



Front-end electronics for LumiCal detector

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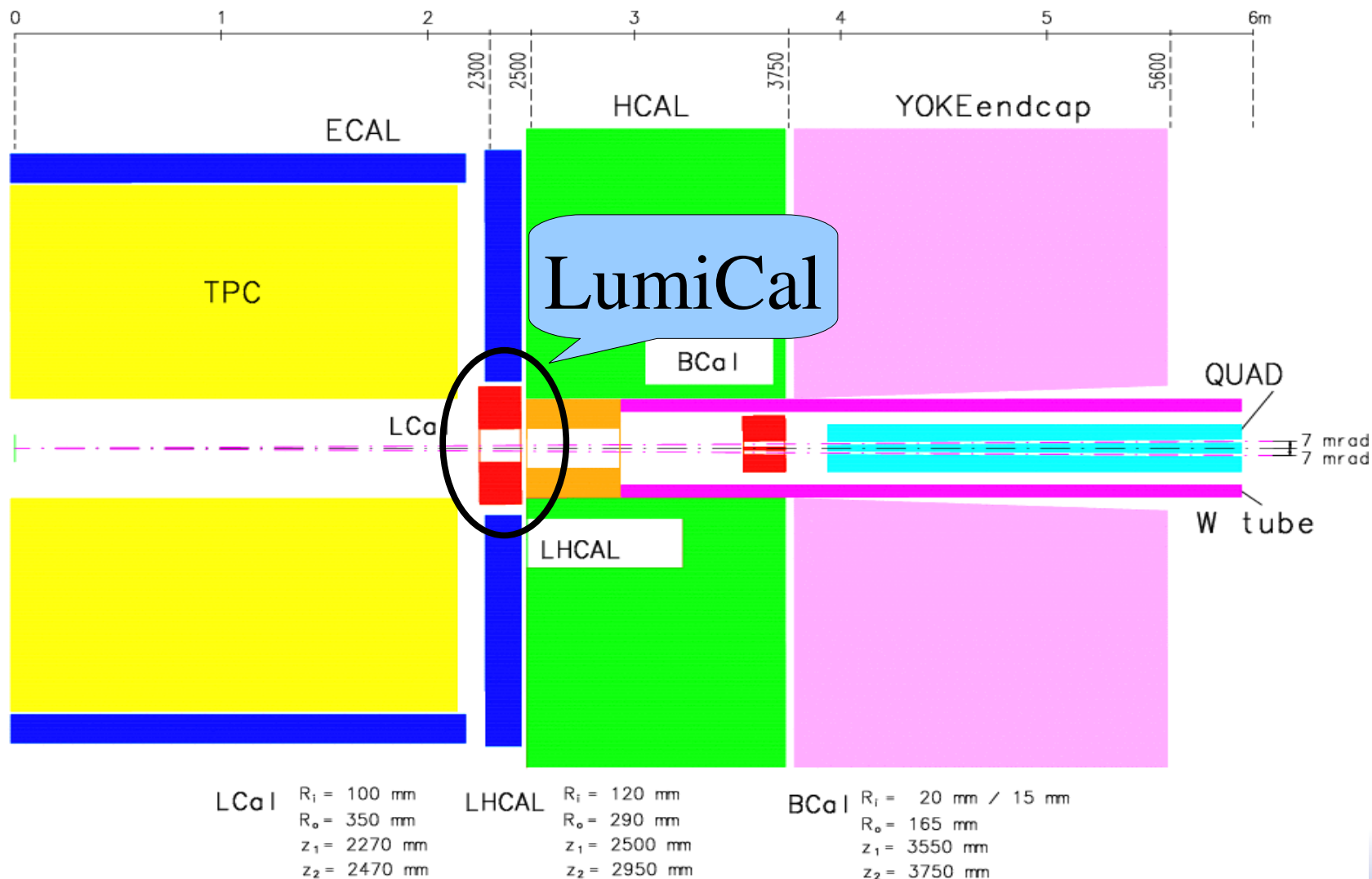


