Rome Cryolab

BULLKID KOM

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The lab

- \- Total surface of about 100 m^2
- \- 1 DR currently operating
- \- 1 DR will arrive in 1 yr
- \- 1° floor of a historical building (working to allow a higher load on the floor)

The present: PUPONE

- Oxinst Triton 200

- (Well) operating from 2016

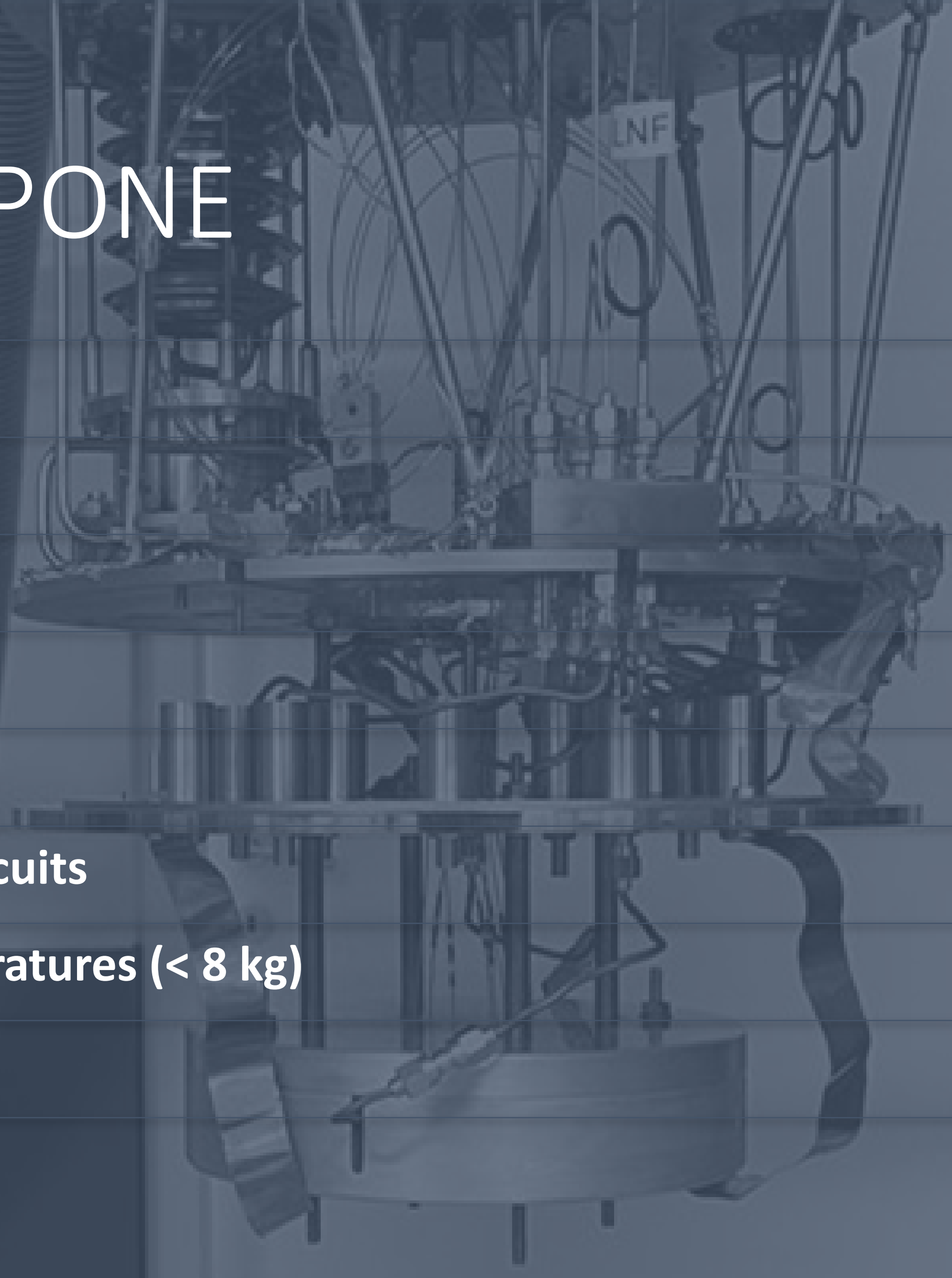
- Base temperature 25 mK

- Antivibration stand

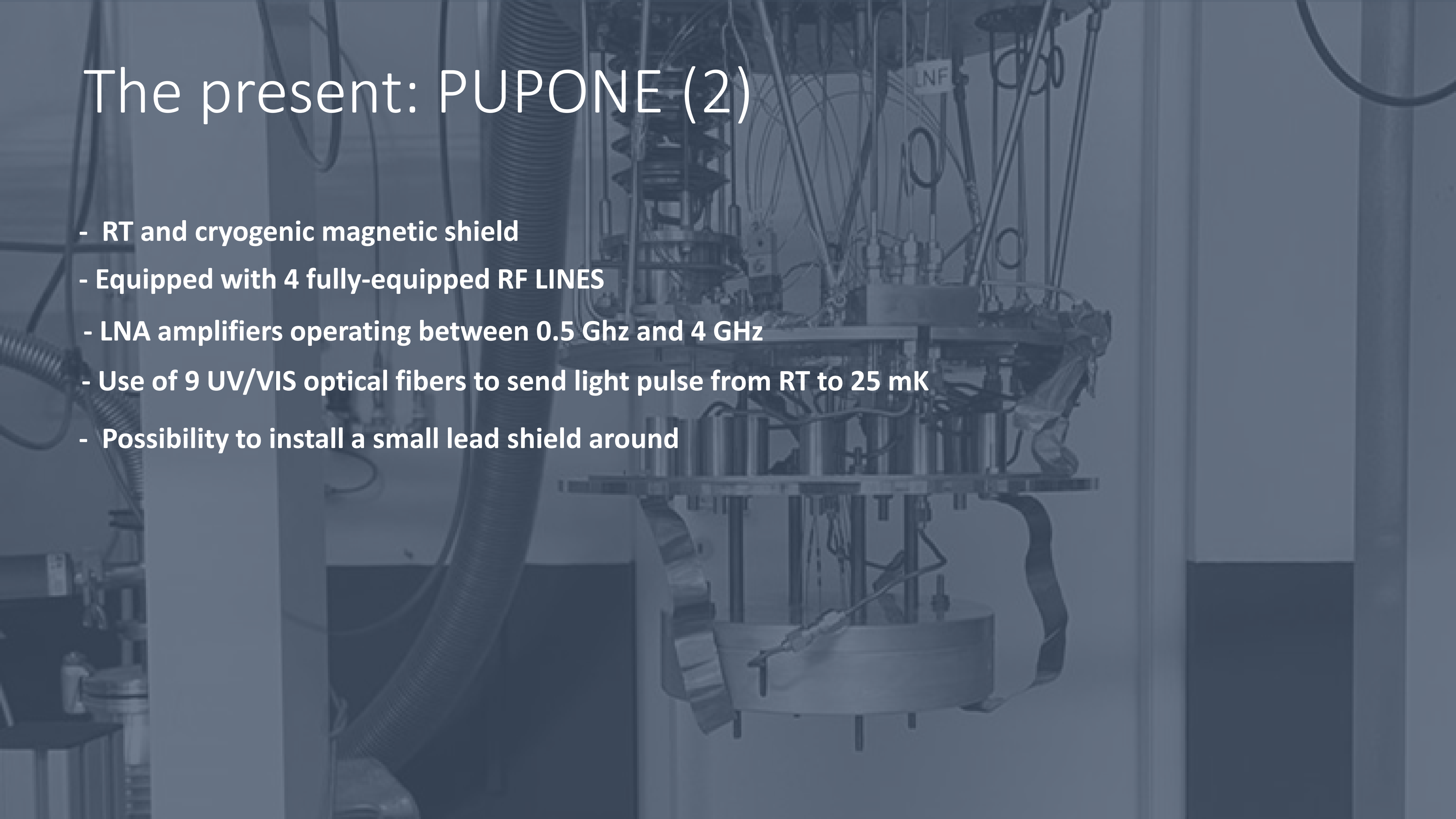
- Cryomech PT410 based

- Precooling through a dedicated circuits

- Limited weight load at low temperatures (< 8 kg)

