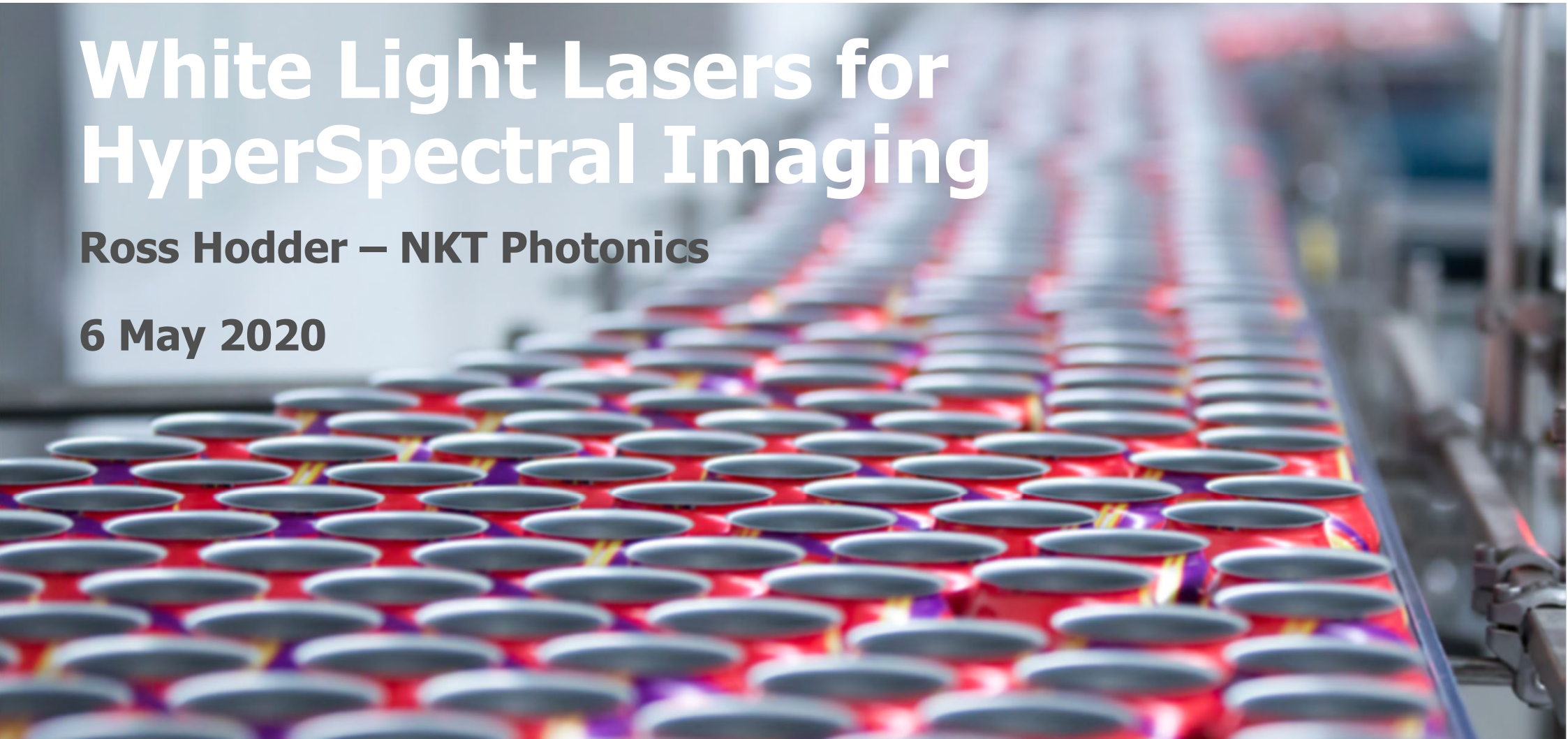


# White Light Lasers for HyperSpectral Imaging

Ross Hodder – NKT Photonics

6 May 2020



# NKT Photonics at a glance

## Imaging & Metrology



Bio-imaging & medical  
Semiconductor  
Industrial metrology

White Light Lasers

Pulsed Diode Lasers



SuperK &  
Fianium



Onefive

## Sensing & Energy



Energy  
Security  
Structural monitoring

Distributed Temperature Sensors

Single Frequency Fiber Lasers



LIOS DTS



Koheras

