Sensing is life

LiDAR System Advantages using 905nm Lasers with Wavelength Stability Technology

DVN LiDAR Conference Frankfurt – 15 & 16 November 2021

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2021-11-16

Agenda

- Key Challenges in LiDAR – From a Laser’s Perspective
- Existing 905nm Edge Emitting Laser Behaviour
- Introduction of Wavelength Stability Technology
- LiDAR System Impacts
- Looking Ahead

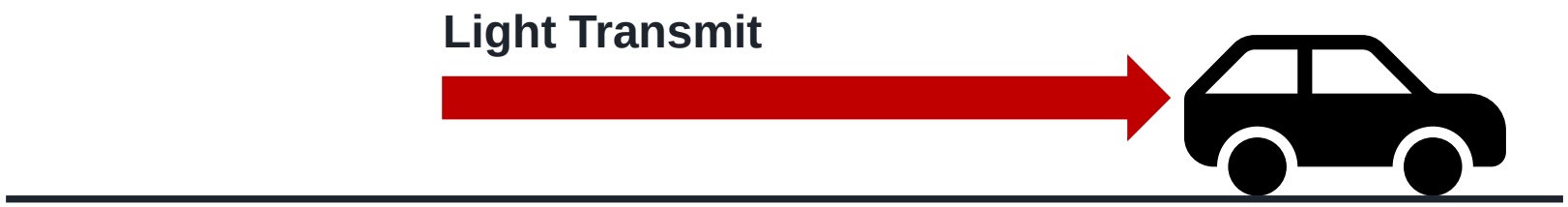
Key Challenges in LiDAR Today

Laser Emitter Perspective

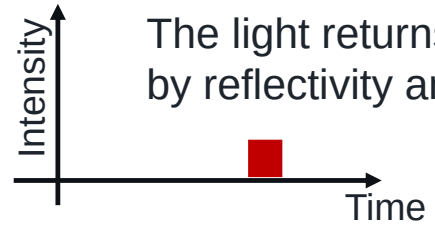
1. The 6C’s. Cost, Cost, Cost, Cost, Cost, Cost
2. Environmental Impacts (sunlight, rain, snow, dirt, fog, etc.)
3. Range and Eye Safety
4. Manufacturability and Scalability
5. Electrical Efficiency and Laser Driver

LiDAR Basics

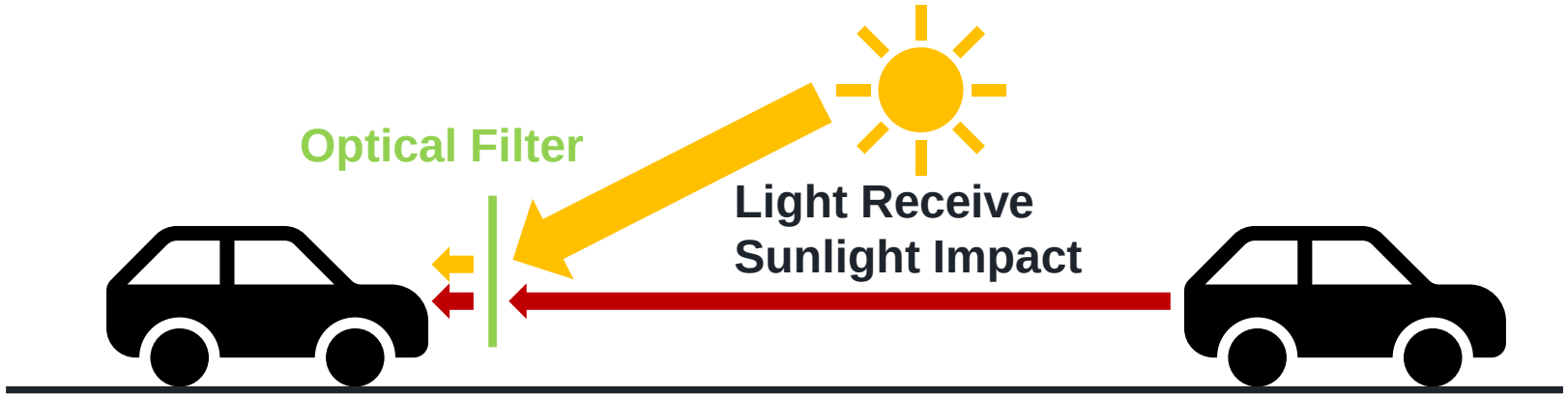
Transmit and Receive



Light is transmitted in a series of short pulses.



