

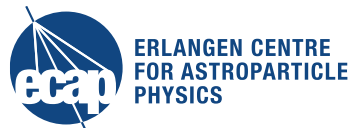
PANDA Collaboration Meeting

CERN 2016 Beamtime Results Preview

ERLANGEN CENTRE
FOR ASTROPARTICLE
PHYSICS

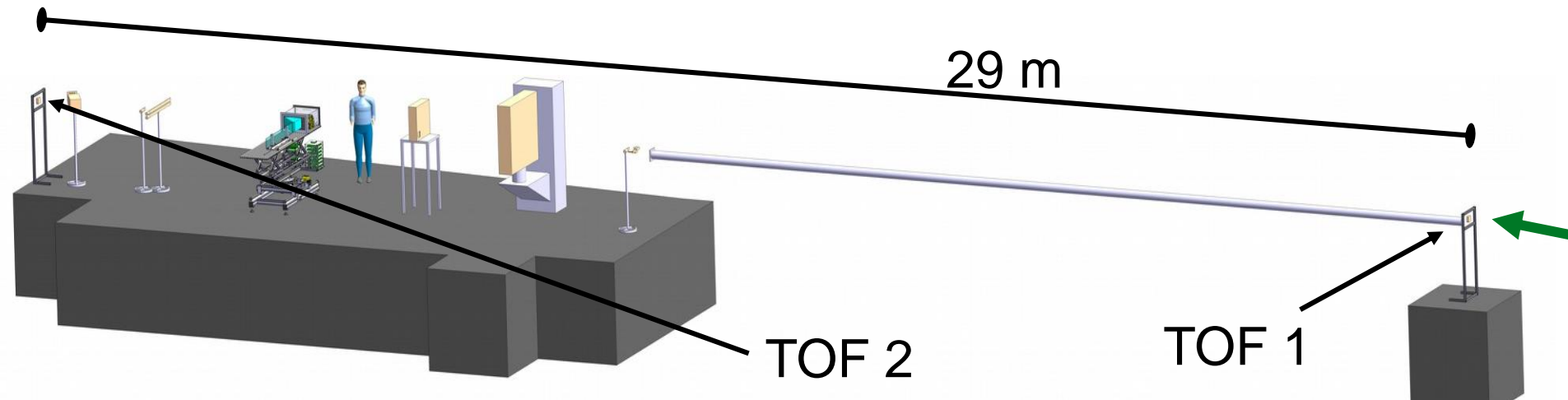
ecap

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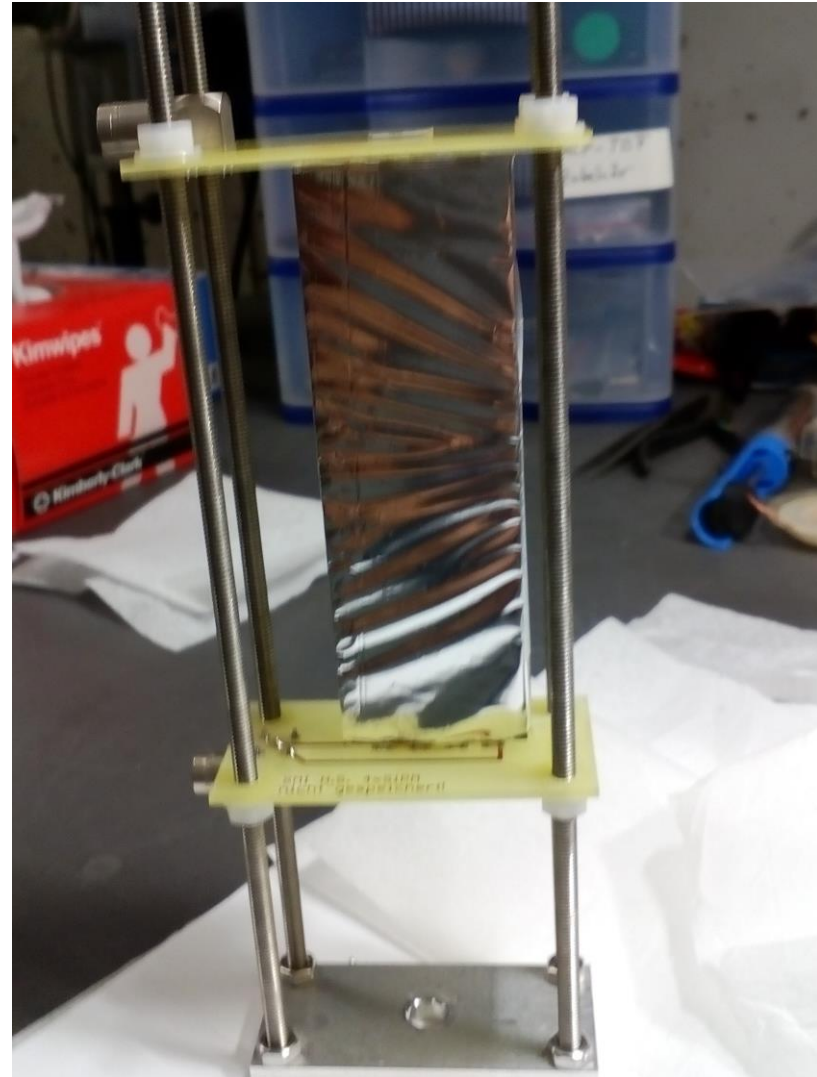
Beamtime 2016 - Setup

