



# Time Resolution Scans of SciTils and SciRods

A. Lehmann, S. Motz, et al.

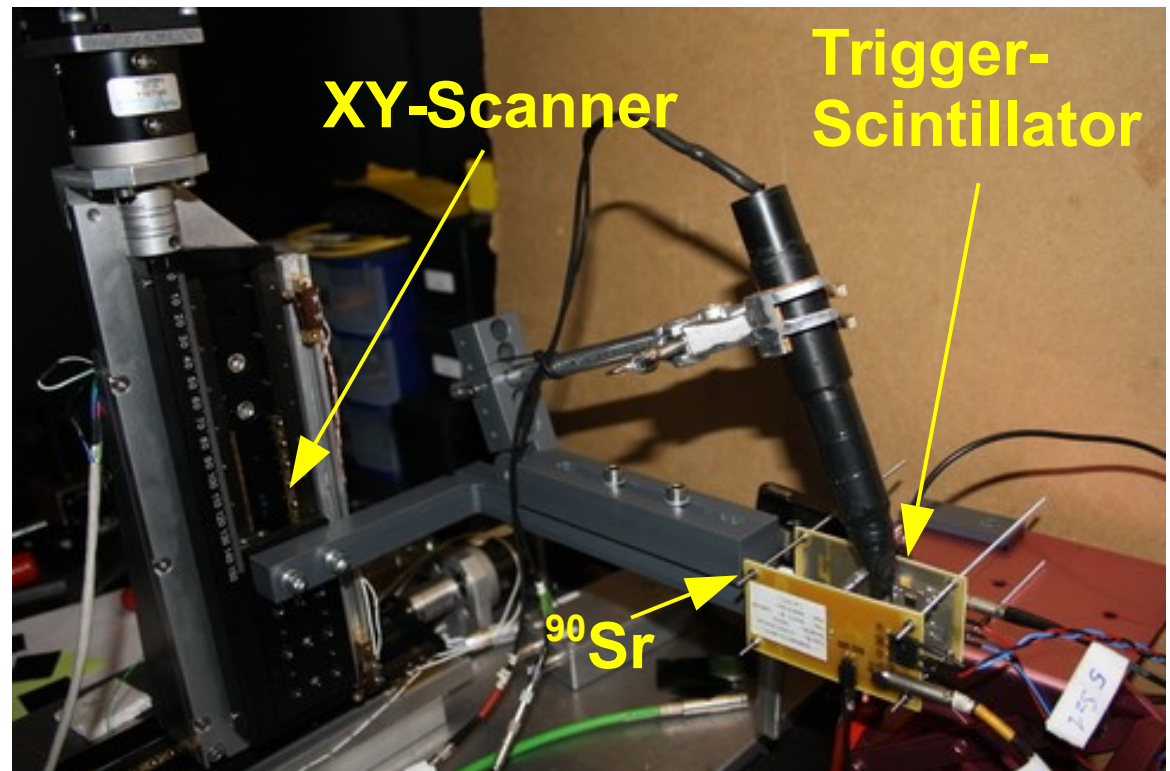
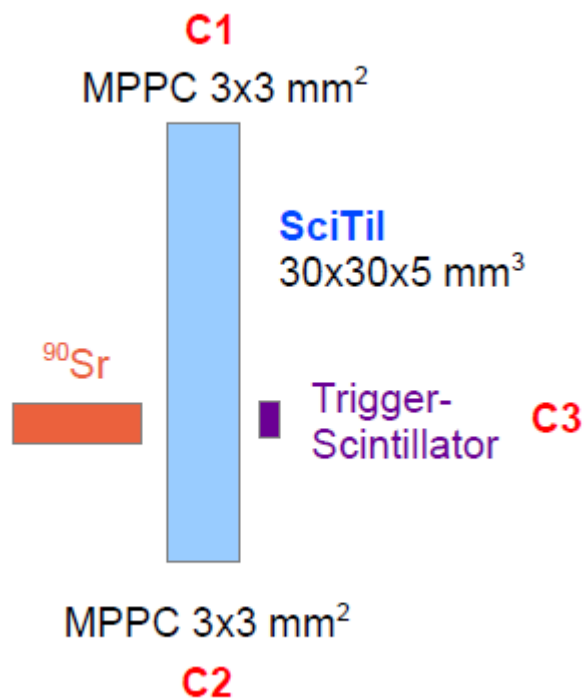
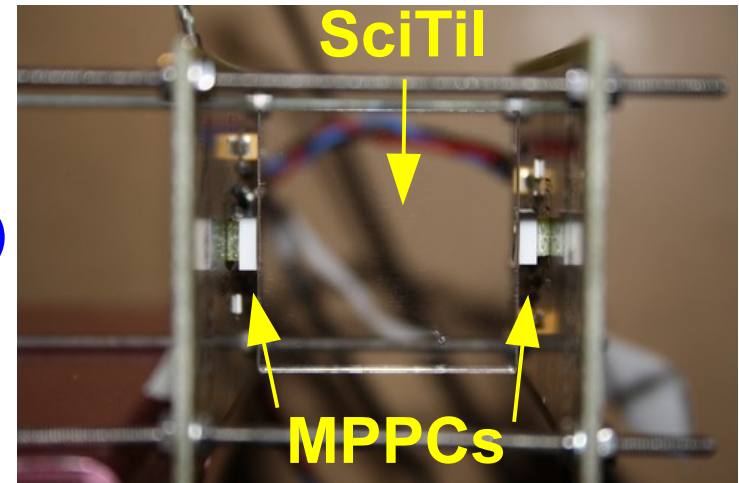
- Setup for Time Resolution Scans
- Results for SciTils
- Results for “SciRods”
- Summary





