A Lower Cost, Semiconductor based HSRL, Designed for Application in Lidar Networks

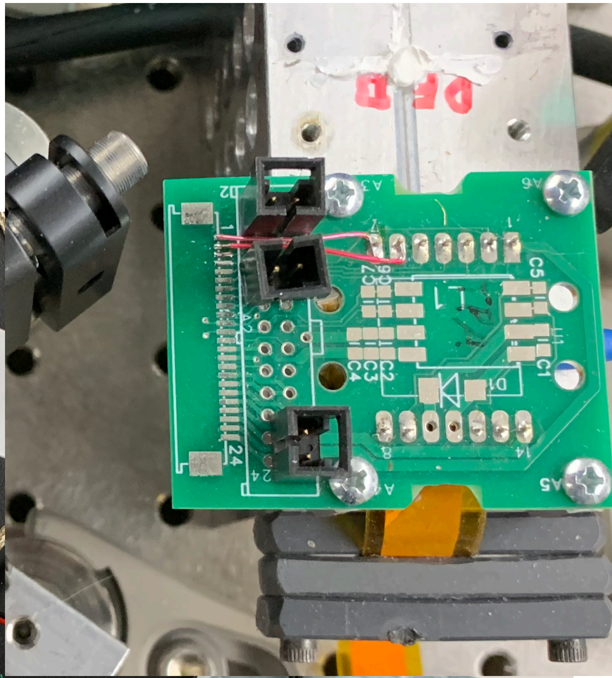
Our University of Wisconsin lidar group is developing a lower cost high spectral resolution lidar for potential application in lidar networks. This system leverages technology developed for fiber communications and physics research to reduce cost and increase system reliability.

System Characteristics:

1) Robust HSRL retrievals of backscatter cross-section without assumptions about the atmosphere.
2) Signal-to-Noise performance comparable to current micropulse lidars.
3) Semiconductor laser and fiber technology are expected to provide outstanding reliability.
4) Cost is expected to be 1/4 to 1/3 that of our standard HSRL systems.
5) The system is eyesafe at the exit pupil and operates 780 nm were it is not subject to FAA regulation.
6) No water chiller required. Much less power dissipated reduced air-conditioning load.
7) Smaller size—uses less shelter space.

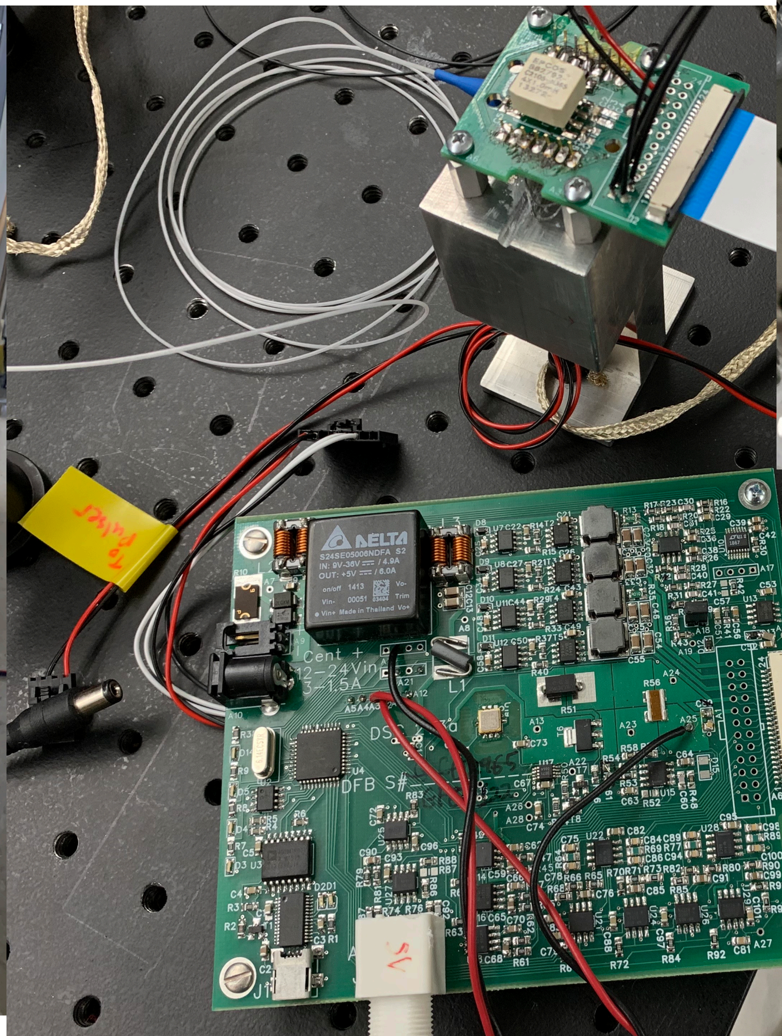
~$100k injection seeded laser system ------→ replaced by ~$15k semiconductor DFB and tapered amplifier