The light returns, but it is impacted by reflectivity and distance.



Environmental factors impact the returning light pulse.

LiDAR sensor performance can improve by gains in signal to noise of the returning light pulse.
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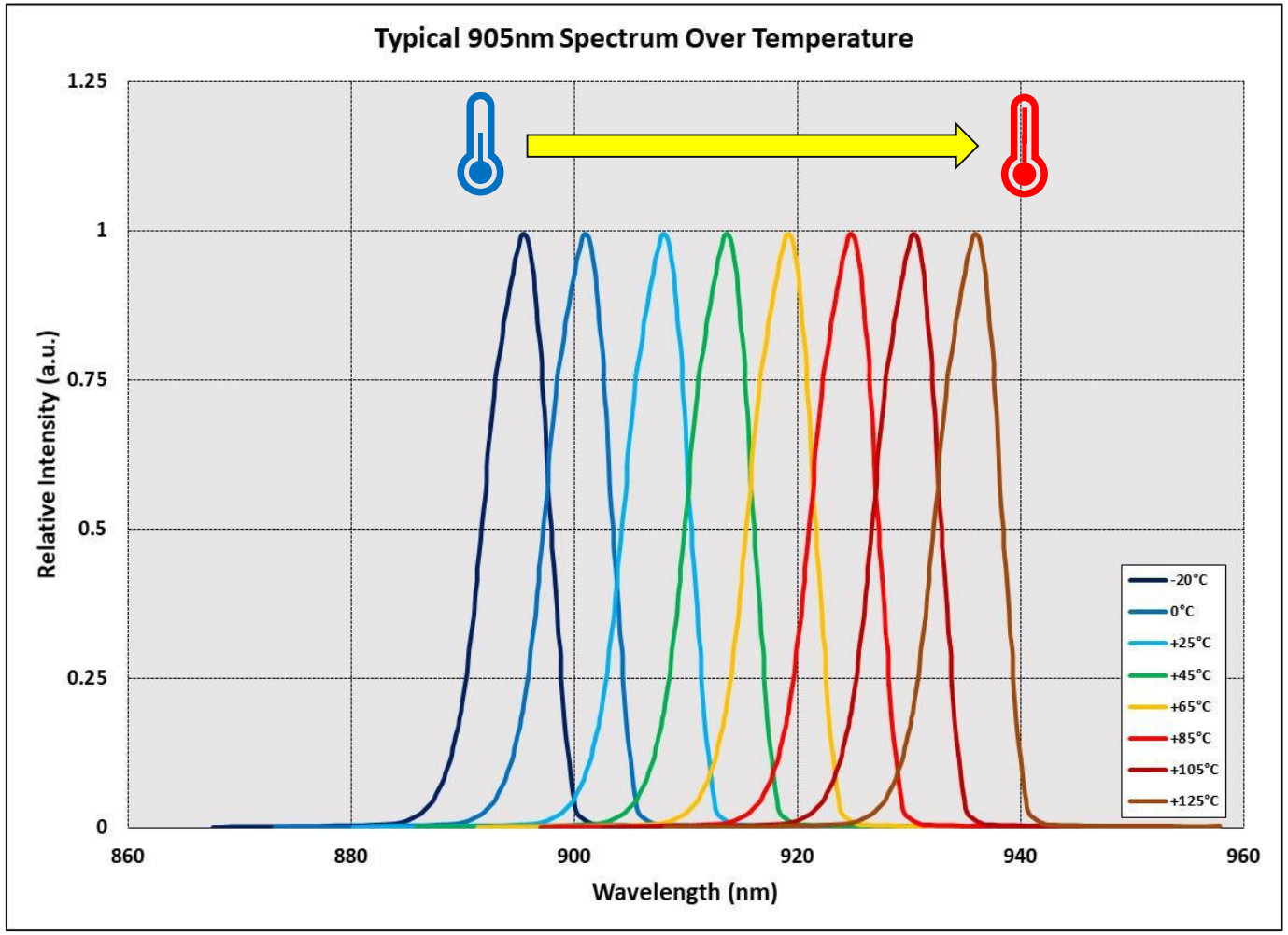
Current Edge Emitting Laser Technology

