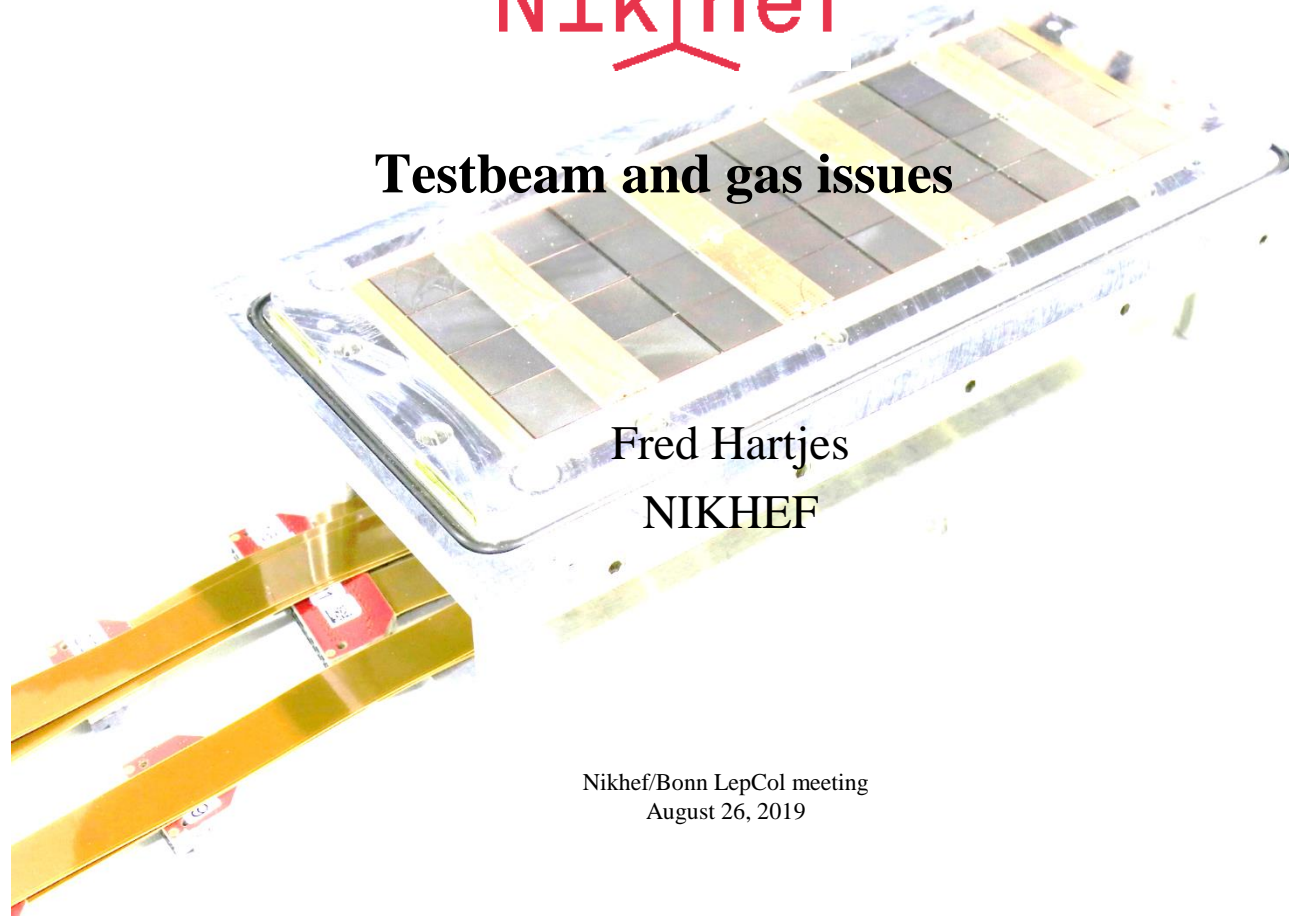




Testbeam and gas issues

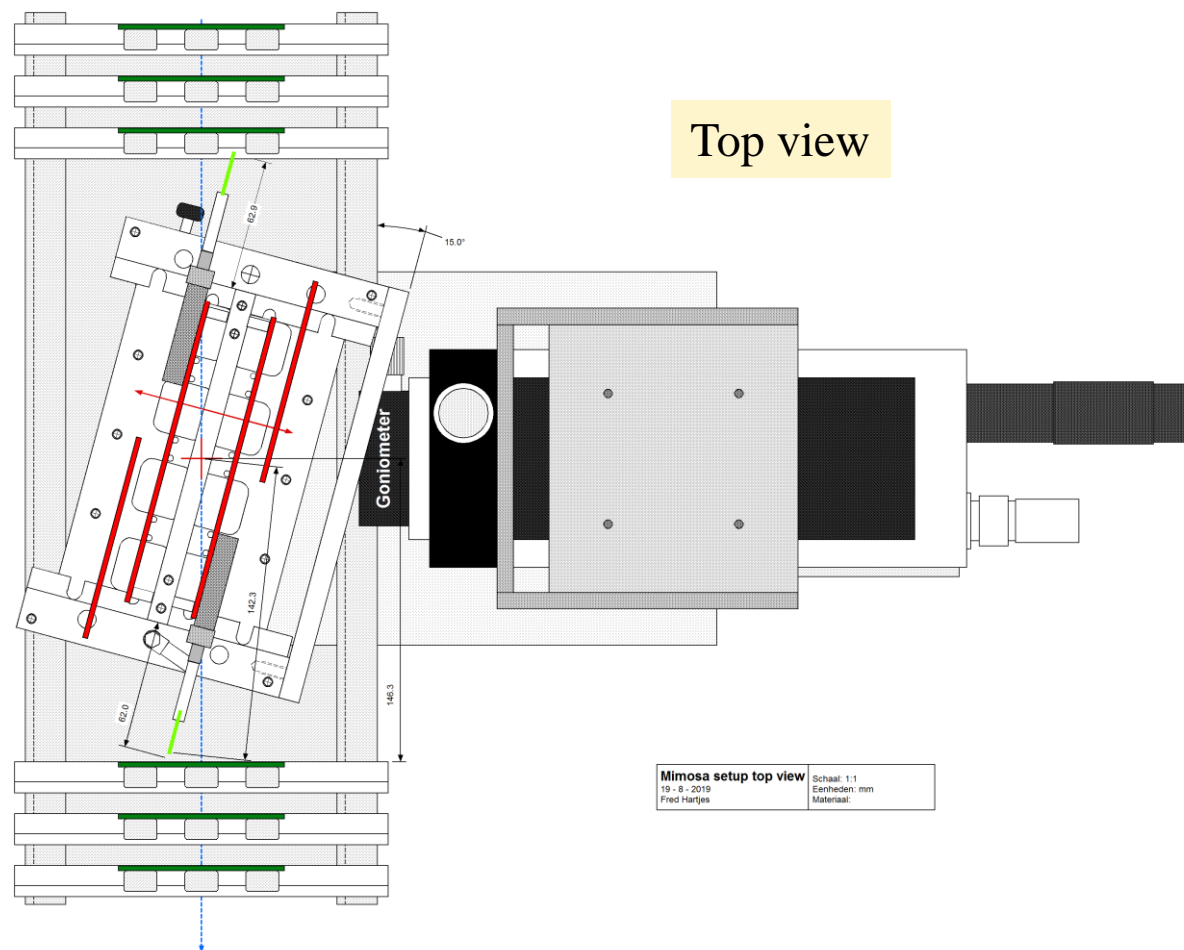
Fred Hartjes
NIKHEF



Nikhef/Bonn LepCol meeting
August 26, 2019

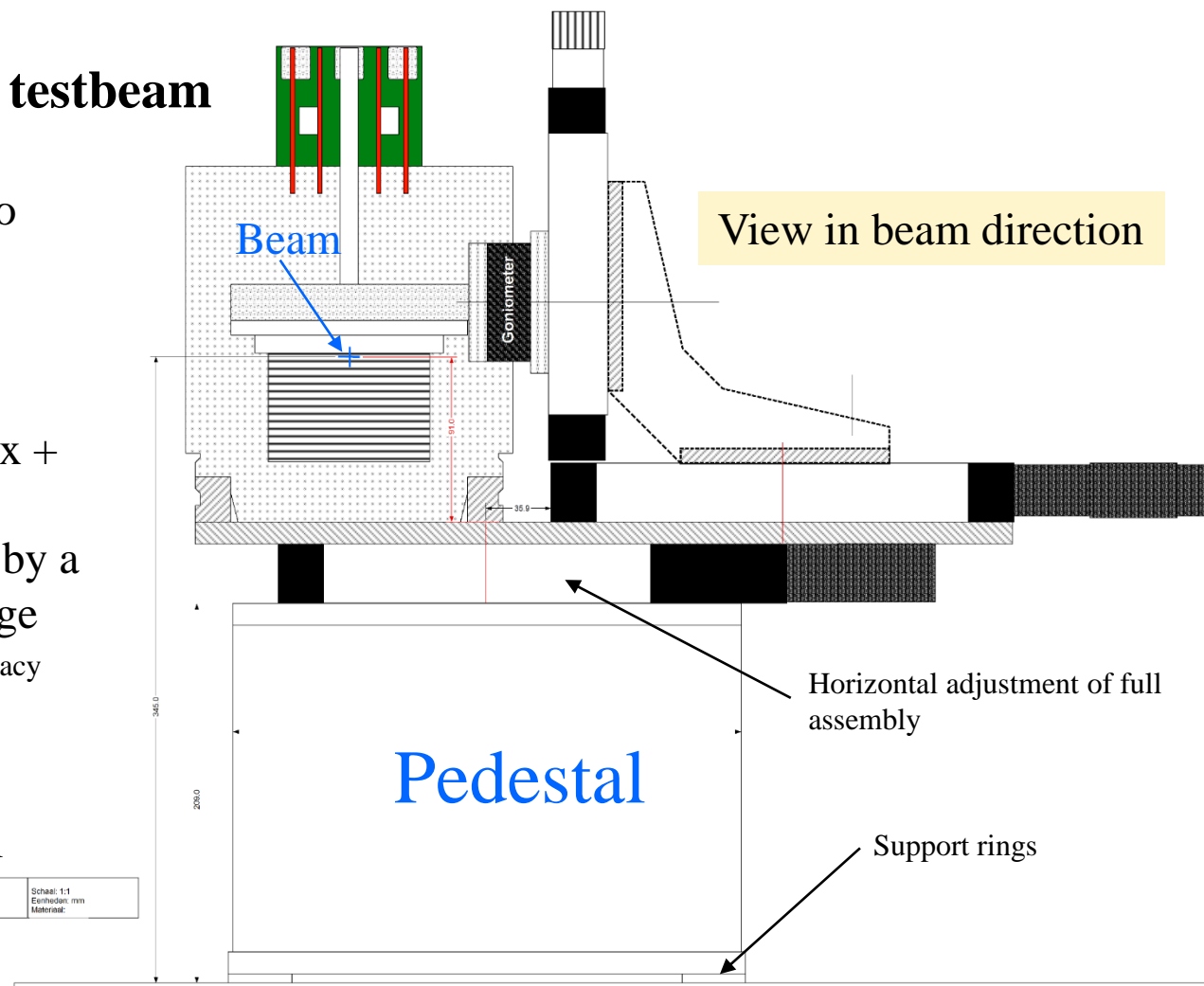
Preparations for Bonn testbeam

- Testbox sandwiched between 2 x 3 Mimosa planes
- Mechanically very well coupled
- Testbox position relative to the telescope has 3 degrees of freedom
 - Horizontally by remote control
 - ~ 1 mm accuracy
 - Manual adjustment vertically