Outline

- ❑ Introduction
- ❑ Challenges for LumiCal electronics
- ❑ Readout architecture
- ❑ Front-end design & simulations
- ❑ Summary & milestones

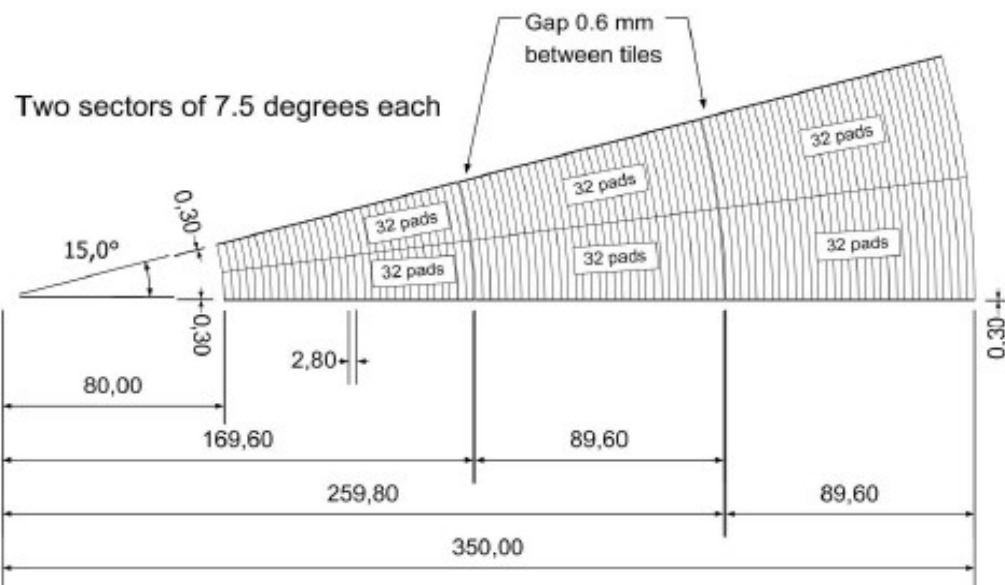
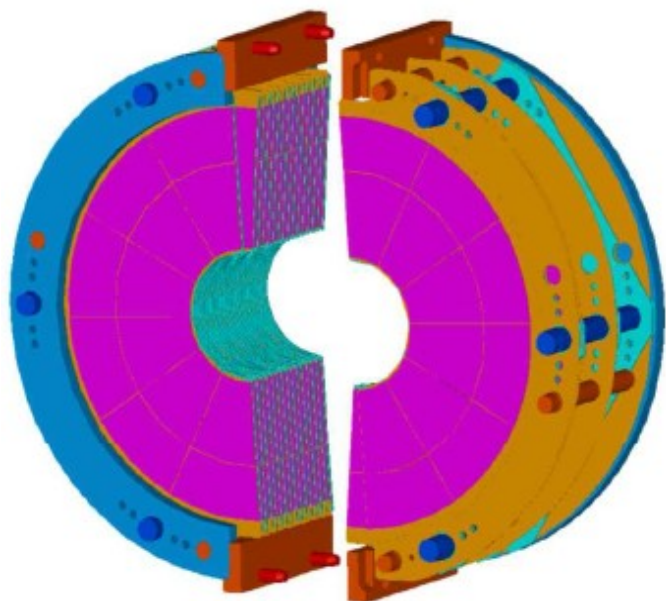