Wavelength Behavior



Laser Temp

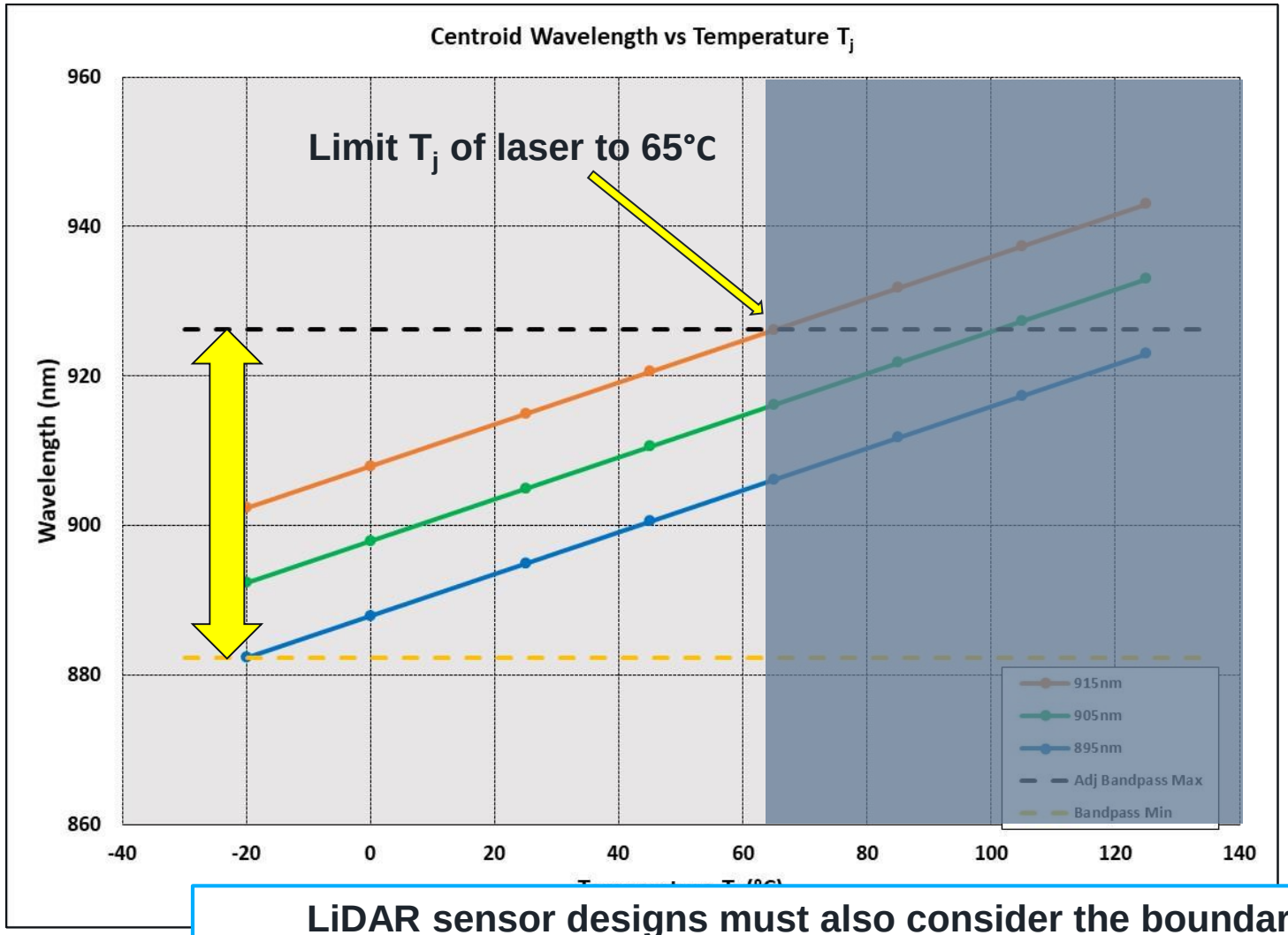
Shorter Wavelength

Longer Wavelength

LiDAR sensor designs must consider this behavior in the optical path from Tx to Rx.