# Measurement Setup

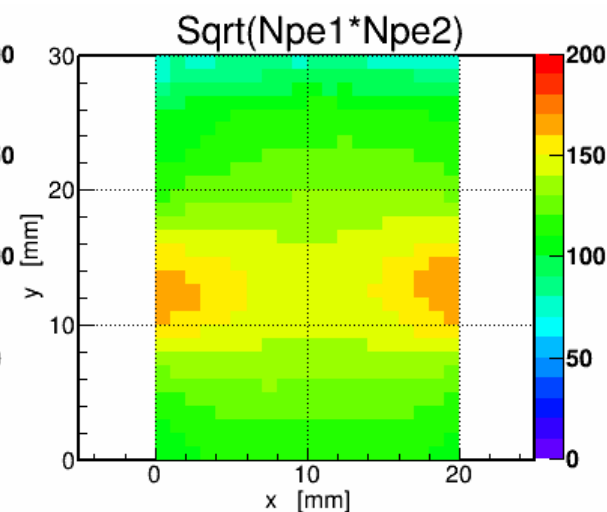
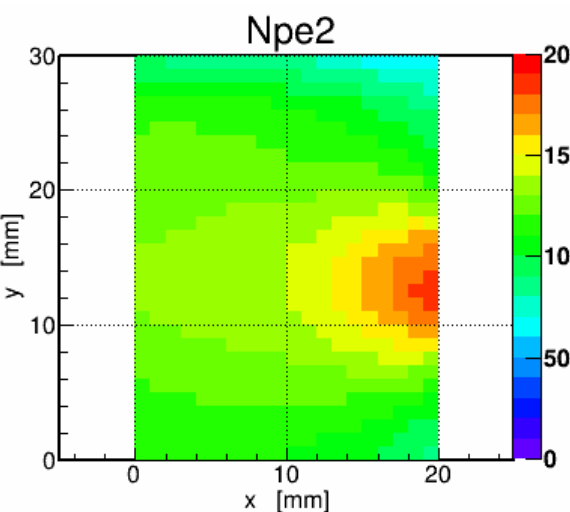
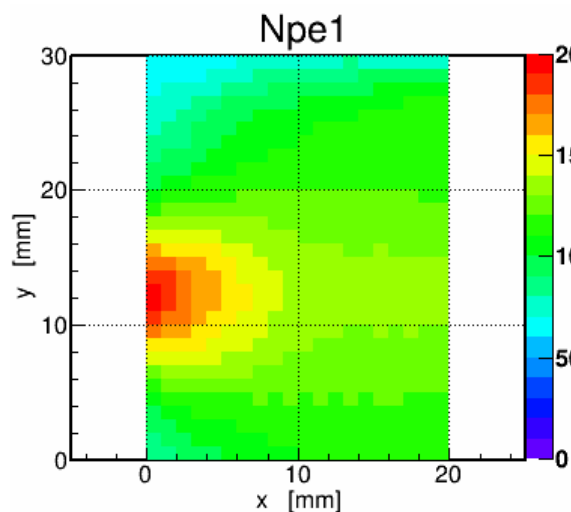
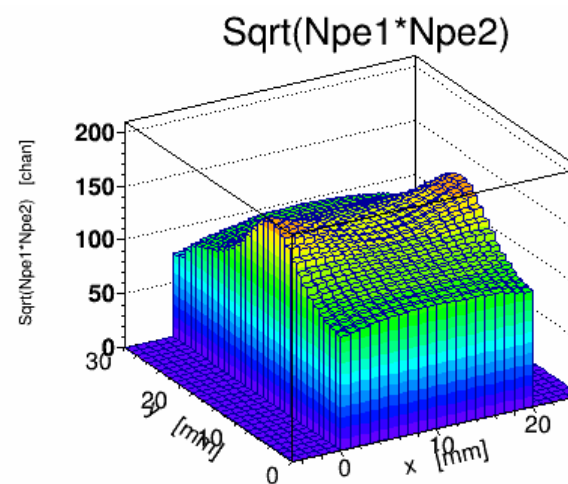
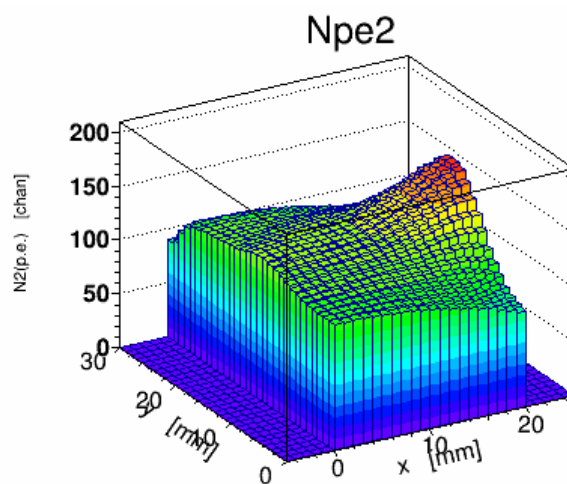
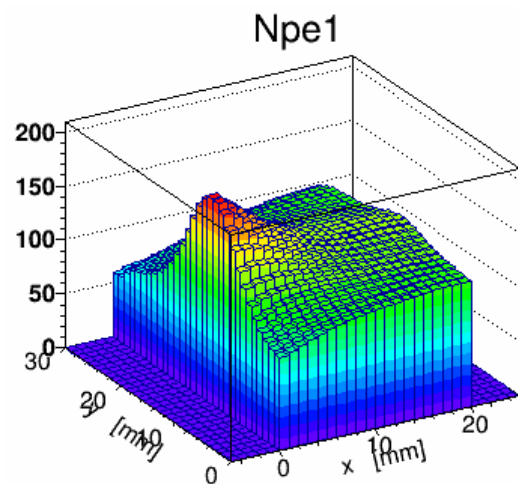
- SciTils/-Rods read out at opposite sides
  - With/without aluminum wrapping  
(→ collect only totally reflected photons)
  - Measure pulse heights (→  $N_{ph}$ )
  - Measure time difference (→  $\Delta t \rightarrow \sigma_t$ )