- Test of DIRC-Prototype, needed TOF-Detektors for PID
- Opportunity to test several SciTil configurations
- Setup
 - Two TOF-Stations, 29 m apart
 - Beam with 7 GeV/c, containing protons, pions, electrons and kaons



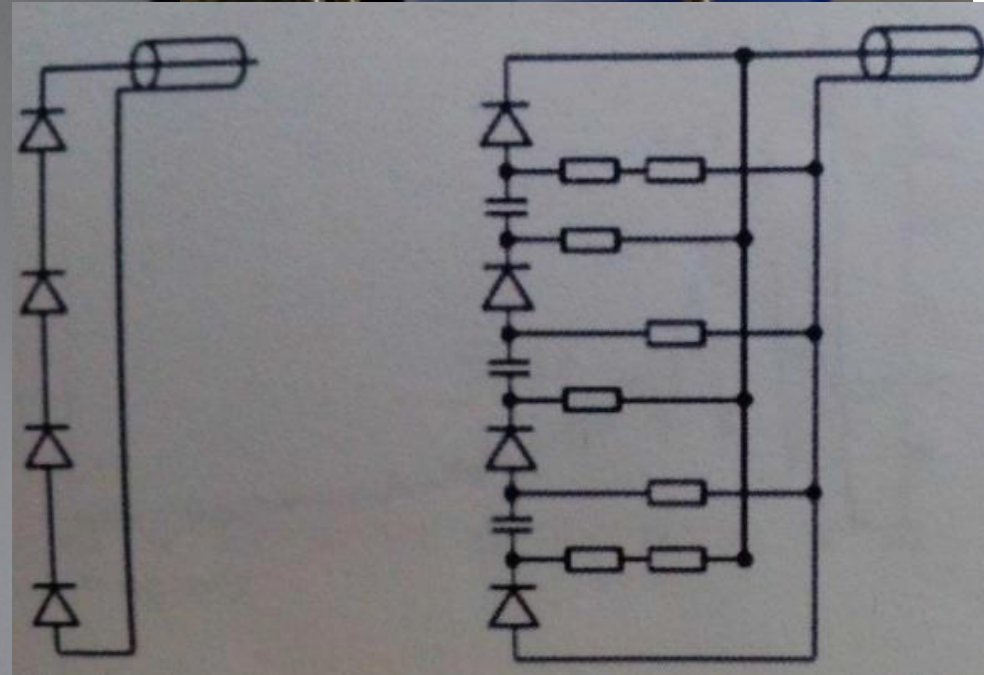
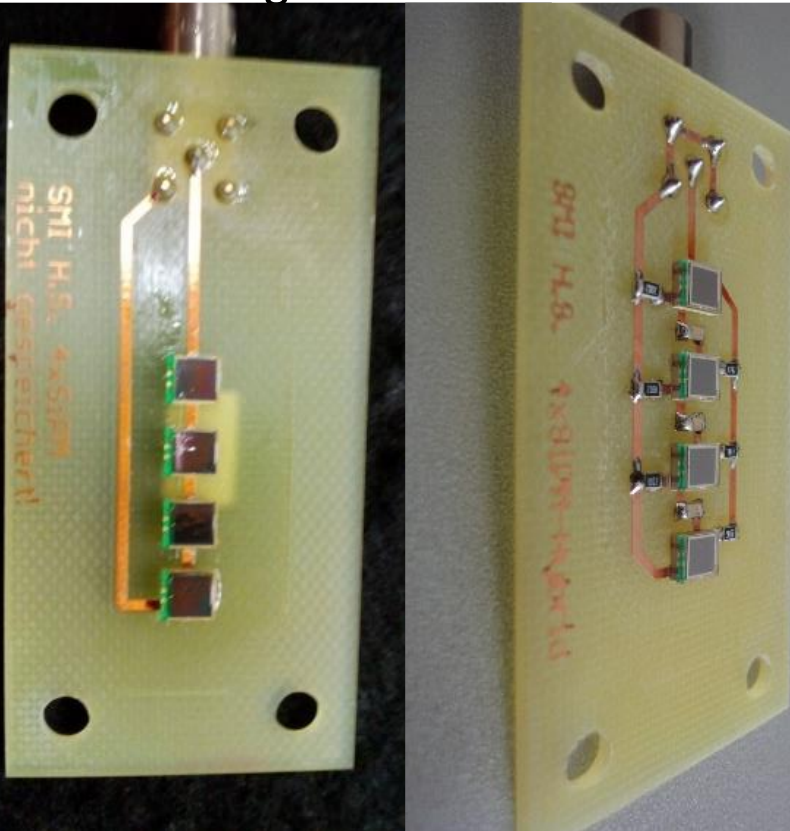
Beamtime 2016 – SciTil configurations