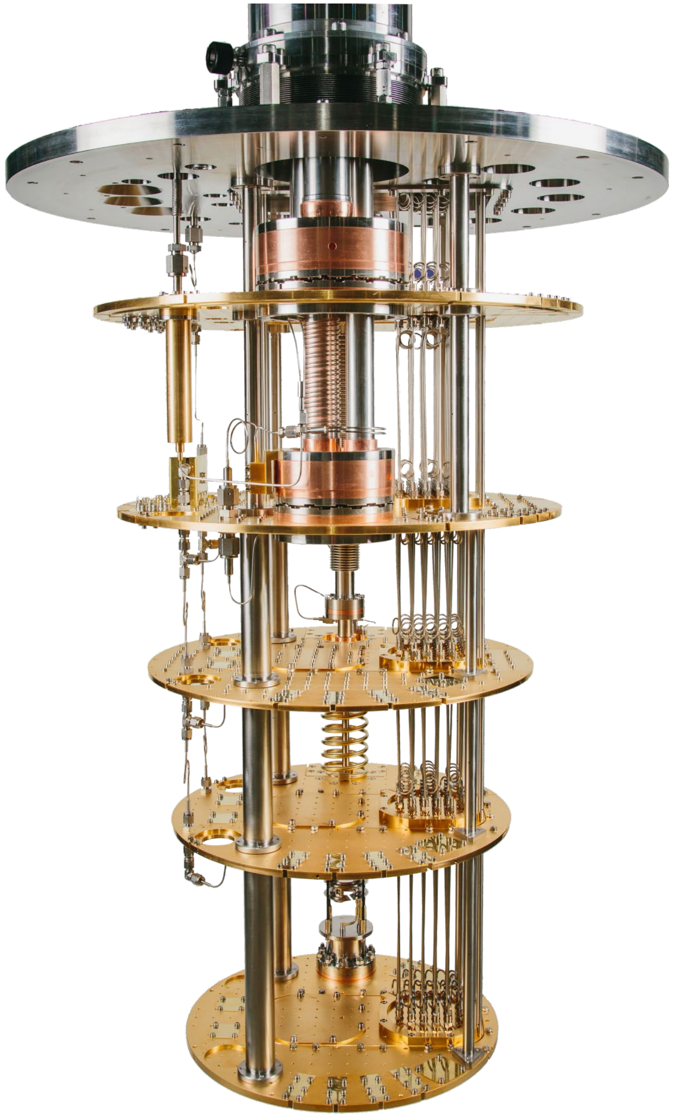


The present: PUPONE (2)



- RT and cryogenic magnetic shield
- Equipped with 4 fully-equipped RF LINES
- LNA amplifiers operating between 0.5 Ghz and 4 GHz
- Use of 9 UV/VIS optical fibers to send light pulse from RT to 25 mK
- Possibility to install a small lead shield around

FUTURE cryostat



MODEL	Triton 200	Proteox MX 450
Exp. room	d: 24 cm h: 20 cm	d: 36 cm h: 65 cm
Pulse tube	PT410	PT420
Optical fibers	9 → 64	128 (?)
RF lines	4	16
Load limit @ MC	8 kg	250 kg
Time of cooldown	1-2 days	1 day -> 2 weeks (?)

Sapienza
Università di Roma

LANTERN: A novel characterization technology for cryogenic detectors

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Calibration Procedure

Based on Poisson Distribution

$$\mu = r \cdot N_{ph}$$

Assuming total linear dependence

$$\sigma = \sqrt{N_{ph}} \cdot r = \sqrt{\mu \cdot r}$$

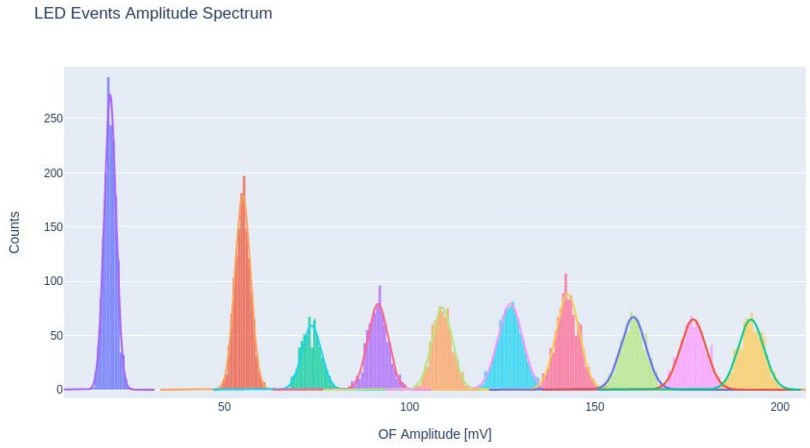
Fitting Function:

