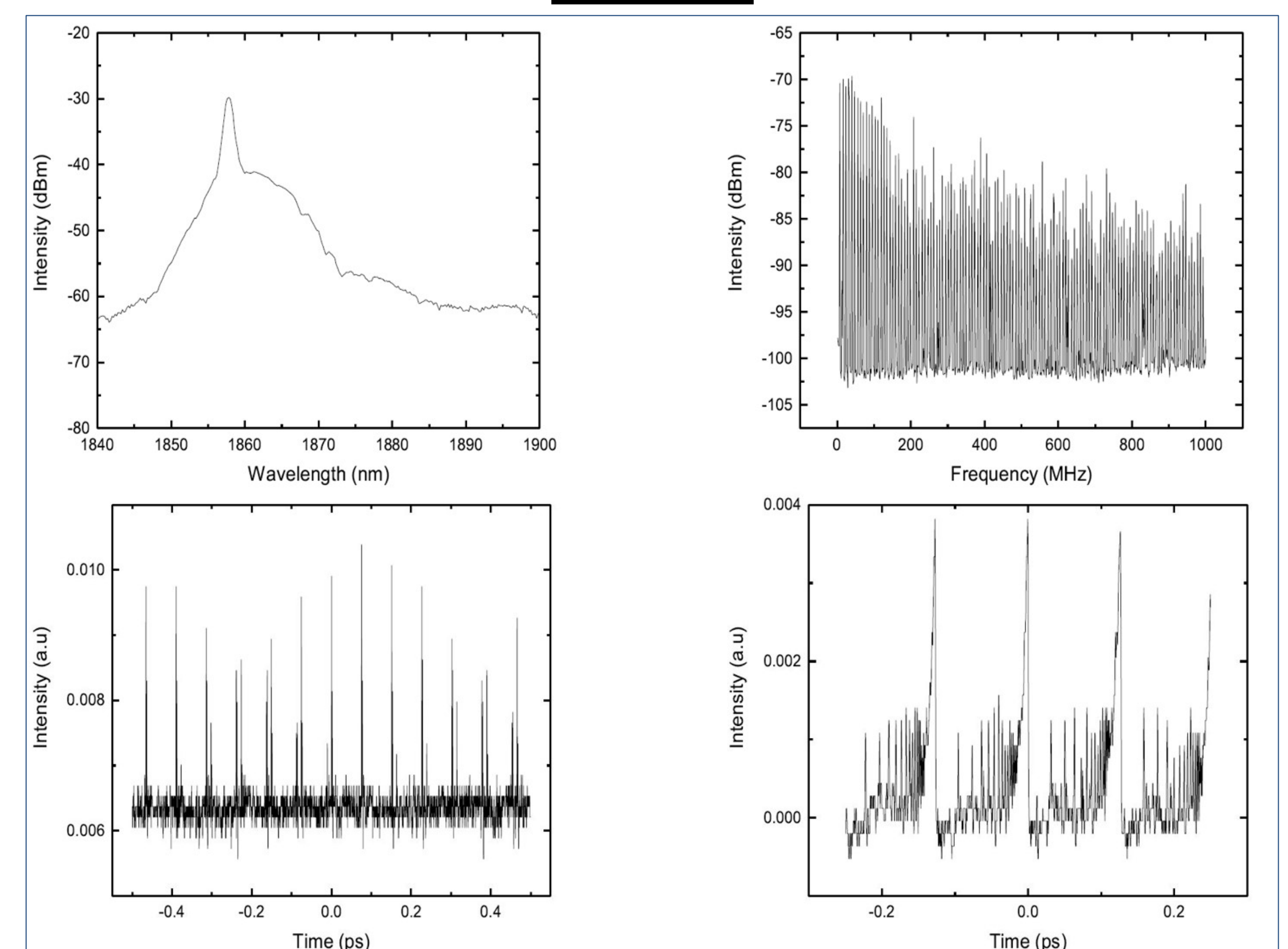
- Simulation of fibre cavity
 - Reduce trial and error
- Obtain supercontinuum
 - Well into mid-IR range for gas absorption bands
- Gas separation system
- Spectrum gas response
 - For gas detection