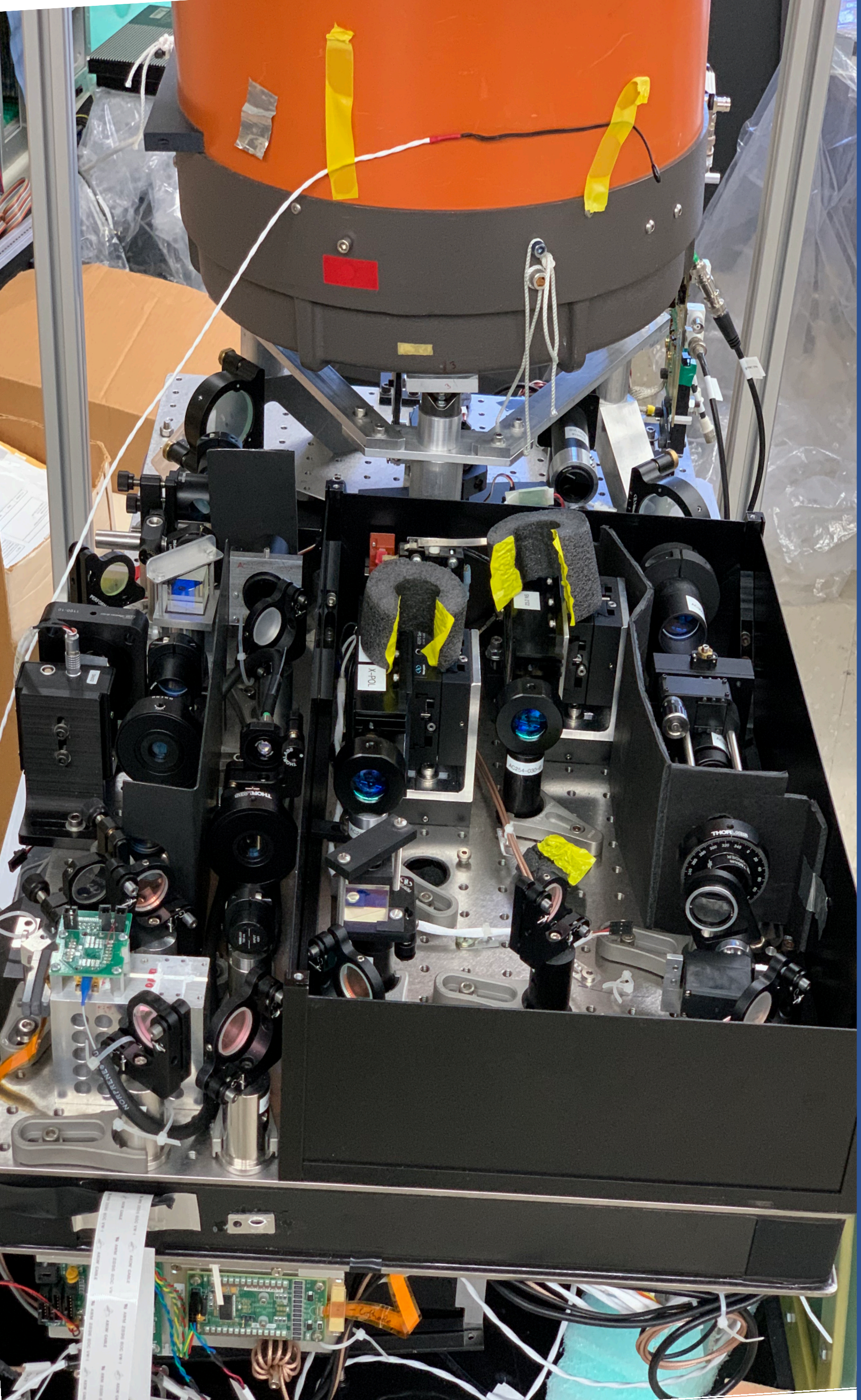
Tapered semiconductor amplifier



Seeded Nd-YAG laser in current HSRL

DFB master oscillator in RBHSRL





Rubidium HSRL

Standard HSRL

Comparison of Specifications

	Rubidium HSRL	Micropulse lidar	Standard I2 HSRL
Wavelength	780 nm	532 nm	532 nm
Pulse repetition rate [1]	8 kHz	2.5 kHz	4 kHz
Average power [2]	7 - 28 mW	25 mW	200 mW
Range resolution[3]	37.5 - 150 m	15 m	7.5 m
Telescope Diameter	35 cm	20 cm	40 cm
Receiver field-of-view	100 urad	~100 urad	100 urad
Power x receiver area[4]	8.6 – 34.3 W cm^2	10 W cm^2	320 W cm^2