- Serial design
 - 4 SiPMs in series, EJ232
 - 8x HPK S13360-3050, 248V
- Hybrid design
 - 4 SiPMs in hybrid configuration, EJ232
 - -> lower voltage needed
 - 8x HPK S13360-3025, 62V
- Prototype with serial design (damaged)
 - 4 SiPMs in series, EJ228
 - 8x AdvansID sensors, 130V
 - 2 Scintillators glued to 3 SiPM boards
 - -> Damaged, only 1 scintillator usable



Beamtime 2016 – SciTil configurations

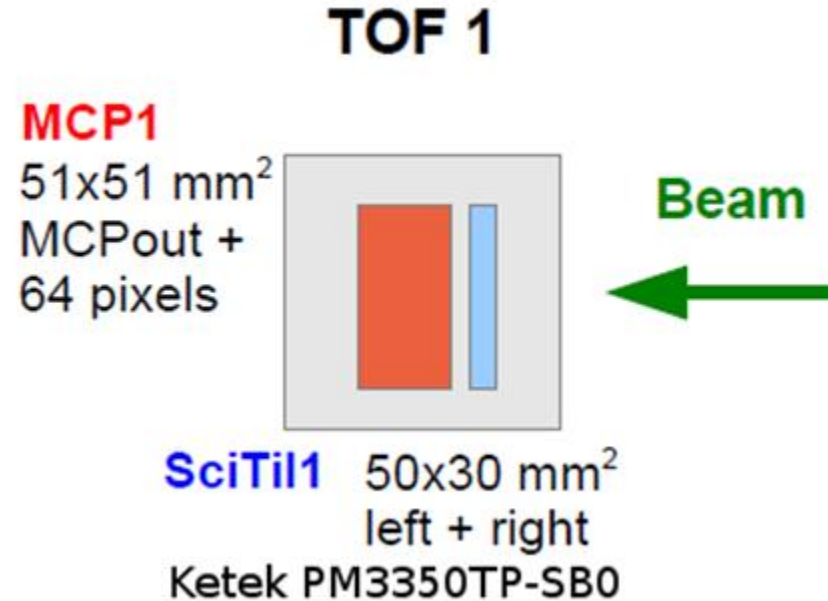
- Serial design



→ Damaged, only 1 connector usable

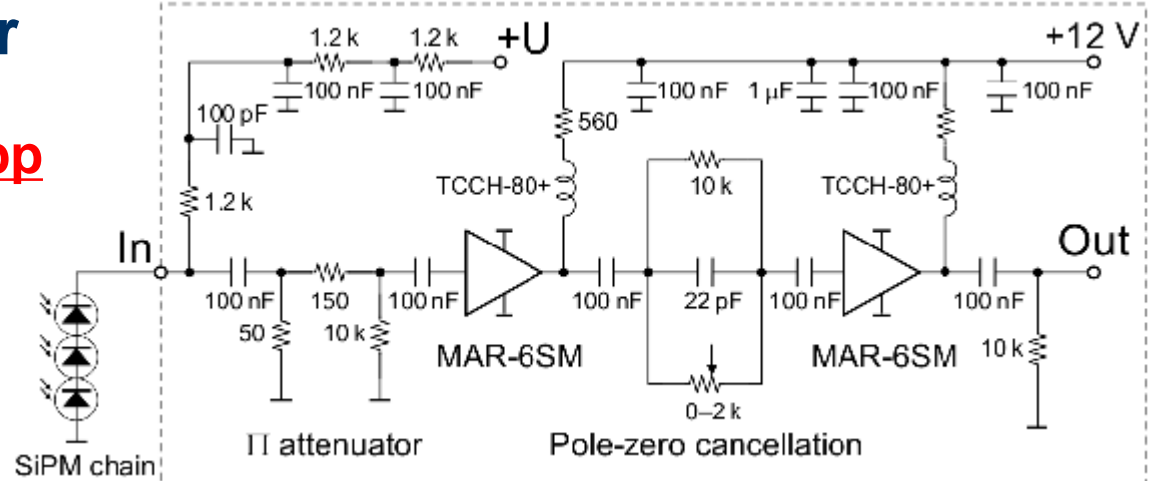
Beamtime 2016 - Setup

- SciTils wrapped in mylar foil, readout on both sides with 4 SiPM-Sensors
- Time informationen for Analysis of the SciTil-Counters
 - Time: $\frac{1}{2} [t(\text{SciTil}_{left}) + t(\text{SciTil}_{right})]$
 - Pulsheight: $tot(\text{SciTil}_{left}) + tot(\text{SciTil}_{right})$



