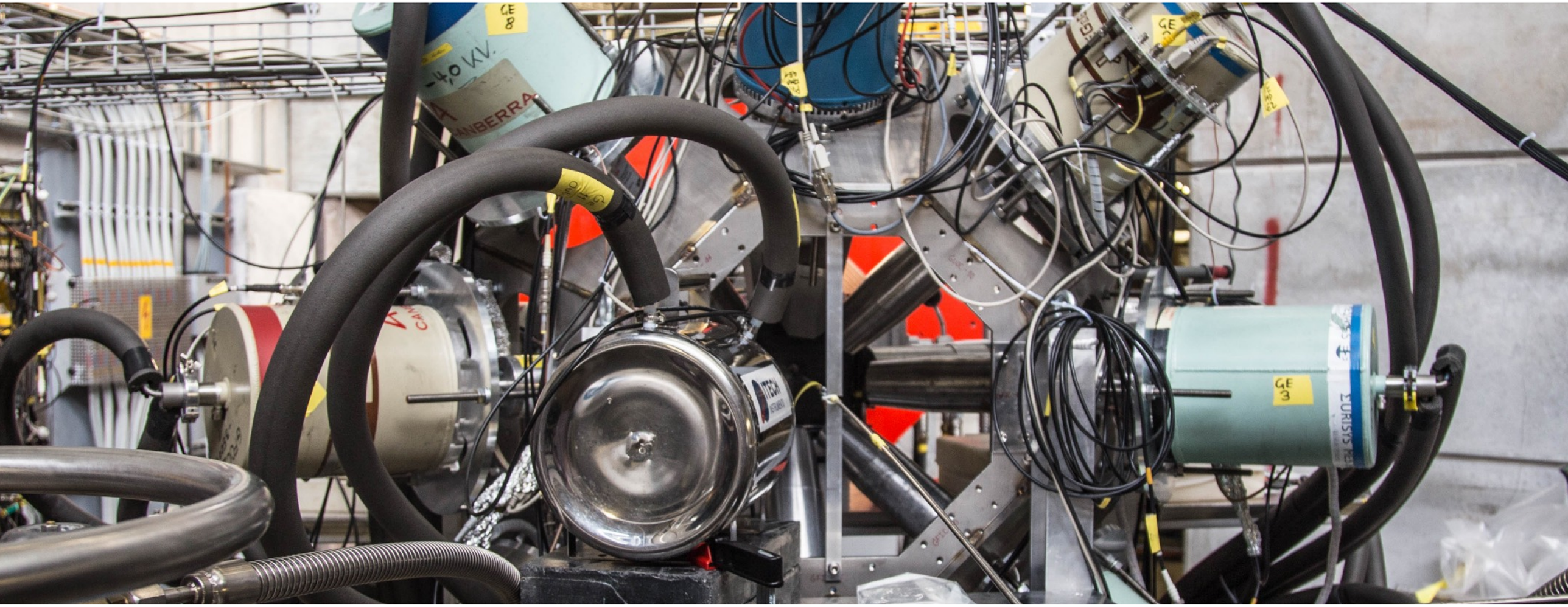
ETH zürich

PAUL SCHERRER INSTITUT PSI

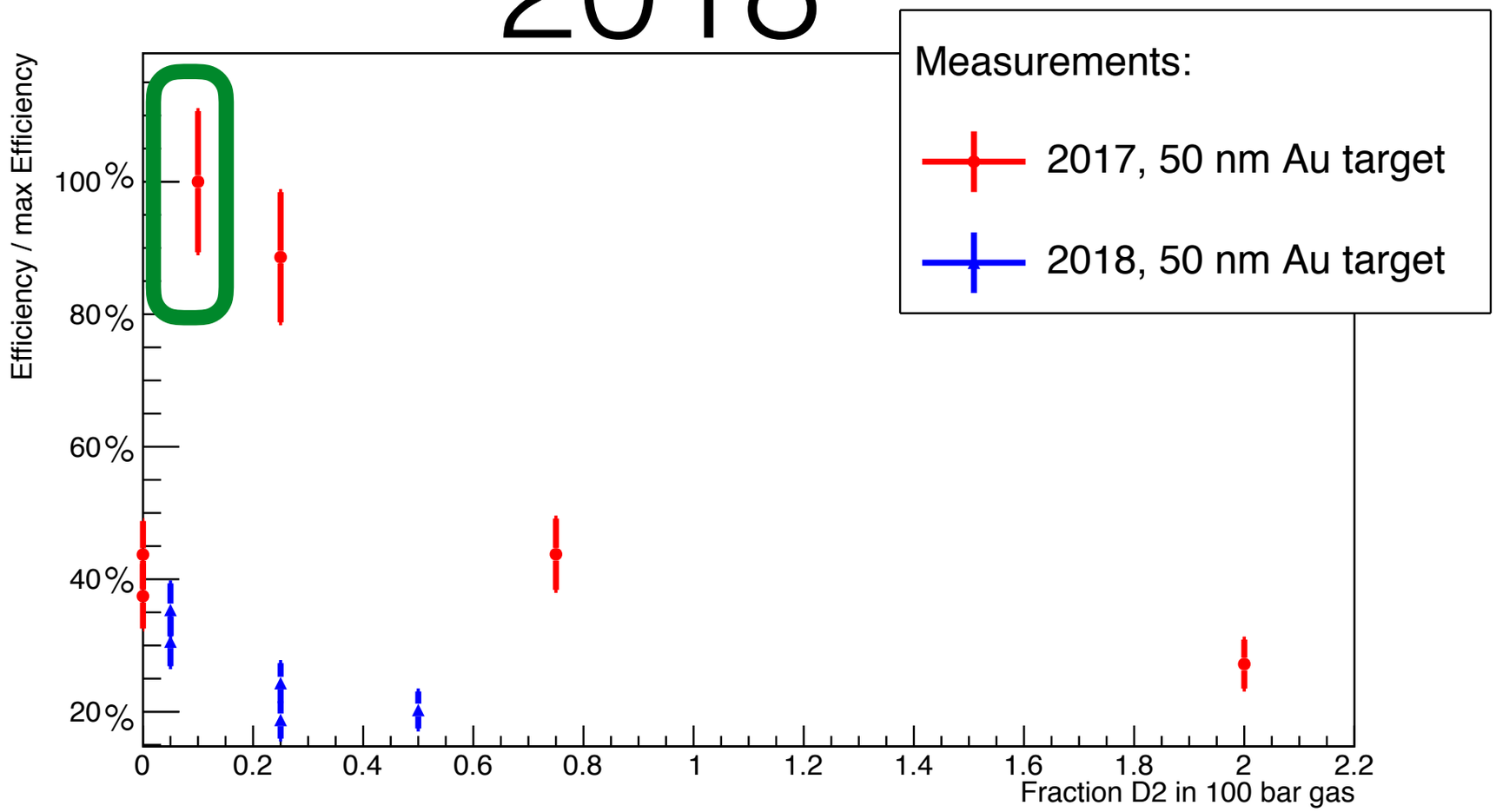


CURRENT STATUS OF ANALYSIS

MUX COLLABORATION MEETING
18 JUNE 2019, JOHANNES GUTENBERG UNIVERSITY MAINZ

Alexander Albert Skawran

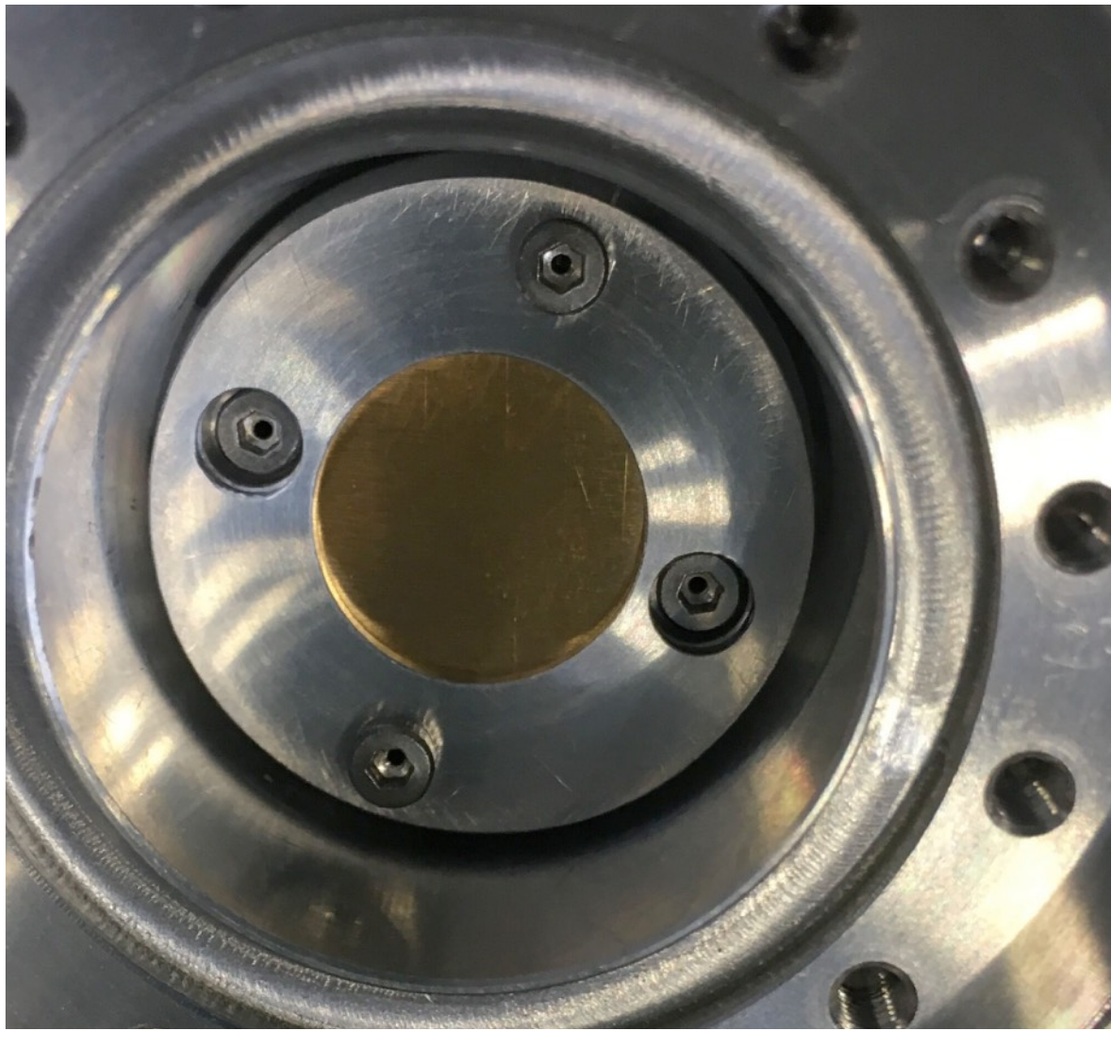
Problems during Beam Time 2018



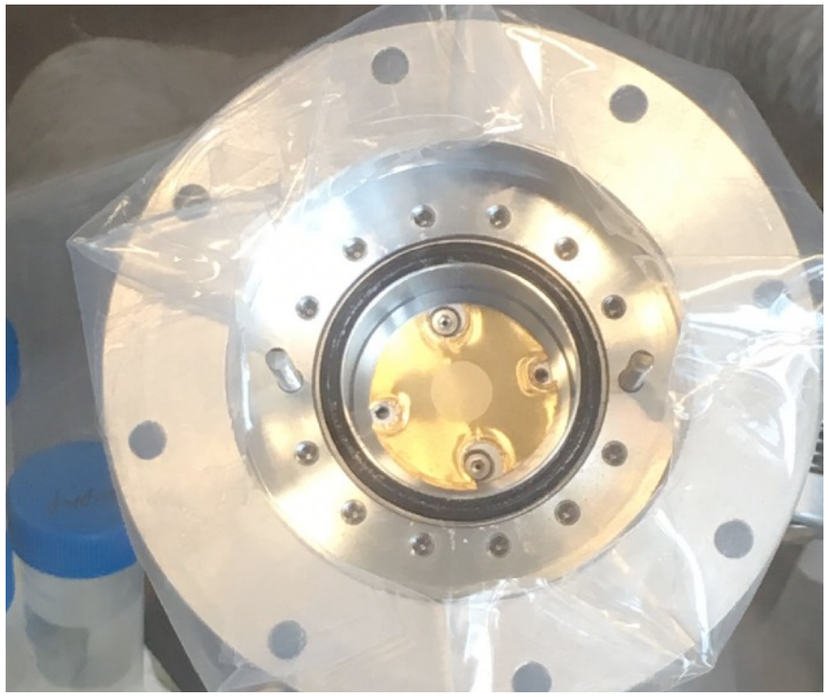
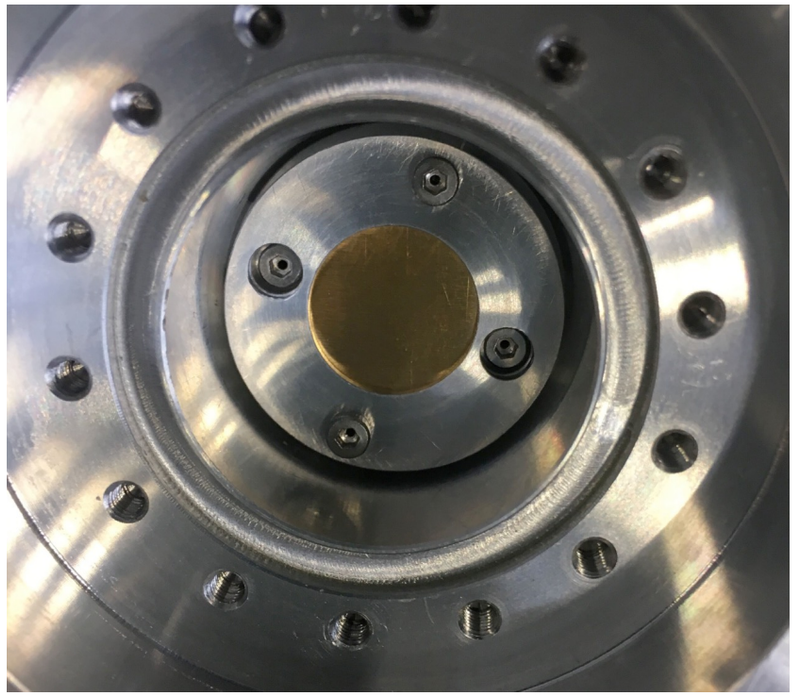
- The muon transfer efficiency depends strongly on the mixture of H_2 and D_2 in the gas
- We have strong discrepancies in the results for 2017 and 2018
- Possible reasons are bad gas mixtures or problems with the target

Is the new gold target responsible for the results of 2018

- 2018 we used another target than in 2017
- Was it different than the target in 2017
- As an indication we used the gold target, which we used to check the influence of organic layer on top the gold plate



