Analog Optical Transceiver Status at APC

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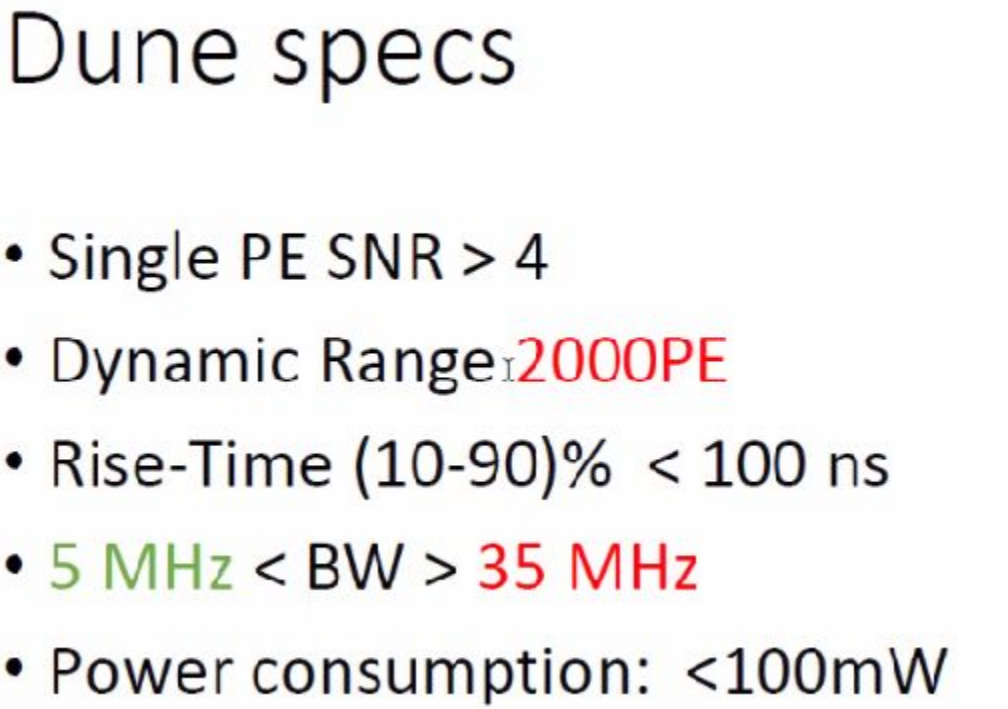
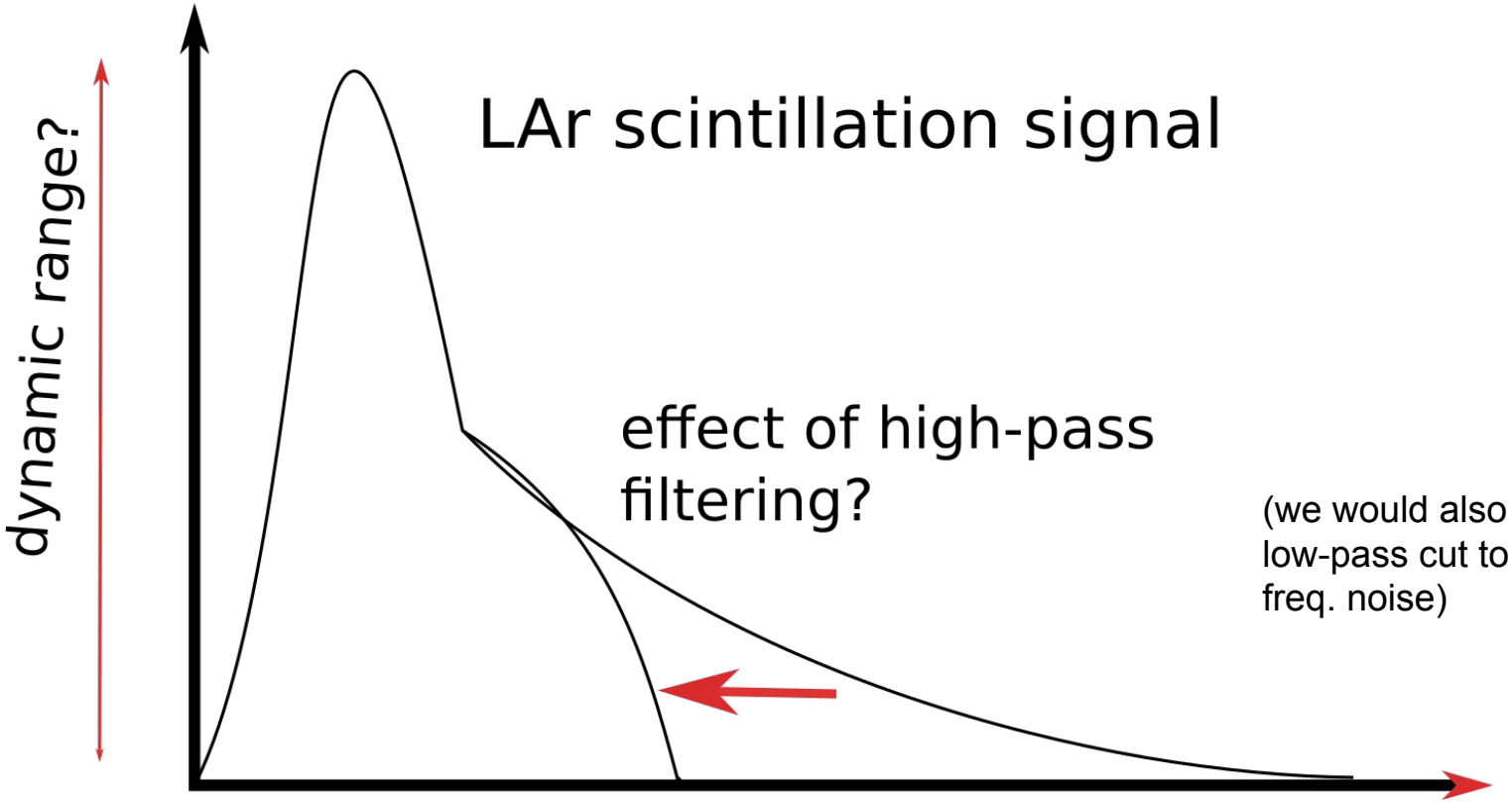
Requirements