# Number of Photons from SciTil

Scintillator BC408  
MPPC S12652-050C



- In average ~120 photons detected (?? calibration correct ??)
- Highest close to MPPC and significantly fewer far away from MPPC



# Time Resolution of SciTiL

MPPC S12652-050C  
Scintillator: BC408  
with alu wrapping

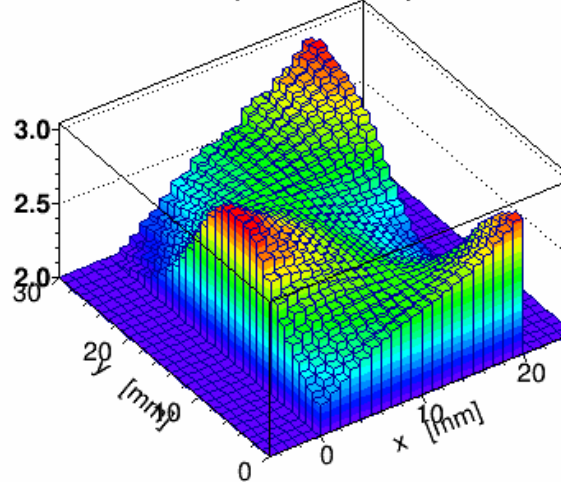
## Time difference

- 3 regions
- varies by almost 1 ns

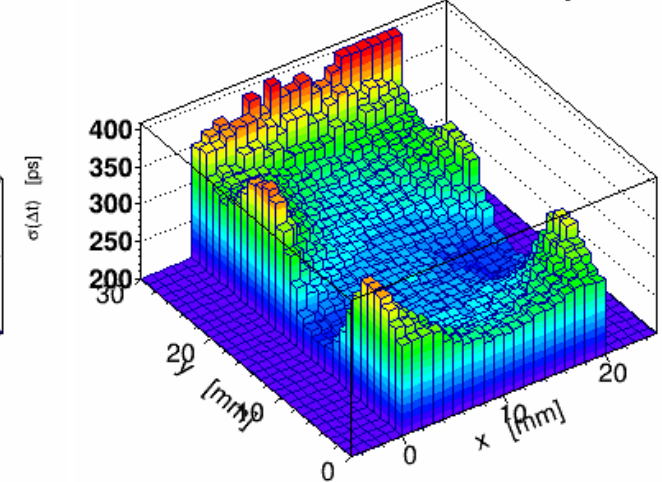
## Time resolution

- A lot of structures
- Varies between 240 and 380 ps
- Best resolution directly at sensors