FCAL architecture





LumiCal architecture

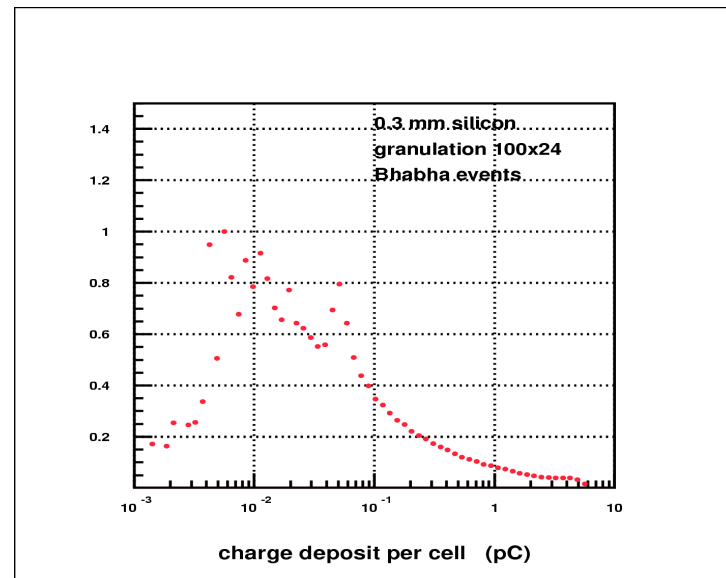


- ❑ LumiCal $\Leftrightarrow$ 30-40 discs of silicon detectors
- ❑ Disc $\Leftrightarrow$ 48(?) azimuthal (7.5°) sectors
- ❑ Sector $\Leftrightarrow$ $R_{\text{in-out}} = 8\text{-}35$ cm, built of ~ 100 radial pads
- ❑ Channel number estimation $2 \cdot 35 \cdot 48 \cdot 100 \sim 340000$



Detector specifications

- ❑ Signal: from 2 fC (muons in test mode)
up to more than 10 pC (physics mode)
- ❑ Occupancy: up to ~20% (beam-strahlung), below 1% (bhabha)
- ❑ Sensors: DC-coupled 300 μm thick Si pads. (C_{det} 10-100 pF plus fanout
~1pF/cm ?, leakage current ?)
- ❑ Inter bunch time ~ 300 ns
- ❑ Low average power dissipation