We've followed the discussion with DarkSide, from which we take the following requirements/specs expected in the system… but we have questions



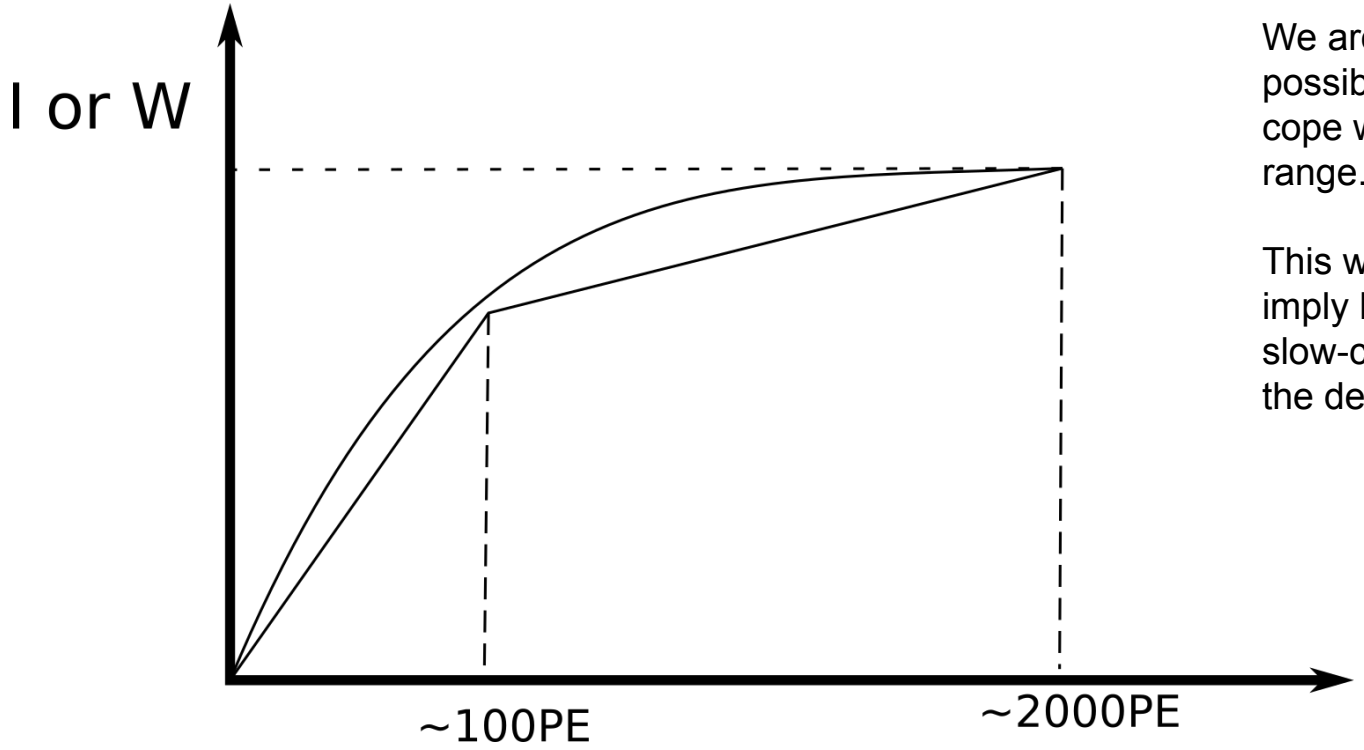
It would be useful to have some more information on the output of the ARAPUCA (max size of signal, capacitance?, impedance)

Getting the terms right?