 - ~ 10 μm accuracy
 - Manual rotation around vertical axis by goniometer
 - +/- 14 deg
 - ~ 0.1 deg accuracy



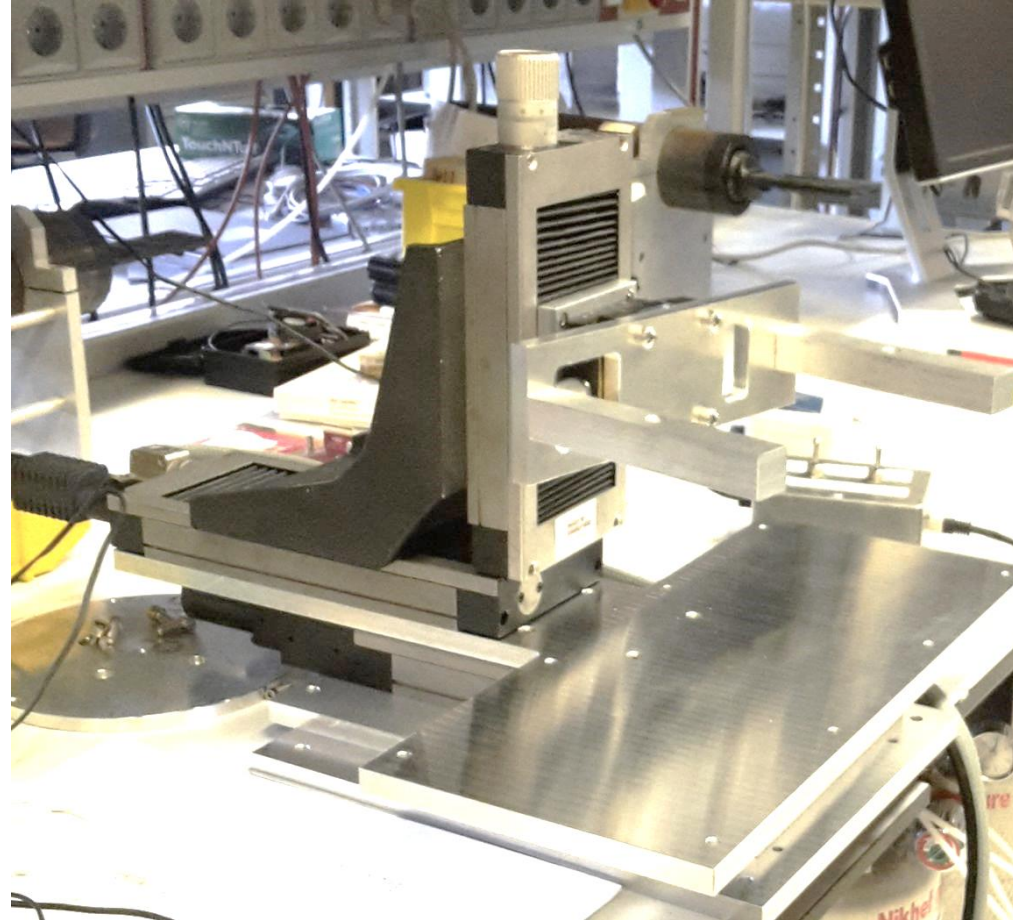
Preparations for Bonn testbeam

- Testbox hanging on two bars attached to the goniometer
- Full assembly of testbox + Mimosa planes is horizontally adjustable by a remotely controlled stage
 - ~ 0.5 mm resolution, no accuracy
- Vertical adjustment by support rings of several heights
 - Steps of 1 mm