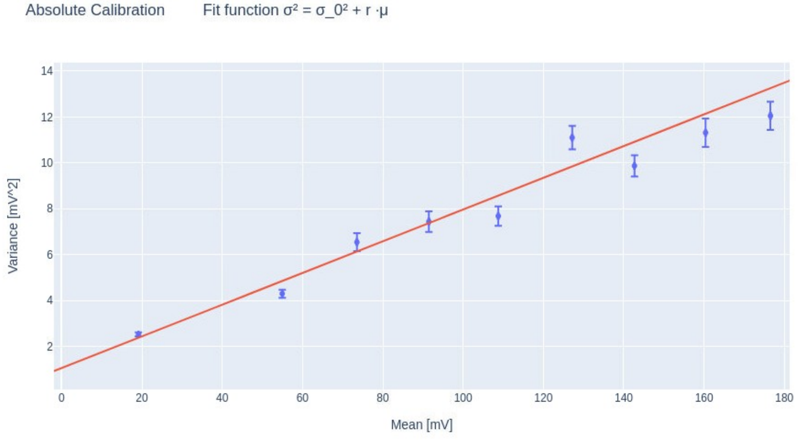
$$\sigma^2 = \sigma_0^2 + r \cdot \mu$$

$$\sigma_0 = \text{Detector Threshold}$$

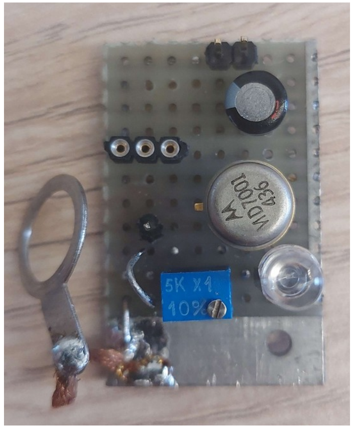
$$r : \frac{\text{mV}}{\text{photon}} \qquad k = \frac{\text{photon energy}}{r} \left[\frac{eV}{mV}\right]$$

