Photon Detection module for Intensity Inteferometry (PDMII) for the ASTRI telescope and camera - Design, specifications, costs - v. 5.0 - Aug 26, 2019

ASTRI Int. Interf. WG

Optomech. Module

4 (custom) lenses

1 filter with 5nm FWHM

1 polarizer

Detector

Hamamatsu MPPC S14520SPL
6x6 mm2, cooled

Front-end electronics

MUSICR1:
8 channel Multiple Use IC
for SiPM anode readout

Amplifier for analog mode output

MiniCircuits ZX60-P103LN+

Time tagger unit for photon counting output

Cronologic TimeTagger4-2G

Telescope interfaces

Input:
1. HV power supply for detector: 50 Ohm shielded cable
2. LV power supply for front-end electronics: 3-pole cable
3. USB-UART: shielded 5-pole cable

Output:
4. Output signal from front-end electronics (analog or digital): 50 Ohm shielded cable (LEMO connector)

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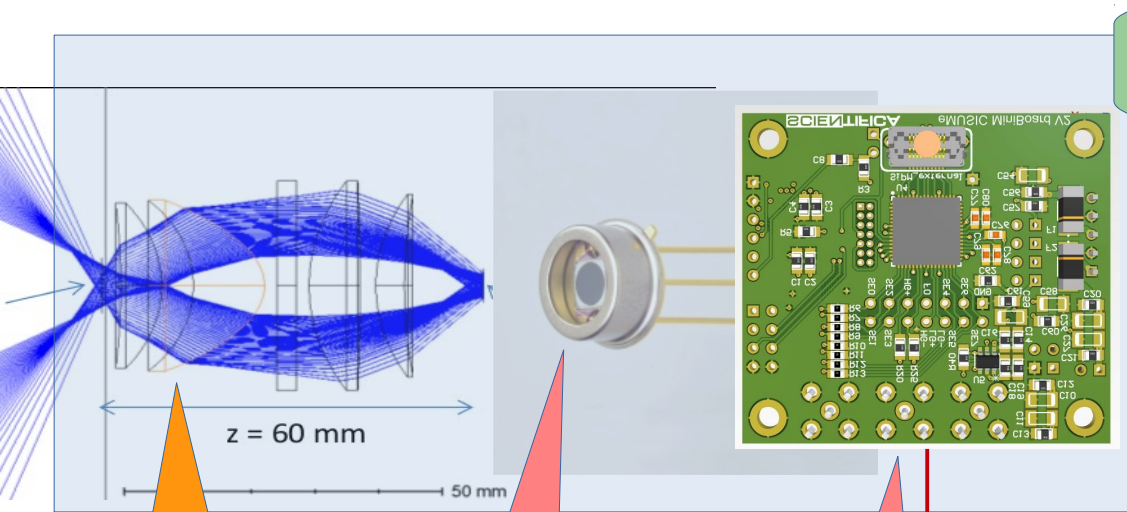


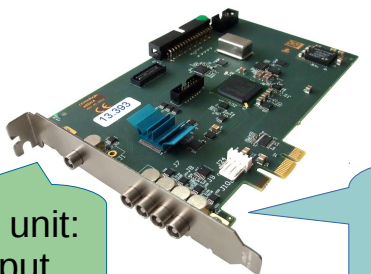
Focal plane optics

SiPM detector (cooled)

Front-end board for SiPM readout (USB controlled)

Amplifier: Analog output

To acquisition electronics: Analog output



Time tagger unit: Digital output

To acquisition electronics: Digital output

White rabbit node for time distribution provides reference signal for the time tagger unit

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Detector

Hamamatsu MPPC S14520SPL
6x6 mm2, cooled

Specs:

- Dark count rate = 150 kcounts/s
- Size: 15.3 x 15.3 x 22.3 mm3
- Operating voltage: 41 V

Cost: 700 Euro per unit

Front-end electronics

MUSICR1:
8 channel Multiple Use IC
for SiPM anode readout

Specs:

- Max rate (analog) = 150 MHz
- Max rate (digital) = 50 MHz
- Size: 50 x 45 x 1.6 mm3
- Operating voltage: +/-6.5 V
- Additional USB UART board for output and other controls
- Size (incl. USB board): ~ 50 x 45 x 45 mm3
- Output connector: strip or SMA
- Output sig. (digital): TTL (<20 ns)