Current Edge Emitting Laser Technology

Wavelength Behavior + Production Binning



Laser Datasheet

$\lambda_{centroid}$	Wavelength
Min	895nm
Typ Δ= ±10nm	905nm
Max	915nm

Optical Filter
Bandwidth = 60nm

Optical Filter
Bandwidth = 44nm

Thermo Electric Coolers are often used to control laser temp.

LiDAR sensor designs must also consider the boundary conditions of the laser. Controlling the T_j of the laser comes at a cost (capital, electrical, size, weight, etc.).

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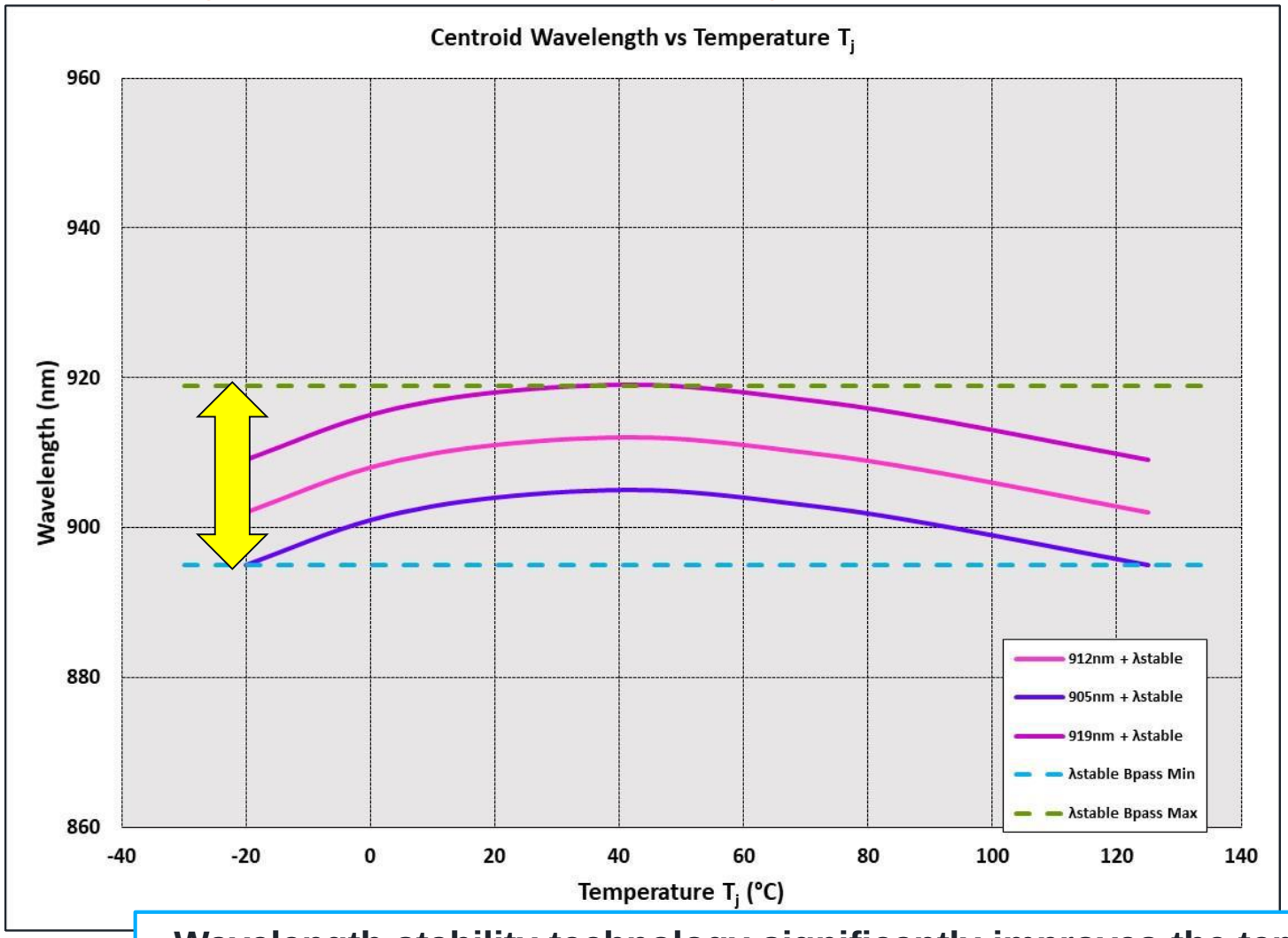
NEW Wavelength Stability Technology