## Material Processing



Micromachining  
Medical  
R&D

Femtosecond Industrial Lasers

Fiber Amplifier Modules

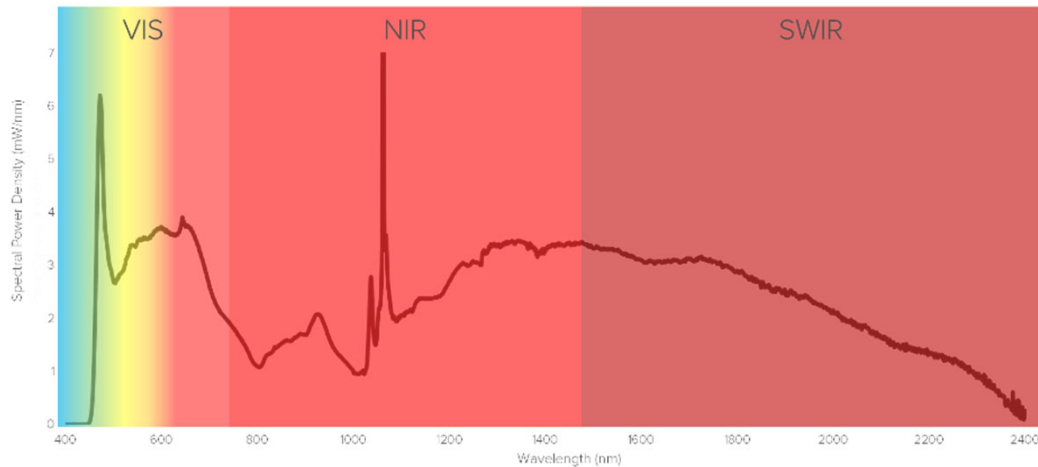


Onefive



aeroGAIN

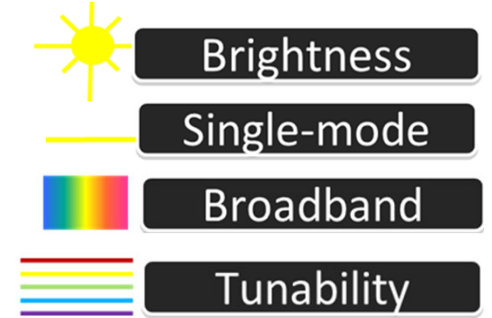
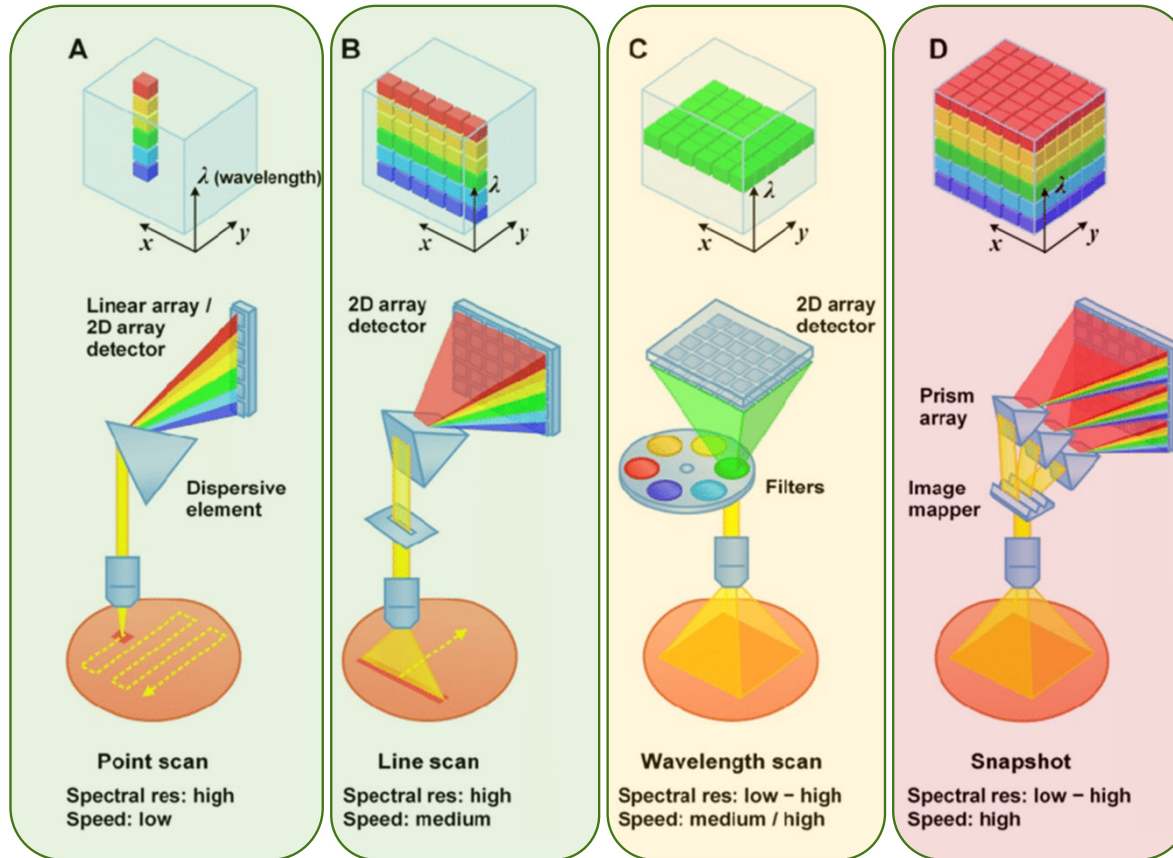
# White Light (Supercontinuum) Lasers



- Spectrally broadened Fiber Laser
  - No alignment or maintenance
  - Long lifetime
- Spectral properties = lamp
  - UV-Visible-nIR spectral coverage
  - Flat, stable spectrum
- Beam properties = laser