(we would also include a low-pass cut to get rid of high freq. noise)

Idea to have a non-linear transmitter

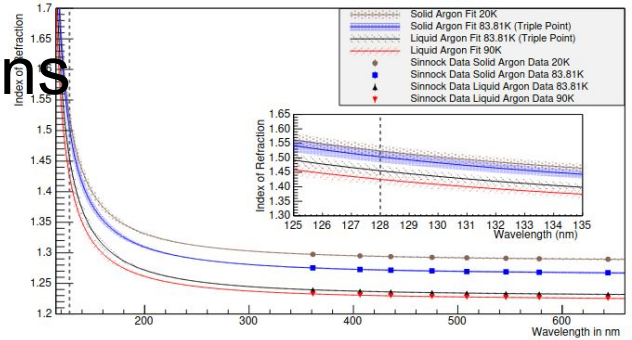


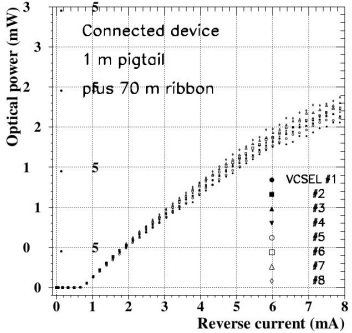
We are considering this possibility in order to cope with the dynamic range.

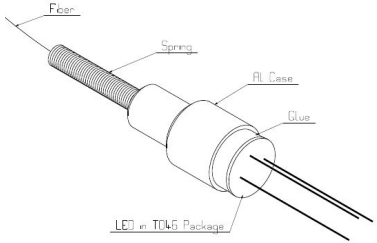
This would possibly imply having slow-control included in the design.

Prototype Transmitter board - connections

- How best to connect fibre to laser diode?
- Sealed or liquid argon seeps in?
- Expect slight losses to occur at connection with fiber as components constrict. May have large variation from connector to connector?
- Include calibration circuit to investigate and monitor changes

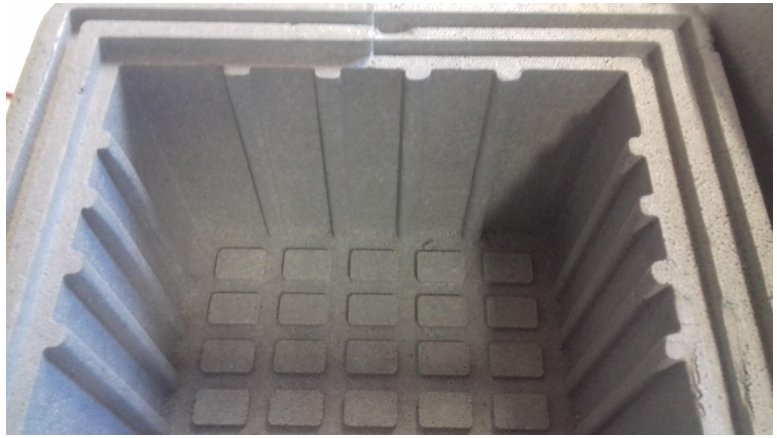






ATLAS solution - fibre glued to lens on LED
ATLAS-LARG-NO-8

Equipment at Lab



Short cold tests will be performed in a loosely closed styrofoam box with interiour 235mm x175mm x 150 mm (deep)

Black cloth (and if necessary large dark box) for light tightness

Temperature monitoring by thermocouple

Start with commercial photodetectors

- FEMTO (HCA-S-200M-SI-FC, 320-1000 nm, 200 MHz)
- *For longer wavelengths either ultra-fast PD UPD-500-UD (1100nm) or order