Challenges of LumiCal front-end

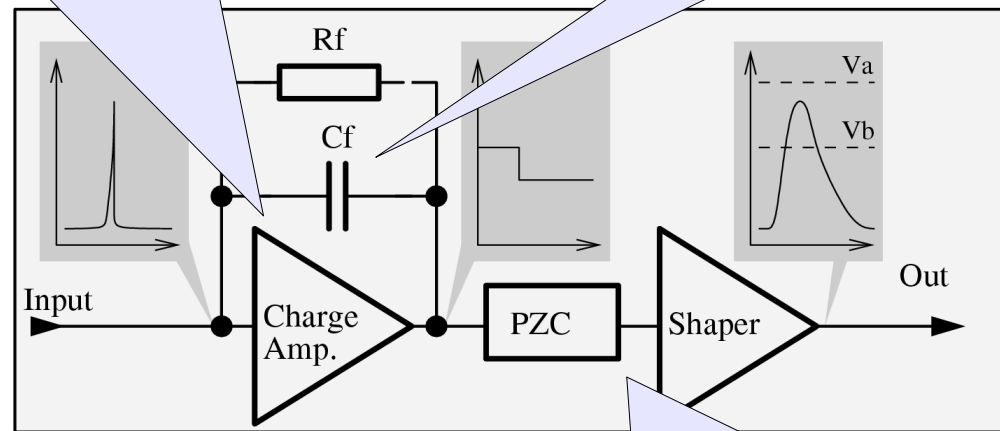
Large C_{det} range 10-100 pF

Test mode S/N ~ 10 for MIP

Charge sensitive amplifier

$Q_{\text{max}} \sim 10 \text{ pC}$

$C_f \sim 10 \text{ pF}$



Test & Physics mode

Variable gain

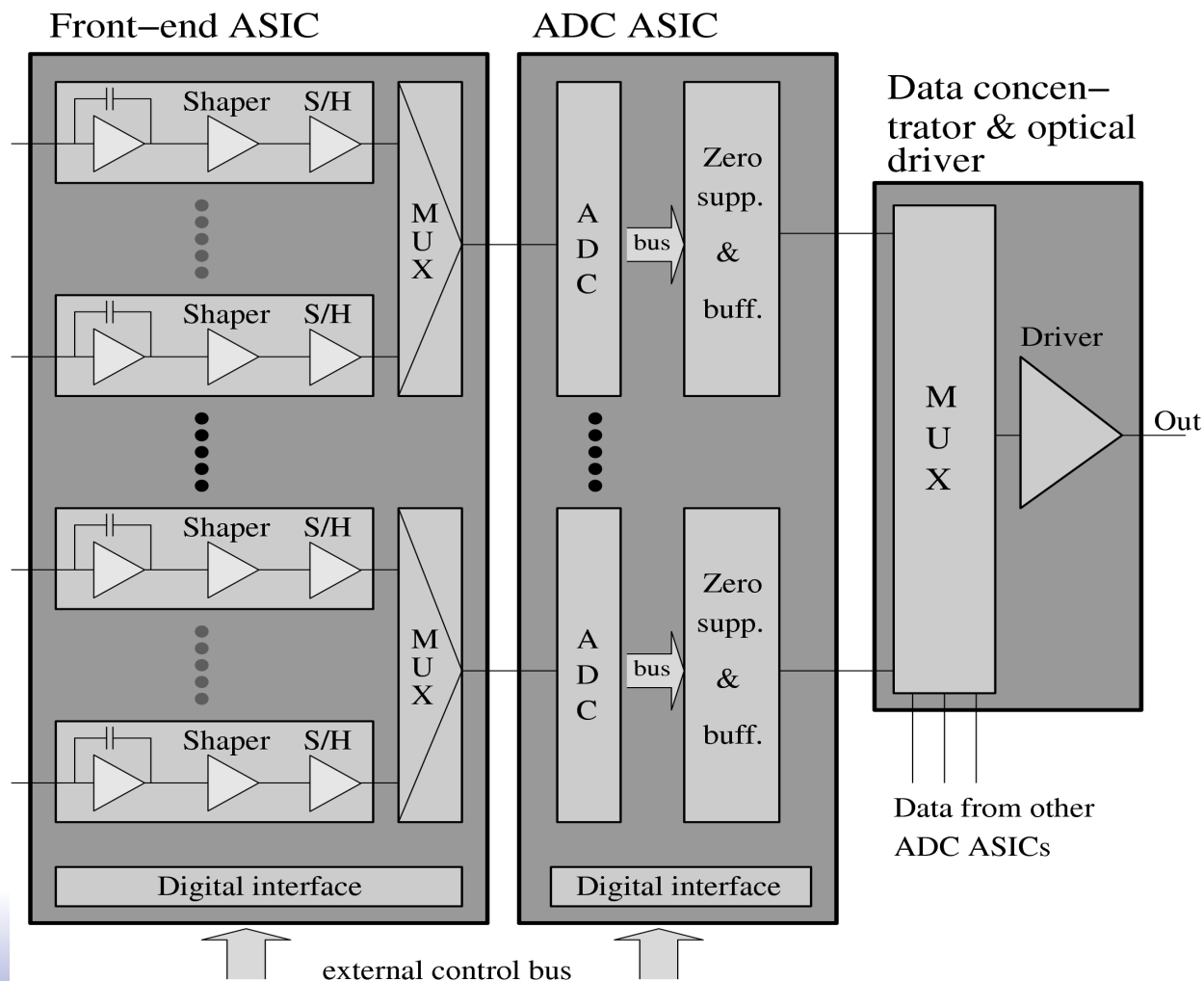
$\Delta t \approx 300 \text{ ns}$, high occupancy

