Direct Read-Out of Scintillator Tiles with Large-Area SiPMs

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Direct Read-Out of Calorimeter Tiles

Why?

- more simple configuration compared to tiles with WLS r/o
  → lower costs

Challenges?

- lower light yield (compared to WLS r/o)
- homogeneity is an issue

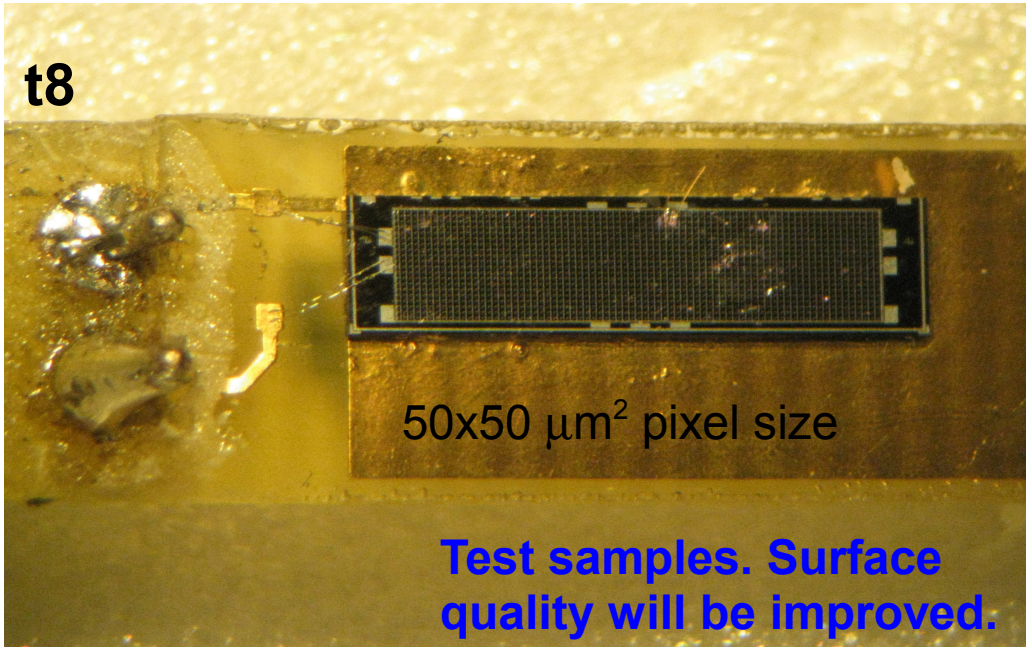
Special requirements to the SiPM for direct r/o:

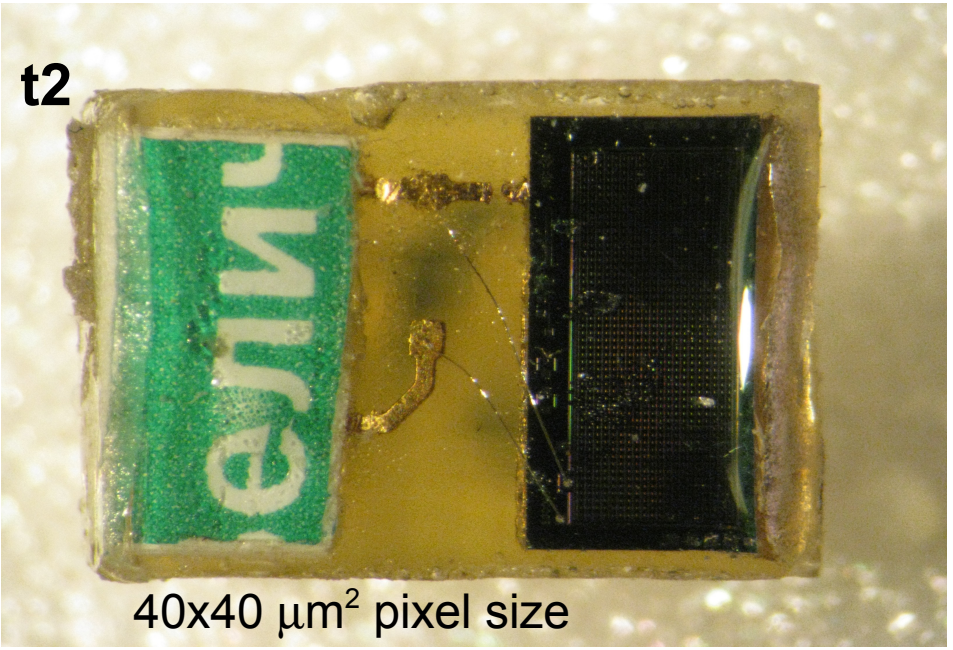
- blue sensitive devices (to match peak emission of plastic scintillators) → light yield
- large area but low noise → light yield and homogeneity
- dynamic range