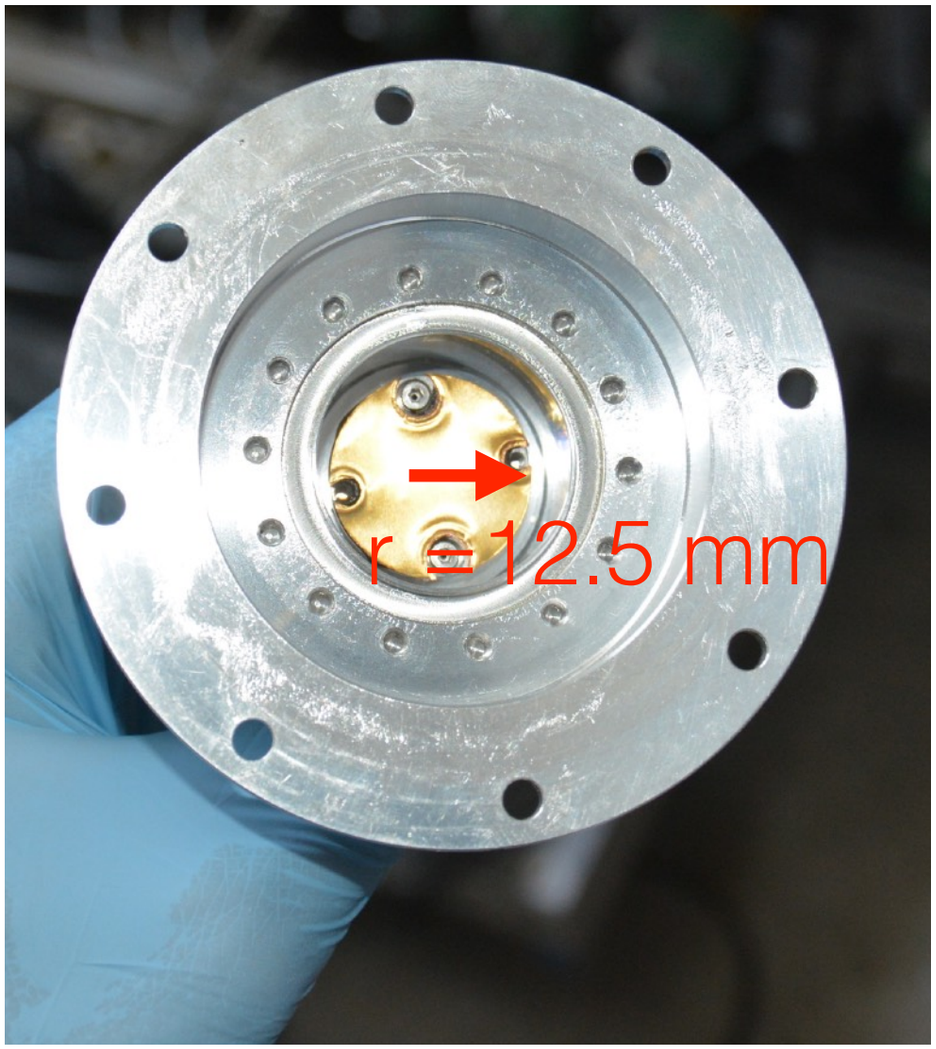
Is the new gold target responsible for the results of 2018


$$\varepsilon = \frac{\text{stopped muon in target}}{\text{incoming muons in gas cell}}$$

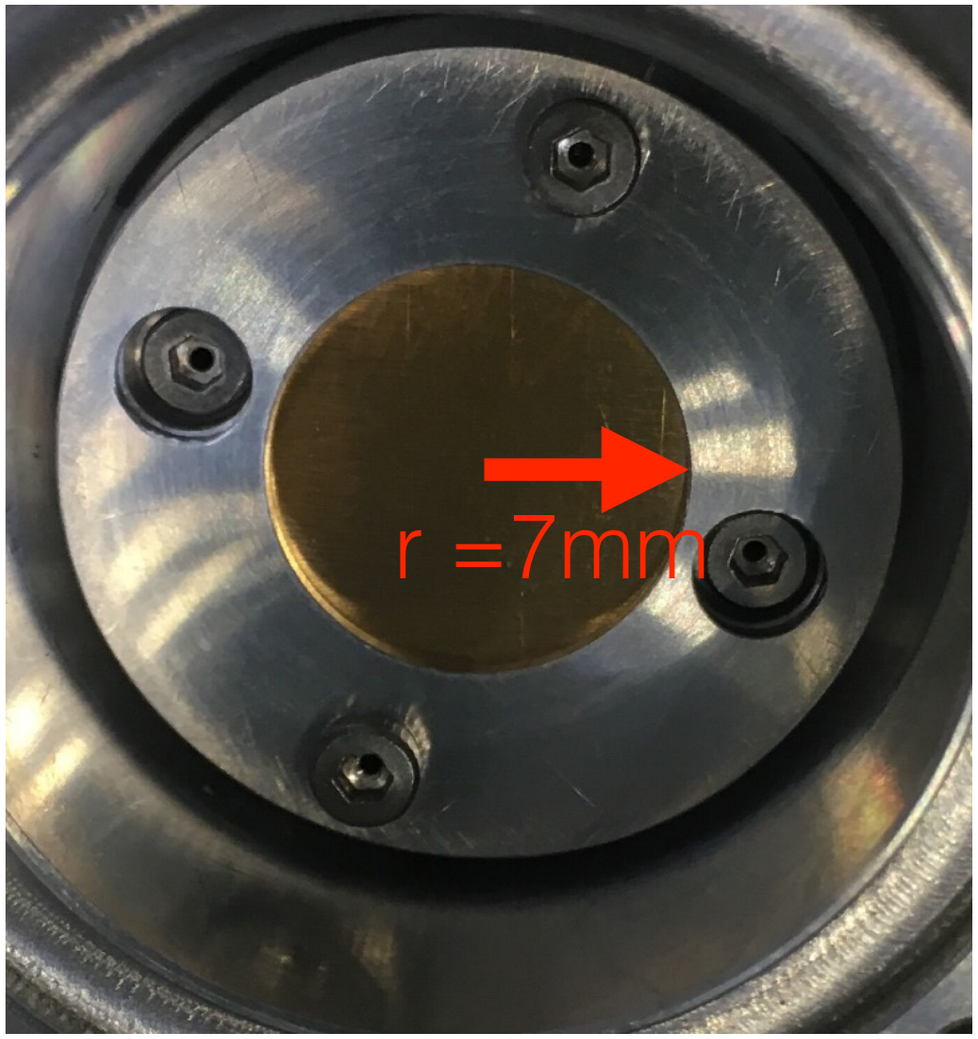
Thickness carbon layer	0 nm	100 nm	500 nm
ε(Au)	2.7(3)%	0.61(1)%	-