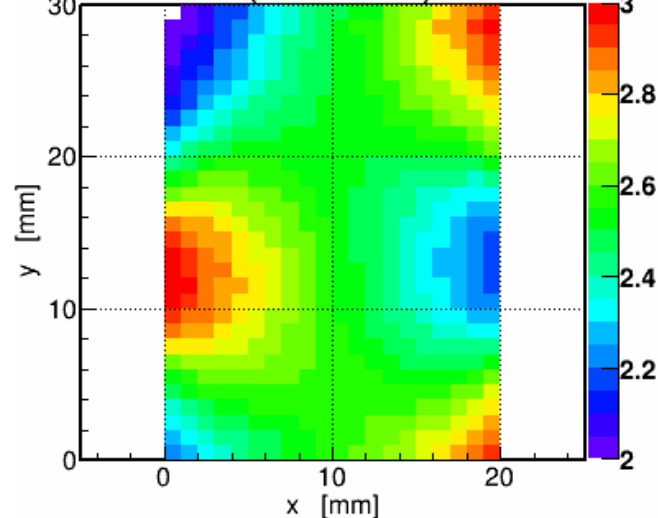
TDiff (Position) in ns



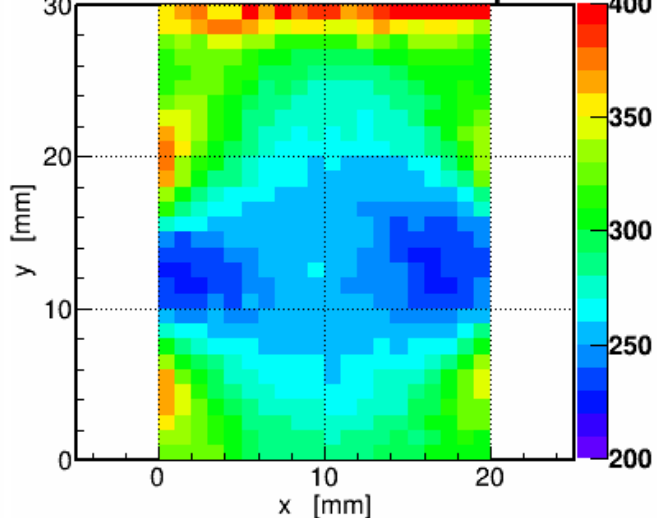
TDiff Resolution in ps



TDiff (Position) in ns



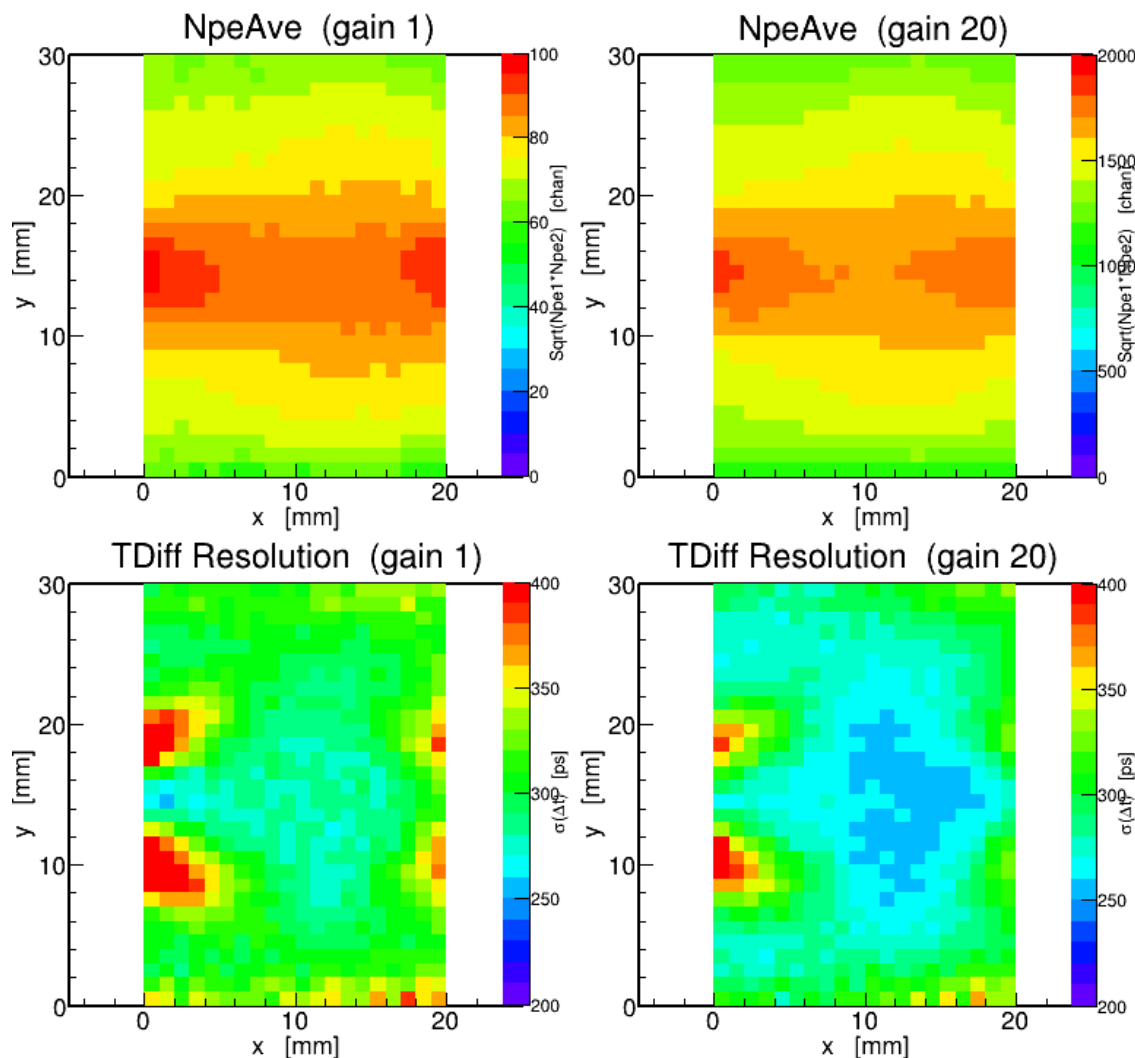
TDiff Resolution in ps





# SciTiL Results for Different Gains

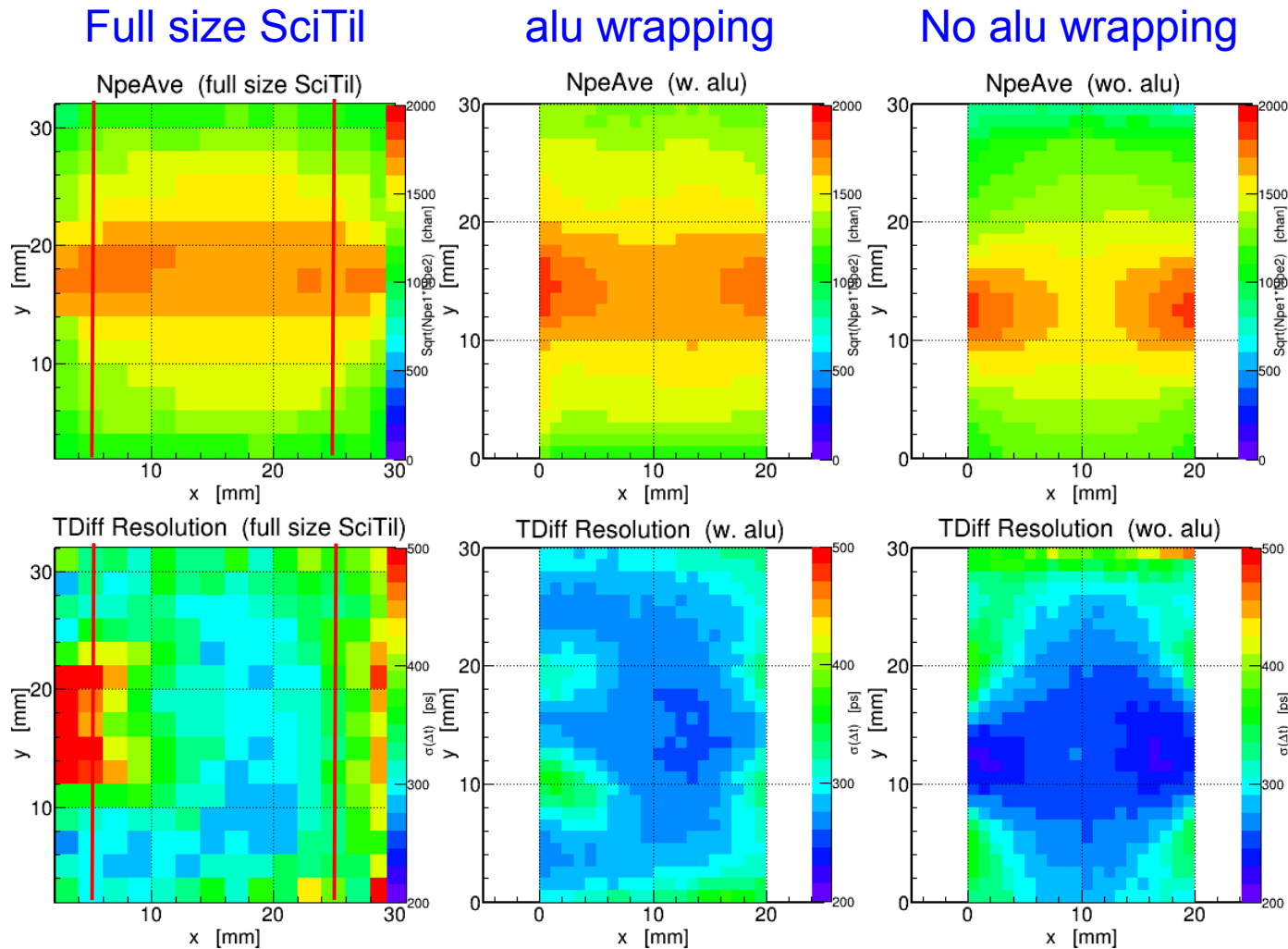
Scintillator BC408  
MPPC S12652-050C



- Average Charge
  - 77 ch. for g=1
  - 1507 ch. for g=20
- Average Time Resolution
  - 309 ps for g=1
  - 286 ps for g=20

● The usage of a x20 amplifier (in addition to the AD8000) does not give a big improvement in the time resolution

# SciTils with/without alu wrapping



- Average Charge
  - 1440 ch. (full)
  - 1504 ch. (alu)
  - 1386 ch. (no alu)

