Calibration Devices
CDMR & Progress Status

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Calibration devices of NectarCAM

Flat-field light source

At the center of the dish

Aim: relative gain of all PMTs

Focal-plane calibration device

In NectarCAM (between PMTs & window)

Aims:

- on-/off-axis point spread function
- absolute gain of each PMT

CDMR outcome

Overview of RIXs

Ten RIXs to be addressed

Most of them can be addressed in April - May

Main possible blocking point (see next slides): dark room time for flat-field characterization

Nine normal priority RIXs

3 normal-priority RIXs require email exchanges:

- unclear proposed actions to be followed up for 2 RIXs (42563, 42735)
- hazard analysis in cooperation with K. Tegel (42727) to be followed up by RAMS?

6 normal-priority RIXs with text updates (42622, 42959, 42732, 42734, 42855, 42988)

→ will be swiftly addressed with minor updates of the documentation text

One high-priority RIX (42556)

Finalization of V04 flat-field flasher:

- Mechanical upgrade proposed following Adleshorf campaign (this RIX was expected)
- Action items proposed by panel in line with planned actions at LUPM & IJCLab

Open item to be discussed: electronics updates suggested by panel (see next slides)

Normal priority RIXs

Text updates

DD183 internal FFCLS interface: 42622 - AI (JB): "rename the document to indicate that it includes the laser specifications”

FFCLS User Manual 42959 - AI (PB-KP): briefly describe control and diagnostics, supplement maintenance & software upgrade sections, even if not complete

FPCD stress and durability test: 42732 - AI (KP-JB): justify XY table random motion test duration

→ Comment on this RIX (*to Oscar*): "A combined structural analysis of the NectarCAM + structure shall be done as a design verification of the overall MST, that is not in the scope of the NectarCAM CDMR."

FPCD RAMS & Obsolescence: 42734 - AI (KP): update the text indicating that providers of off-the-shelf component have been carefully identifying to guarantee long-term provision + remove mention to RAMS analysis

DD197 FPCD perf. vs req.: 42855 - AI (KP-MJ): minor specific updates suggested by panel member to be added

FPCD User Manual: 42988 - AI (KP-PB): briefly describe control and diagnostics, supplement maintenance and operation sections

Email exchanges needed

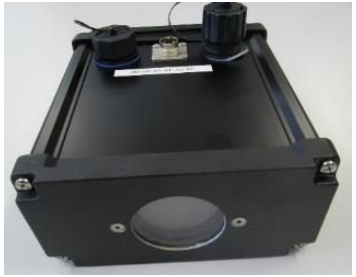
Missing reference standard FFCLS: 42563 - AI (JB): contact Francesco Dazzi → unclear proposed action to be followed up

FPCD classification: 42735 - AI (JB): contact Francesco Dazzi → unclear proposed action to be followed up

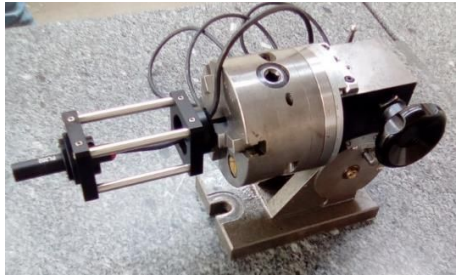
FPCD safety system: 42727 - AI (JB): discuss with Stephane: "The proposed action is to develop a hazard analysis and a risk assessment in cooperation with the safety engineer (K. Tegel). Then, you have assess if the current design satisfies the EU product safety requirements."

High priority RIX: flat-field new design to be tested

Mechanics V03



Mechanics V04



Upgrades wrt Adlershof

Mechanics V03 → V04 outlined in CDMR doc DD187

- **Laser alignment system** (δθ < pixel)
- **Engineered diffusive window** (flatness within 2%)
  Note: better than requirement = pattern known within 2%
- **Associated mechanical enclosure**

Upgrades suggested by CDMR panel

- **Spare fiber connector**: **implemented**
- **Humidity sensor + Power-surge / Lightning protection**:
  → AI CTAO: decide if Power-surge / Lightning protection improvements to be mandated.
  → Better course of action, AI JB: contact Markus to determine if such protections are applied to other components in the center of the MST dish

Timeline

- April 2021: **IP67 waterproofness** of V04 enclosure
- By spring 2021: **Illumination vs θ(°) & T(°C)** in IRFU dark room

  → Highest priority (IRFU-IJCLab-LUPM): pre-summer timeslot for angular measurements

