



**MONASH**  
University

# Monash University Laboratory Status

**Monash Warwick Alliance in Particle Physics Meeting 13/03/24**

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# Introduction

- Time of Internally Reflected Cherenkov light (TORCH) detector upgrade will be used for low momentum PID
  - See Eliot's talk for more details
- Proposal is to use SiPM detectors for detecting Cherenkov radiation from the quartz detector material, with a requirement order 10 ps time resolution
- We are setting up a new laboratory space to test the time resolution/suitability of various SiPM detectors at Monash University

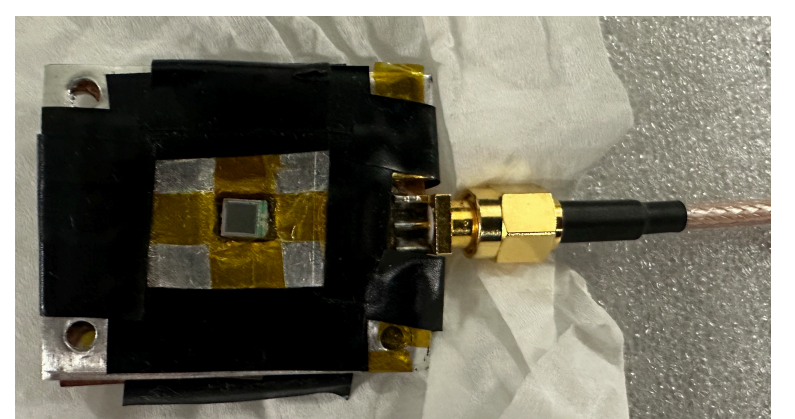
# Initial Setup

A first step will be a simple time resolution measurement of a SiPM candidate(s).

In this setup the time tagger can be utilised by looking at distribution of photons from laser as recorded by the SiPM.

Also requires timing jitter of laser:

$$\sigma_{SiPM} = \sqrt{\sigma_{Measured}^2 - \sigma_{Source}^2}$$



**Test SiPM #1: Hamamatsu S14160-3015PS**

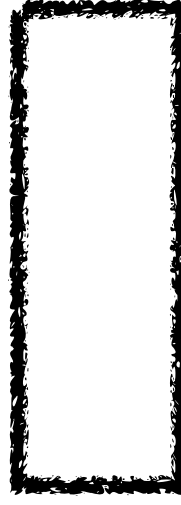
- > 20 % PDE @ 375 nm
- V<sub>Br</sub> ~ 38 V
- Gain: 3.6 × 10<sup>5</sup>
- Dark Count: ~700 kcps
- Terminal Capacitance: 530 pF

Time Jitter ~ 3-5 ps

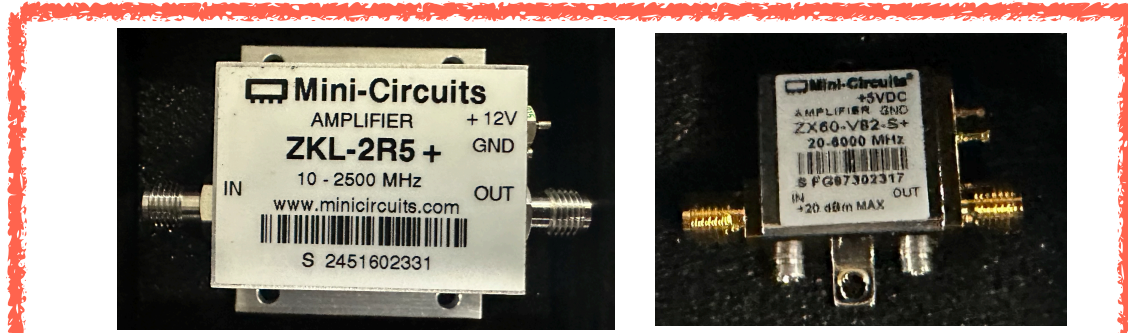
**PicoQuant Taiko PDL M1**  
Picosecond Diode Laser Driver



**Swabian Instruments Time Tagger Ultra (Performance)**



Readout and biasing electronics



Currently have two commercial RF amplifier options for initial measurements

Wavelength (± 10) [nm]	Type (LDH-)	Pulse <sup>1</sup> (FWHM) [ps]	Max. rep. rate [MHz]	High avg. power <sup>2</sup> [mW]	Low avg. power <sup>3</sup> [mW]	CW power [mW]
375	IB-375-P	< 40	70	3.0	1.0	10