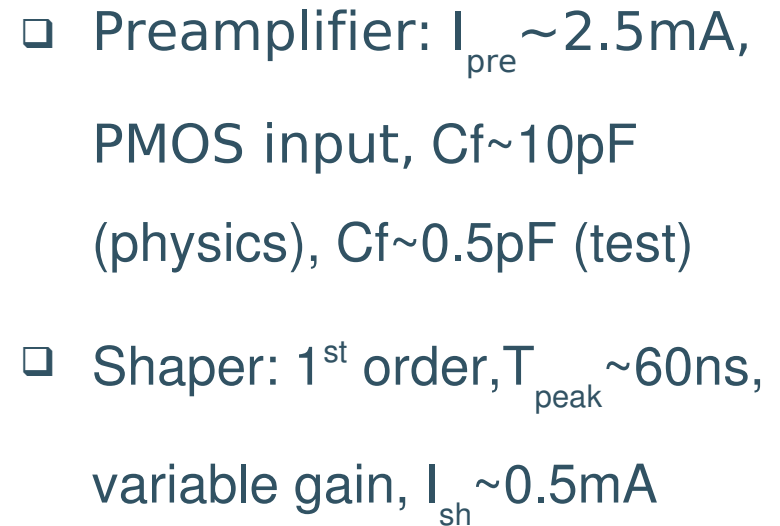
PZC + Shaper $T_{\text{peak}} \sim 60 \text{ ns}$



LumiCal readout architecture

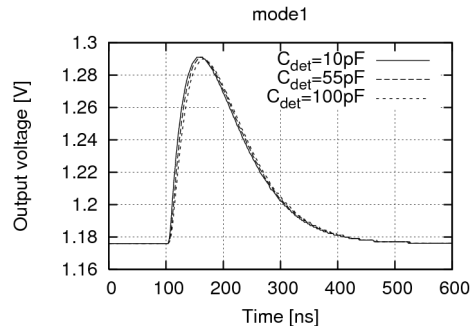
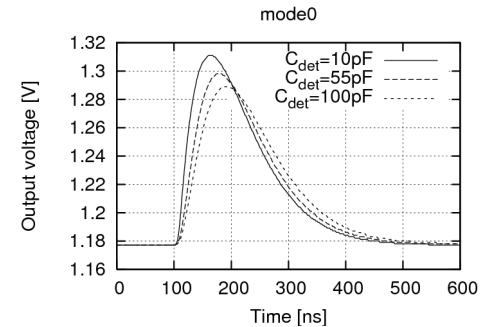
- Front-end ASIC will contain 32-64 channels
- An ADC will serve ~8(?) front-end channels
- First prototypes in AMS 0.35 μm