New SiPM Devices

Company (sample)	Area [mm^2]	# Pixels	PDE [%] (435 nm)	Gain [10^6]	Dark Noise [MHz]	Bias Voltage [V]
KETEK*) (t8)	2x7.5=15	1500	15-20	1.2	2-3	67
KETEK (t2)	2x5=10	1000	8-9	2.3		38

Low density reduces crosstalk.

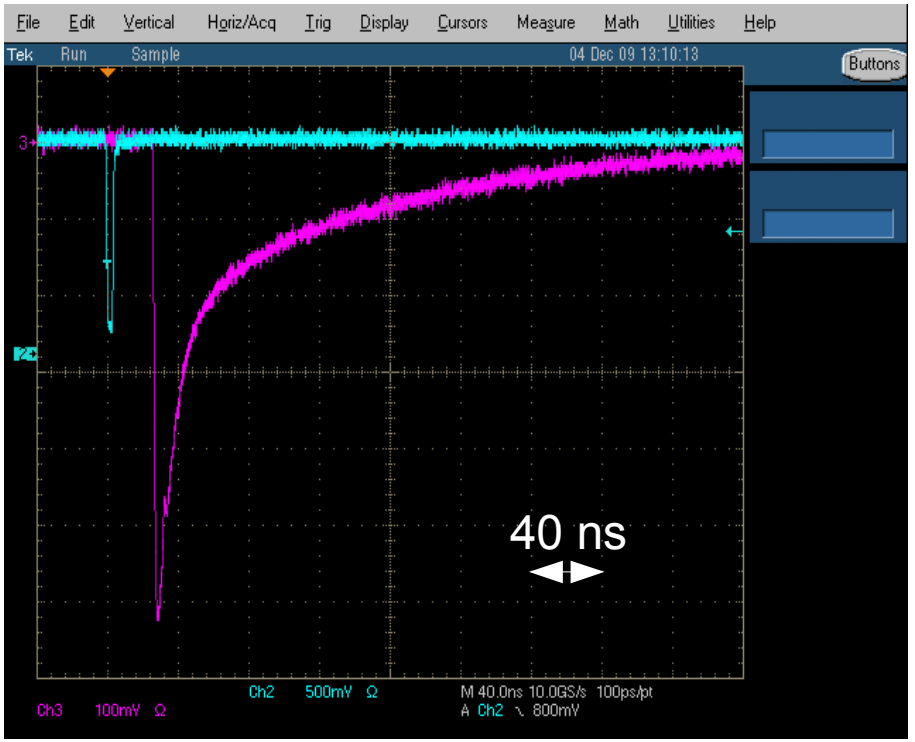




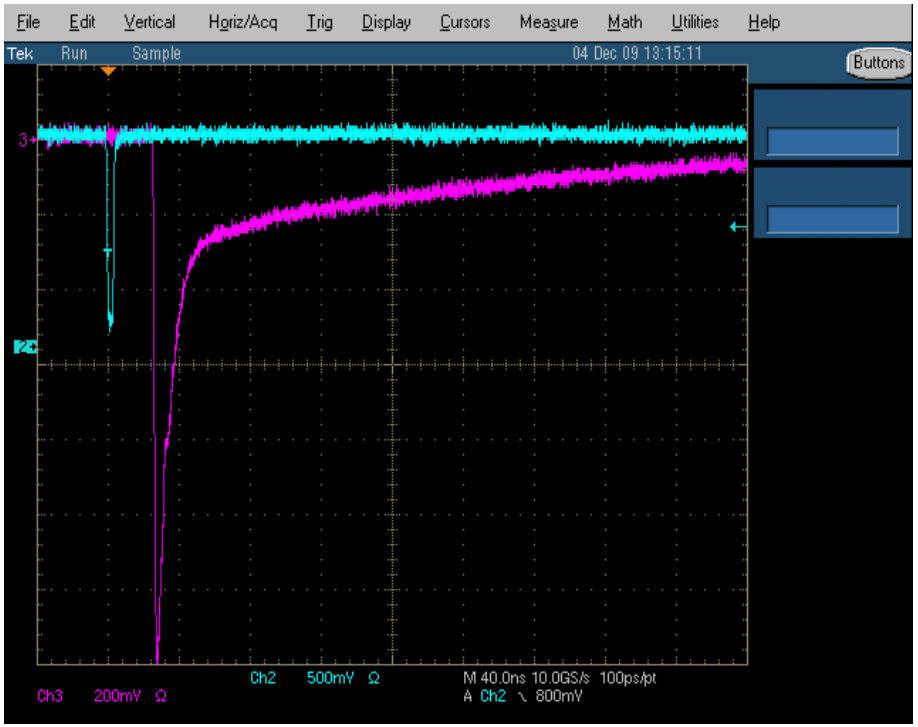
*) www.ketek.net

SiPM+Light

t8

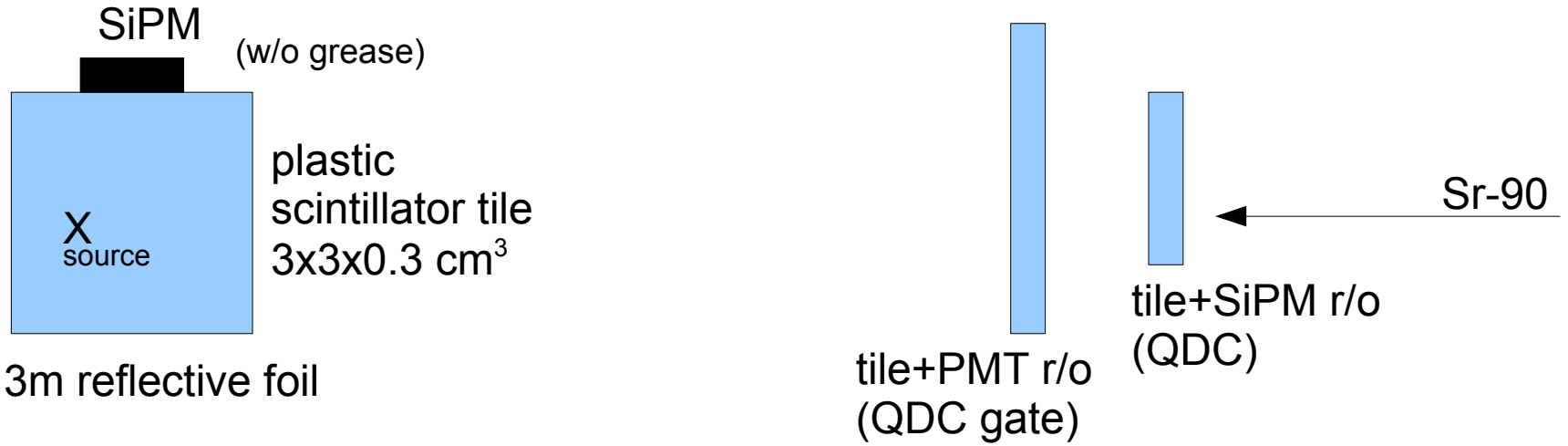


t2



→ Long tail (quenching resistor)