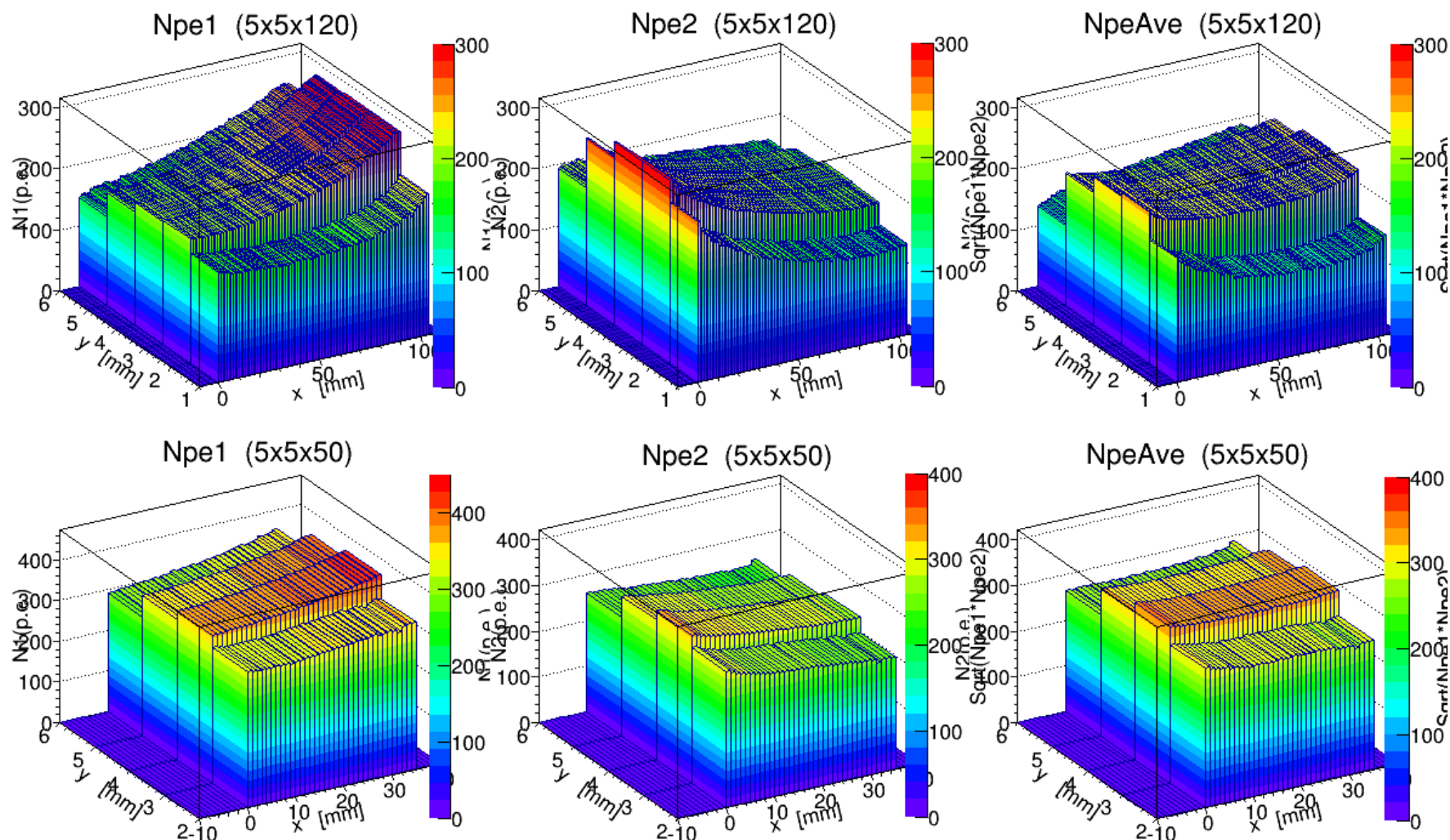
- Average Time Resolution
  - 347 ps (full)
  - 285 ps (alu)
  - 285 ps (no alu)

- Only minor increase of photon yield with alu wrapping of SciTil
- Time resolution does not improve with alu wrapping



# Number of Photons from SciRods

Scintillator BC420  
MPPC S12652-050C



- Detect in average 220 (5x5x120 cm<sup>3</sup>) and 310 (5x5x50 cm<sup>3</sup>) photons
- Highest close to MPPC (~exponential decrease as expected)