Is the new gold target responsible for the results of 2018



Standard target

Area ~4.9 cm^2

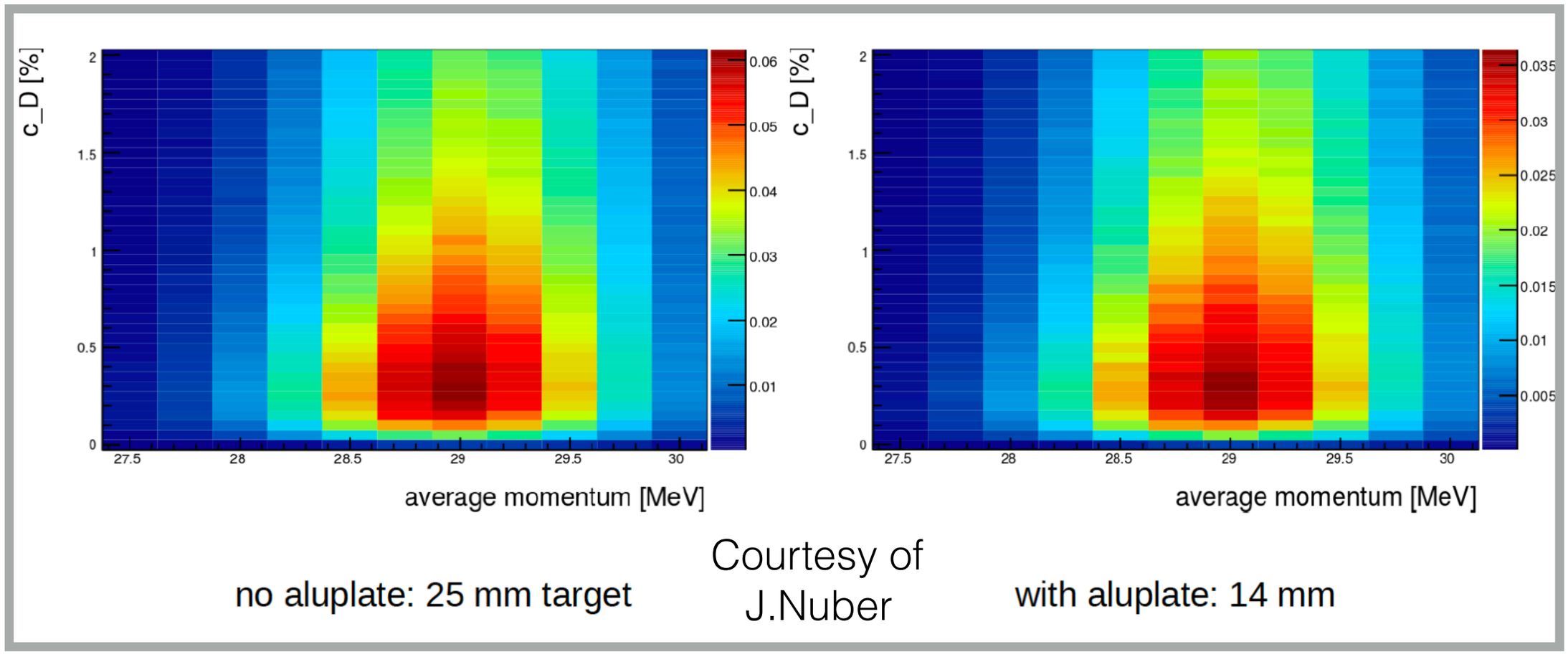


Target with Al plate

Area 1.5 cm^2

Simulated Transfer Efficiency

$$\varepsilon = \frac{\text{stopped muon in target}}{\text{incoming muons in gas cell}}$$



no aluplate: 25 mm target

Courtesy of J.Nuber

with aluplate: 14 mm

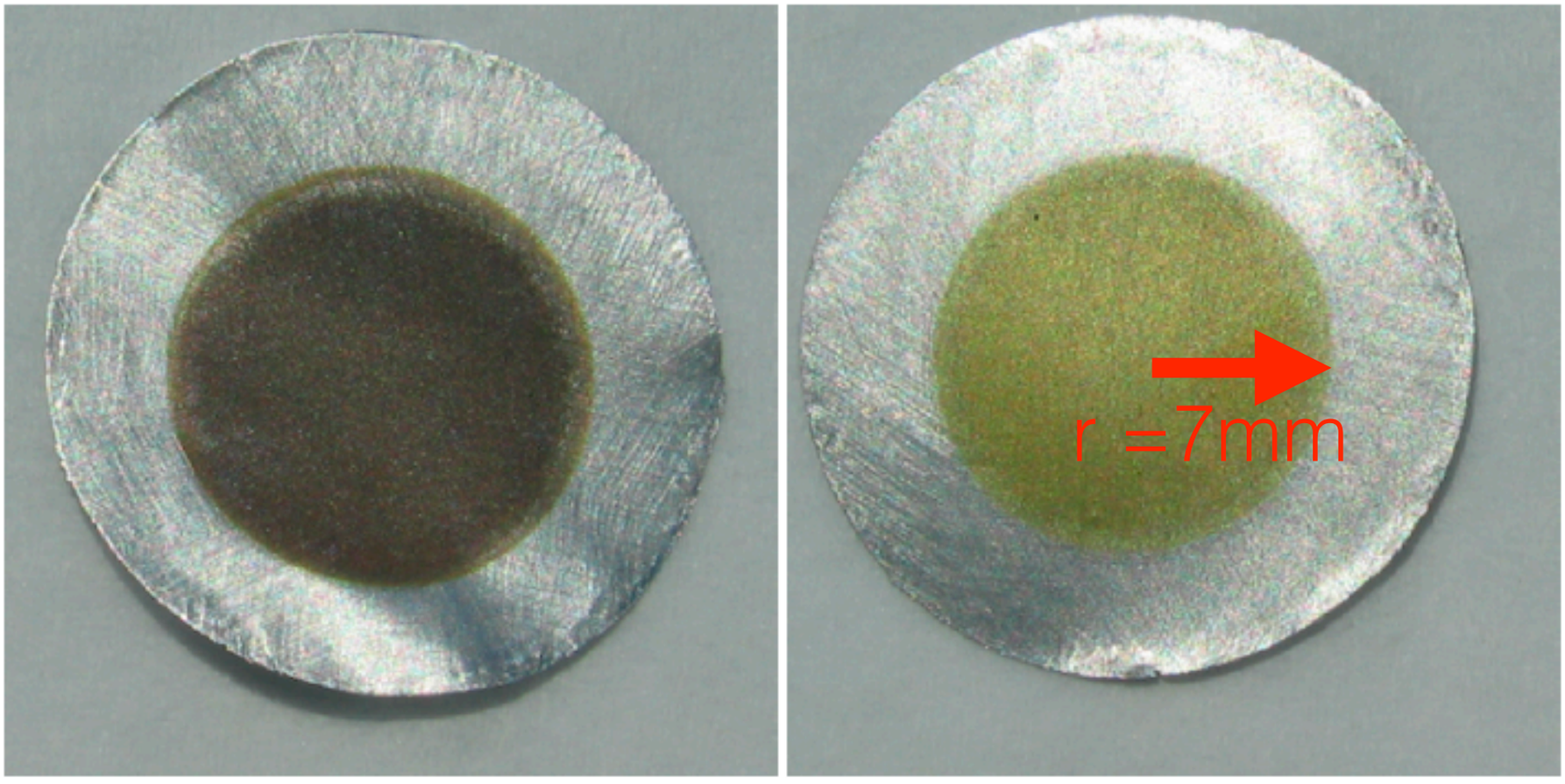
Regarding simulations the transfer efficiency for a plate of 14 mm diameter has to be 58.3% of the 25 mm diameter plate

Muon Transfer Efficiency Gold

Run	Gold target	**ε**(Au)	**ε**(Au,R=7mm)/**ε**(Au)	**ε**(Cu)	**ε**(Cu,R=7mm)/**ε**(Cu)
8739-8750	R = 12.5 mm	4.6(5)%	58(13)%	41(4)%	66(10)%
8803-8820	R = 12.5 mm	4.8(5)%	56(12)%	42(4)%	64(10)%
11137-11161	R = 7 mm	2.7(3)%	1	27(2)%	1