Calibration devices: status

Flat-field calibration light source: electronics

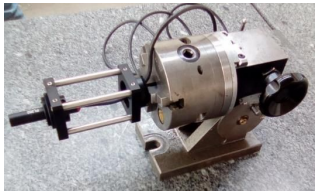
Electronics design unchanged ✅

Main open item: high-priority RIX

Addition of power-surges and humidity sensor. Based on Markus's feedback on other central-dish components:

- Either discuss lightning protection standards with CTAO, implement upgrades, re-implement IPC Class 3 routing
- Or do not implement any of the change and validate this with CDMR panel

Flat-field calibration light source: mechanics



Alignment system ✅

Procurement & manufacturing ✅

IP67 Waterproofness: to be done in April

2% flatness + temperature: dark-room timeslot

Focal-plane calibration device: overview

Electronics design unchanged ✅
IPC Class 3 routing launched
Note: not implemented for 2 pairs of SPE boards at IRAP

XY automatics design unchanged ✅
TBD: test MCB with NectarCAM OPC-UA architecture

XY mechanics design unchanged ✅
Done: X motorization installed on NectarCAM
Integration TBD: transverse Y rail, SPE screen, MCB
Testing TBD: realistic tests with camera structure

Dip coating reproducibility ✅
Improvement of SPE screen optical performance (see next slide)

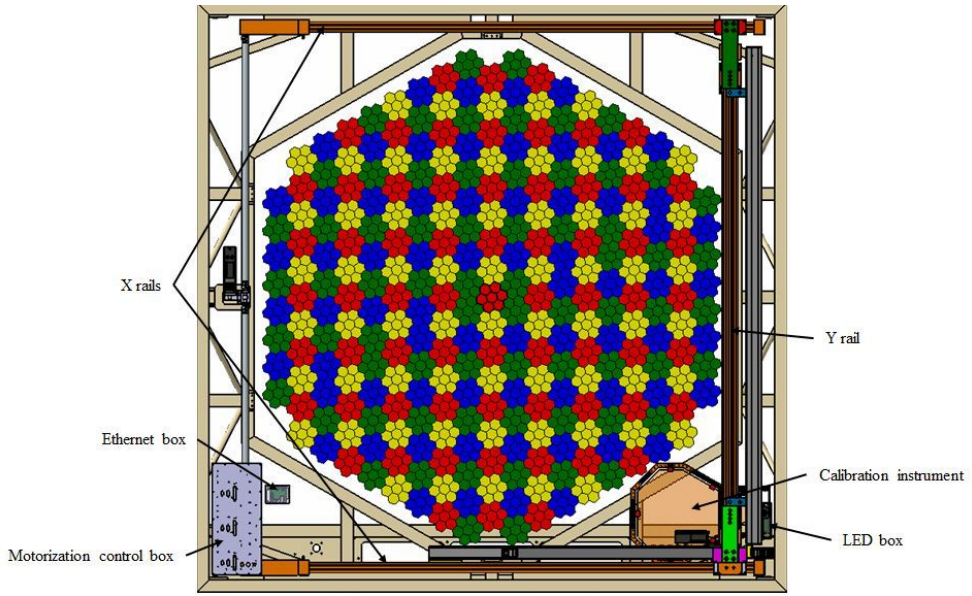


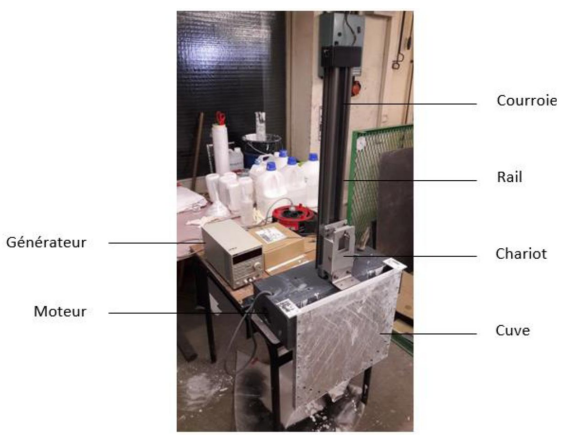
Fig. 2: Front view of the NectarCAM camera with the focal plane calibration device in parking position