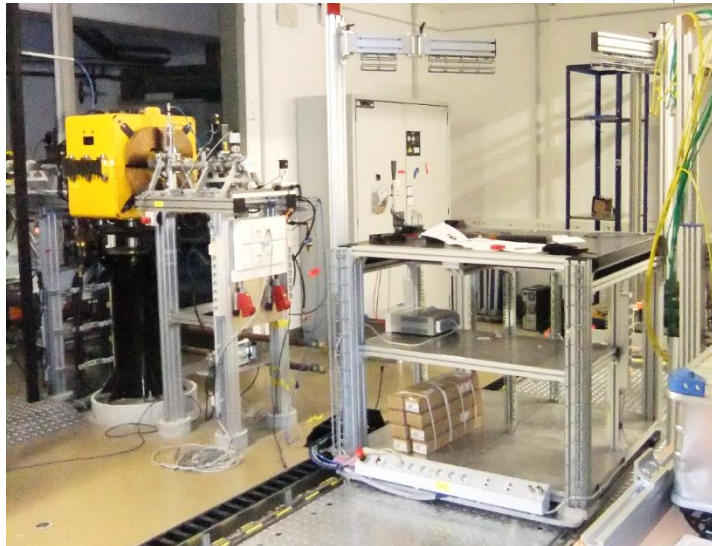
Preparations for Bonn testbeam

- Most mechanics finished
 - Mimosa rails and pedestal still to be done
- Expected to be completed beginning of September

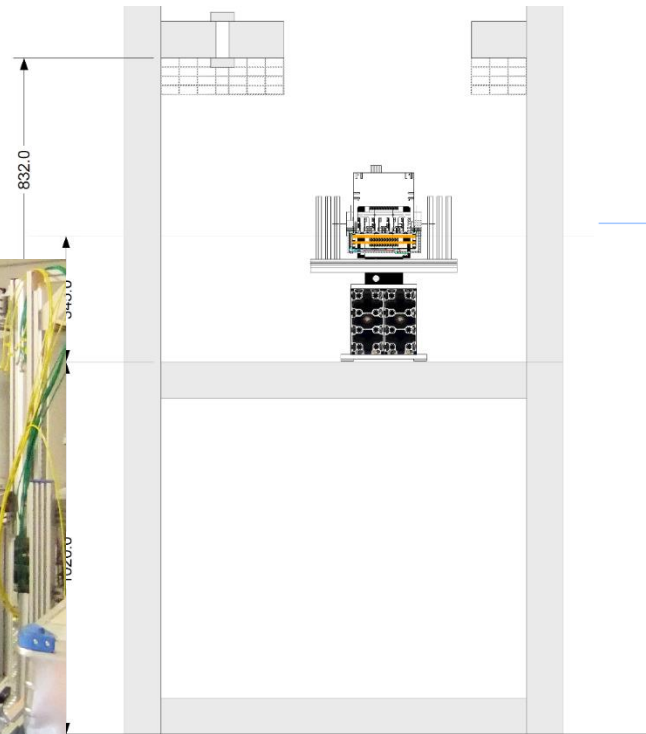


Setup in Bonn

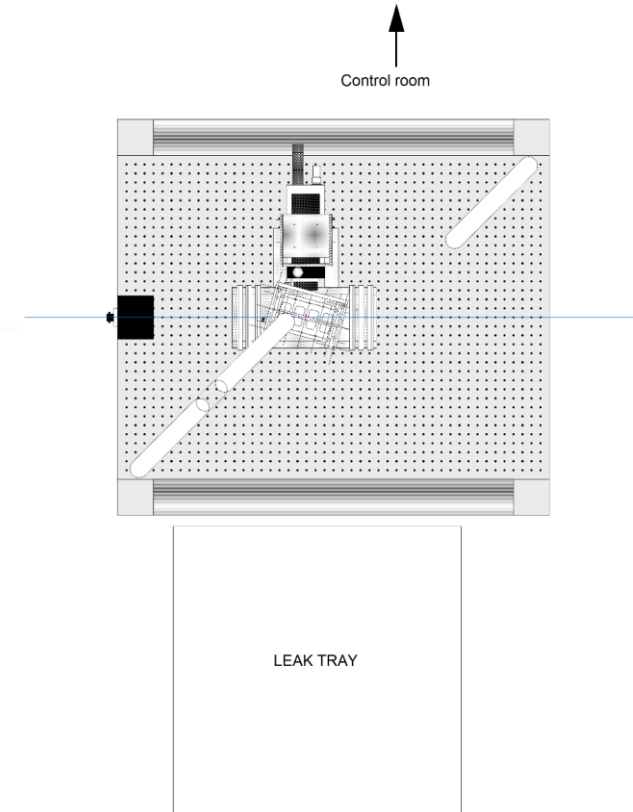
- New experimental table
- Practical guidance of the cabling



Side view



Top view



Status ELSA still unclear

- Probably no testbeam for us this year
- Alternative Desy TB24/1



DESY Test Beam Schedule 2019 - Version 8 02/08/2019



Ralf Diener, Norbert Meyners, Marcel Stanitzki - DESY Test Beam Coordinators

Week	Date	TB21		TB22		TB24/1		TB24		ANNOUNCED	
			DATURA		DURANTA	PCMAG	Telescope in PCMAG		AZALEA		
2-Sep-19	36	CMS-Pixel-Phase2		Setup Time							
9-Sep-19	37	CMS-Pixel-Phase2	X	ATLAS-ITk-Strips	X			CEPC-STCF	X		
16-Sep-19	38	AFP-TOF	X	Mu3e	X			CEPC-STCF	X		
23-Sep-19	39	CLIC PIXEL	X	ATLAS-ITk-Pixel	X	TPEX		TOTEM	X		
30-Sep-19	40	X-Ray-Crystal-Rad	X	ATLAS-ITk-Pixel	X	TPEX					
7-Oct-19	41										
14-Oct-19	42	BL4S	X	SHiP-SplitCAL				ATLAS-ITk-TJCMOS			
21-Oct-19	43	BL4S	X	SHiP-SciFi							
28-Oct-19	44	CMS-Pixel-Phase2	X	SHiP-SciFi				SHiP-Emulsion+Ship-SBT			
4-Nov-19	45	CMS-Pixel-Phase2	X	ATLAS-HGTD	X			LHCb-ECAL	X		
11-Nov-19	46	FCAL	X	ATLAS-HGTD	X			LHCb-ECAL	X		
18-Nov-19	47			Setup Time							
25-Nov-19	48	CMS Outer Tracker	X	ATLAS-ITk-Strips	X			ATLAS-ITk-Pixel	X		
2-Dec-19	49	CMS Outer Tracker	X	ATLAS-ITk-Strips	X			ATLAS-ITk-Pixel	X		
9-Dec-19	50	ELIOT		CMS-Pixel-Phase2	X			Mu3e	X		
16-Dec-19	51	Beam till 20/12 0800		CMS-Pixel-Phase2	X			CLIC PIXEL	X		
23-Dec-19	52	Shutdown									
30-Dec-19	1										