Readout - Amplifier

Problem: Oscillations ~2Vpp



Source: arXiv 1402:1404



SiPM Voltage

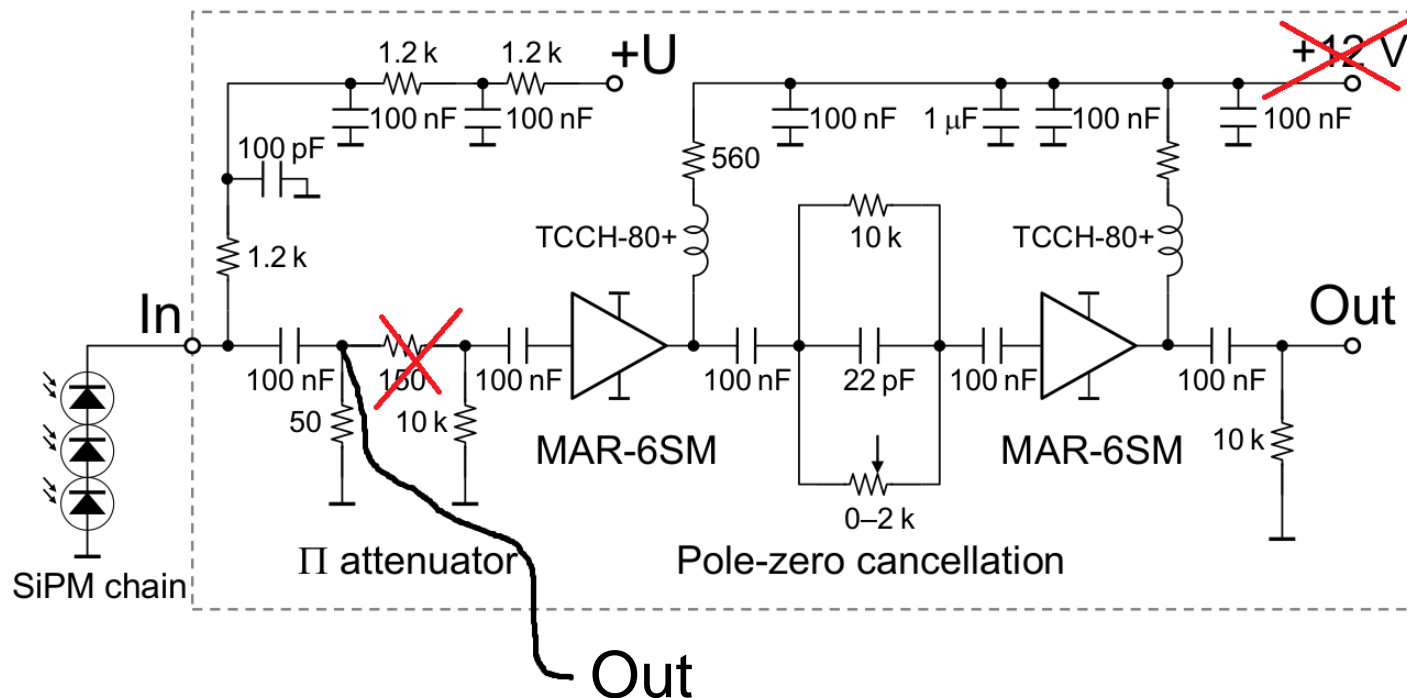
To SiPM

+12 V

Signal Out

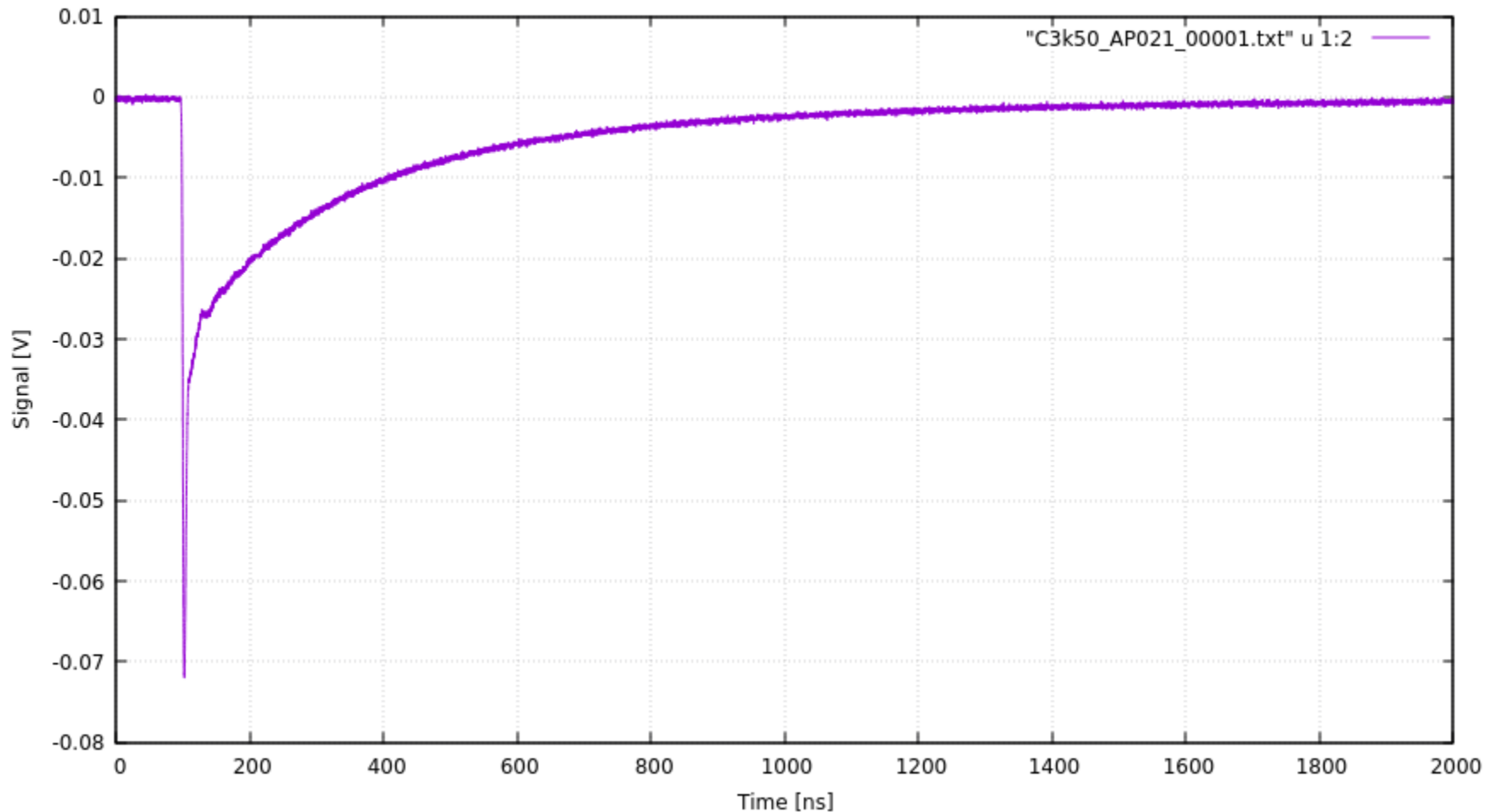
Readout – Modified Amplifier

- Using unamplified signal
- Signal height $\sim 10\text{-}15\text{mV}$
- TimeRes SciTil1 (front) – MCP2 (rear): $\sim 180\text{ps}$