  - Collimated, Single-mode beam
  - Extreme brightness



# Hyperspectral Imaging Techniques

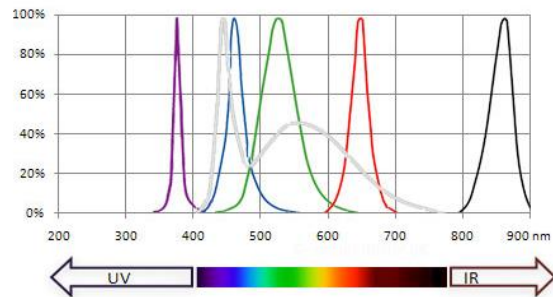


Wang, Yu & Reeder, Nicholas & Kang, Soyoung & Glaser, Adam & Liu, Jonathan. (2017). Multiplexed Optical Imaging of Tumor-Directed Nanoparticles: A Review of Imaging Systems and Approaches. *Nanotheranostics*. 1. 369-388. 10.7150/ntno.21136.

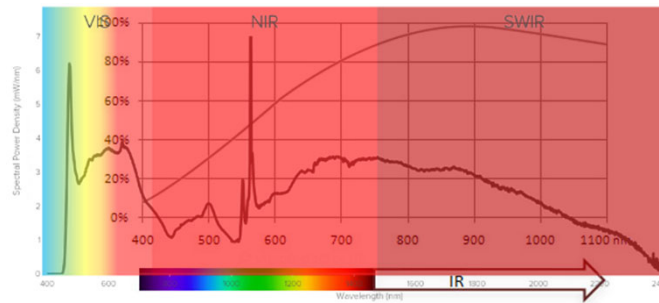
Ross Hodder, NKT Photonics, EPIC Online Technology Meeting on Hyperspectral Imaging