- P = 28.6 MeV, 0.05% D2 in 100 bar D2/H2
- Results agree with simulation 58.3%

URANIUM

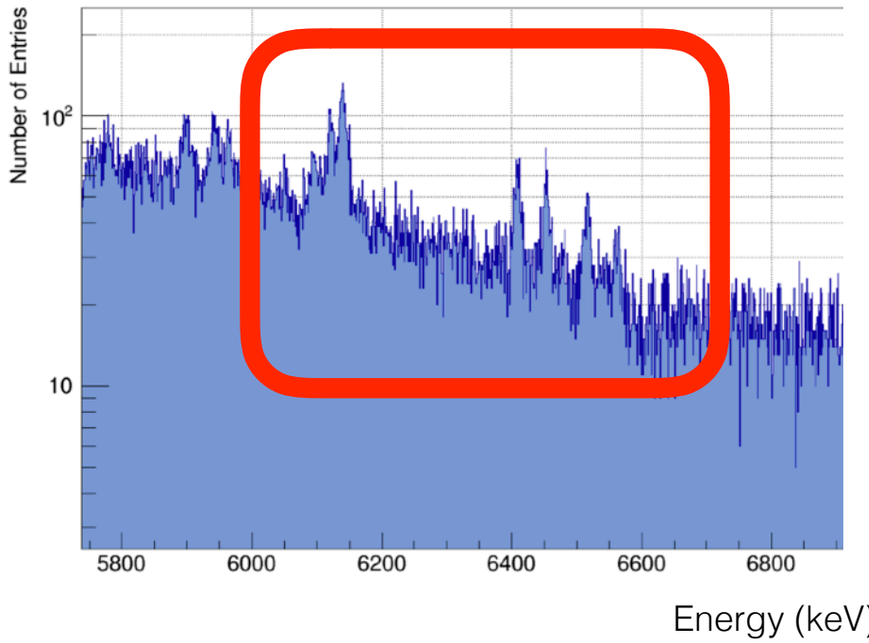


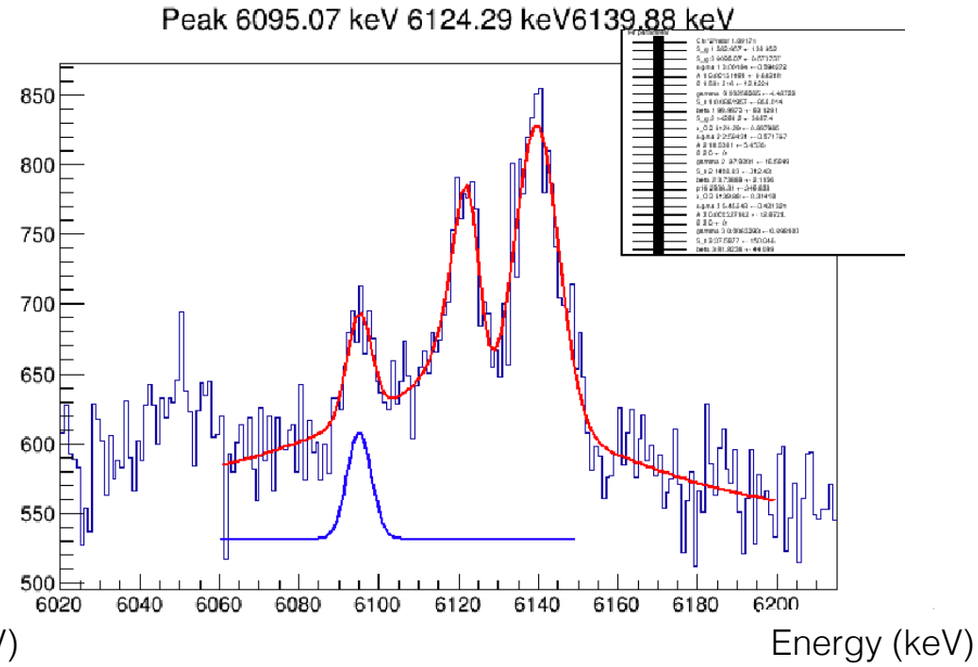
(a) Uranium dioxide target.

(b) Uranyl nitrate target.

- 2017 we measured two different uranium targets
- The target surface is the same as for the gold target with Al plate