Focal-plane calibration device: optics

Characterization of properties of paint layers

Density, viscosity and surface tension vs dilution

Impact of temperature, lift-up and dip-down speed on thickness



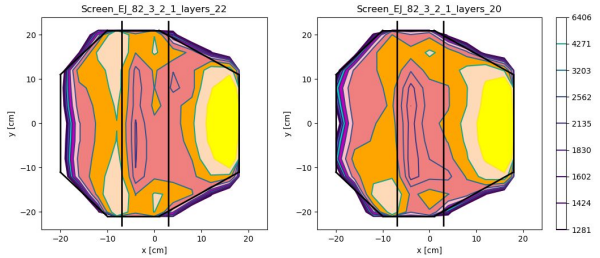
10-15 paintings tested over the past year

Nice improvement of the lateral profile wrt Adlershof screen

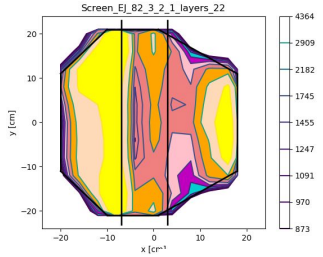
Minor room for improvement on longitudinal profile (≠ v(lift) for ≠ layers)

Reproducibility: all area covered within max/4-5

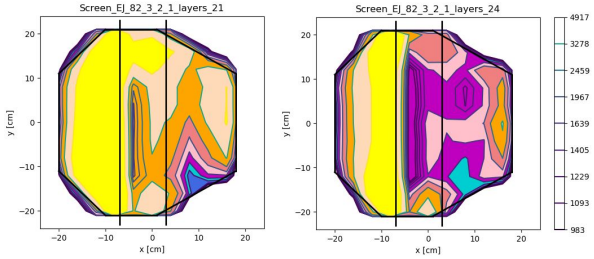
v(lift-up) = 2.0 mm/s →



v(lift-up) = 3.0 mm/s →



v(lift-up) = 4.0 mm/s →



Focal-plane calibration device: SPE scan

Optimization of scan procedure

Less than 60 successive positions

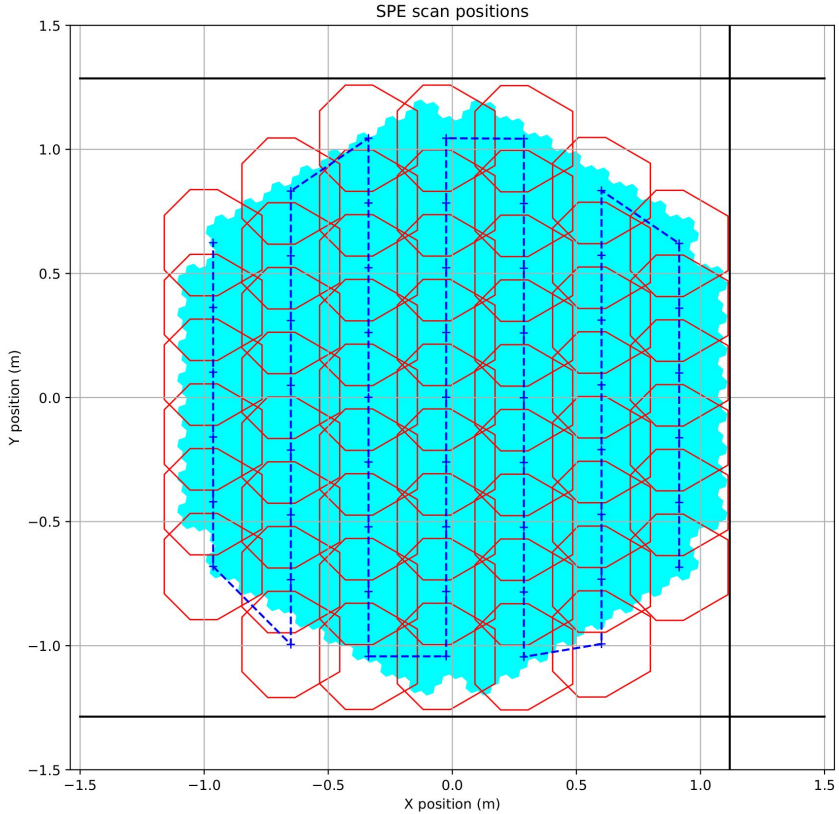
Estimated duration: **15-30 min**

- Transit time from one position to another:10-15 s
- DACQ time per position: 10s at 1 kHz

→ to be validated on NectarCAM

Ongoing software work

Association of screen position with relevant PMTs during scan



Summary

Tentative planning & Critical items