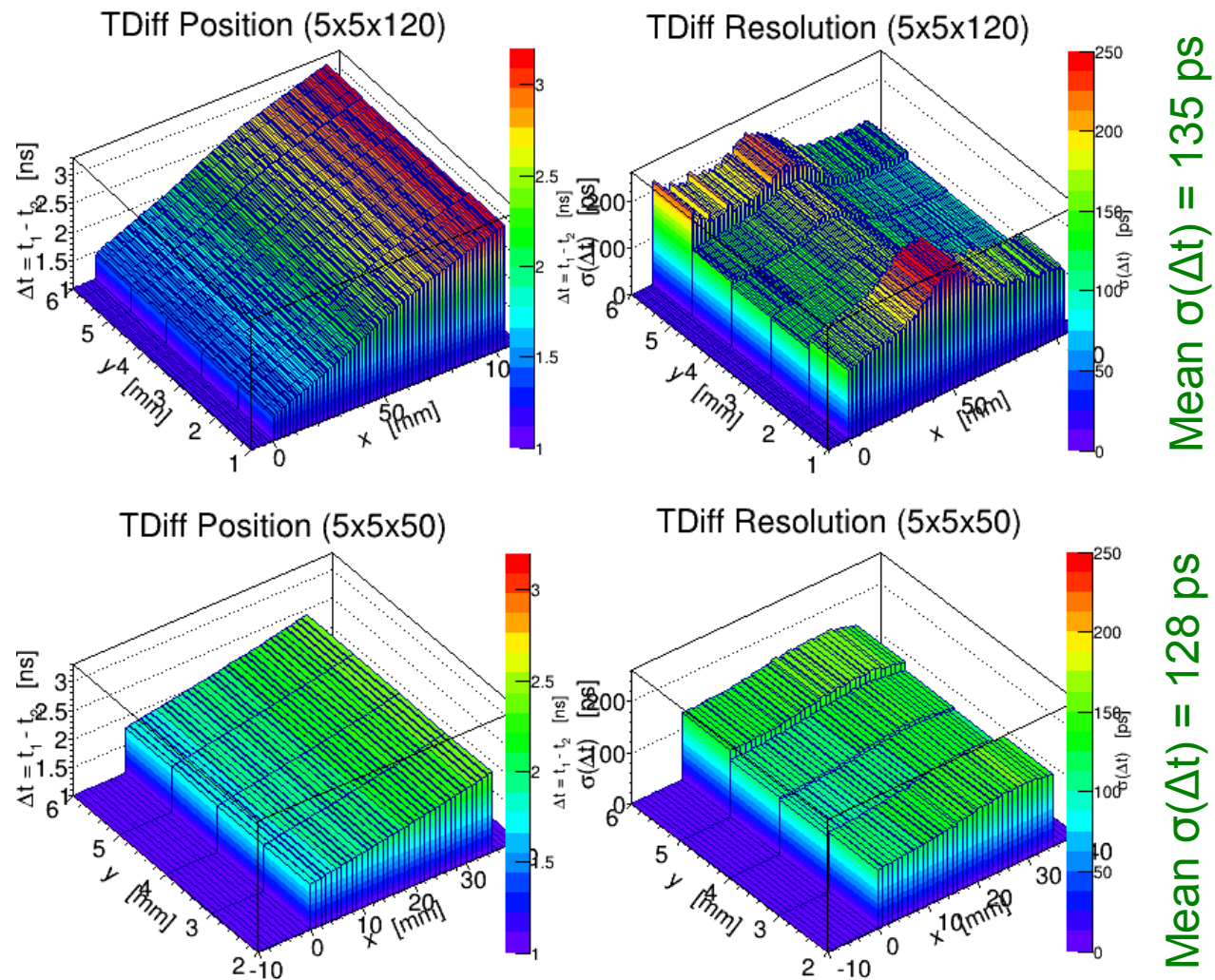


# Time Resolution of SciRods

MPPC S12652-050C  
Scintillator: BC420

- Time difference
  - Smooth slope
  - Determine x-position !
- Time resolution
  - Best resolution directly at sensors
  - little worse in rod center
  - varies from ~100 to ~150 ps and back
  - Slightly better for 5x5x50 cm<sup>3</sup>

Only amplification with AD8000





# SciRod Time Resolutions

Scintillator  $5 \times 5 \times 120 \text{ mm}^3$

	BC408		BC420	
MPPC	Mean $\sigma(t_1-t_2)$	Best $\sigma(t_1-t_2)$	Mean $\sigma(t_1-t_2)$	Best $\sigma(t_1-t_2)$
S10931-100P	$166 \pm 21$	120	$131 \pm 17$	98
S10931-050P	$190 \pm 15$	170	$141 \pm 18$	114
S12572-050P			$124 \pm 20$	104
S12572-015P	$202 \pm 26$	151	$169 \pm 22$	132
S12652-050C	$161 \pm 24$	125	$136 \pm 19$	101

