Analog Optical Link Development at APC

DUNE VD-PDS meeting
31/03/2021

On-going activities

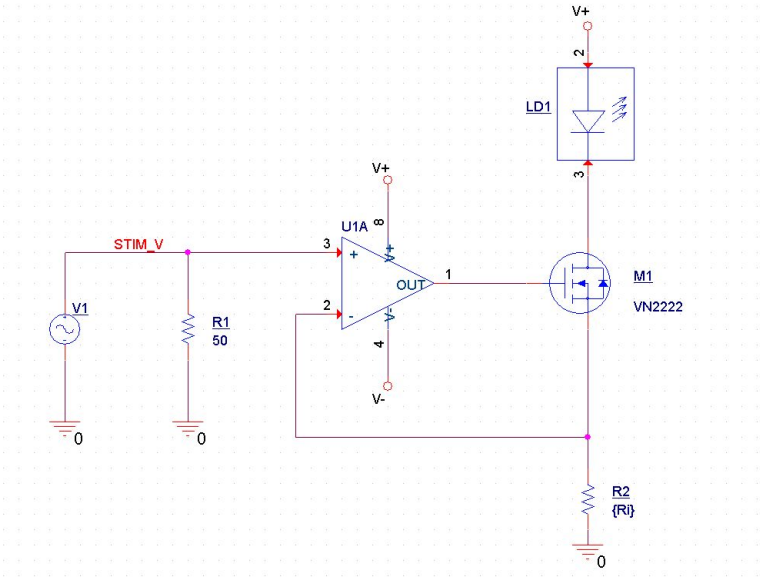
- Laser driver design:
  - expecting to have a basic driver circuit on PCB to start tests by the end of the week
  - have selected some components and hoped to be able to test them this week but have delays

- Toy setup test in LN_2
  - first test as exercise
  - useful to get a first estimation of parameters

- Optical tests at room temperature:
  - characterize VCSELs and LEDs
  - understand relevant parameters
  - and if it is better to do in-house connectors or factory-coupled devices
  - estimate possible optical power output at receiver

Laser Driver

- Sticking to the most basic design (+ LDO)
- A non-linear driver would allow to have a lower power laser, looking for possible implementations.
- Grounding:
  - is our ground shared with the SIPMs?
- Estimation of powering needs is a bit hard without a choice of components but
  - 6V for biasing
  - laser should take max 60mA at maximum signal
  - 20 mA constant for keeping it close to lasing

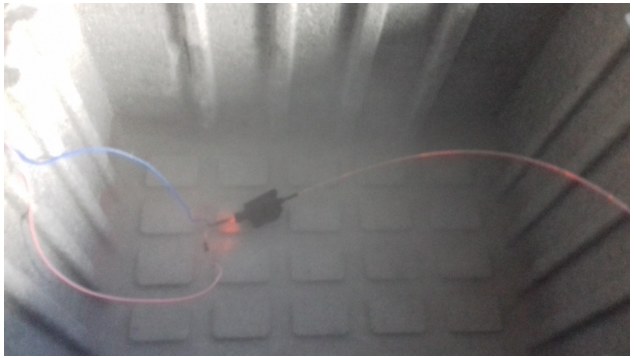


Playing with LED/fiber coupling - a quick test

- Large (1mm diameter) plastic fiber used
- Small hole drilled on the top of a LED

→ held together with heat shrink

(connection was more stable than expected!)



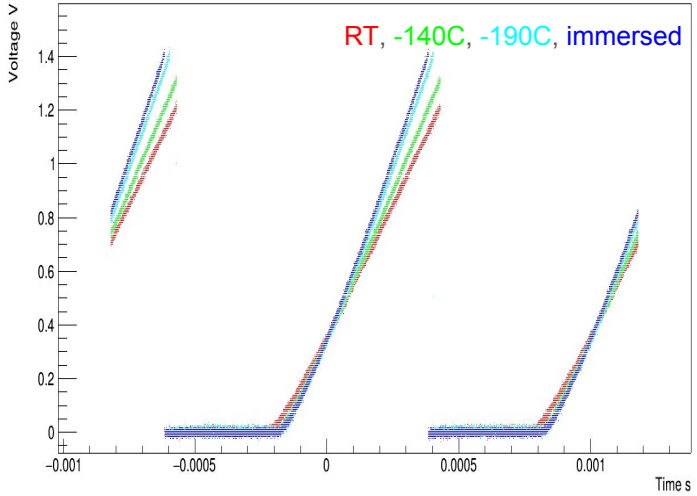
Setup tested

Pulse generator

Femto optical receiver

LED is not quick

→ tests limited to a few MHz



Some first estimations….