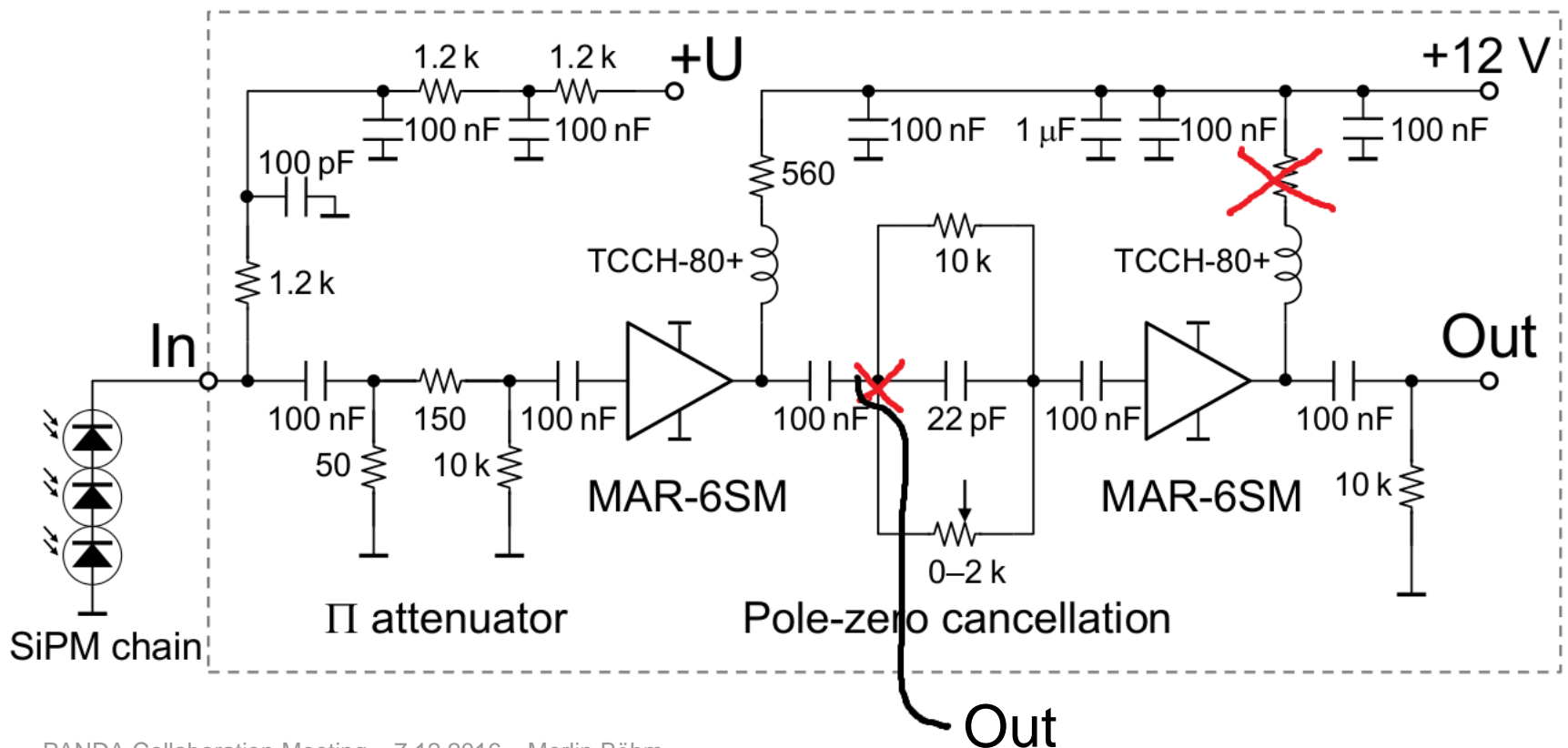
Readout – Modified Amplifier

- Using unamplified signal



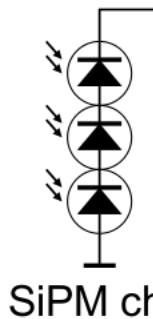
Readout – Modified Amplifier

- Using only one amplifier
- Signal height $\sim 100\text{mV}$, but inverted
- TimeRes SciTil1 (front) – MCP2 (rear): $\sim 165\text{-}170\text{ps}$