References

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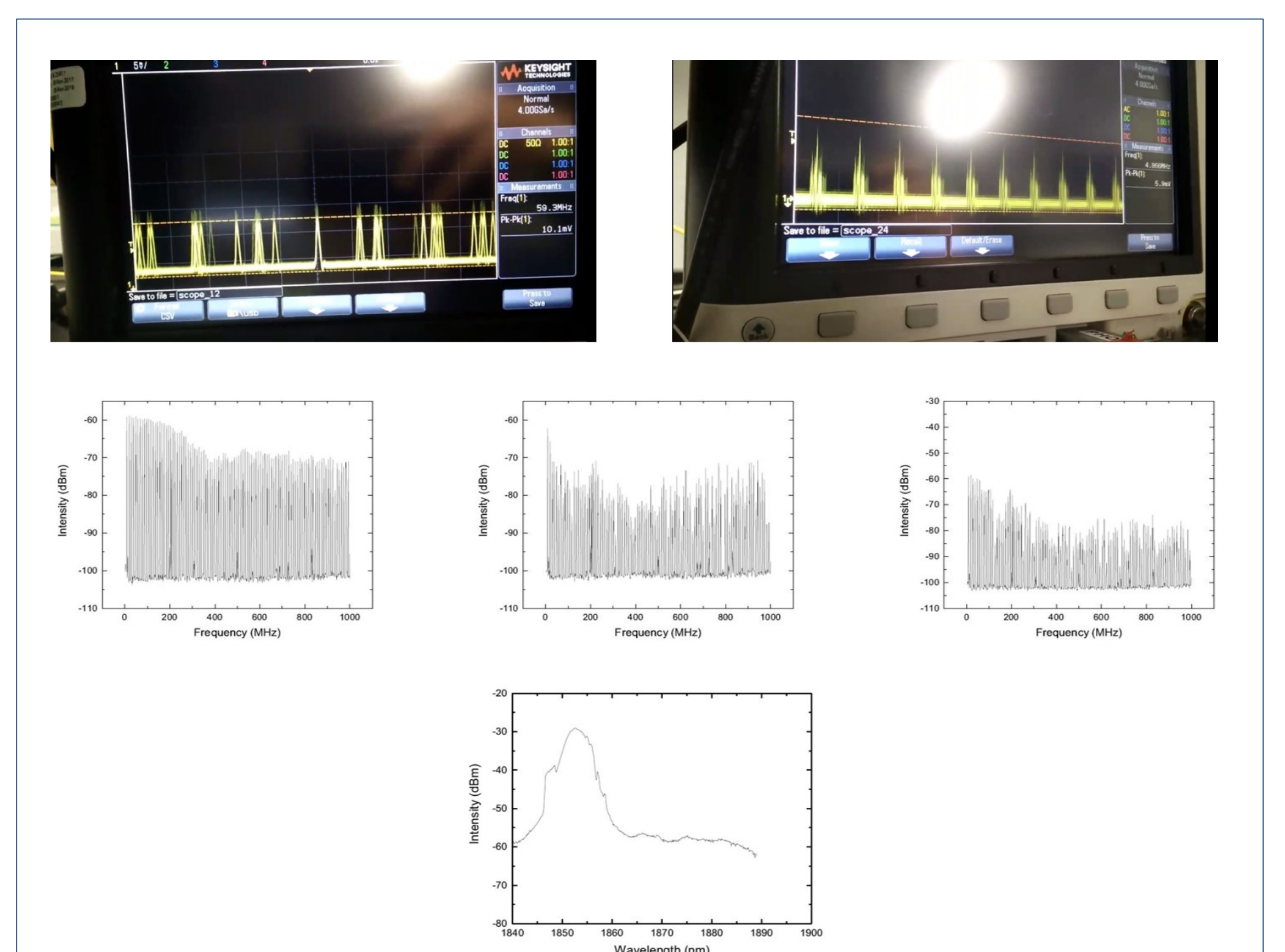
Dispersion Phenomena: DWCNT

Drifting



- Stable pulse shed smaller pulses.
- Decreased dispersion compacts frequency, weaker pulses gain intensity from component separation [8].
- Could be due to different group velocities [5,6] or soliton destruction [7].
- DWCNTs could act as a slower SA, leading to resaturation during relaxation time.
- Unique CW element adds instability.

Oscillating



- First reporting in 2 μm laser, occurred at -0.5679 ps^2 .
- Smaller pulses oscillate around stable pulse.
- Possibly due to asymmetric perturbations [9]. These cause noise like pulses from energy fluctuations which change temporal oscillations [6, 10].
- Similar phenomenon to vibrating soliton pairs.
- Either oscillate between two distinct energy levels (Hopf bifurcation) or energy evolves chaotically causing shaking (Subcritical bifurcation) [11].
- Modelocking stabilised at higher powers, shows acting as slow SA; where stable modelocking occurs at three times saturation power [12].

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