Data channels	combined– 780 nm, molecular--780 nm, cross-pol --780 nm	combined—532 nm, cross-pol—532 nm	combined---532, 1064, 532 wfov, 532 low cross-pol---532, 1064 molecular---532, 532 wfov

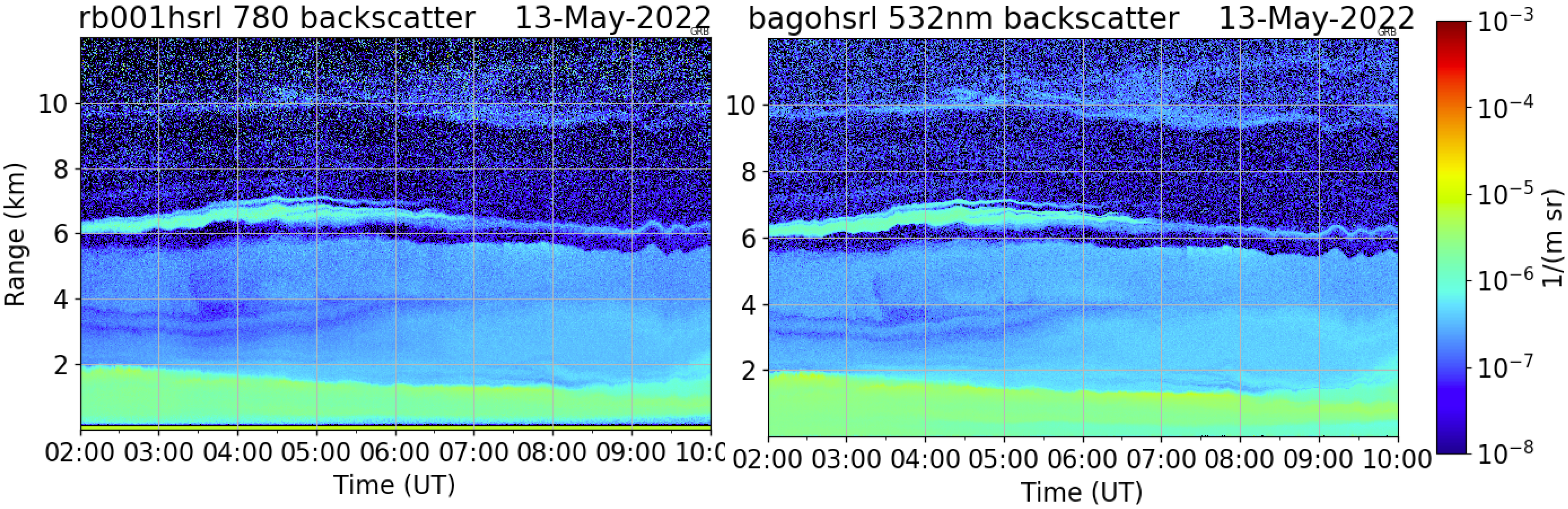
Notes: 1 – Rubidium HSRL provides a total of 8000 pulses per second which can be distributed between molecular and combined channels under program control.

2 – Rubidium average power depends range resolution used. The molecular channel varies less than the combined channel and will normally be recorded with a lower resolution.