Cost: 800 Euro per unit

Amplifier for analog mode output

MiniCircuits ZX60-P103LN+

Specs:

- Bandwidth: 50 to 3000 MHz
- DC Supply Voltage: 5.0 V
- Size: 29.97 x 18.80 x 11.68 mm3
- Input/Output connectors: SMA
- Input/Output signal: TTL

Cost: 100 Euro per unit

Time tagger unit for photon counting output

Cronologic TimeTagger4-2G

Specs:

- Frequency bandwidth: 48 Mhits/s
- Size: ... mm3
- Jitter: 50 ps
- Input/Output connectors: LEMO
- Input signal: TTL
- Output signal: ...

Cost: 5950 Euro per unit

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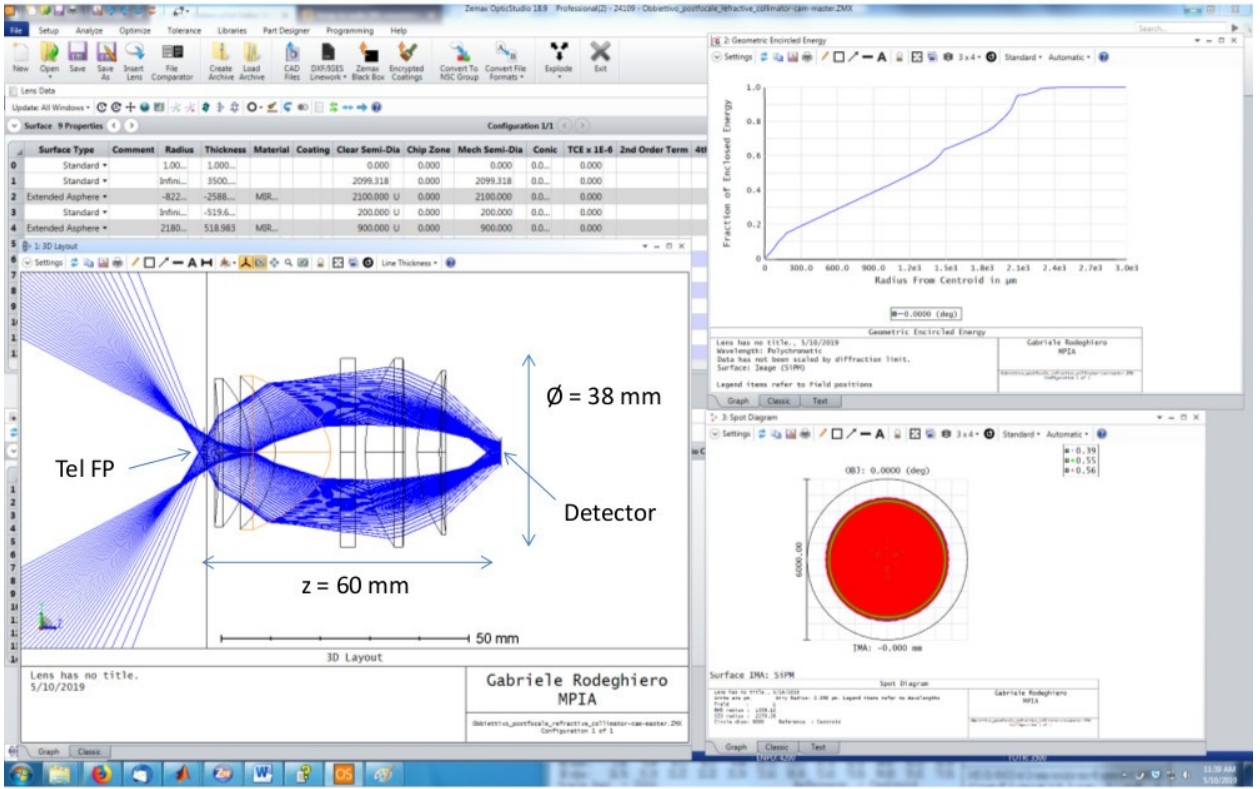
Design activity on the optics and optomechanical module (G. Rodeghiero, E. Giro, C. Pernechele, C. Gargano)



