

# Preliminary Study on Timing Characteristics of Fast SiPMs

**Peng Hu on behalf of**

Dong An, Peng Hu, Min Yan, Lishuang Ma, Sen Qian

The 23rd IEEE Real Time Conference

01 - 05 August 2022

# Design of the amplifier circuit board

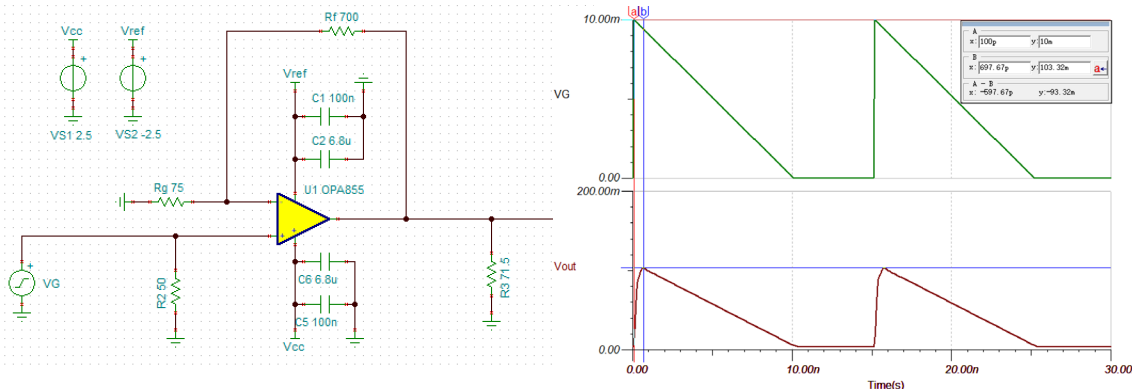
- ❑ A fast-timing amplifier circuit board is needed for fast silicon photomultipliers (SiPMs) to enable single photoelectron calibration and keep excellent time resolution

candidate amplifiers

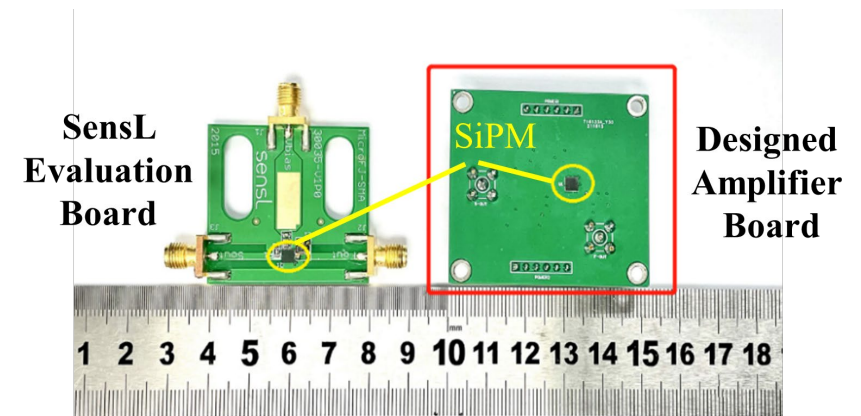
Parameters	OPA847IDB VT	OPA855	OPA856	OPA858	AD8099	AD8045
Gain bandwidth (GHz)	3.9	8	-	5.5	3.8	-
Bandwidth (GHz)	0.35	2.5	1.1	1.2	0.55	1
Gain	20	7	1	7	10	1
Slew rate (V/ $\mu$ s)	950	2000	350	2000	1350	1350
RT (ps)	1000	170	750	300	600	1000

Parameters	Gain	Noise [mV]	Bandwidth [MHz]	Power [mW]
Target Value	10	1	1000	50
Simulated Value	10.3	0.5	>1000	40
Measured Value	10.5	0.8	>1000	45

- OPA855 is a broadband, low-noise operational amplifier with bipolar inputs for broadband transimpedance and voltage amplifier applications

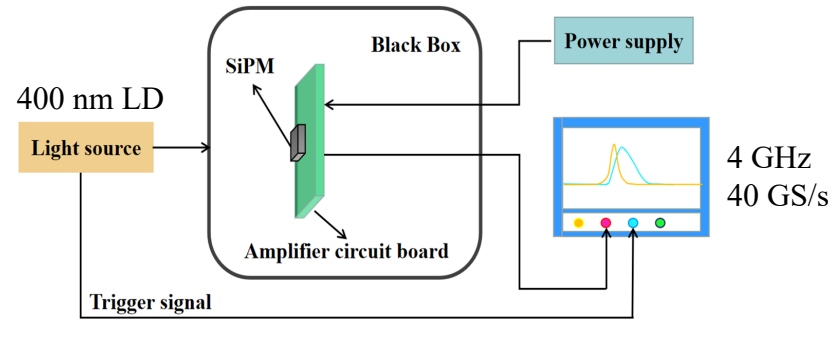


- A simulation based on TINA-TI was done to select a set of reasonable resistance and capacitance



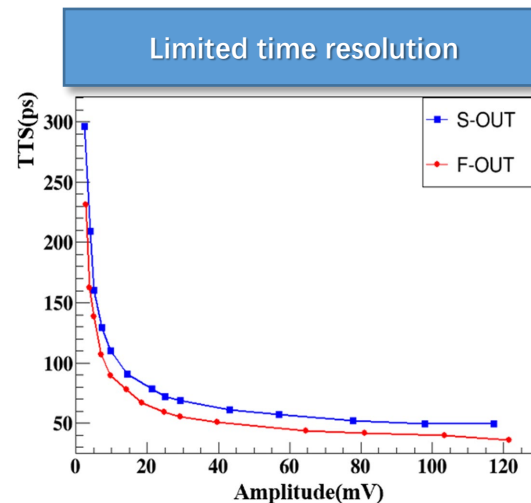
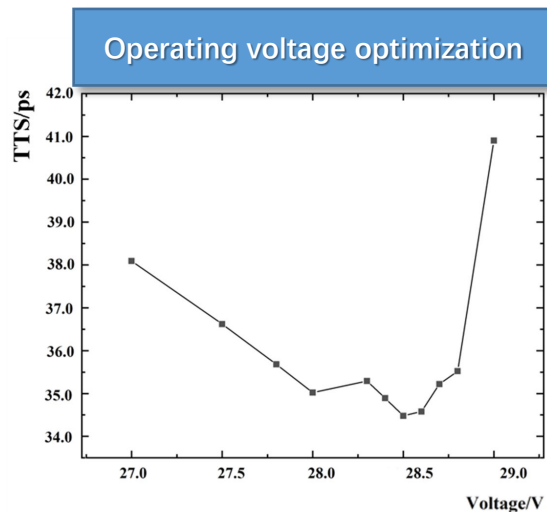
# Timing characteristic of fast SiPMs

- The timing characteristics of SiPMs from three vendors (Hamamatsu, NDL, SensL) was evaluated by using our designed fast-timing amplifier circuit board, showing great application potential in timing measurement.



Schematic diagram of the test system for time resolution

	SensL J-30035	NDL 11-3030C-S	Hamamatsu S13360-1325CS
Optimized Voltage [V]	28.5	41.0	58.0
Rise Time [ns]	~ 0.5	~ 1.5	~ 1.5
Limited Time Resolution [ps]	~ 22.2	~ 21.8	~ 193.6



- Measurement of limited time resolution and rise time at optimized voltage for the three type of SiPM