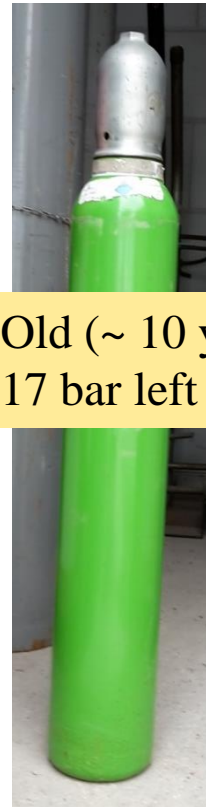
Options

- **Integration in LCTPC setup**
 - Includes magnetic field
- **Requires NEW testbox**
 - Design
 - Fabrication
 - Testing (laser)
 - 0.5 to 1 year needed to get this operational
- **Alternative: run parasitically outside the LCTPC setup**
 - Using the testbeam setup prepared for ELSA
 - Probably not much work
 - We would need a Desy movable table to get it in place

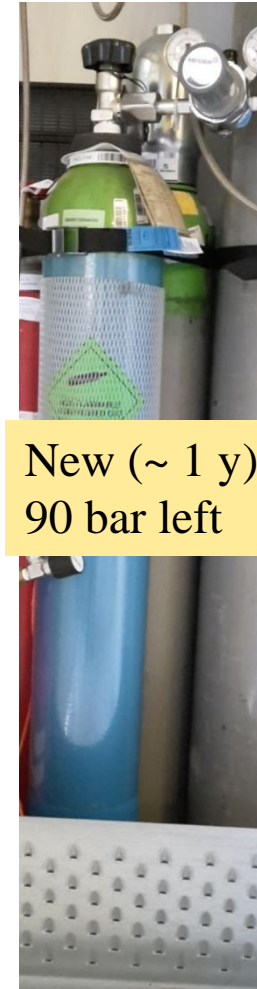
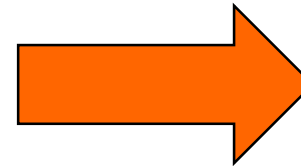


Unexpected transport behavior using the T2K mixture

- Vdrift always lower than expected
 - Suspects on CF4 bottle



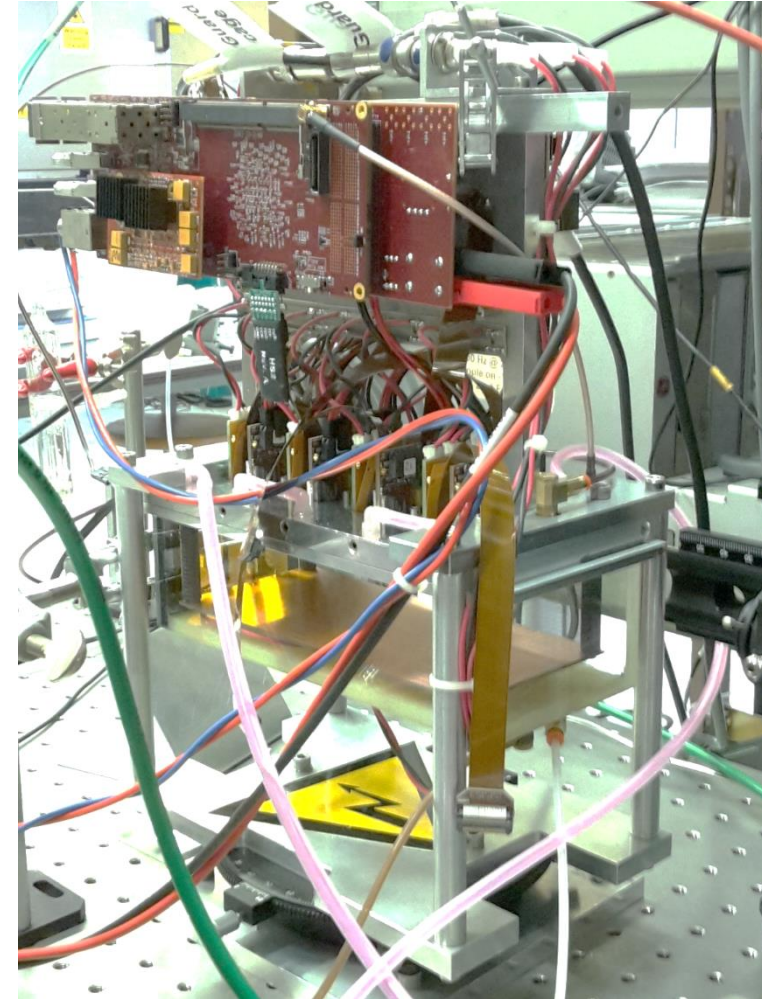
Old (~ 10 y)
17 bar left



New (~ 1 y)
90 bar left

Single electron efficiency with ^{55}Fe source

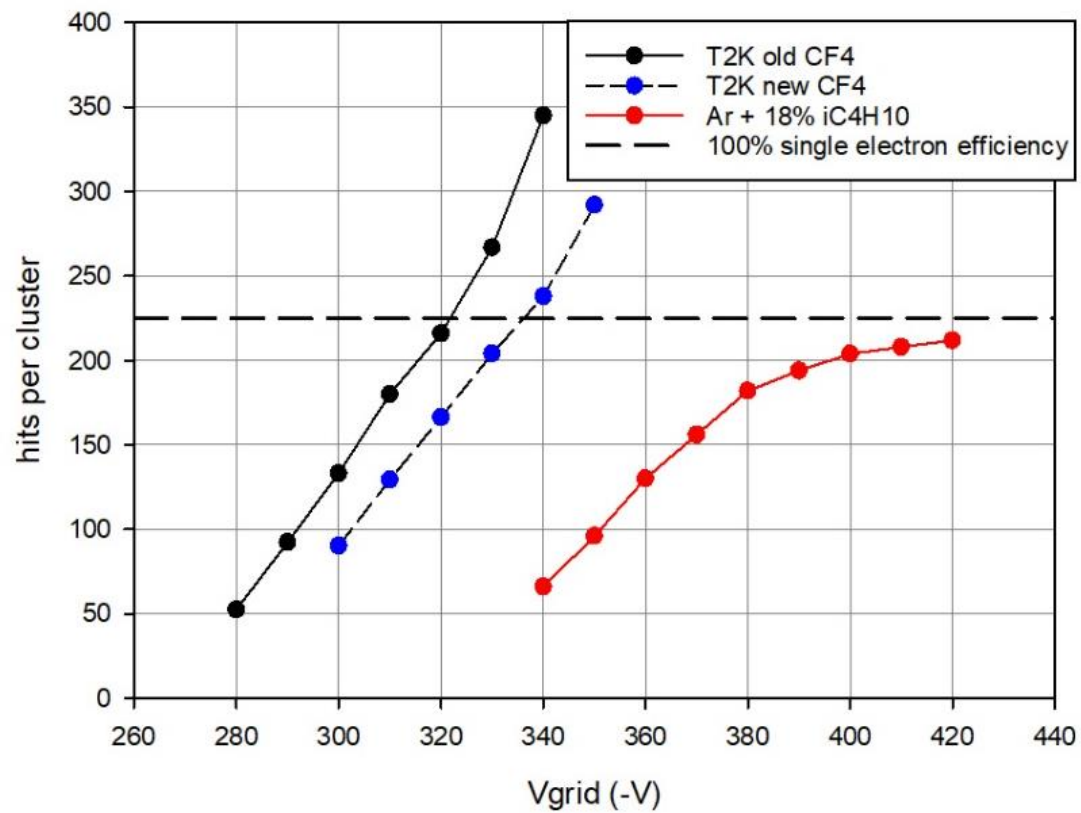
- Source Fe-55-04
 - 5.6 keV gamma
- Expecting with Ar a peak of ~ 220 e- and a second peak at ~ 110 e- (escape peak)
- **Test repeated with T2K made from the new CF4 bottle**
- Cluster tracing by finding hits within -40 to 400 ns window from 1st hit
- Cluster rate 25 – 100 Hz depending on chip position
 - => Igrid ~ 10 pA/chip
 - => hardly voltage drop across the protection layer