Wavelength Behavior + Production Binning



Laser Datasheet

$\lambda_{centroid}$		Wavelength
Min		905nm
Typ	**Δ= ±7nm**	912nm
Max		919nm

Production Binning
Reduce to ±7nm

Optical Filter
Bandwidth = 24nm

Wavelength stability technology significantly improves the temperature impact on spectrum. Reduction in laser wavelength binning also reduces optical filter bandwidth.

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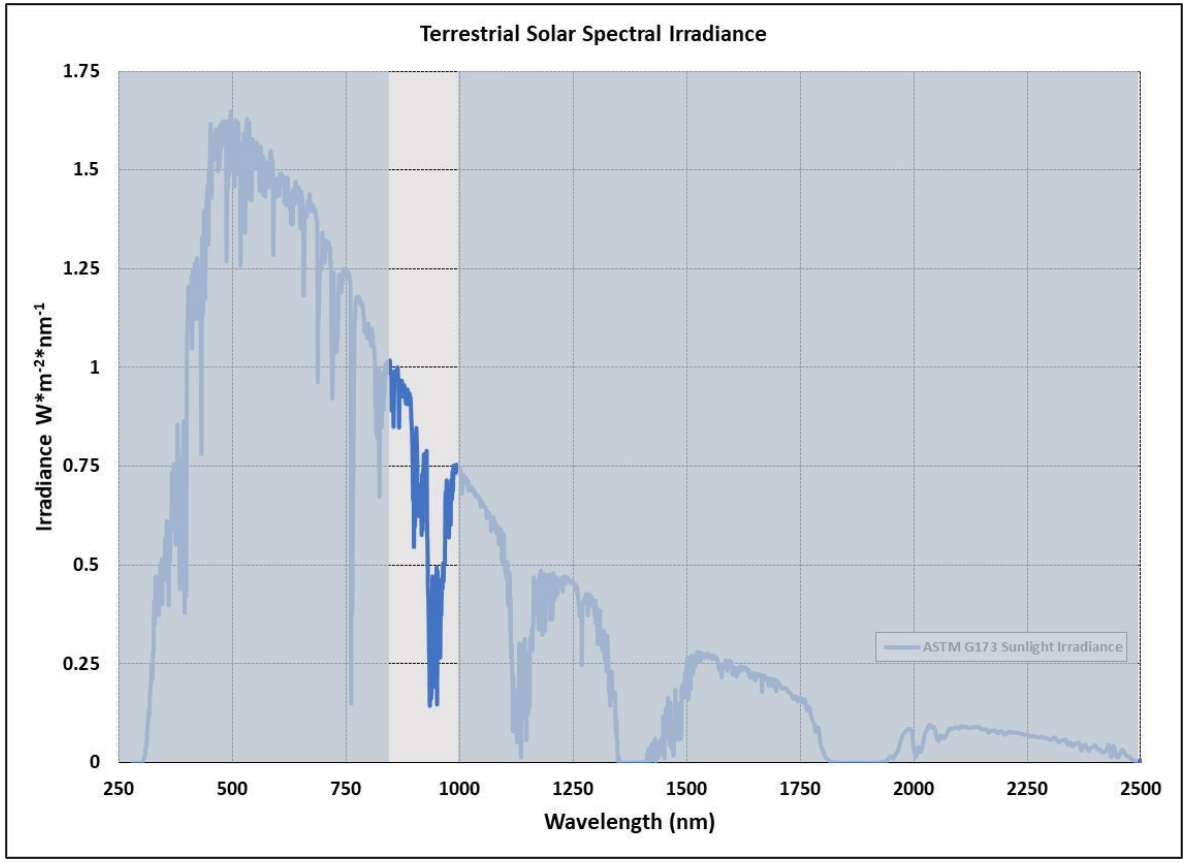
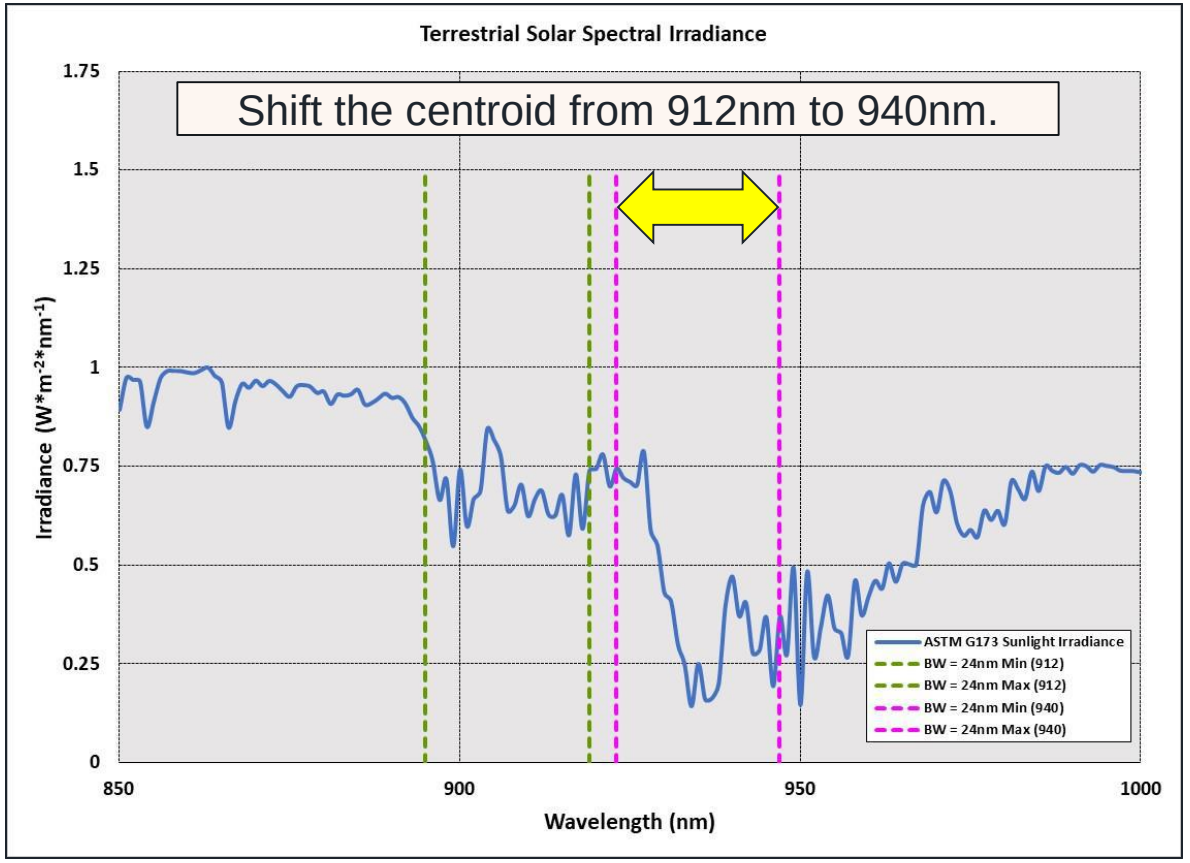
Sunlight Relationship

Laser wavelength and ambient noise





Reduced sun load impact can improve SNR for LiDAR sensors.
By shifting the nominal centroid wavelength to 940nm, the impact from sun load can further be reduced.