URANIUM

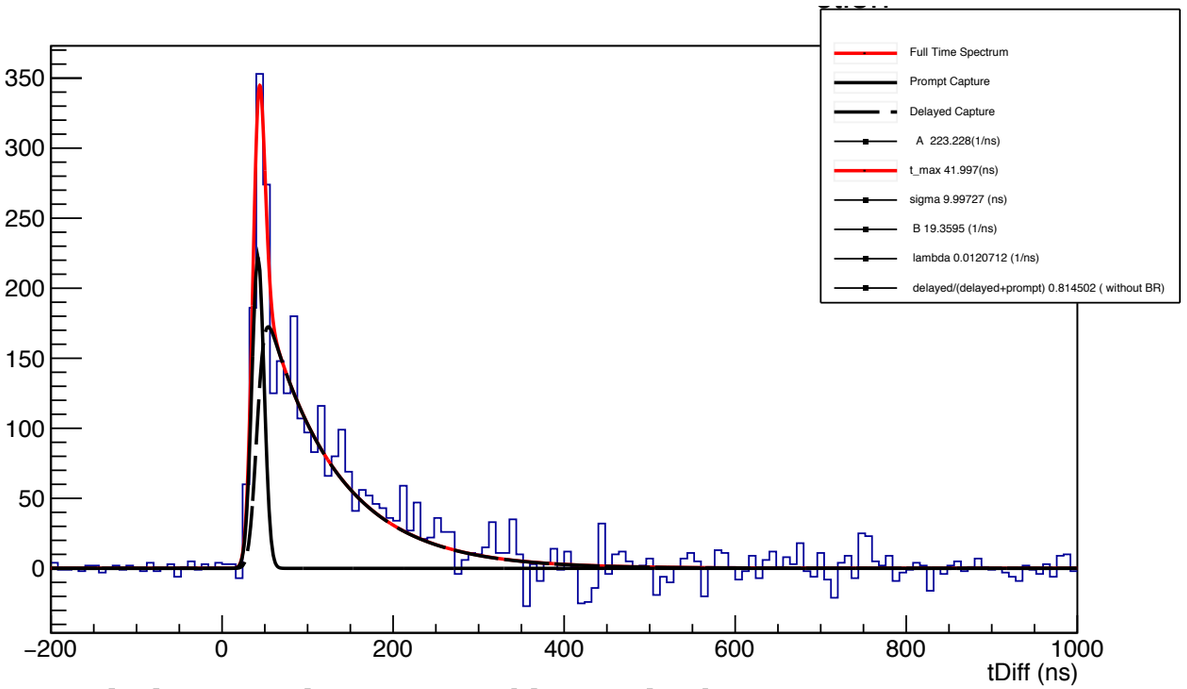




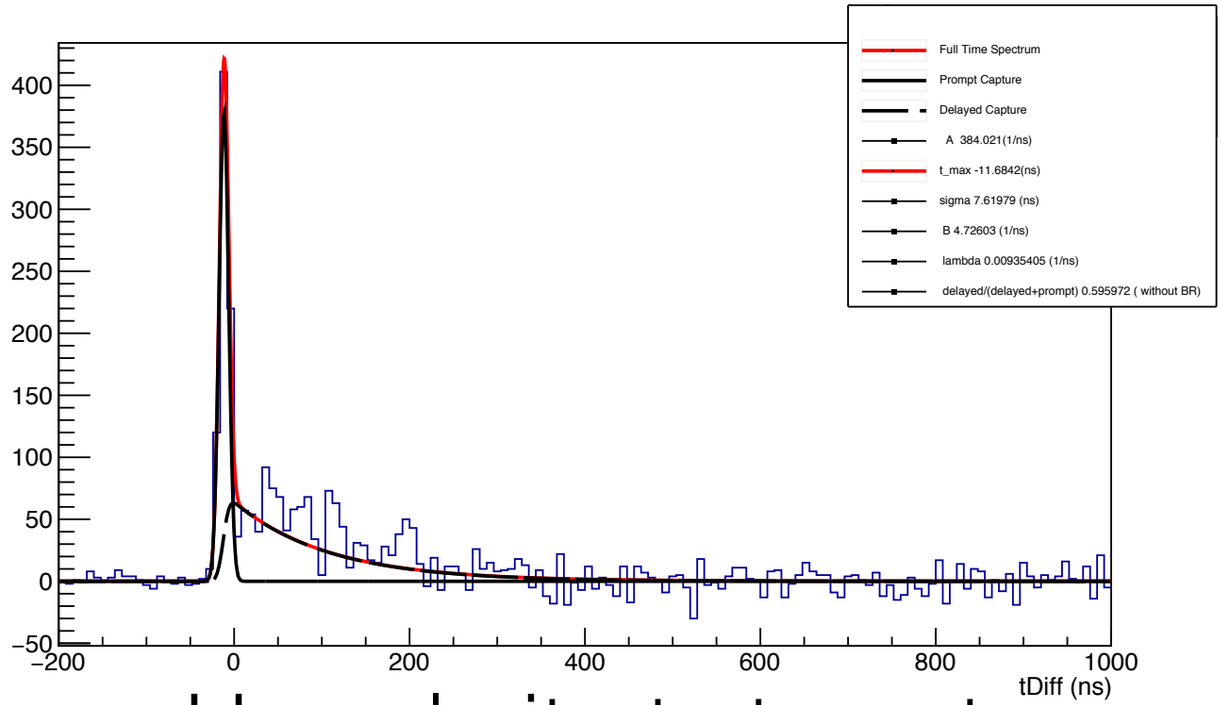
Target	UO_2	$UO_2(NO_3)_2$
ε	5.3(5)%	2.6(3)%

- The gold target with the same settings had **ε**(Au)
- Including the smaller size of the UO_2 layer we expect ~ 5.8%

URANIUM DELAYED



Uranium dioxide target



Uranyl nitrate target

$$\frac{dN}{dt} = A \cdot e^{-\frac{1}{2}\left(\frac{t-t_0}{\sigma}\right)^2} + B \cdot e^{-\lambda t} \int_{-\infty}^{t} e^{\lambda t'} e^{-\frac{1}{2}\left(\frac{t'-t_0}{\sigma}\right)^2} dt'$$

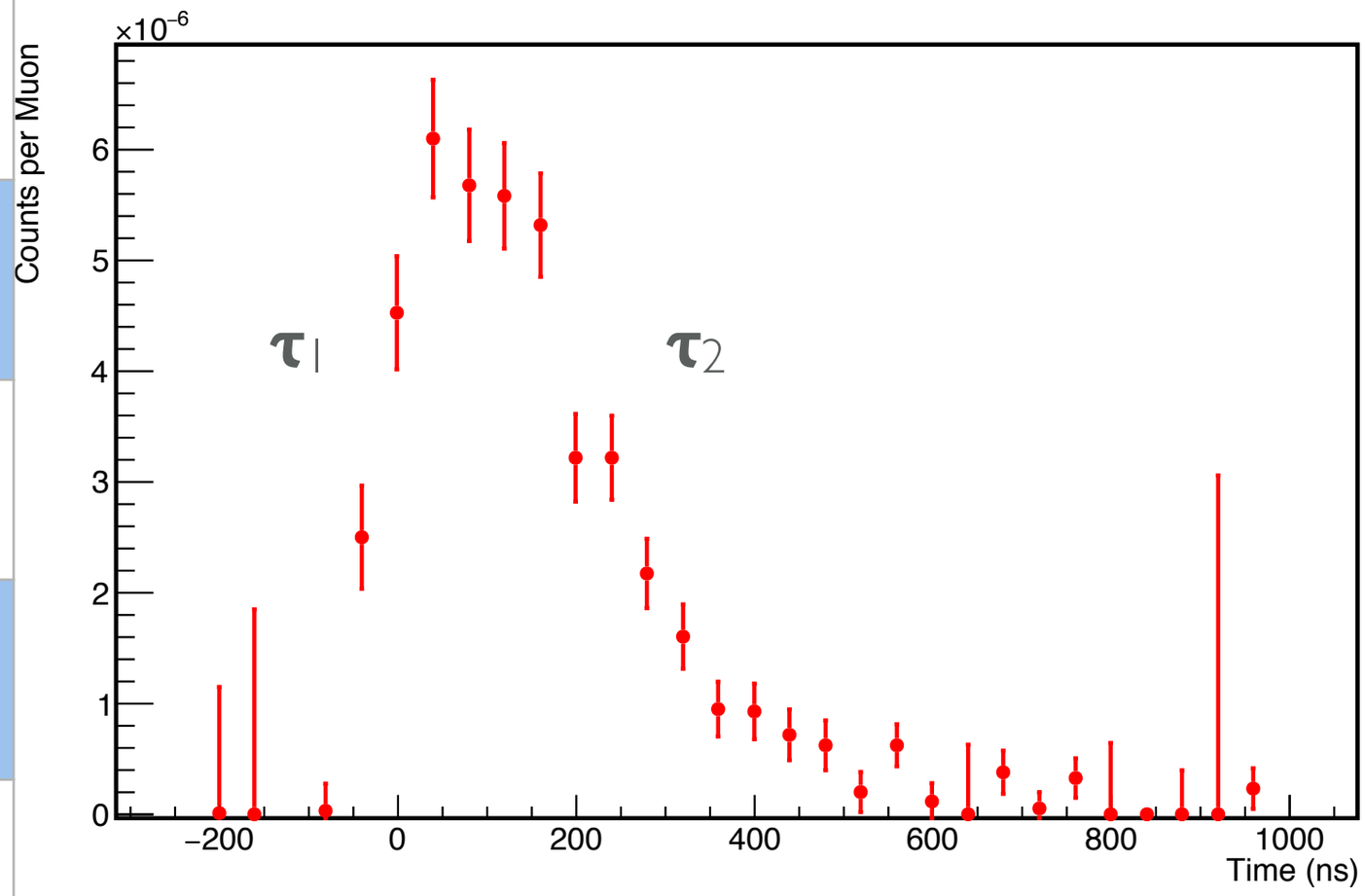
Delayed fraction 81%

Delayed fraction 60%

- The delayed signal is created by muon transfer
- The prompt signal by direct stops in the uranium targets