■ ~ 10V higher Vgrid needed to get the same number of hits per cluster

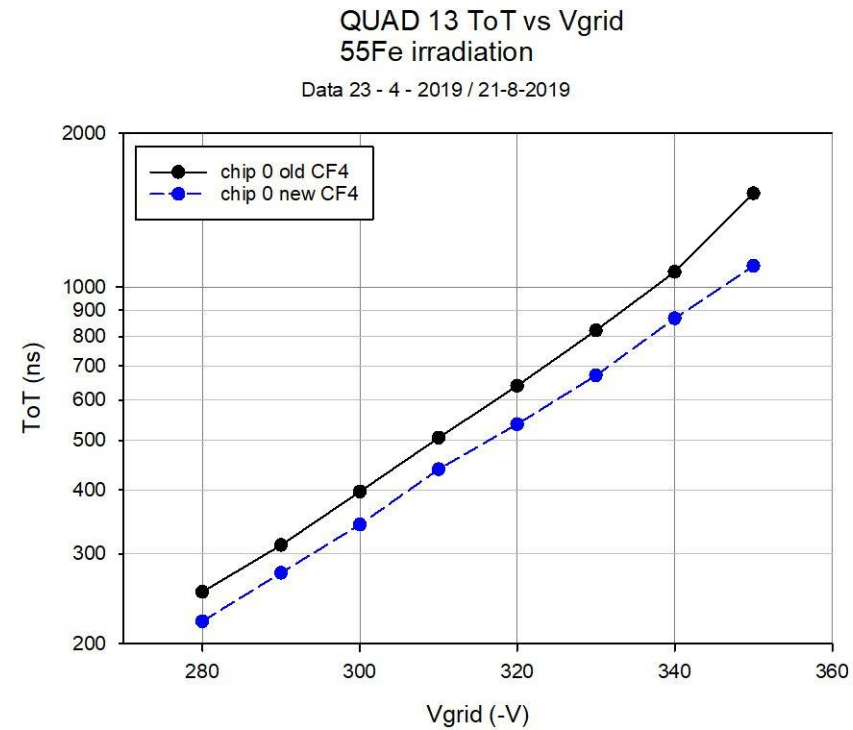
Hits per cluster under ^{55}Fe irradiation

Data 23 - 4 - 2019/ 21-8-2019
Irradiation with ^{55}Fe -04 source



Gas gain old vs new CF4

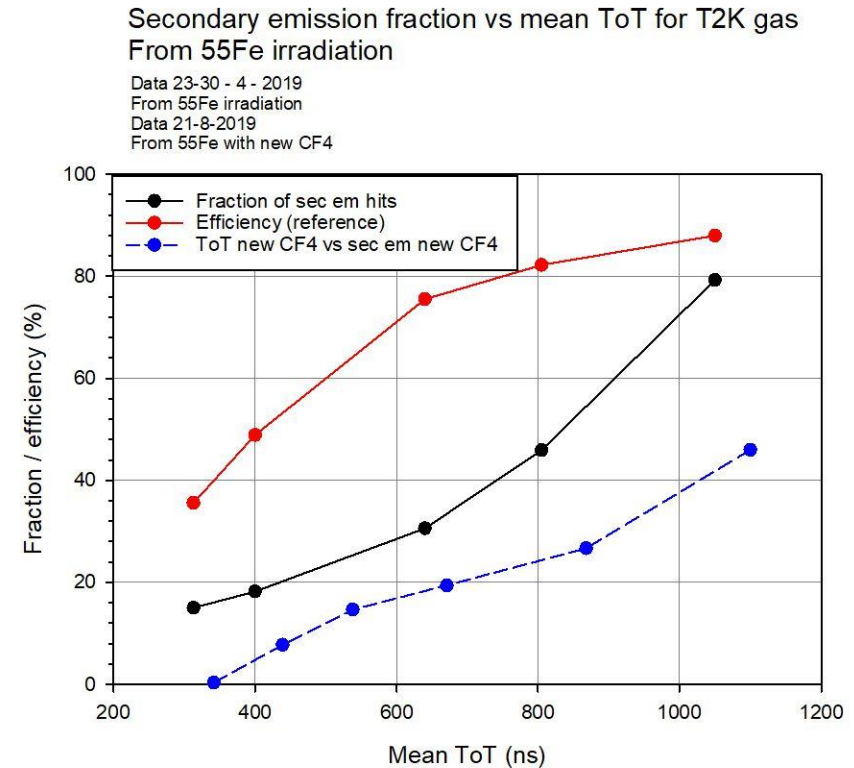
- For the new CF4 we need 10 V higher Vgrid to get the same ToT i.e. the same gas gain



Secondary emission

- For the new CF4 we win on the secondary emission
- 40 – 50% less at the same ToT
- => CF4 is a good quencher (UV absorbent) as well

- At 40 % secondary emission we have
 - 79% efficiency for the old CF4 mixture
 - 87% efficiency for the new CF4 mixture



Deduced from 18% iC4H10 measurements: Single electron efficiency vs mean ToT

- The acceptable working range (up to 50% secondary emission hits) has been significantly increased for the new CF4