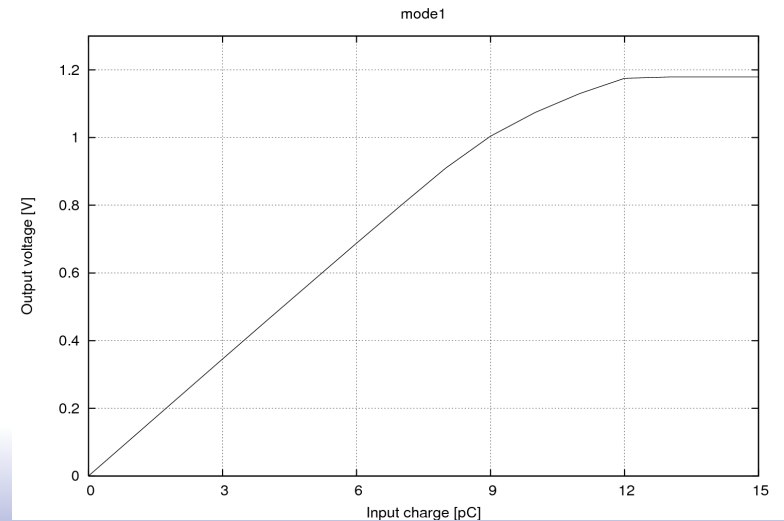


Front-end simulations



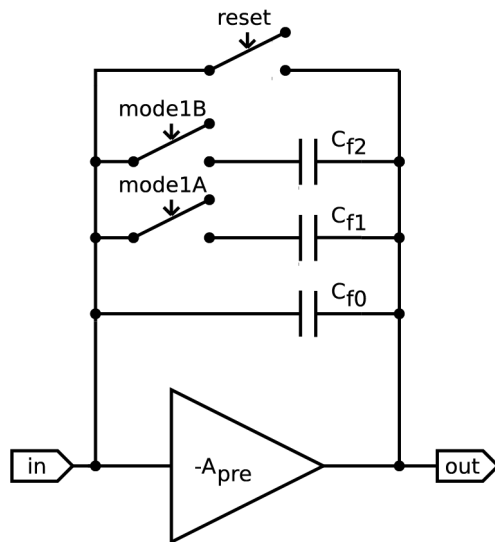
► Front-end response in test (mode0) and physics (mode1) mode for different C_{det}

► Output amplitude versus injected charge in physics mode

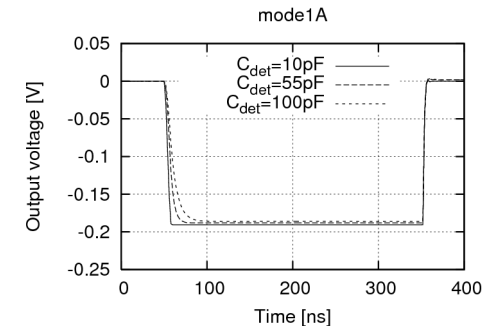
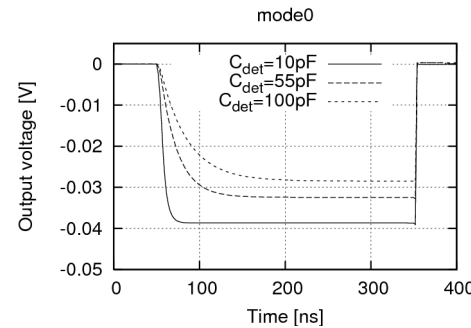




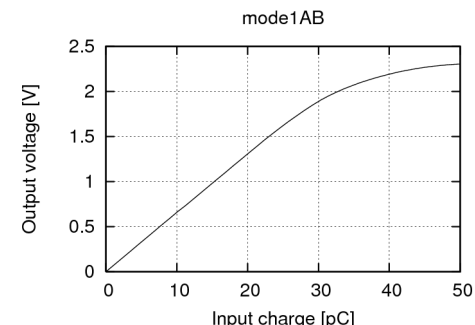
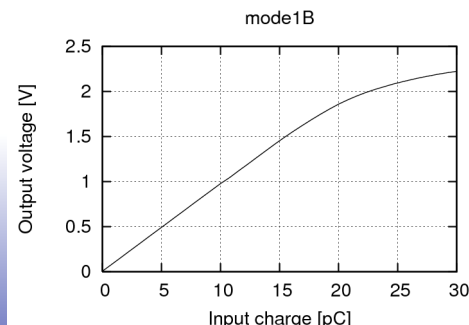
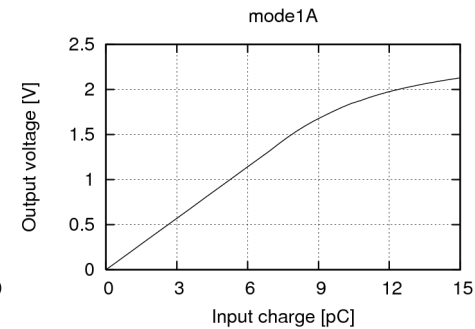
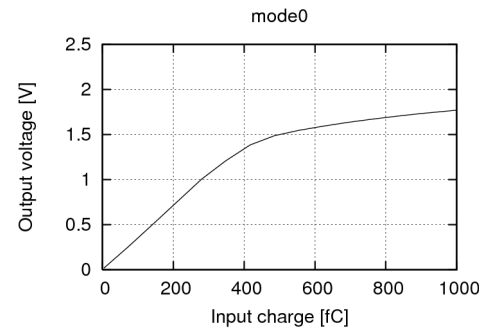
Alternative front-end Switched-Reset configuration