Based on: https://doi.org/10.1088/1361-6668/aac1d4

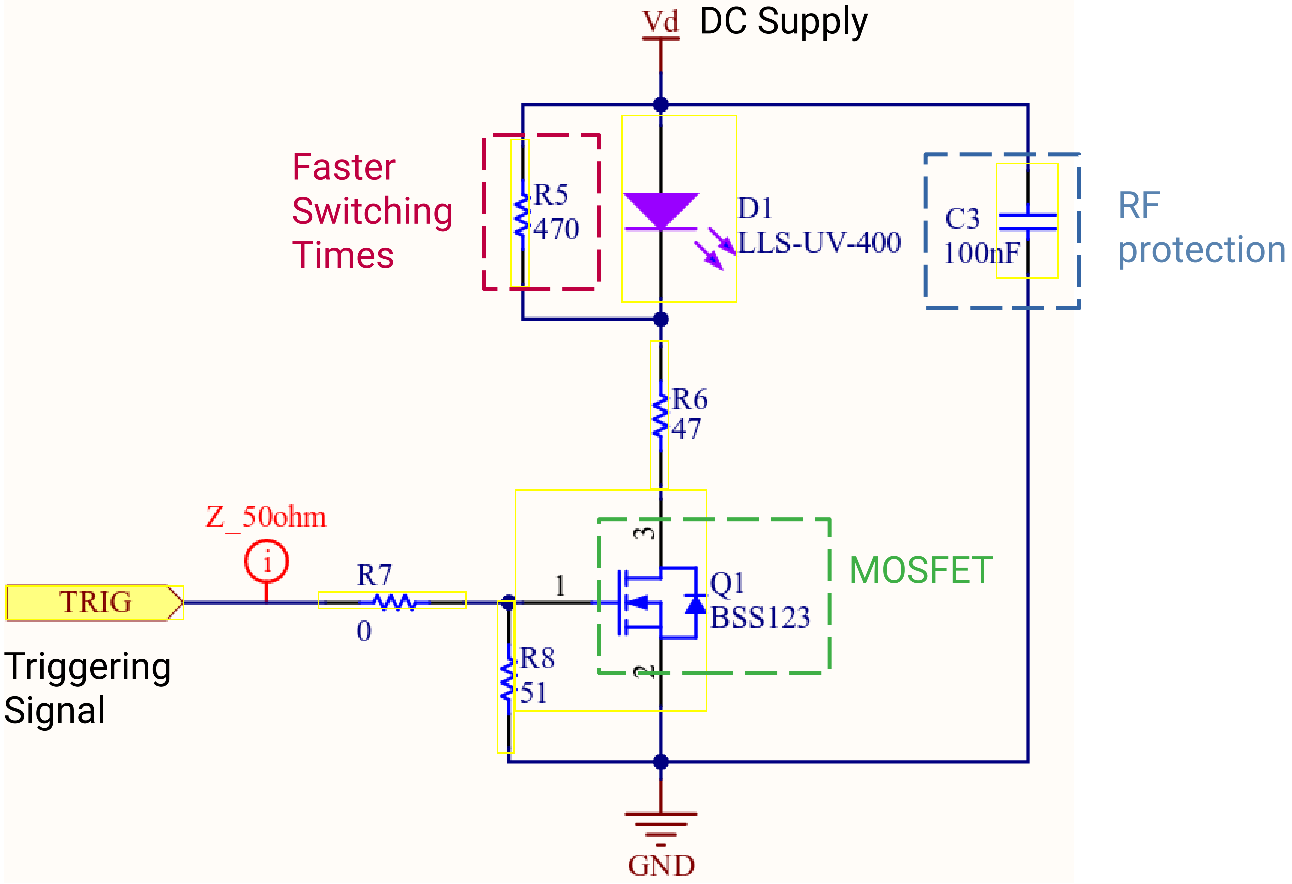




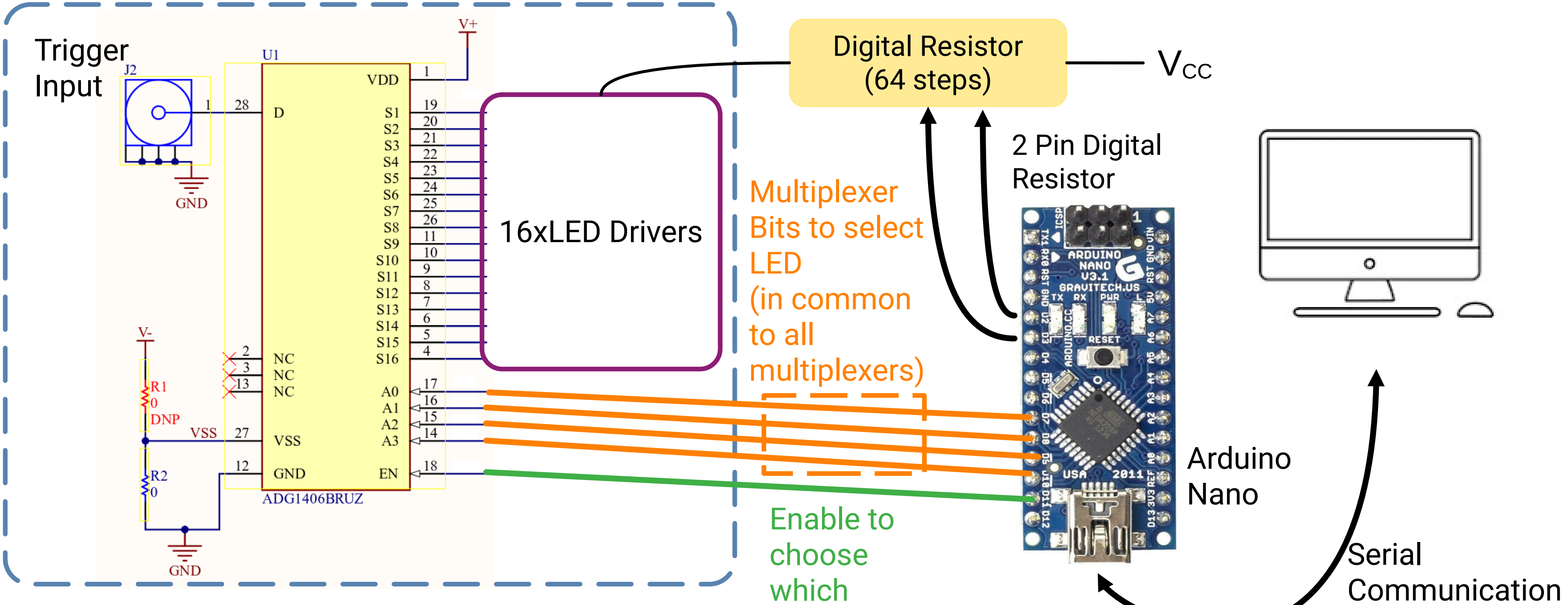
LED Driver Circuit



Single LED driver prototype with several circuit attemps