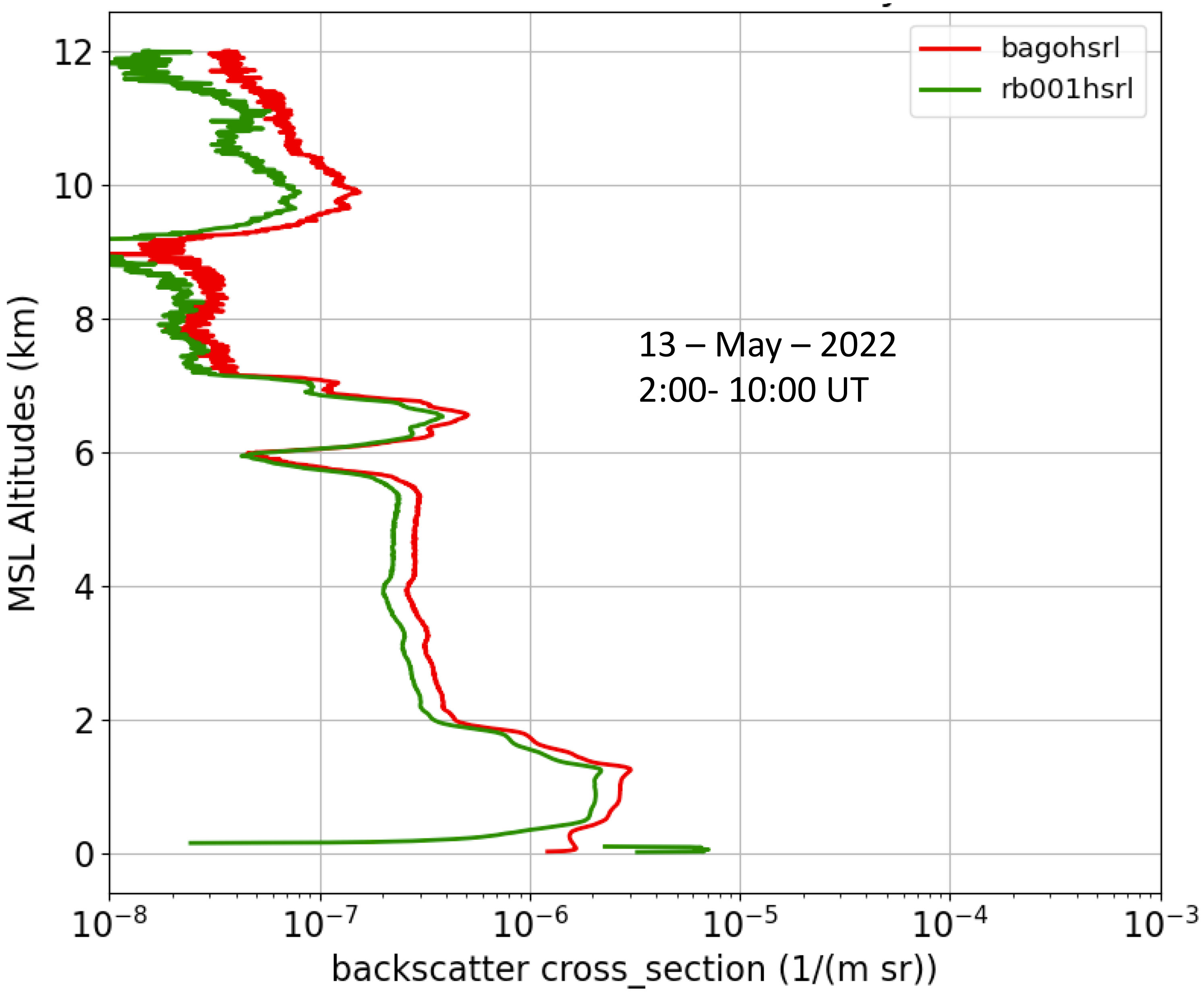
3 – Rubidium HSRL range resolution can be different for combined and molecular channels and a mixture of range resolutions can be selected in each averaging interval to produce a composite profile which optimizes range resolution and sensitivity.