Switched-Reset configuration



Response in test (mode0) and physics (mode1) mode

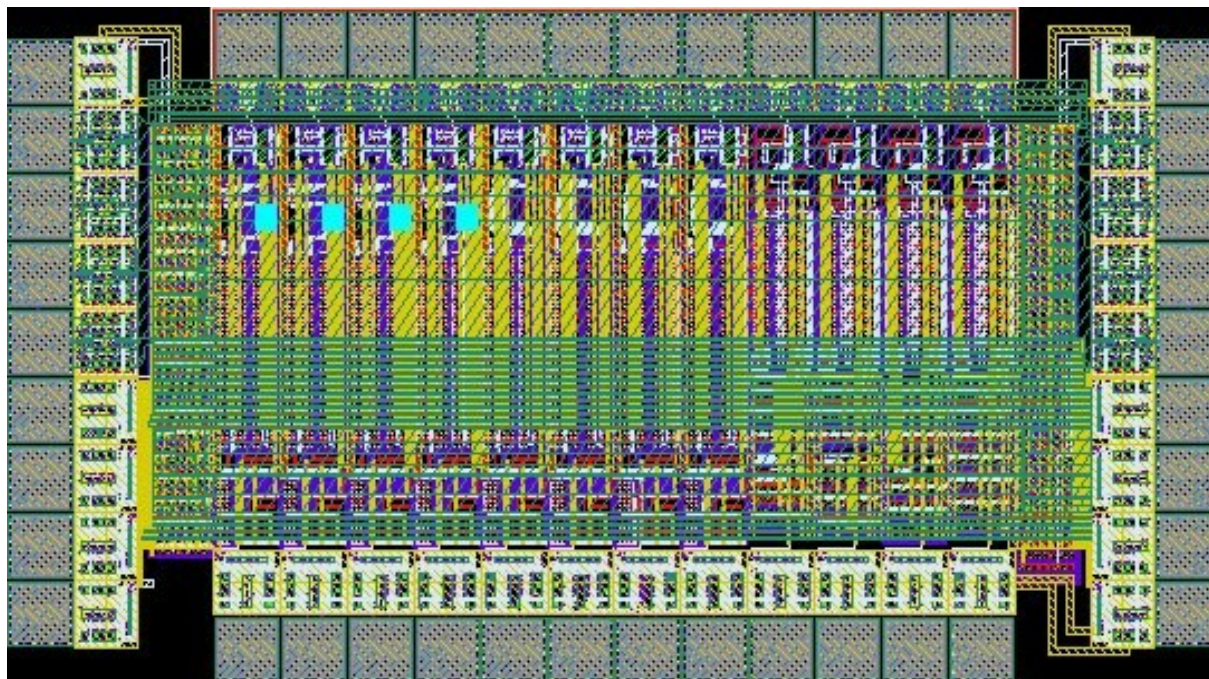


► Output amplitude versus Q_{in} for different gain setting



Layout of LumiCal front-end ASIC

Prototype ASIC contains 8 channels with continuous shaping and 4 channels with switched-reset



Pad Pitch 100 μm



Summary & milestones

- ❑ Now - first prototypes of the front-end and ADC functional blocks are being submitted
- ❑ ~December 2007 - tests of prototypes completed, design of ADC, S/H
- ❑ ~March 2008 - submission of ADC prototypes and front-end prototypes including S/H
- ❑ ~October 2008 - tests of ADC and front-end completed, design of supporting circuitry (biasing, DACS,...)
- ❑ ~December 2008 - submission of complete front-end and ADC prototypes
- ❑ ~June 2009 - tests of prototypes completed