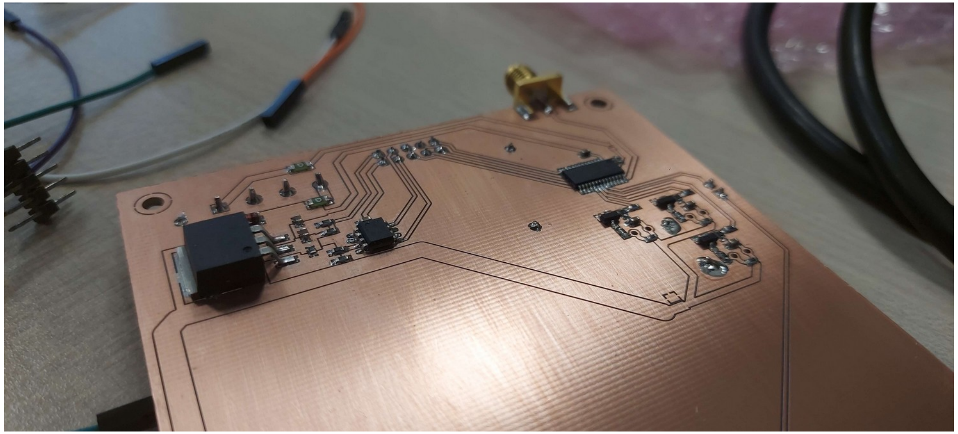


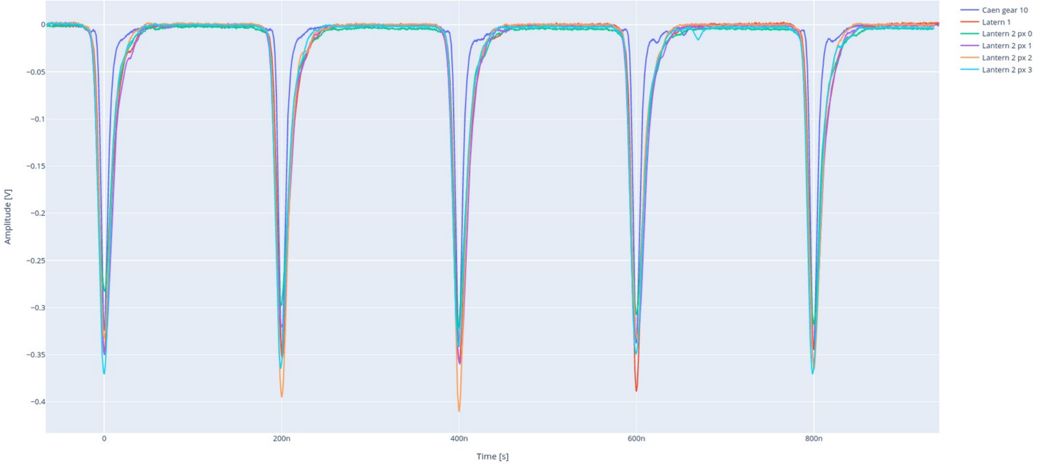
Multiplexing and Light Reulation



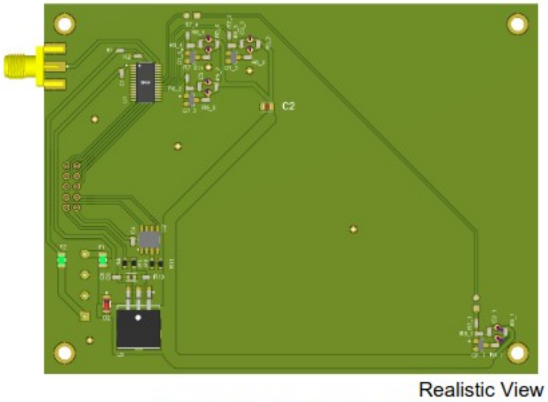
Repeat 4 times to reach 64 LEDs (3’’ BULLKID wafer)