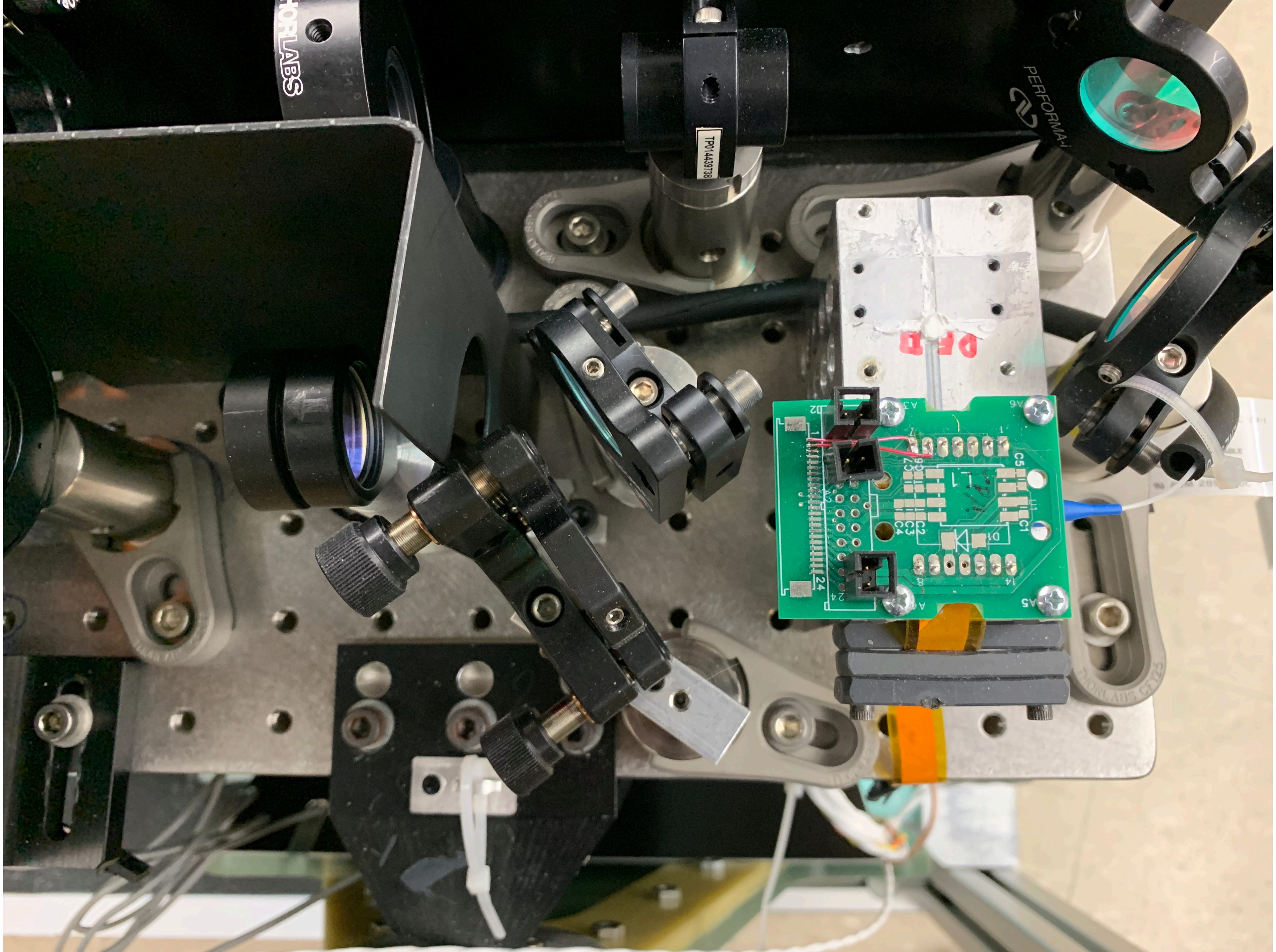
4 – The power-area product gives a rough estimate of relative system sensitivities except for the additional HSRL losses in the I2 and rb filters—the HSRL values should be reduced by ~1/2 to account for these loses. The range of values for the rubidium system depends on selected range resolution. The RBHSRL sensitivity is comparable to that of the micropulse with added advantage of robustly calibrated HSRL retrievals.

