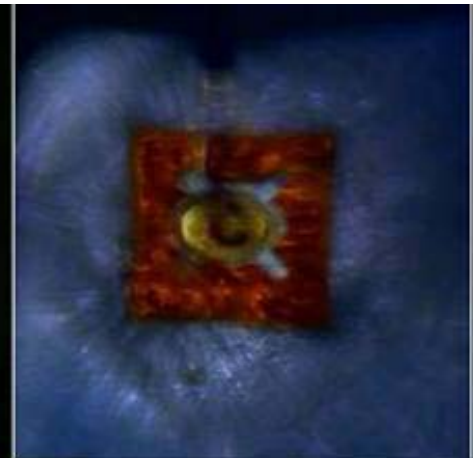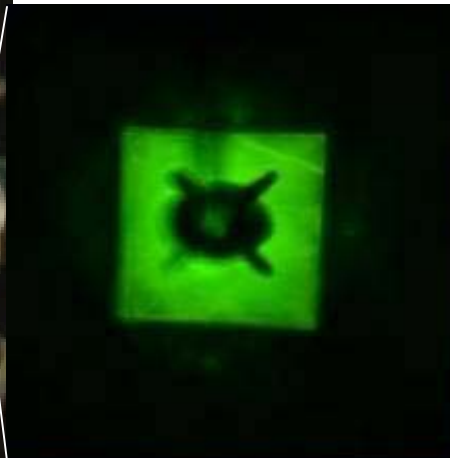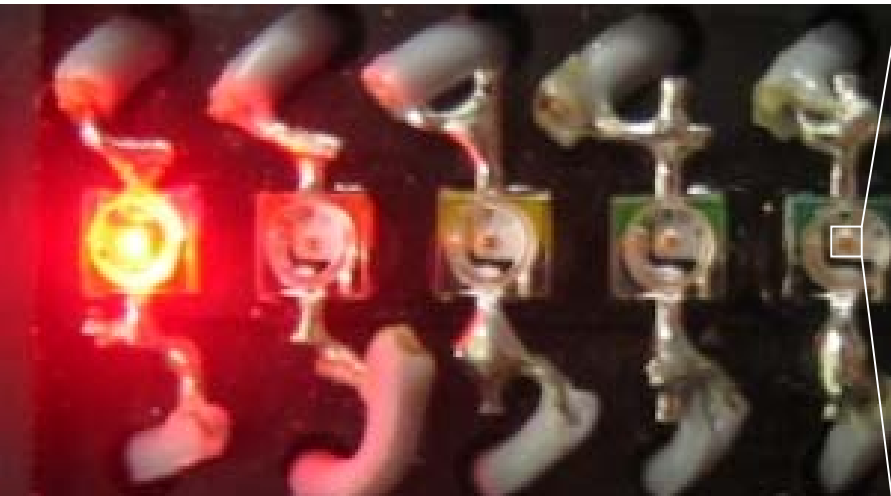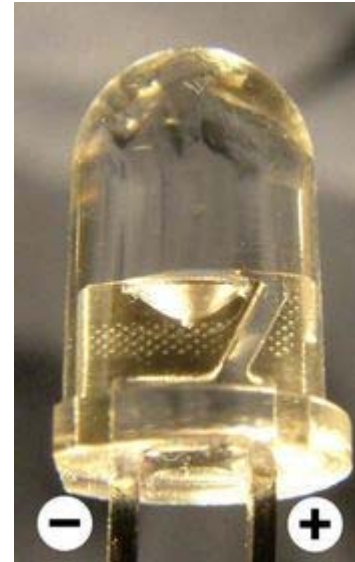# Electronic Design and R&D

LED properties

- Point-like, stable, adjustable, bright, uniform angular distribution, spectral bandwidth

- Flat-top vs. dome

LED properties

- High efficiency/dual heterojunction

LED precedents in HEP

- ZEUS
- H1-SPACAL
  - 405 calibrating LEDs + monitoring photodiodes for 1600 PMs
  - Stability 3‰, 1‰ with temperature corrections
- D0
- BaBar

Requirements for DICE electronics

- Spectral coverage from near UV to near IR
- Monitoring and control of LED outputs
- Measure of the flux at the focal plane level : a few pA/cm^2
- Target precision : < 1 ‰ , accuracy : < 2 ‰
- Communicate with camera operations (shutter and camera readout)

Overview of the calibration system

LED head

(LED source)