Prototype of focal plane optics redesigned to fit inside a camera module

Size: Diameter 38 mm, Depth (z) 60 mm

Contains 1 aspherical lens with custom design

Windows above the focal plane still to be included in the final design

Test with the 'camera x luce tecnica'

Without USB-UART board, detector and front-end electronics fit inside the module (to be checked in the final design)

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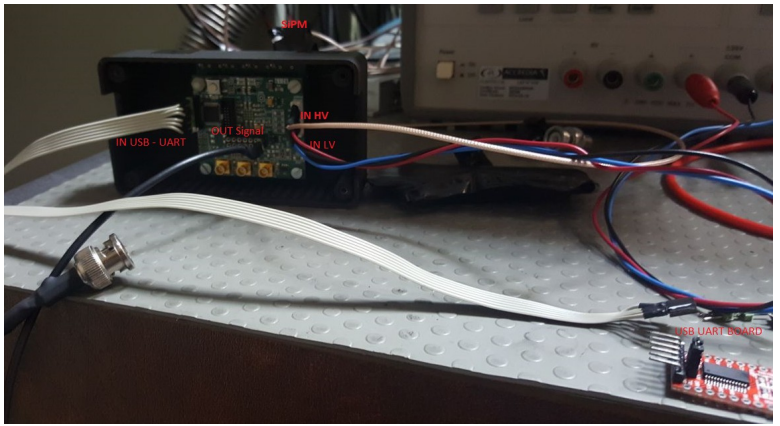
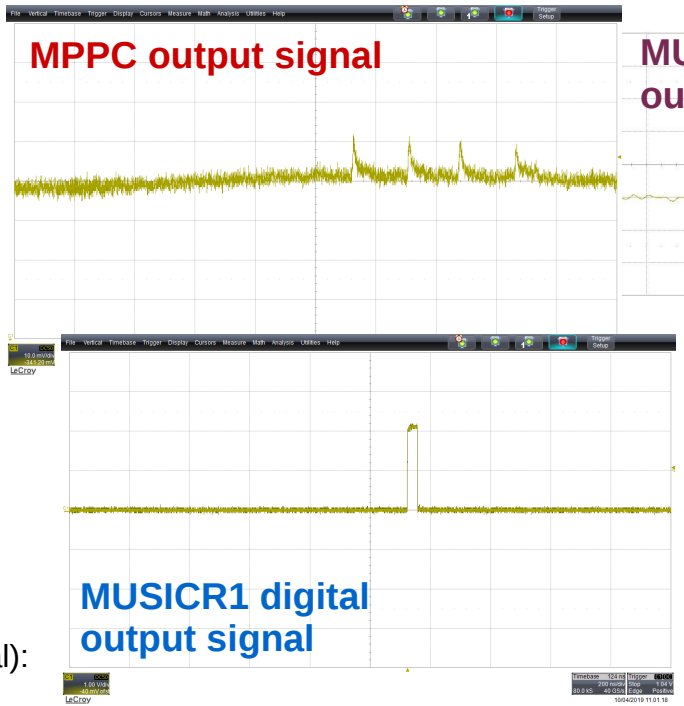
Testing activity on a prototype of the front end electronics with a 3x3 mm2 MPPC detector carried out in Catania (G. Bonanno)





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Output:
4. Output signal from front-end electronics (analog or digital): 50 Ohm shielded cable (LEMO connector)

After Pole Zero Cancellation (PZC) two pulses detected at 7 ns (analog output), corresponding to 130 MHz

Some problems with the 'discriminatore' for the digital output

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Design activity on the acquisition electronics (L. Zampieri, G. Naletto)

Studied feasibility of an acquisition system based on the White Rabbit (WR) signal for time synchronization (in collaboration with Aldo Morselli and Gonzalo Rodriguez)

The idea is to use the PPS from the ASTRI telescope WR board for providing a synchronization and reference signal

PPS and signal from WR board and digital output from MUSIC board are reference signals sent to an external TDC streaming data continuously to disc at the digitizer rate

TDC specs: 0.5 ns time resolution, 1 ns double hit resolution, 24 bits per event (role over every ~5-10 ms), bandwidth ~40 MHz, 4 input ports (PPS, reference from WR, output from MUSIC, free), jitter < 100 ps, clock temperature stability 10ppb (for intervals of 1s 15ps TDEV, 200ps MTIE and typically -85dB phase noise)