**PicoQuant LDH-IB-375-P**  
373 nm Laser Diode Head



3.0 m Single Mode FC/APC Optical Fibre

SiPM

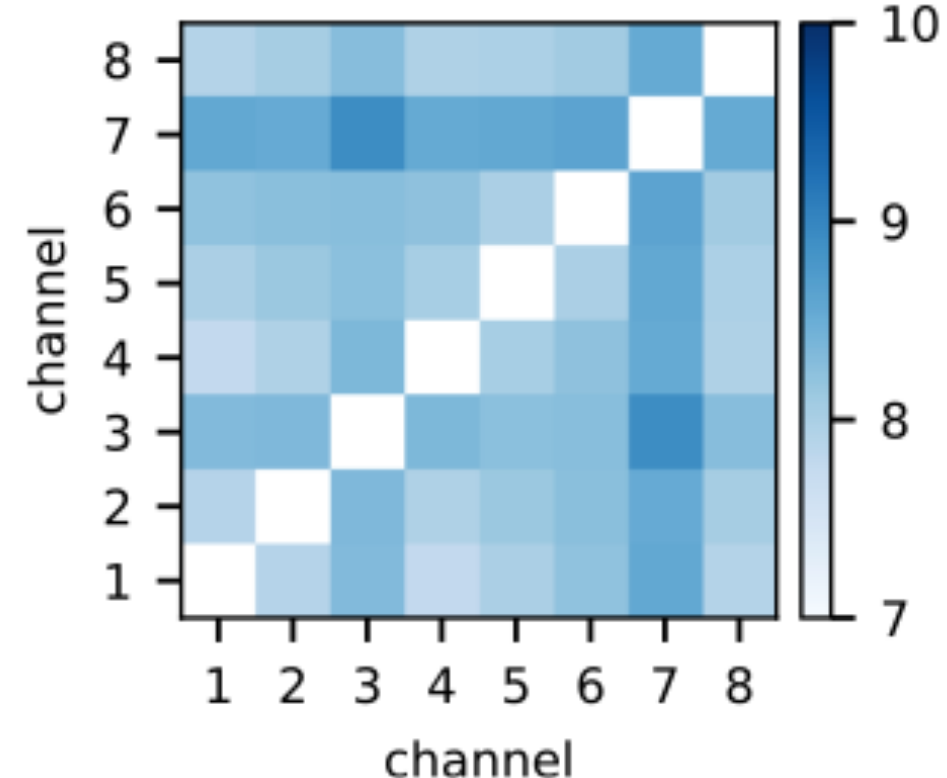
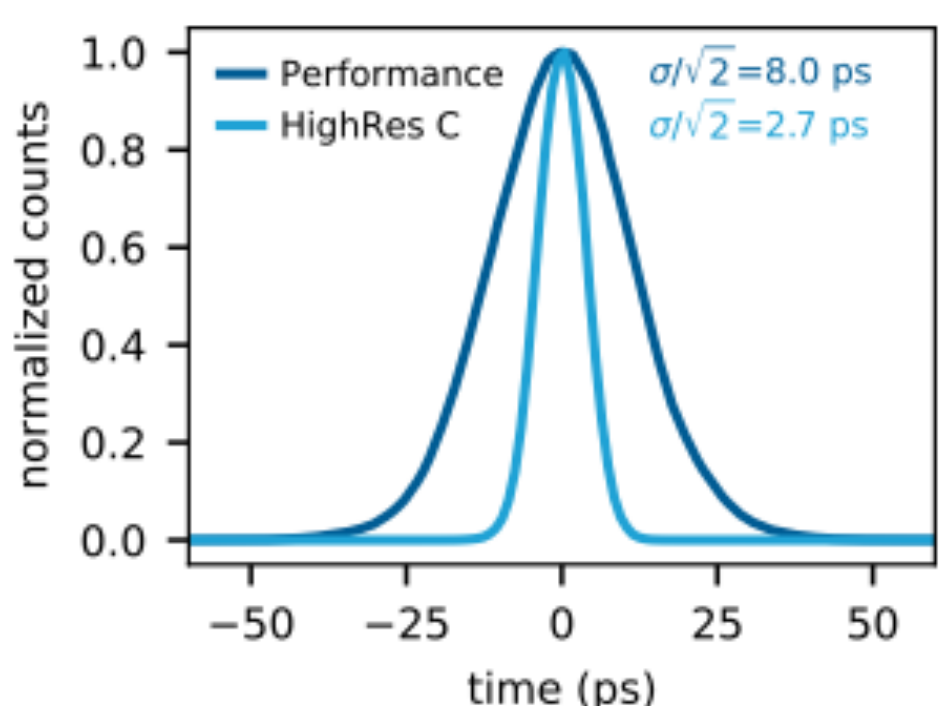


Thorlabs Cage Mount Components

Thorlabs CFC2A-A Adjustable Fibre Collimator  
(FC/APC, f = 2.0 mm, 350 - 700 nm AR Coating)

Thorlabs Aluminium Optical Enclosure

Time Tagger Ultra



Timing precision

	Time Tagger Ultra	
RMS jitter (typical)	8 ps (Performance)	42 ps (Value)
RMS jitter (typical, HighRes)	3 / 4 / 6 ps (2 / 4 / 8 HighRes channels)	
FWHM jitter (typical)	19 ps (Performance)	100 ps (Value)
FWHM jitter (typical, HighRes)	7 / 10 / 14 ps (2 / 4 / 8 HighRes channels)	
digital resolution	1 ps	

# Current Status

- Optical enclosure, laser and optical mount for collimator installed
- Approved to begin using laser once interlock is installed
- In process of obtaining SiPM options and making mount for optical cage
- Timeline is approximately 1-2 weeks before we can begin using the setup!