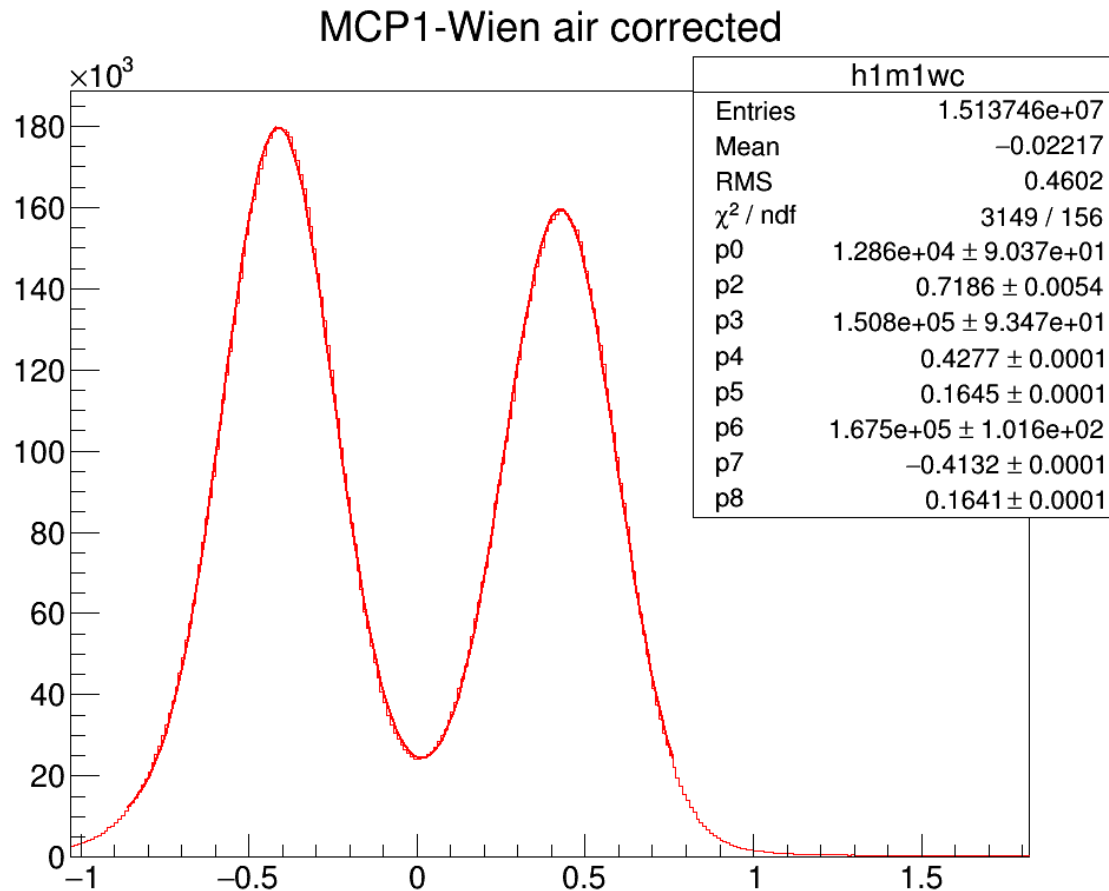
Readout – Modified Amplifier

- Use
- Si
- Tim



Analysis

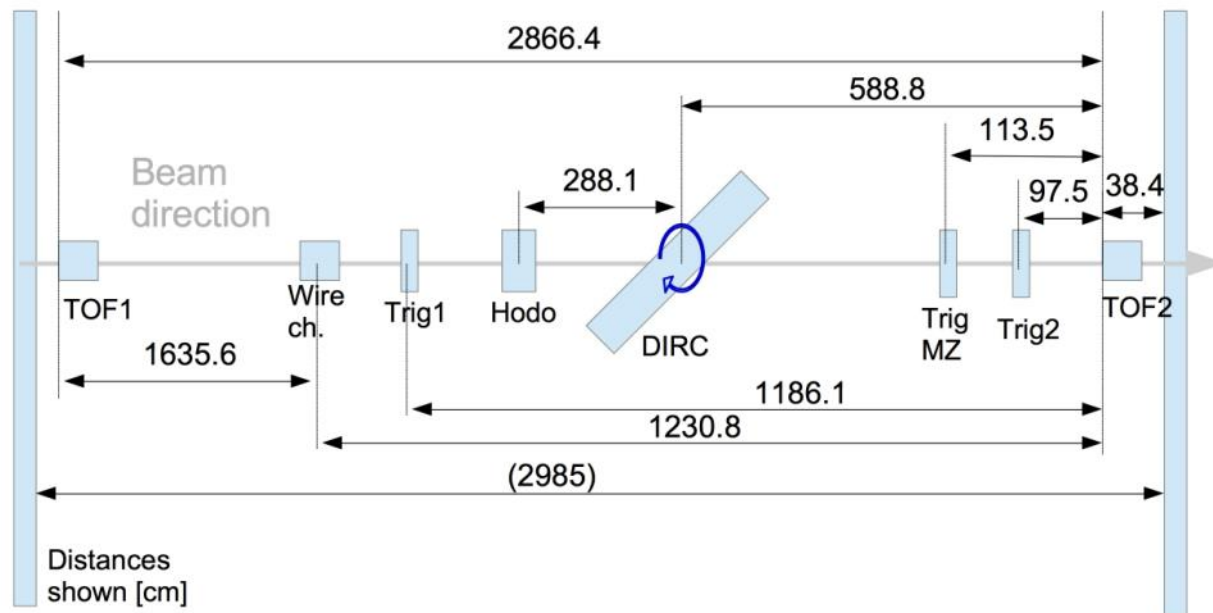
- Taking all data for one configuration
- Calculate time differences for each counter combination
- Applying timewalk correction