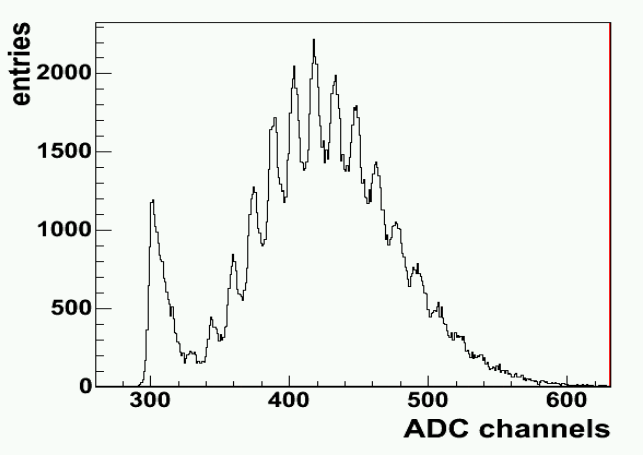
Pixels fired per MIP – Experimental Setup and Method



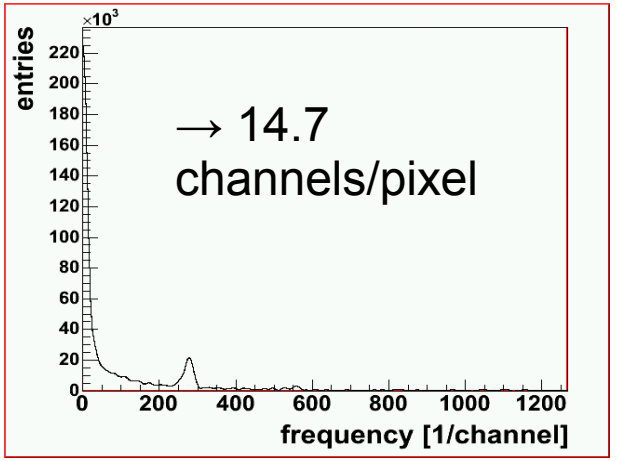
- Calibration with LED (channels/pixel)
- Extract most probable value from MIP spectrum

Pixels/MIP Result - Sample t2

Single photo-electron spectrum:

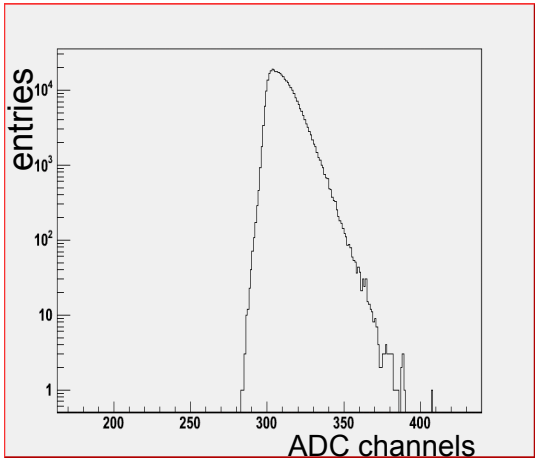


Fourier transform:

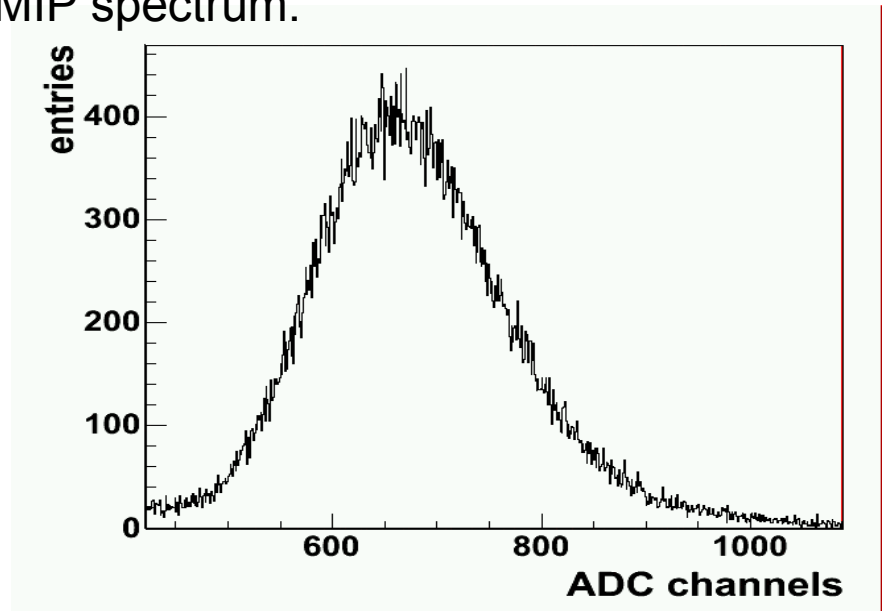


→ 14.7 channels/pixel

Noise:



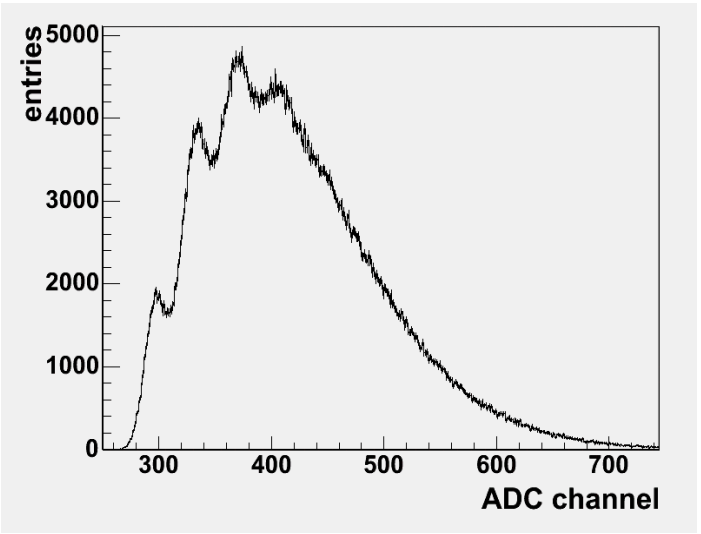
MIP spectrum:



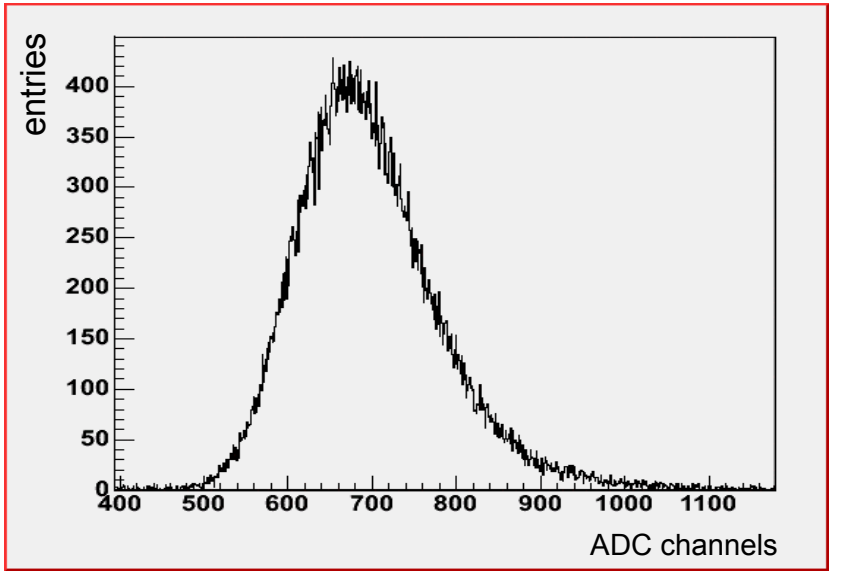
→ 25 pixels/MIP

Pixels/MIP Result - Sample t8

Single photo-electron spectrum:



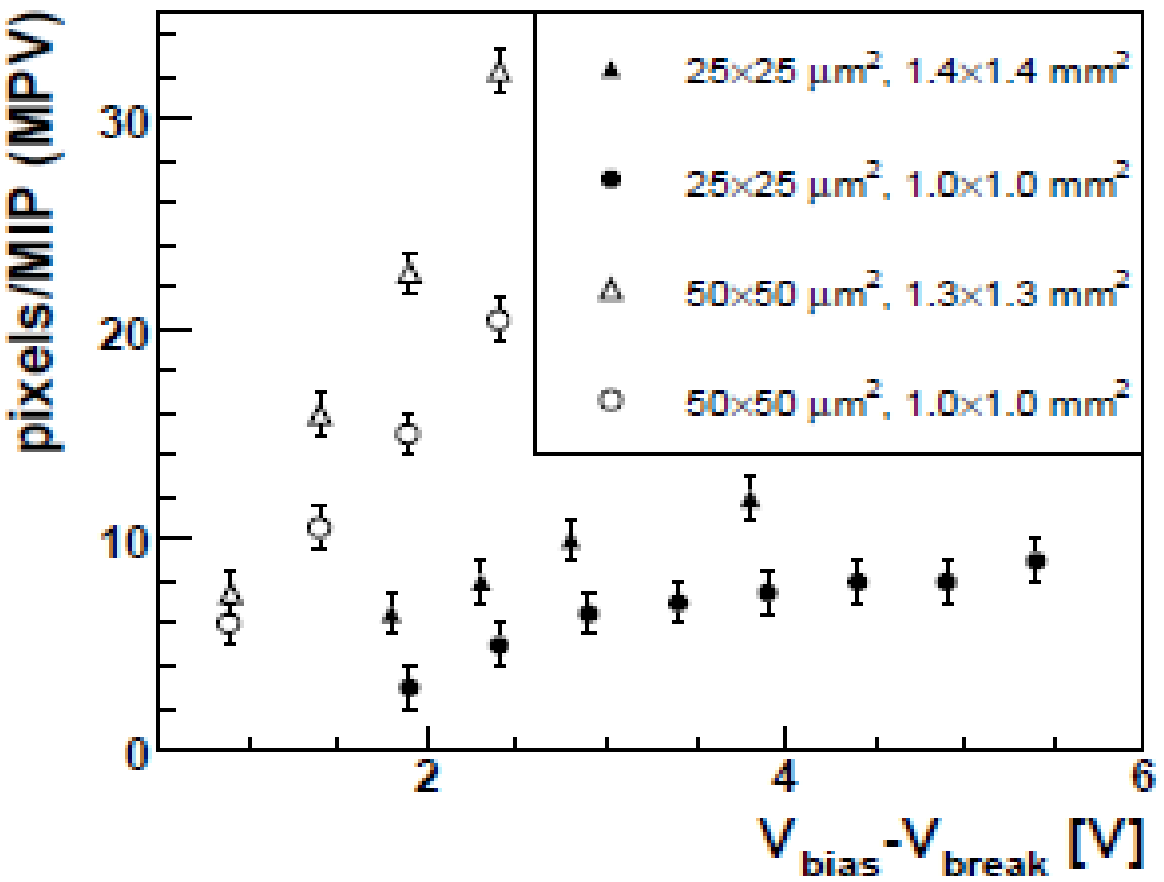
MIP spectrum:



→ 46 pixels/MIP

Comparison to t2:
- factor 2.5-3.0 expected (scales with PDE and area)
- measured factor 2; surface properties and alignment

Comparison with Previous Results



Direct r/o with HAMAMATSU MPPCs.

Conclusions

- Hight light yield due to large area and blue sensitivity (dynamic range?)
- Homogeneity studies to be performed (MPI Munich)