# Light Sources for Hyperspectral Imaging

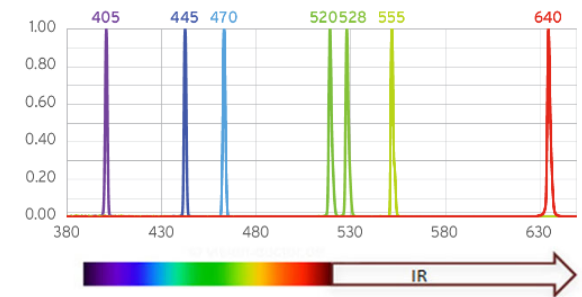
## White Light Laser



- + Low cost
- + Long lifetime
- + Low power consumption
- Narrow spectrum
- Gaps in available colours
- Limited brightness



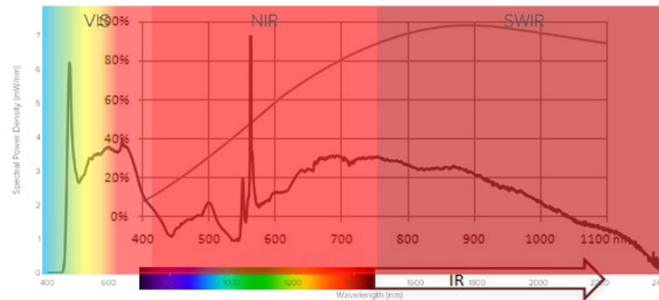
- + Very low cost
- + Wide spectral range
- + High power output
- Short lifetime
- High heat generation
- High power consumption



- + High brightness
- + High power
- + High spatial resolution
- Higher initial cost
- Not broadband
- "multi-spectral" only

# Light Sources for Hyperspectral Imaging

## White Light Laser



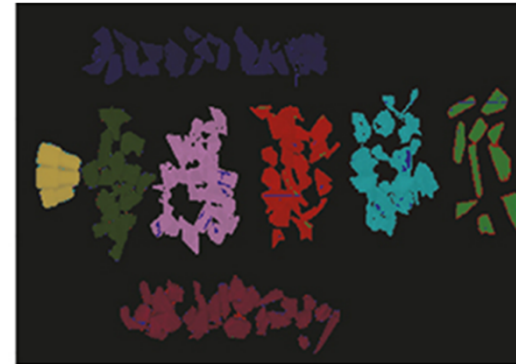
- + Long lifetime
- + Low power consumption

- + Wide spectral range
- + High power output

- + High brightness
- + High power
- + High spatial resolution
- Higher initial cost

# Beyond Spectral Imaging

- 3D Imaging / Profilometry
  - Optical Coherence Tomography / White Light Interferometry
  - Chromatic Confocal measurement
  - Time-of-Flight (ToF)
- Internal Measurements
  - Transmission Spectroscopy
  - Scattering & Diffusion
- Enhanced Imaging
  - Confocal imaging
  - Fluorescence



# White Light Lasers - Summary



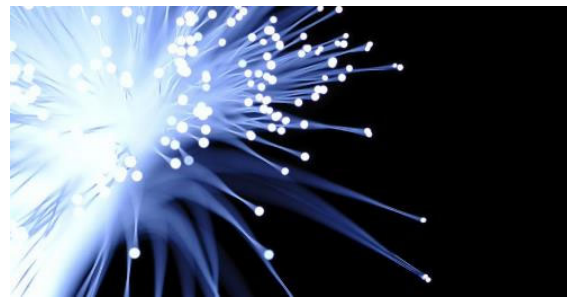
## Brightness



- Reduced sensor cost & complexity
- High throughput
- Reflection, transmission and scattering measurement



## Single-mode



- High resolution
- Efficient illumination
  - Point-scan
  - Line-scan
- Advanced measurement techniques
  - OCT / WLI
  - Chromatic Confocal



## Broadband



- UV-visible & nIR
- Flat, Stable Spectrum

- Long-lifetime
- Low power consumption
- Low heat generation