TIME SPECTRUM

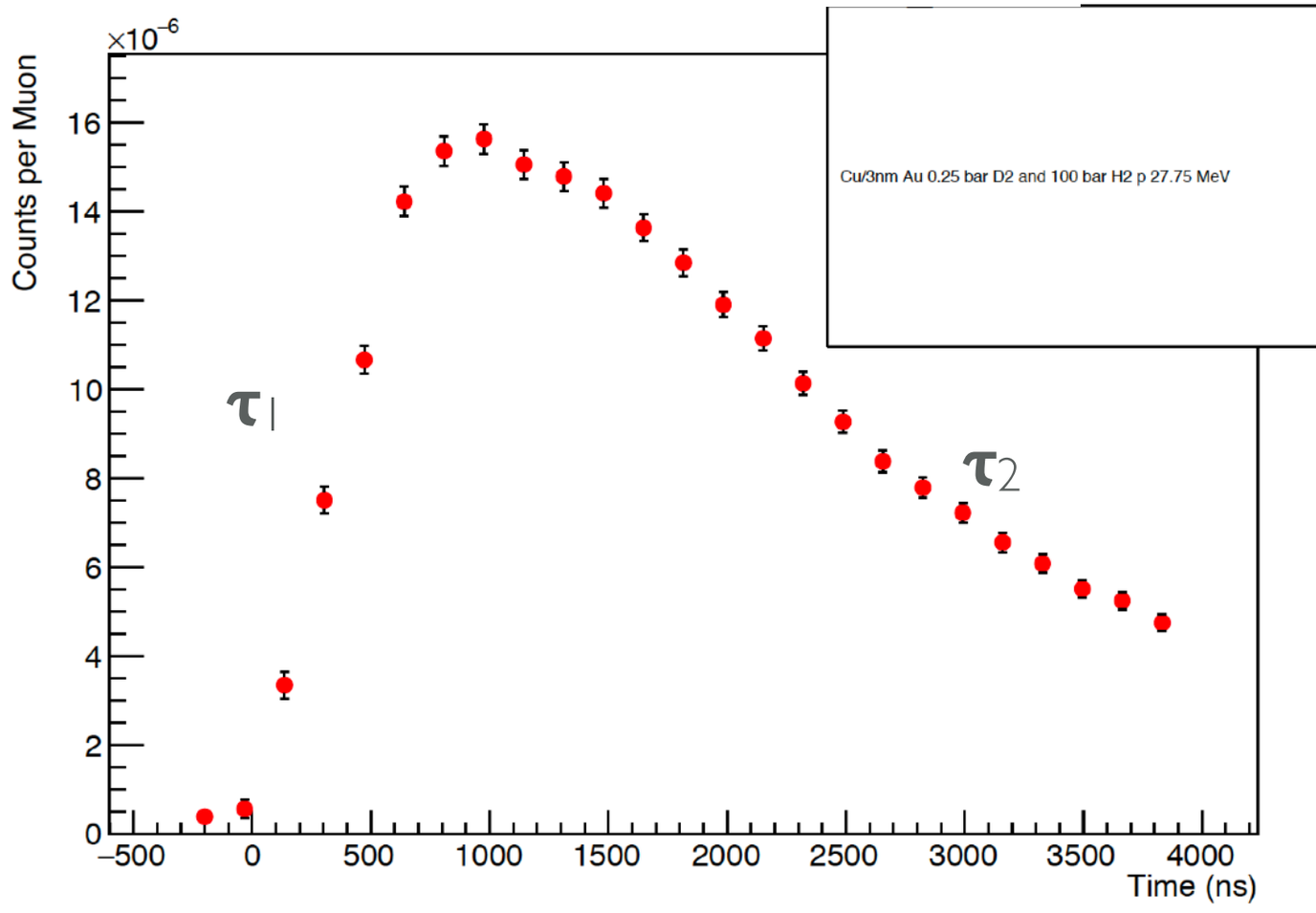
c_D	2017 τ_1(ns)/τ_2 (ns)	2018 τ_1(ns)/τ_2 (ns)
0%	-/1077	-/1355
0.25%	34/185	20/70
0.7%	-/-	22/49
0.75%	26/56	-/-
2%	34/28	22/18



2018, Au 50 nm, 0.25 D_2,
p = 27.75 MeV

TIME SPECTRUM FUSION

c_D	2017 τ_1 (ns)/τ_2 (ns)	2018 τ_1 (ns)/τ_2 (ns)
0%	270/1950	350/2420
0.25%	240/1810	280/2190
0.7%	-/-	250/2300
2%	220/2180	250/2300

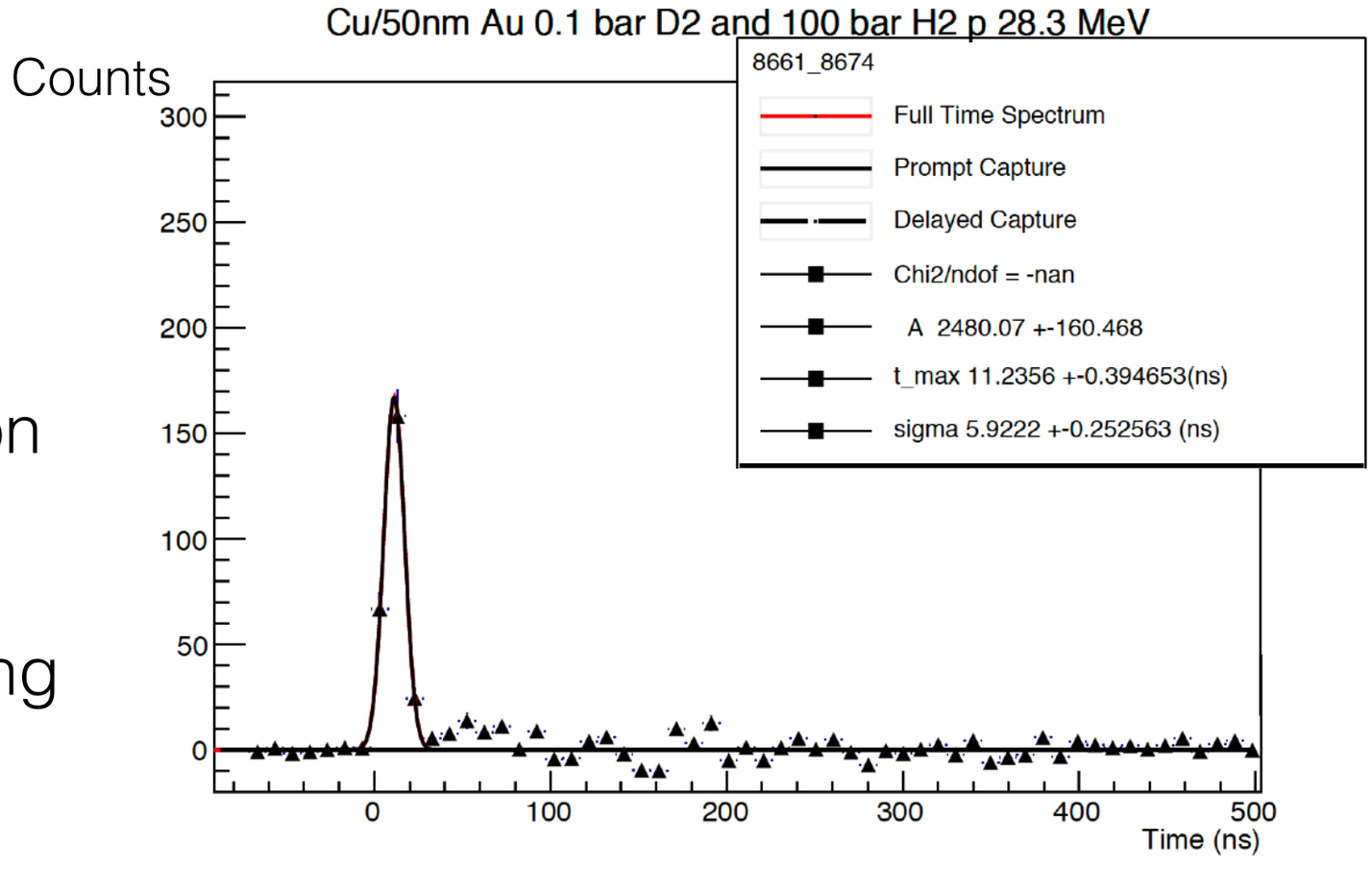


2018, Au 50 nm, 0.25 D_2,
p = 27.75 MeV

Muon Stops in Different Elements 2017/2018

- Compared C,N,Al,Cu for 2017/2018 regarding time spectrum muon stops per incoming muon