Preliminary Results

- Measured Distance with Laser TOF1 – TOF2: 28.66m (MCP)
- Calculated Distance with Beam files TOF1 – TOF2: 28.43m (MCP)

$$\Delta t = \frac{Lc}{2p^2} (m_1^2 - m_2^2)$$



Preliminary Results

- Using MCP1 and SciTil Wien
- Time resolutions [ns] after timewalk correction

Configuration	Resolution p and pi averaged
Serial	136
Serial Prototype	164,3
Hybrid	143,3

Analysis 2

- SciTil Wien = SciTil2
- Calculate time resolutions of each counter
 - 6 measured TOF resolutions
 - -> 6 equations for 5 unknowns

$$\sigma_{MM} = TOFres(MCP2 - MCP1)$$

$$\sigma_{SS} = TOFres(SciTil2 - SciTil1)$$

$$\sigma_{SM} = TOFres(MCP2 - SciTil1)$$

$$\sigma_{MS} = TOFres(SciTil2 - MCP1)$$

$$\sigma_{T1} = TOFres(MCP1 - SciTil1)$$

$$\sigma_{T2} = TOFres(MCP2 - SciTil2)$$

Using MCP-Out signal

$$\sigma_{M1} = TimeRes(MCP1)$$

$$\sigma_{M2} = TimeRes(MCP2)$$

$$\sigma_{S1} = TimeRes(SciTil1)$$

$$\sigma_{S2} = TimeRes(SciTil2)$$

$$\sigma_{beam} = TimeRes(Beam, \dots)$$

$$\sigma_{MM}^2 = \sigma_{M1}^2 + \sigma_{M2}^2 + \sigma_{beam}^2$$

$$\sigma_{SS}^2 = \sigma_{S1}^2 + \sigma_{S2}^2 + \sigma_{beam}^2$$

$$\sigma_{MS}^2 = \sigma_{M1}^2 + \sigma_{S2}^2 + \sigma_{beam}^2$$

$$\sigma_{SM}^2 = \sigma_{S1}^2 + \sigma_{M2}^2 + \sigma_{beam}^2$$

$$\sigma_{T1}^2 = \sigma_{M1}^2 + \sigma_{S1}^2$$

$$\sigma_{T2}^2 = \sigma_{M2}^2 + \sigma_{S2}^2$$

Analysis 2

- 6 equations for 5 unknown variables
- No exact solution
 - > Solving with least square fit using ROOT
- Create histogram with 6 bins
- Each bin represents one combination
- Define function which contains single counter resolutions as free parameters

```
Double_t LinEq(Double_t *x, Double_t *par)
{
    // par[0], MCP1
    // par[1], SciTil1
    // par[2], MCP2
    // par[3], SciTil2
    // par[4], Beam

    if (x[0] < 0.5) // MCP2 - MCP1
        xval = par[0] + par[2] + par[4];
    else if (x[0] < 1.5) // SciTil2 - SciTil1
        xval = par[1] + par[3] + par[4];
    else if (x[0] < 2.5) // MCP2 - SciTil1
        xval = par[1] + par[2] + par[4];
    else if (x[0] < 3.5) // SciTil2 - MCP1
        xval = par[0] + par[3] + par[4];
    else if (x[0] < 4.5) // MCP1 - SciTil1
        xval = par[0] + par[1];
    else if (x[0] < 5.5) // MCP2 - SciTil2
        xval = par[2] + par[3];

    return xval;
}
```

Preliminary Results 2

- Proton and Pion results averaged [ns]
- Need more investigations, cuts too tight

Configuration	M1	S1	M2	S2	Beam
Serial	98,3	95,4	80,3	58,0	79,9
Serial Prototype	90,1	95,4	69,9	110,1	96,3

Summary

- Good match of calculated and measured TOF distance
- Hybrid configuration delivers worse time resolution
- Prototype needs more investigation

- Outlook: Developing new amplifier for lab tests