Based on Femto specifications, estimate 200 uW received through fiber

Femto noise is ~20mV pk-to-pk

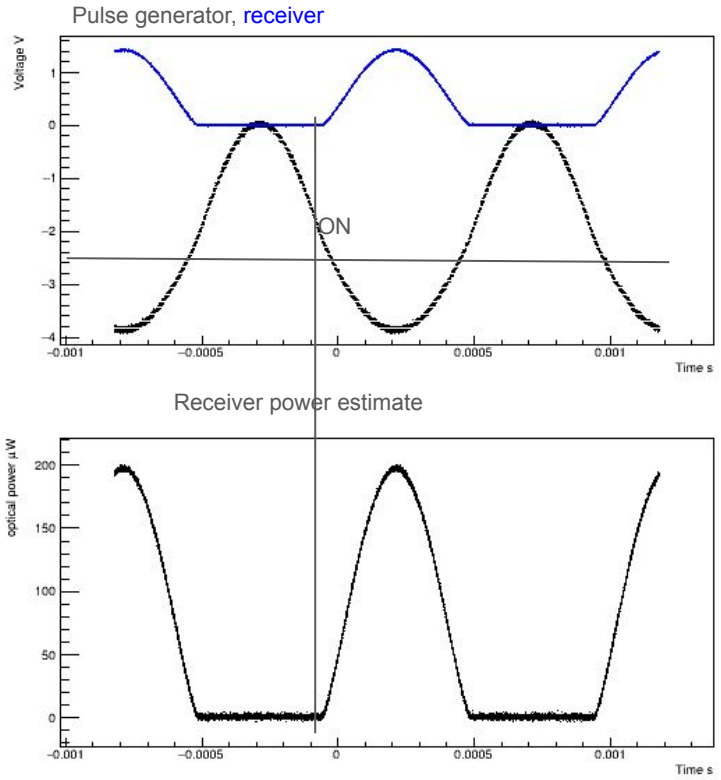
Femto Gain is ~7.2 mV/uW (accounting for wavelength)

So 10 uW signal would give S/N > 3

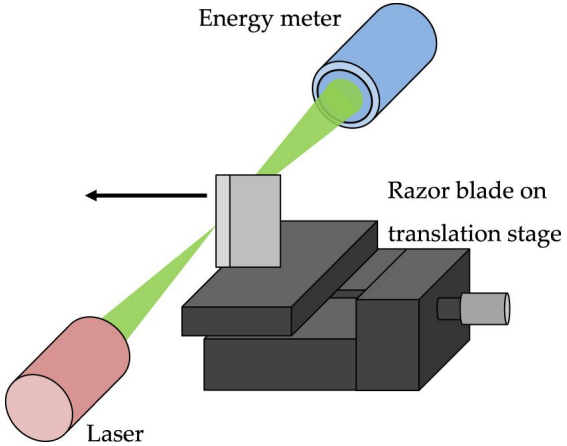
Perhaps this a good starting point for SPE?

Following this logic, here could transmit up to 20pes amplitude

So need to receive at least 2mW (for a factor 10)