Comparison of backscatter cross-section images measured with rubidium HSRL and standard HSRL

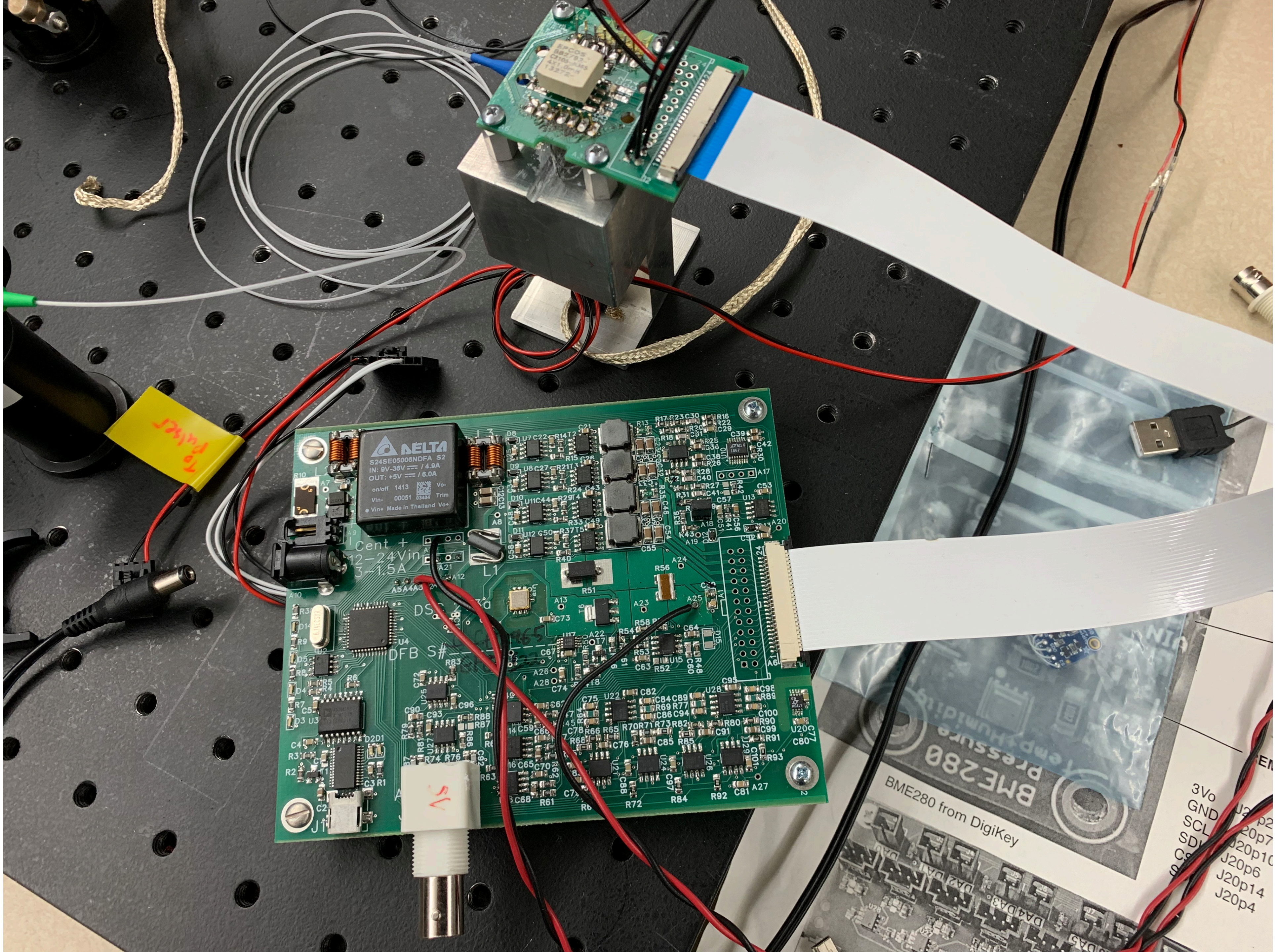


Comparison of aerosol backscatter cross-section profiles measured with rubidium 780 nm HSRL and standard 532nm HSRL, showing the wavelength dependence of the aerosol scattering cross-section





C5
C1
C2
C3
C4
D1
A5
A6



DELTA
S24SE05006NDFA S2
IN: 9V-36V / 4.9A
OUT: +5V / 6.0A
To Pulser
12-24Vin
5V
BME280 from DigiKey