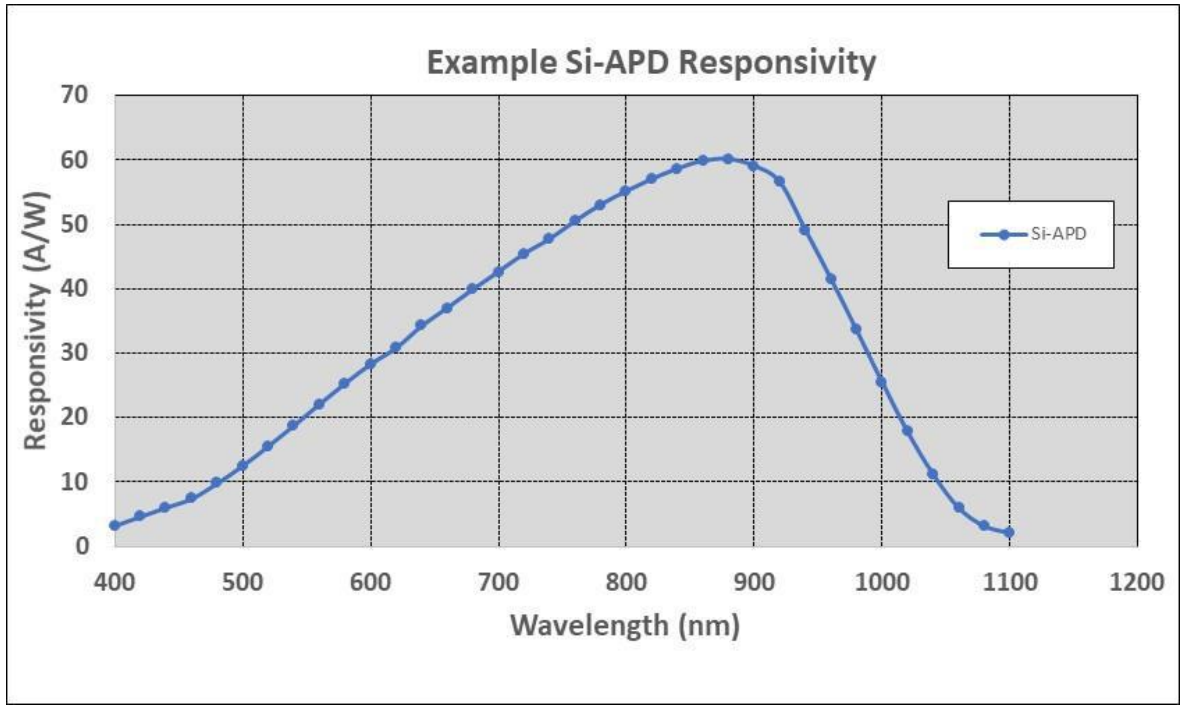
Detector Relationship

Laser wavelength and detector efficiency

- LiDAR system performance is not only dependent on the laser emitter, but the detector as well.

- Selecting a laser wavelength that is in the range of 900-940nm will lead to a selection of silicon based photodetectors.
  - Silicon based photodetectors such as: APDs, SPAD, and SiPMs, will continue to benefit from lower cost manufacturing capabilities.

- Furthermore, by adopting λ-stable technology for the laser, the photodetector technology can be optimized to enhance the spectral responsivity and quantum efficiencies for a narrow spectral operating range.



Key Takeaways

New λ-stable technology will offer LiDAR systems several key advantages

1. Increased range with same laser power
   - By reducing the optical filter bandwidth by a factor of 2, we estimate a range increase of 15%-30% over the existing laser technology.

2. Improved efficiency
   - Keeping the achievable range to a target the same, the λ-stable laser can be driven at a lower power level. We estimate the required laser power to detect the same target to be 25%-40% lower over the existing laser technology.

3. Lower system cost
   - By removing any TEC, the associated power consumption, and processing necessary for monitoring and activation will yield lower system costs.

4. Detector responsivity improvement
   - By narrowing the spectral operating range of the laser, photodetector technology can be optimized to improve responsivity and efficiencies which lead to overall LiDAR system performance improvements

Looking Ahead

ams OSRAM will be launching the first product with the λ-stable technology by the end-2022

- The λ-stable technology is currently being developed. Subsequent product rollout in 2-3 years

1st Product Launch
65W IR Pulsed Laser

Additional Products to Follow

- Expect continued adoption of “905nm” edge emitting laser technology in the automotive LiDAR market segment. Low cost and high performance are the key enablers.
- Value added features continue to be invested in. (e.g. laser + driver micro assemblies)
- Automotive grade SMD packaging will reduce manufacturing complexities and risks.

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