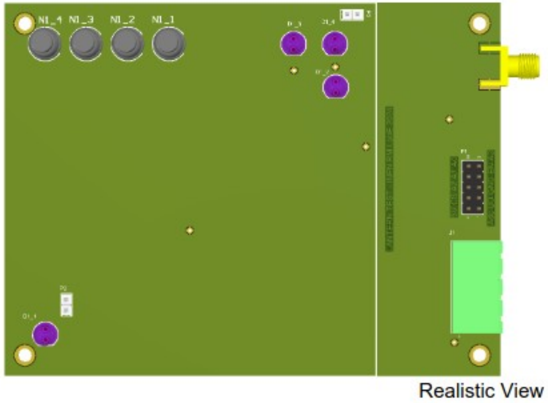
Final Prototype





Multiplexing prototype with 4 LEDs





Comparison of 4 LANTERN channels and reference CAEN LED light yields on PMT:

- Compatible switching times
- Much more light available

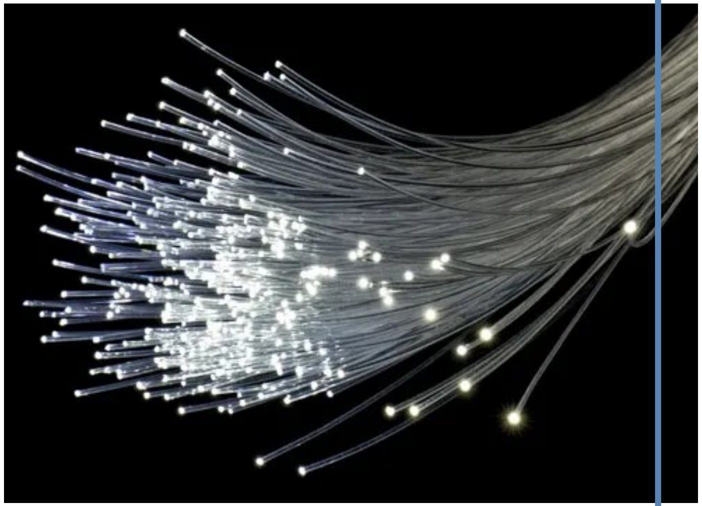
- Light Power is controlled remotely by digital potentiometer