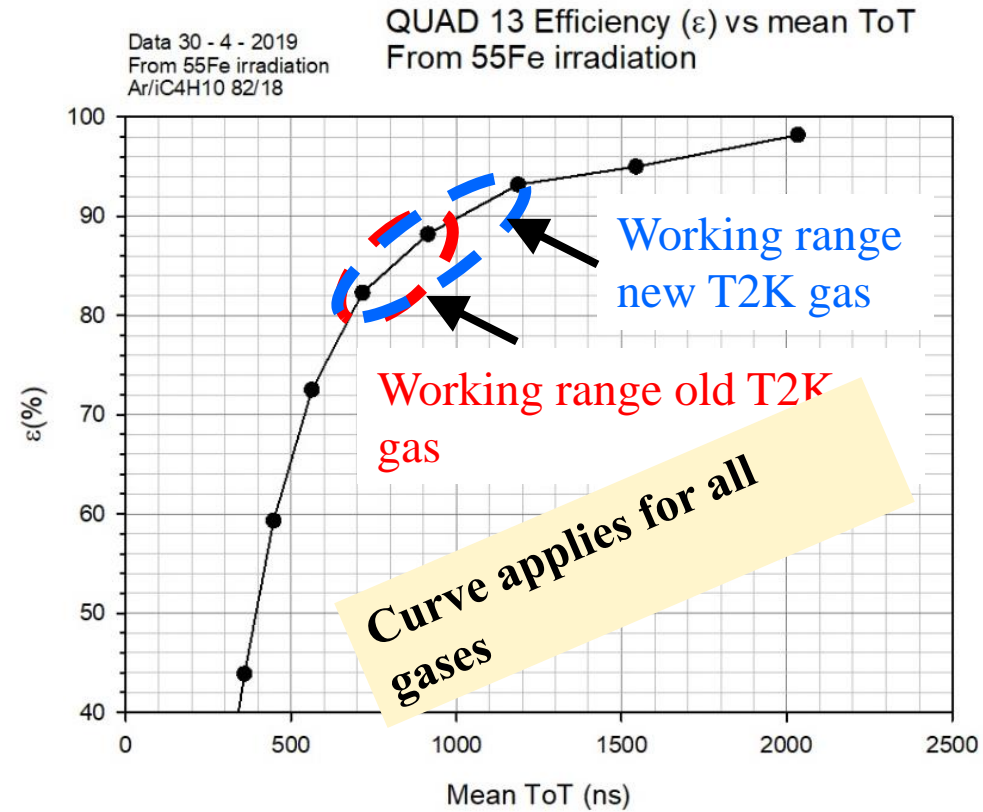
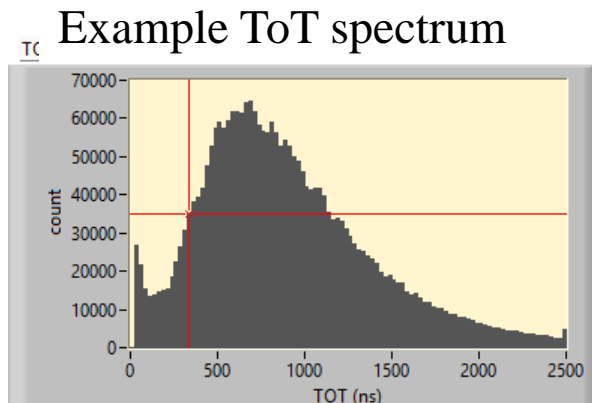
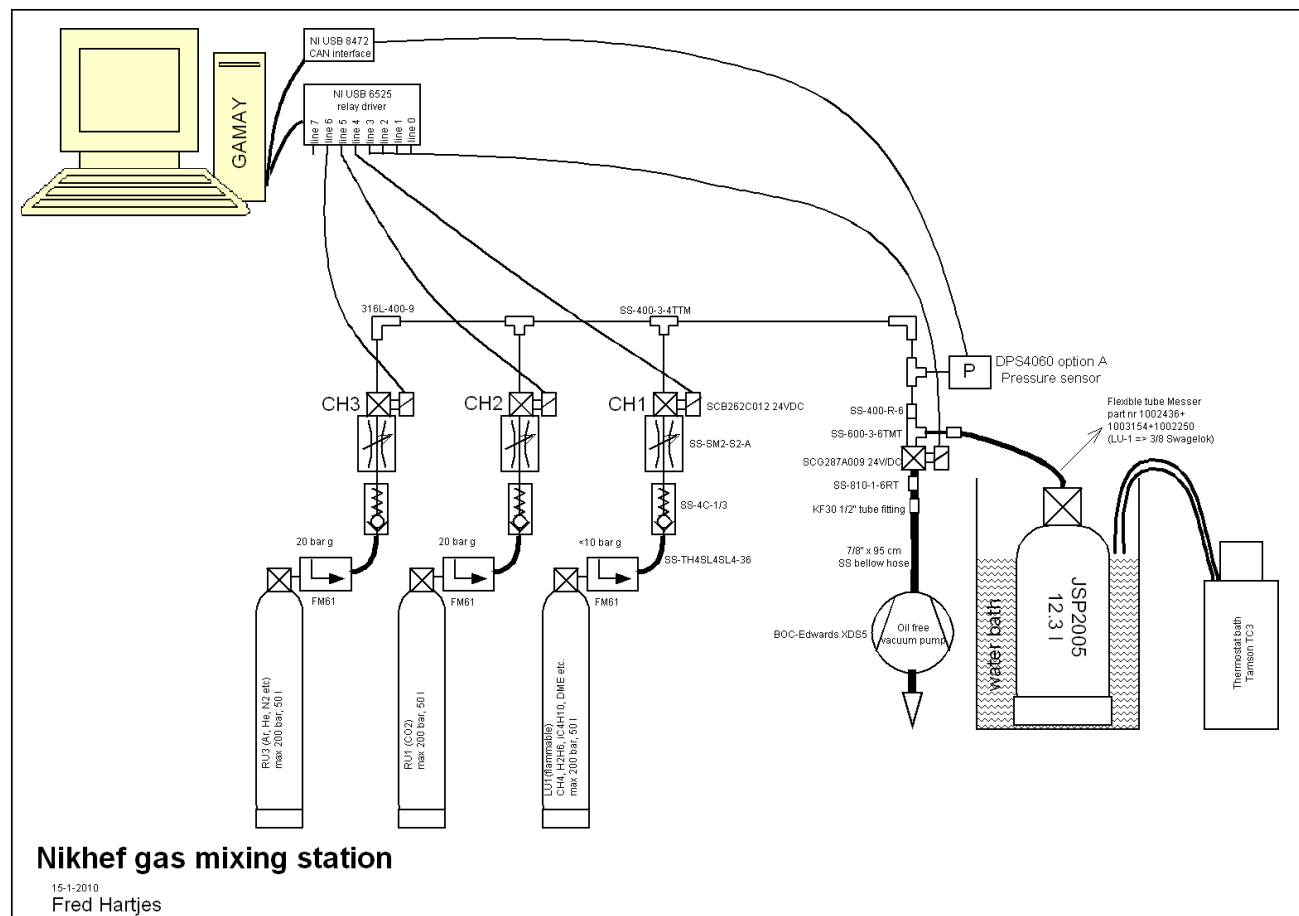