Electronic Card

computer

CLAP

CLAP Acquisition

MegaCam
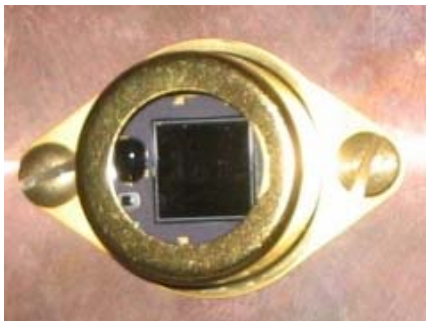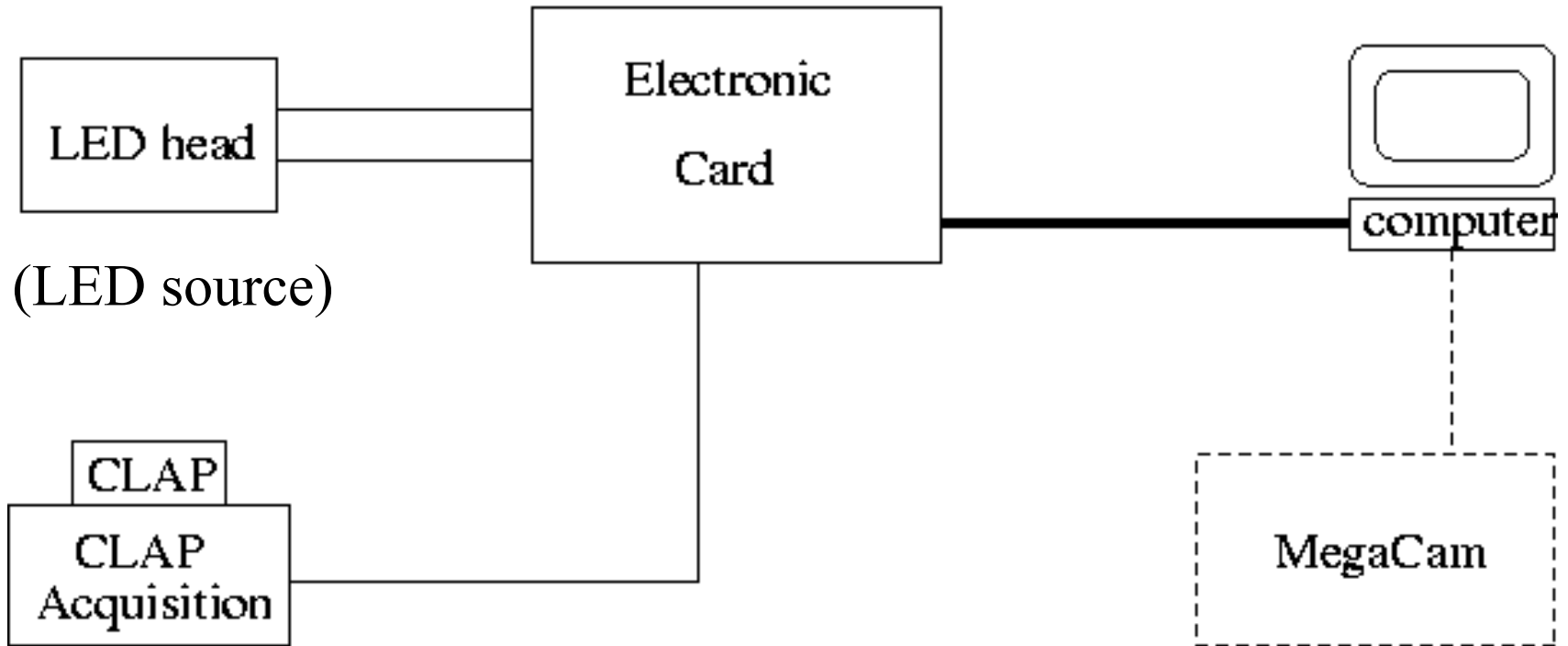
(Cooled Large Area
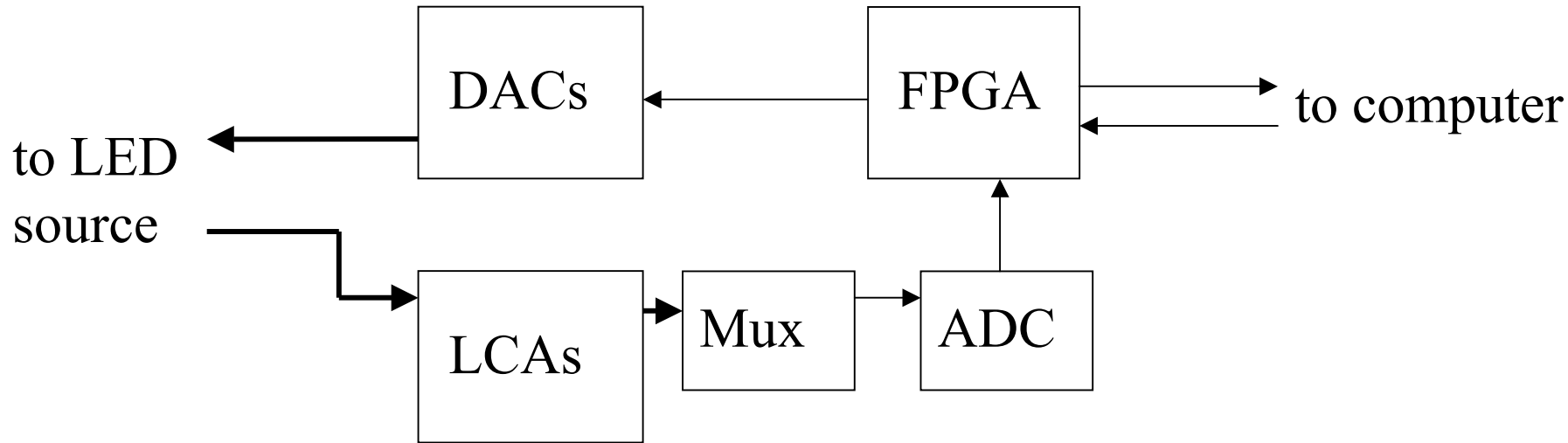Photodiode)