Scintillator  $5 \times 5 \times 50 \text{ mm}^3$

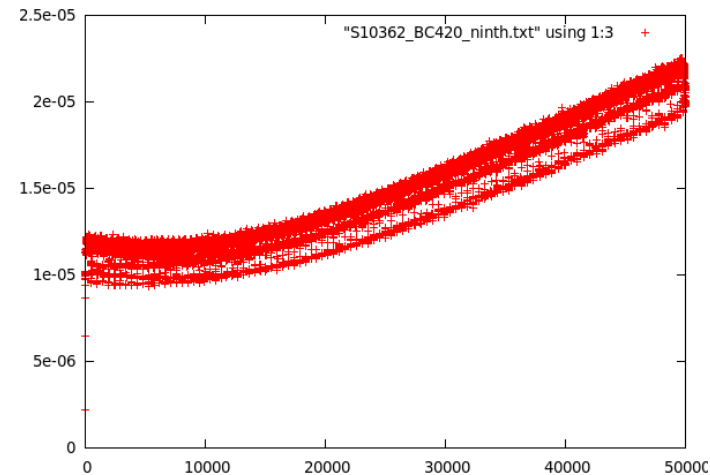
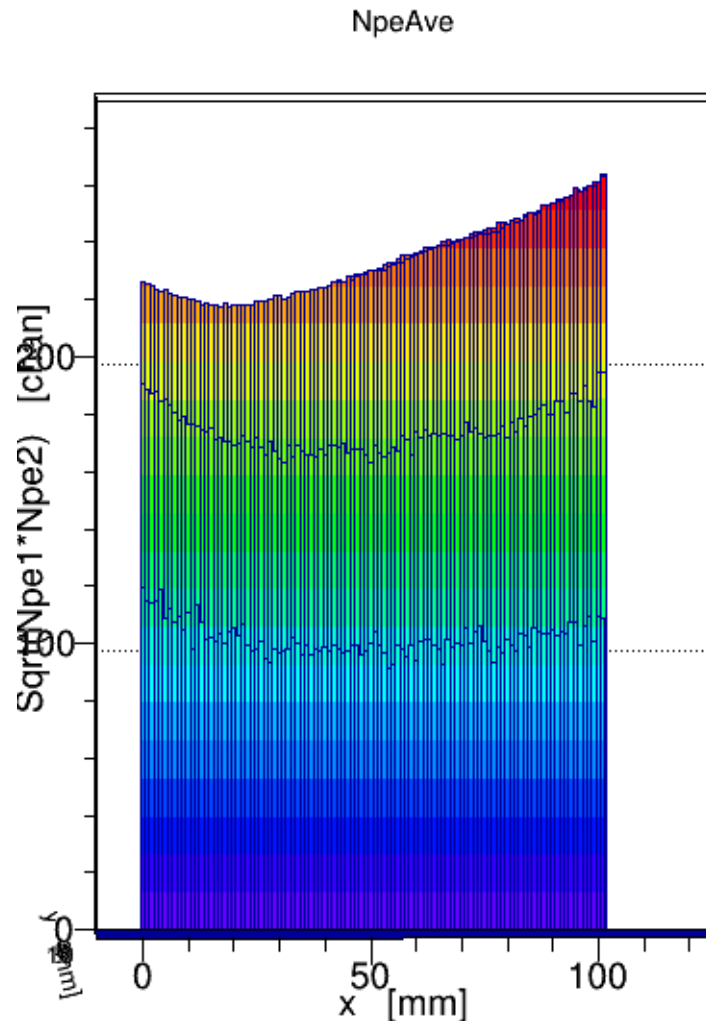
	BC408		BC420	
MPPC	Mean $\sigma(t_1-t_2)$	Best $\sigma(t_1-t_2)$	Mean $\sigma(t_1-t_2)$	Best $\sigma(t_1-t_2)$
S10931-100P	$173 \pm 11$	143	$127 \pm 8$	112
S12652-050C	$165 \pm 11$	144	$123 \pm 9$	106

- Only moderate dependence on scintillator length
- Best results for BC420 scint. and S12572-050P/S12652-050C MPPC

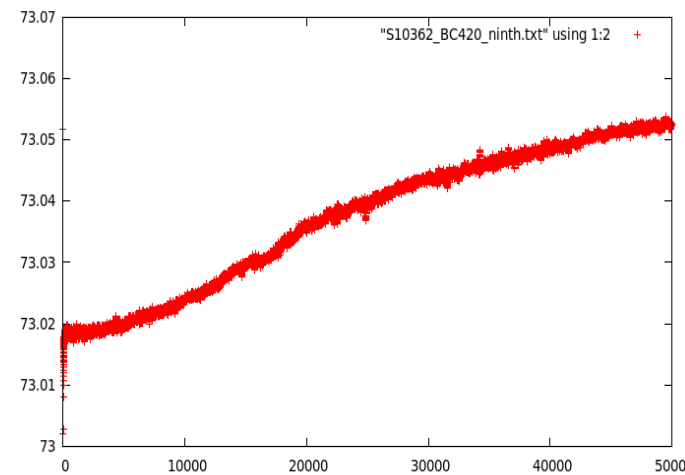


# Temperature Dependence

Scintillator BC420  
MPPC S10931-100P



SiPM  
current



SiPM  
voltage

- Same slope of NpeAve (average charge output) and SiPM current !
- Probably a hint of temperature dependence in SiPM charge output !



# Summary and Outlook

- Scanned SciTils and SciRods
- SciTils (time resolution and number of photons) show a lot of structure across surface
  - time difference ( $t_1 - t_2$ ) resolution varies between 250 and 350 ps
  - No significant improvement in time resolution with alu wrapping and additional amplification
- SciRods show fewer structures and much better time resolution
- SiPM charge is temperature dependent → stabilization needed?
- Outlook:
  - Build a small TOF prototype with SciRods ( $\sim 5 \times 12 \text{ cm}^2$ ) using BC420 and MPPC S12572-100P
  - run readout with new TRB boards (possibly with ADCs)