Diagram Nikhef gas filling system



Discussion

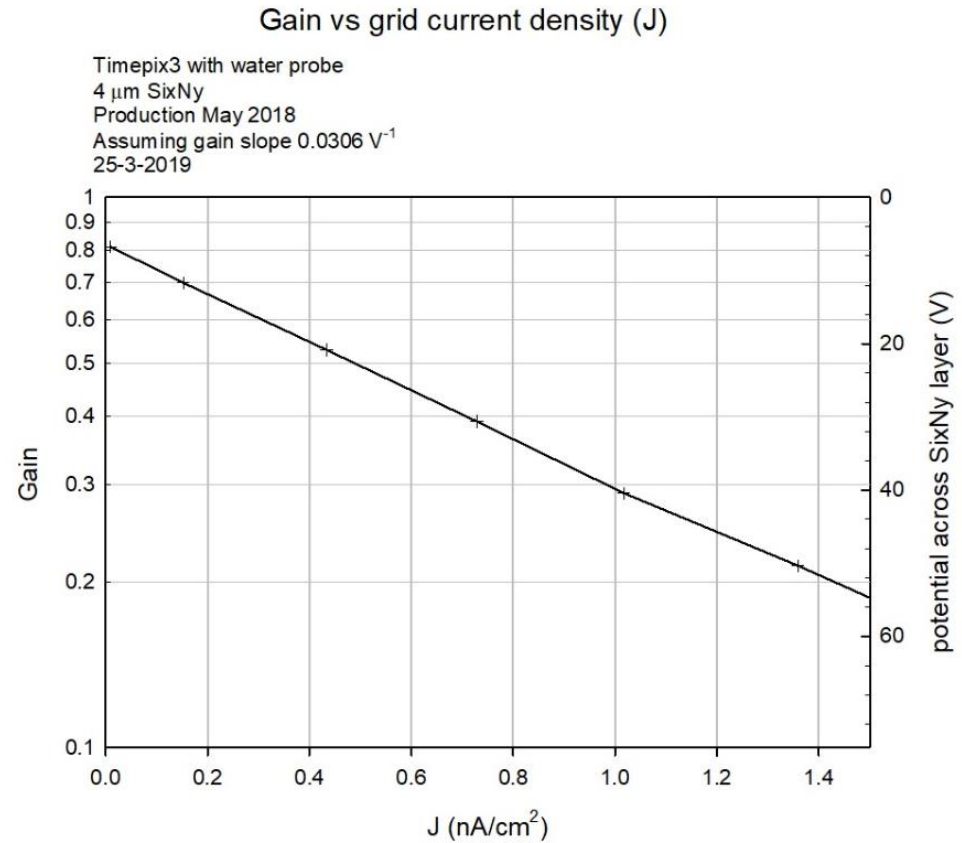
- Old CF4 bottle might be polluted with argon in the early days of the system (2010)
- CF4 bottle pressure 17 bar
- Filling pressure 21 bar
 - => in case of a leaking valve the bottle mixture may flow backwards into the CF4 bottle

- For the new bottle this is excluded
 - Backflow valve installed since then
 - CF4 bottle pressure >> filling pressure

- We will not soon empty the CF4 bottle as long as it is only used for T2K mixture
 - Bottle content sufficient for ~ 1500 T2K fillings

Reference

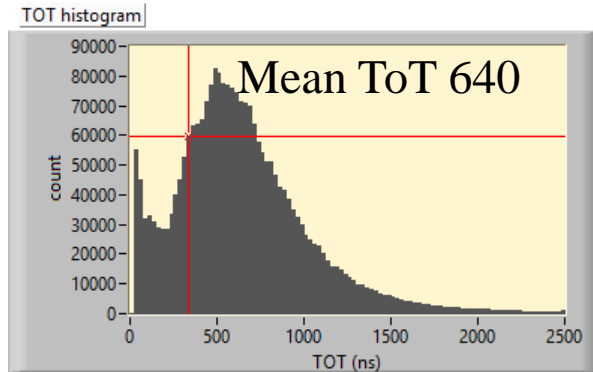
- During testbeam we may easily have **30 – 40 V potential drop** across protection layer
- => we need an extended working range



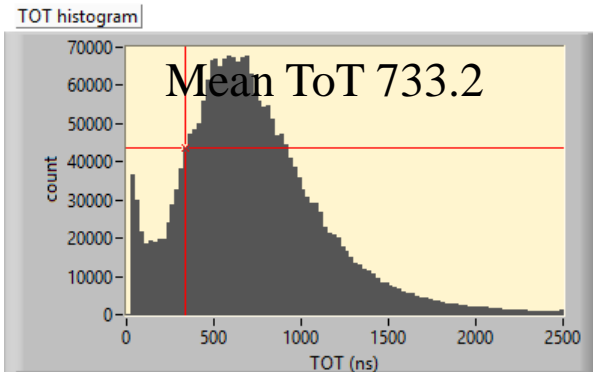
Comparison of 3 different gases for chip 0 at mean ToT = 640 – 730 ns

- => single electron efficiency 77 – 84%

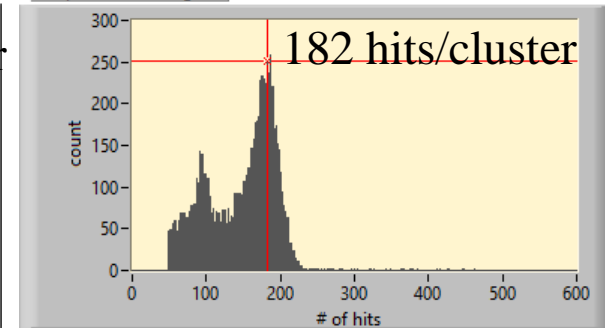
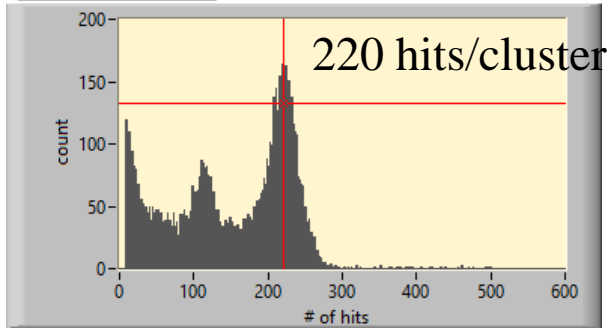
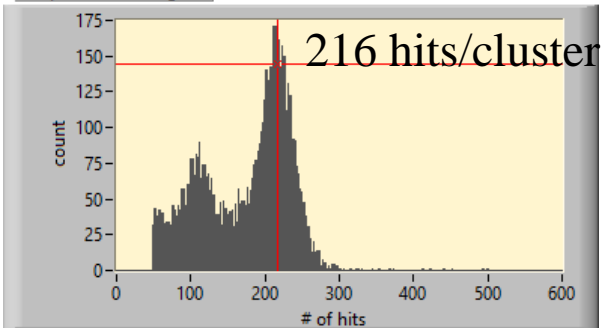
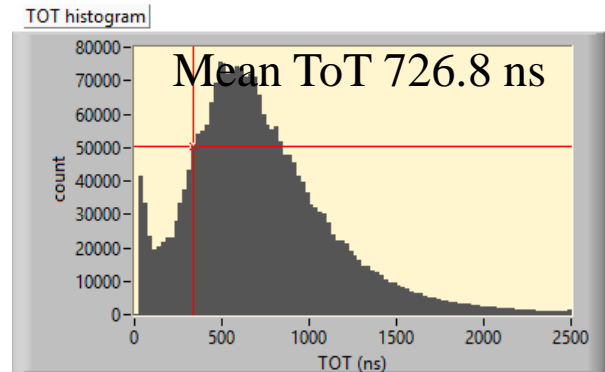
T2K -320 V