System components

- LED source :
  - 20 LEDs from 300 nm to 1.05 µm : "flat-top", high maximal current / high efficiency, current controlled
  - Photodiodes to measure flux close to the source : off-axis control photodiode (Hamamatsu S1337)
  - Temperature monitoring : diode dark current ?

- CLAP and readout :
  - 1000 e-/px/s on 15x15µm pixels -> 70 pA/cm²
  - Low Current Amplifier (LCA) close to the photodiode

- Remote control
  - Link with camera control : trigger for calibration exposures
  - Data acquisition and processing

Main electronics box
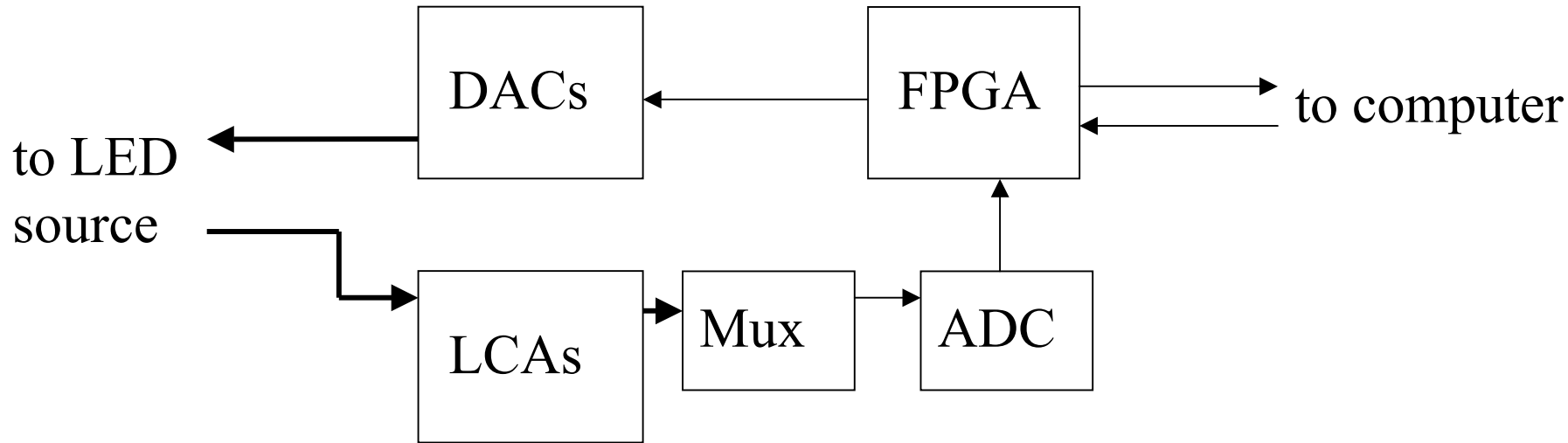
- LEDs current source : 24 12-bit DACs, 24 switches, common exposure time

- Source photodiodes readout : LCA *(see LCA slides)*, multiplexer, 16-bit ADC(s)

Main electronics box

- Power supply for DACs, ADCs, LCAs, photodiode bias voltage
- FPGA
- Ethernet link : XiLinks Virtex 4 for FPGA programming

Preliminary work on test bench

- LEDs as calibration source :
  - Obtaining a stable light emission with feedback from the source photodiodes on the LED current sources
  - Relationships between voltage, current, temperature, and emitted power
  - Spectral distribution
  - Spatial distribution : Integral Radiometric Calibration
- CLAP :
  - Preliminary cross-calibration with NIST-calibrated photodiode
- ➢ Prototype of electronic card with 8 DACs (January 2007)