PANIC

Detector upgrade

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Document Change Log

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Issue 0.1	24.05.2018	All	Initial draft for discussion
Issue 1.0	16.06.2018	All	Approved version

List of acronyms and abbreviations

CAHA	Centro Astronómico Hispano Alemán
IAA	Instituto de Astrofísica de Andalucía
MPIA	Max-Planck-Institut für Astronomie
PANIC	PAnoramic Near Infrared camera for Calar Alto
ROE	Read Out Electronics

List of supporting documents

The following documents provide additional information about topics addressed in this document. They are referenced as RDx in the text:

RD Nr.	Doc. Title and Issue
RD 1	

Contents

1 INTRODUCTION AND SCOPE

This document shall illustrate the selection for a replacement detector for the PANIC instrument.
The original detector array is not usable for scientific operations anymore and needs to be replaced to continue useful work.
The original detectors are not produced anymore in the form as used in PANIC. The mounting of the detectors has changed. So, a simple replacement with identical type of detectors is not possible.
In the meantime also alternative developments can be considered as a potential replacement, in terms of performance and cost.
A replacement with four 2k x 2k detector arrays, as used in the original configuration, is possible as well as a replacement with a now existing single 4k x 4k detector.
In terms of cost, a single 4k x 4k detector is cheaper than four 2k x 2k arrays. For mounting, a new detector interface must be designed in any case since the old detector interfaces are not available anymore. To mount a single detector is a much simpler design and AIV task than mounting 4 individual detectors to one array. The alignment of 4 detectors (in terms of co-planarity and parallelism) is a major operation in a replacement scenario.

2 TECHNICAL ISSUES

The main technical constrains are listed and discussed below; these need to be considered for the replacement in order to keep the efforts low and to avoid re-engineering many fundamental parts of the instrument. The idea is rather to re-use the existing instrument as much as possible.
There are three constrains to be considered:

- Wavelength sensitivity
- Electronics, clock and bias levels
- Software, patterns to control and drive the detector

2.1 Wavelength sensitivity

The detector needs to have the identical wavelength range sensitivity as the previous detector. Different sensitivity would require different temperature of the instrument for background reason. Therefore, the long end cut off must be at ~2.5 µm wavelength. Longer cut off wavelength cannot be operated without changing the complete cooling system and cryo-mechanics.
Shorter wavelength can also not be considered since the optics are designed and coated for the wavelength range of 0.9 to 2.5 µm.
Detectors with different sensitive material can therefore not be considered. The detector must be based on HgCdTe substrate material.

2.2 Electronics, clock and bias levels

The existing readout electronics supports a certain number of clock lines and bias levels in order to control and drive the detector. A different detector type than the TELEDYNE HAWAII technology cannot be operated with the current existing readout electronics. To drive a new type of detector the readout electronics must be designed and built completely from scratch. Therefore only a HAWAII type of detector can be operated without major electronics development.

2.3 Software, pattern to control and drive the detector

Similar arguments apply for the software. The clocking patterns developed for the HAWAII type is only applicable to this detector. For a different detector a completely new set of patterns must be developed, merged to the control software, verified and optimized for science performance.

3 AVAILABILITY

After an extensive search during trade shows, workshops, and internet searches, no other manufacturer of HgCdTe detectors (wavelength range) with a technology as the previous detectors (clocking & patterns) in a 4k x 4k format was found. The availability of this kind of detectors is limited to the *TELEDYNE Imaging Sensors* company. No other manufacturer was found or is known worldwide.

4 CONCLUSION

Since there is only one supplier known worldwide and the cost advantage of a 4k x 4k detector is very significant, the only acceptable detector type is the TELEDYNE HAWAII-4RG detector. In addition, the scientific operation of a 4k x 4k detector versus four 2k x 2k arrays is superior due to the lack of the gaps between detectors. This approach, therefore, yields a scientific improvement for a lower price.