T3K -320 V



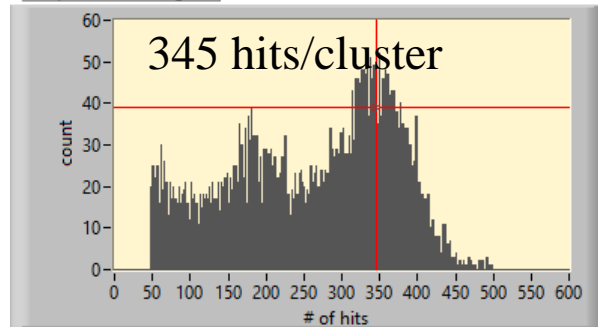
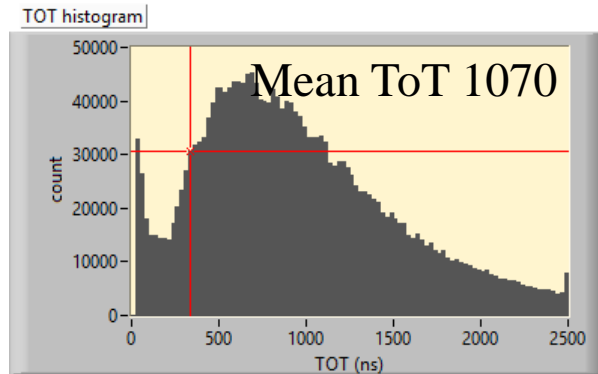
18% iC4H10 -380 V



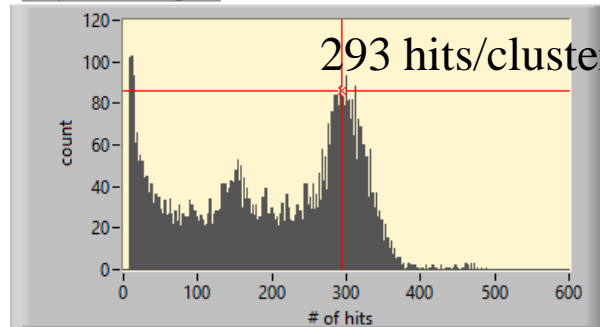
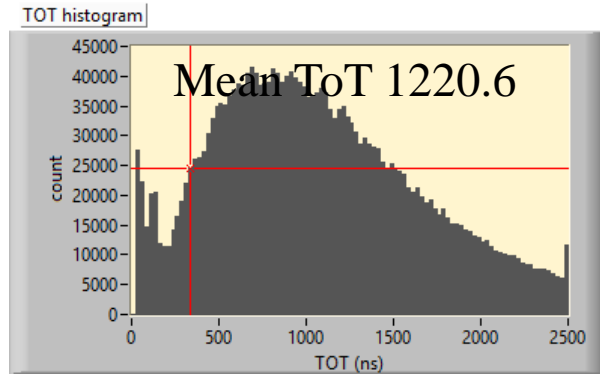
Comparison of 3 different gases for chip 0 at mean ToT = 1000 – 1200 ns

- => single electron efficiency 90 – 93%

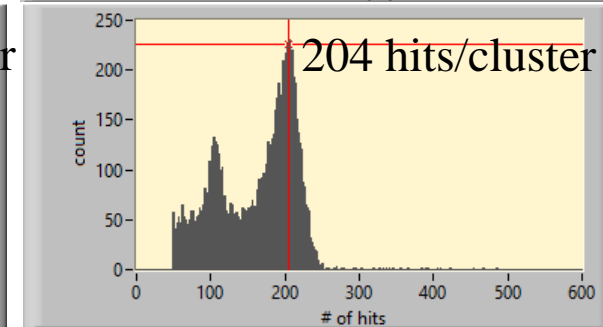
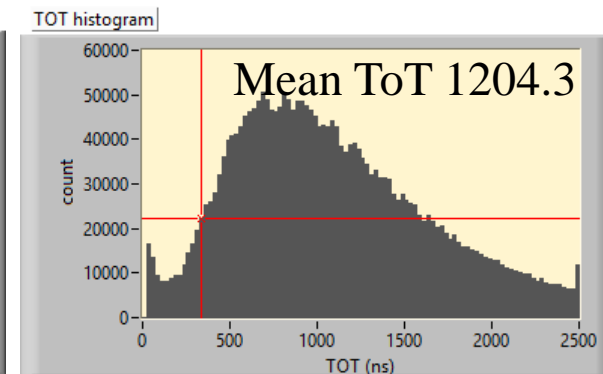
T2K -340 V



T3K -340 V



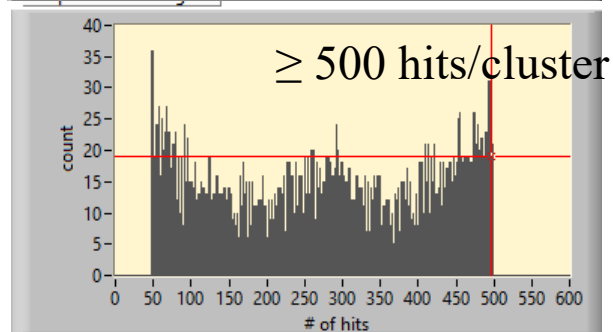
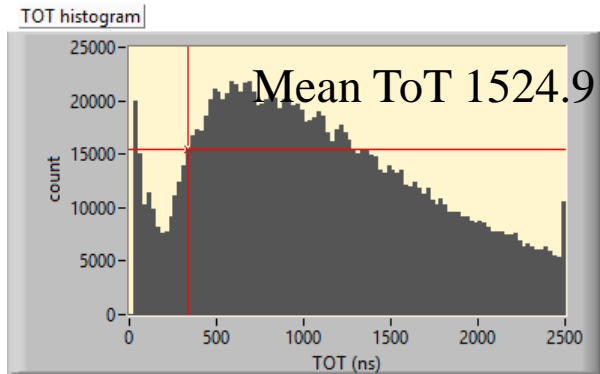
18% iC4H10 -400 V



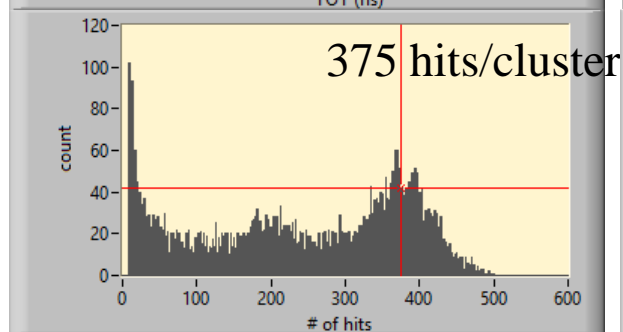
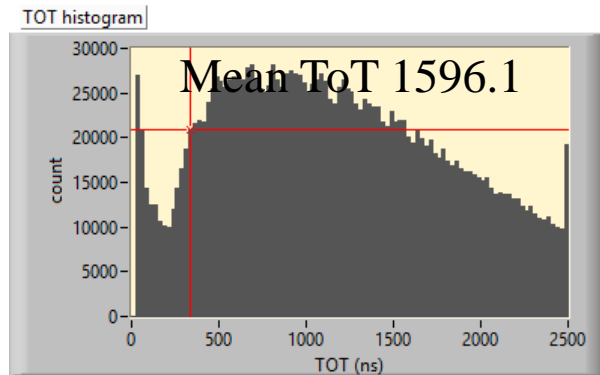
Comparison of 3 different gases for chip 0 at mean ToT = 1525 – 1600 ns

■ => single electron efficiency 95 %

T2K -350 V



T3K -350 V



18% iC4H10 -410 V