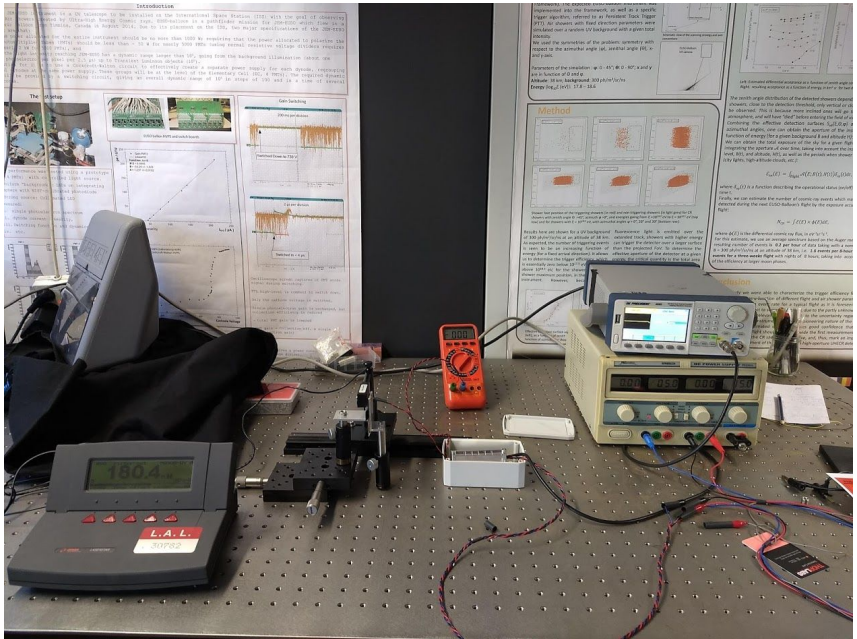


Optical tests at room temperature



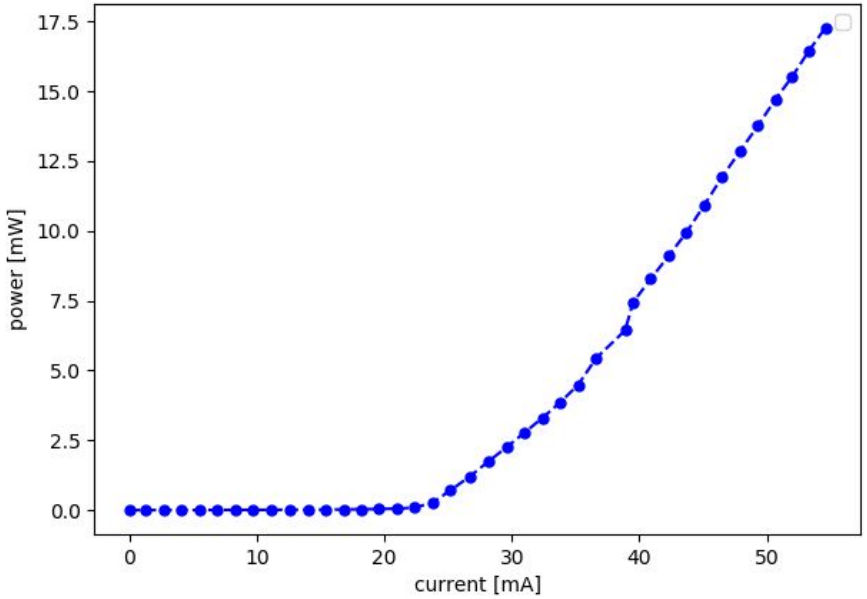
Ophir Photonics PD300-UV:
1x1cm^2 10pW-300mW sensor

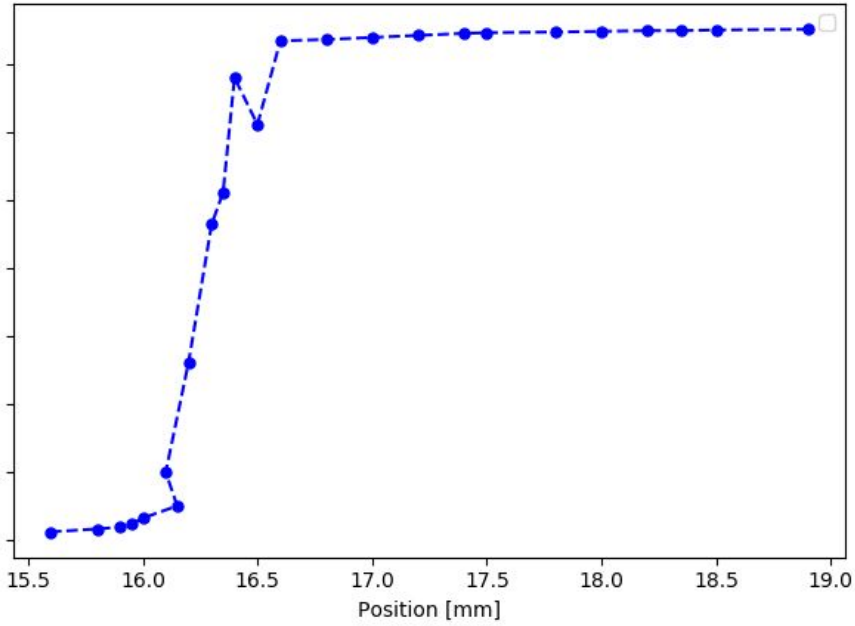
- Thorlabs 10mW VCSEL
  850 nm - LP808010
- in-house current driver



First measurements

→ Still finishing setup (missing some safety measures for IR lasers)





- Power vs I shows reasonable lasing point, but absolute power values look higher than expected → for 0.5mw/mA, 13mW expected at 50 mA (above max power output?)
- First test at measuring beam width ~1mm from window → 0.5 mm beam

Next

- Urgently start tests of laser driver in cold

- Optics:
  - test pigtailed devices to evaluate usage possibility
  - we have a more complete idea of the requirements
  - we are converging on an estimation of the needed "amount of light emitted - received" and S/N to cover the full dynamic range