Optical Coupling

LED-
Fiber
mounting

Ferrule

LED

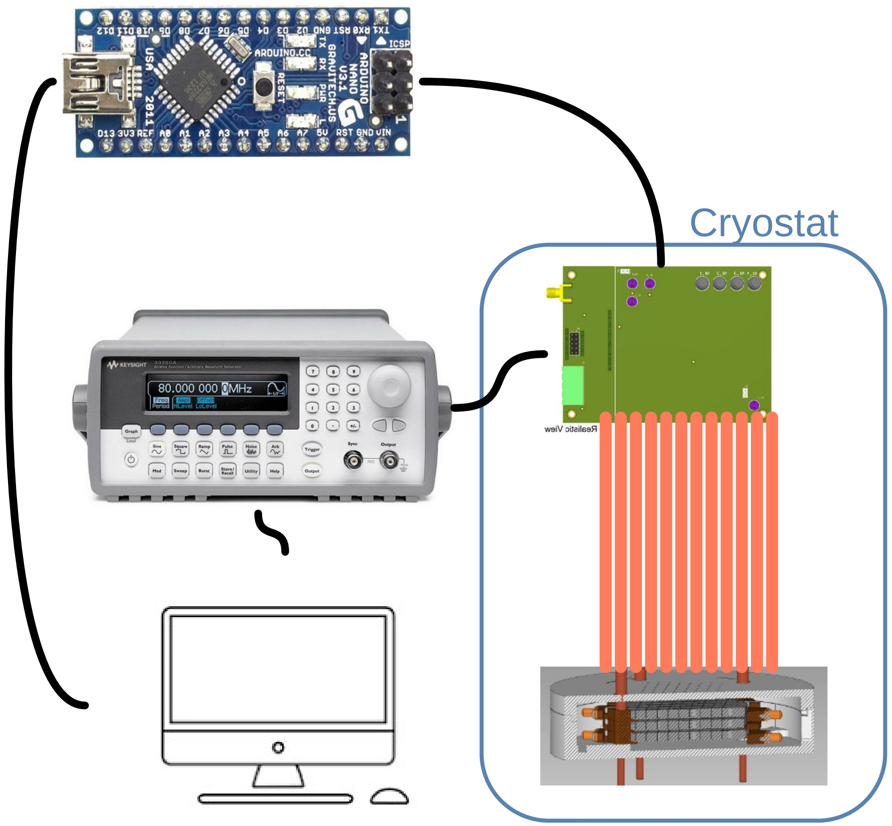


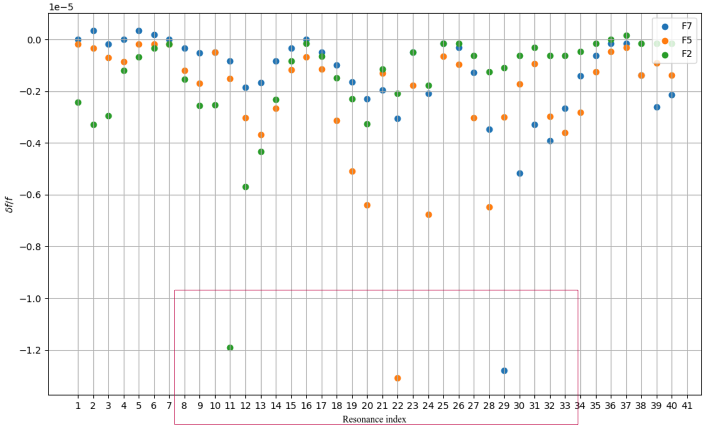
Fiber Bundle

BULLKID 3’’

To be defined due to
cryogenic constrainings

Mounting, Other Applications and Conclusion





Stacked pixel identification using IR light (1200nm)

Cons

- Calibrating stacked is not trivial
- Calibration through ER (need to be proven that NR are the same)

Pros

- System almost ready
- Easy to use & cheap
- Easy to modify to meet specifications
- Could be coupled with temperature calibration for staked calibration

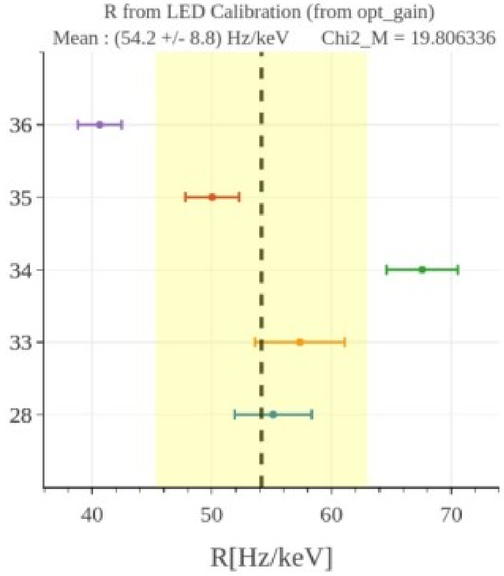
Thank you for your attention!!!

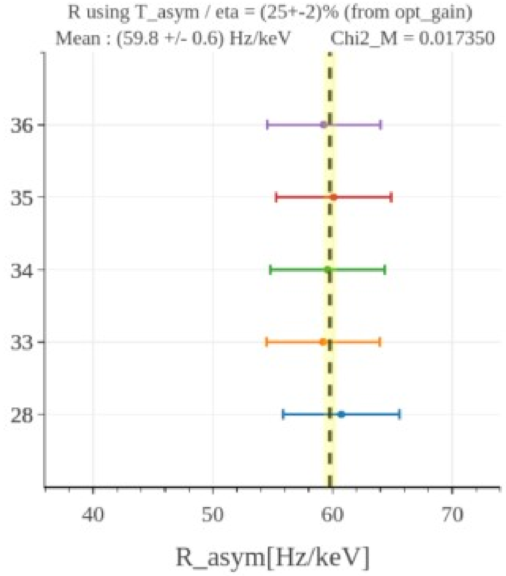
Backup: Temperature Calibration

From temperature scan

$$\frac{d(\Delta f)}{dE} \equiv R_f = \eta \frac{\alpha S_2(\omega_0, T) f_0}{4 N_0 V \Delta_0^2}$$

From LED calibration





The rest of the quantities are known or measured from the VNA

From M. Giammei's thesis: Calibration of a kinetic inductance detectors array for Neutrino scattering and low-mass Dark Matter