Under development

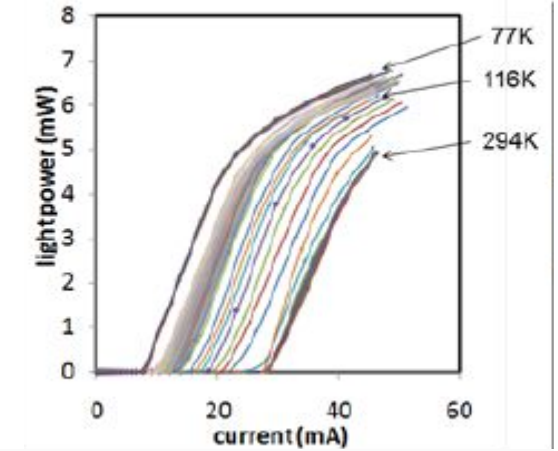
- Prototype transmitter board
- Receiver

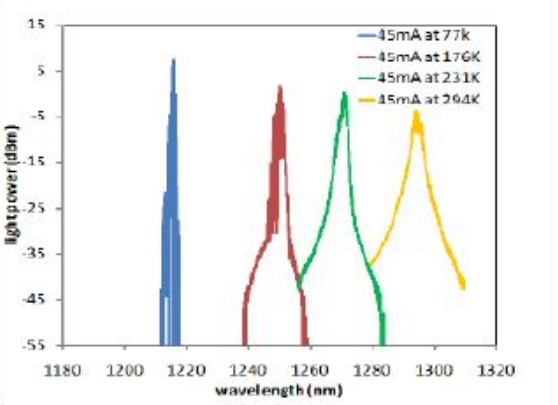
*We didn't consider the possibility of fibers leaking or breaking, yes going to a longer wavelength would be best to screen SiPMs from this light

Prototype Transmitter board

Several components have already been tested in Liquid Nitrogen (Liu et al, JINST 7 C01091 2012), recent discussions with you (DarkSide), ATLAS, upcoming GERDA

- bought several VCSEL (Vertical Cavity Surface-Emitting laser) limited to cheap 20 mW
- I-V, LightPower-I curves change with lowering temperature - have to characterise
- expect Slight reduction of emission wavelength
- Include calibration circuit to investigate and monitor changes





Fiber

Following discussions

Multi-modal seems best (connection to laser diode will be better)

Care with outer coating material

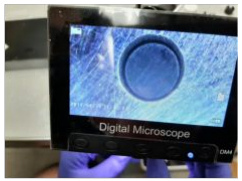
Opto-mechanical components: Fibers

- Additionally, we decide to test cryogenically an optical fiber with TEFZEL coating.
  - TEFZEL (ETFE Ethylene TetraFluoroEthylene): Belongs to the fluoropolymer family.
    - Excellent dielectric insulation properties.
    - Wide range of operating temperatures
- We make the SMA connections to the optical fiber ends.
- The TEFZEL optical fiber has been in liquid nitrogen since ~ 1 month ago.

No mechanical or optical issues with the TEFZEL coating

Before Polish the optical fiber end

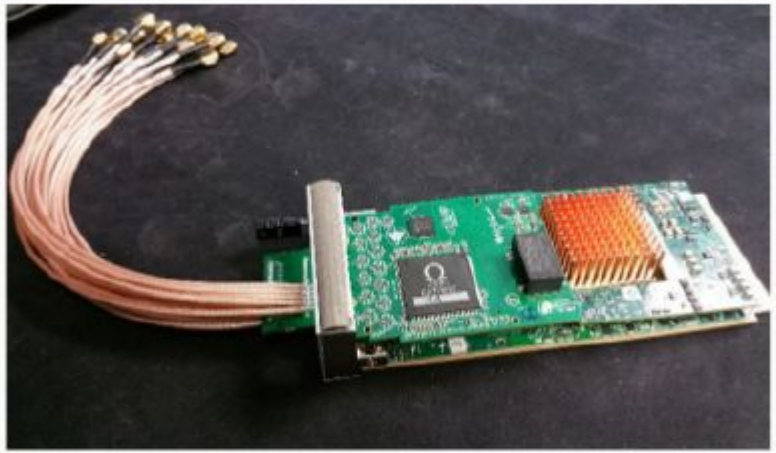
After Polish the optical fiber end



Photon Detector Calibration/Monitoring System
Zelimir Djurcic, David Martinez Steve Magill, Aleena Rafique, Patrick DeLurgio Mike Oberling, Todd Hyden, Marco Trocato, Landon Marzahn, Kole Pickner, Robert Munyan, Arturo Fiorentini, Jairo Rodriguez. collab meeting Jan 26th

Receiver

- uTCA standard (previous effort)
- Commercial Motherboard FPGA (StratixIV)
- Custom daughter board
  - ADC chosen - AD LTC2155-14 - Dual 14-Bit 170Msps ADC
  - SFP-like receiver
    - LMH32401 (450 MHz transimpedance amplifier)
    - PIN diode S5973-02



Previous development for Dual Phase