- So far, we could not find any significant differences regarding these elements



Time Spectrum of Aluminium

Current Issues

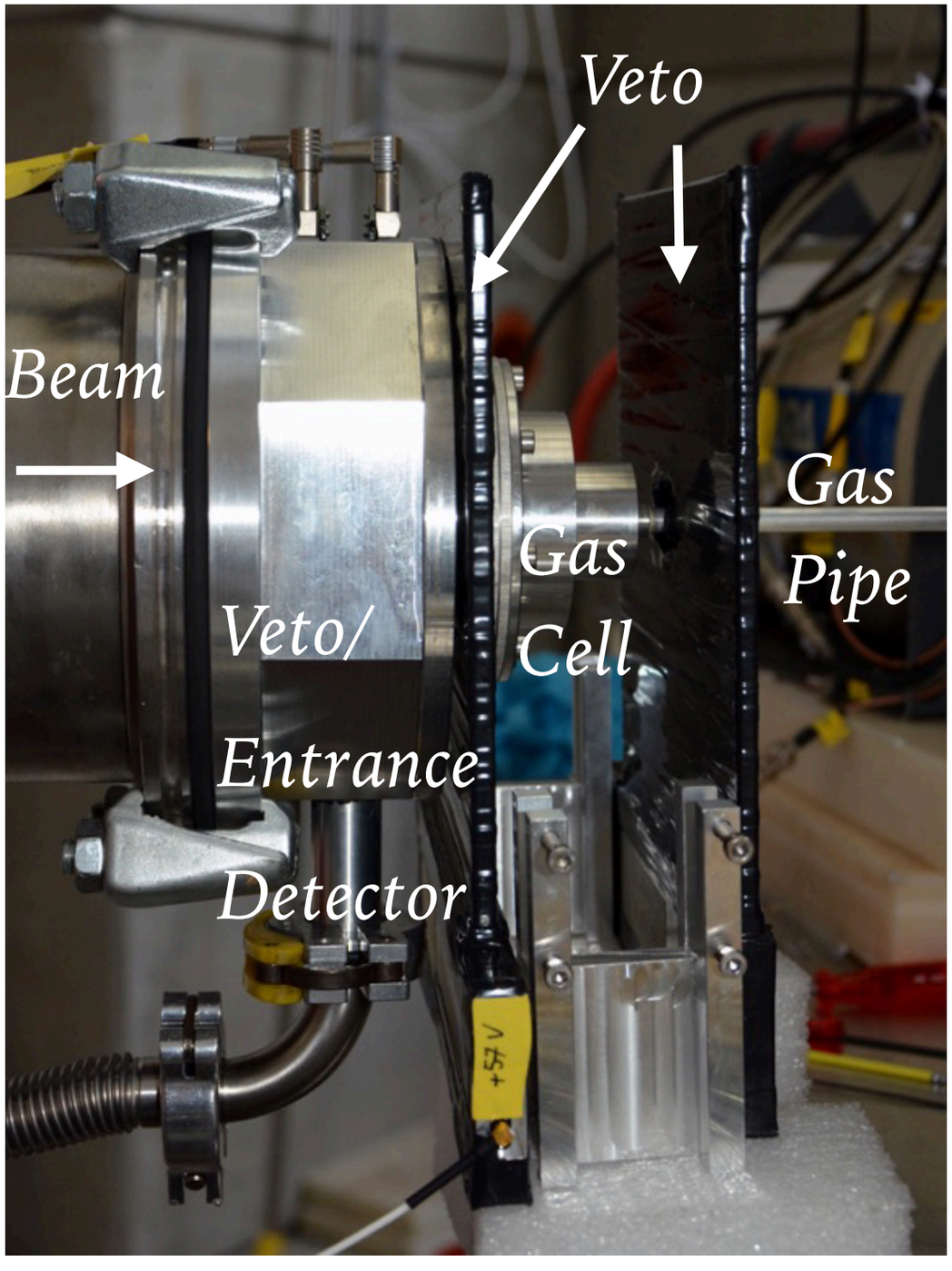
- During the previous beam times we could estimate the beam position by determine the muon stops per incoming muon in copper

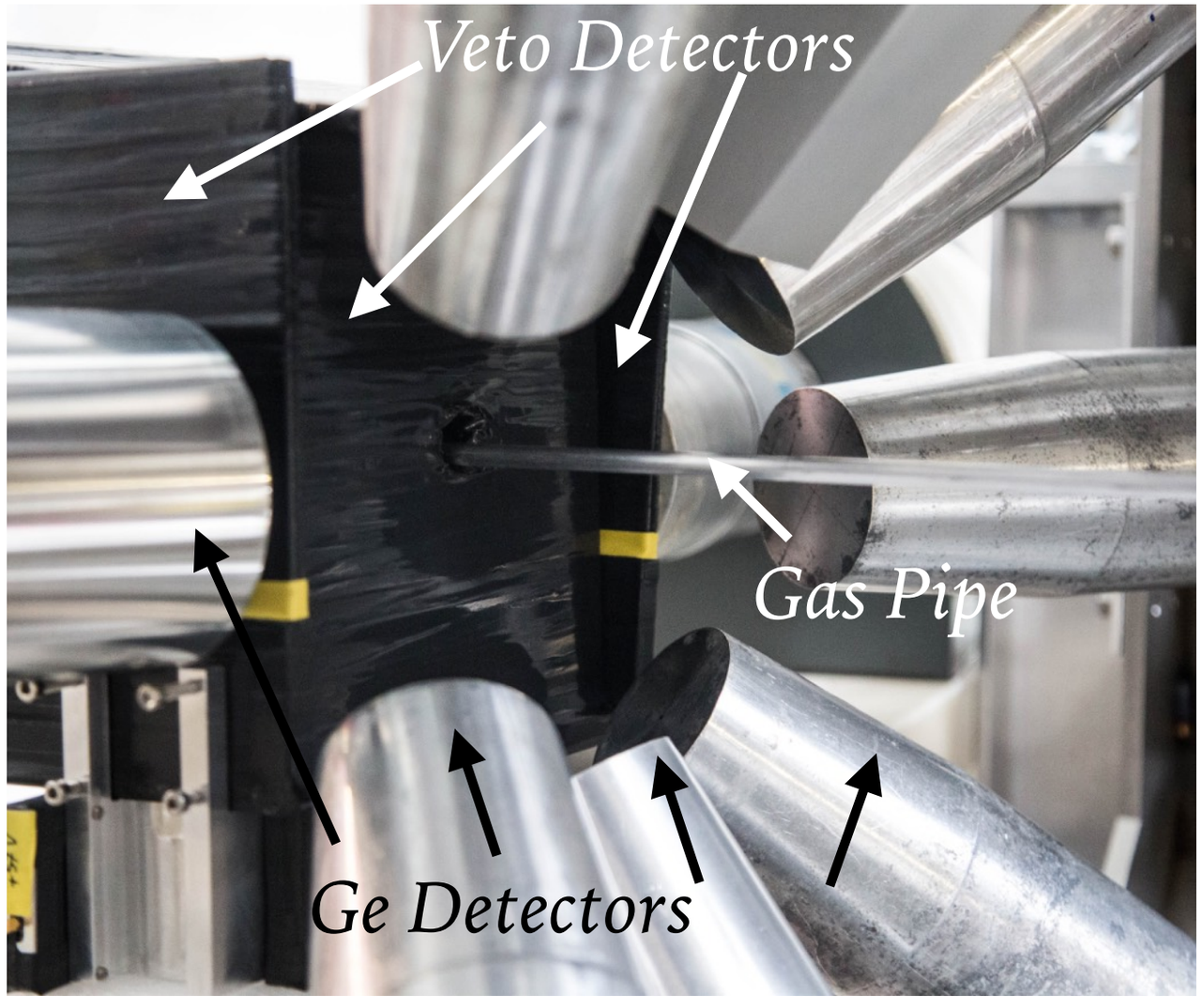
- 2019 we have glassy carbon as a target holder

- We need another possibility to estimate the stopping position in the beam for the low amount targets

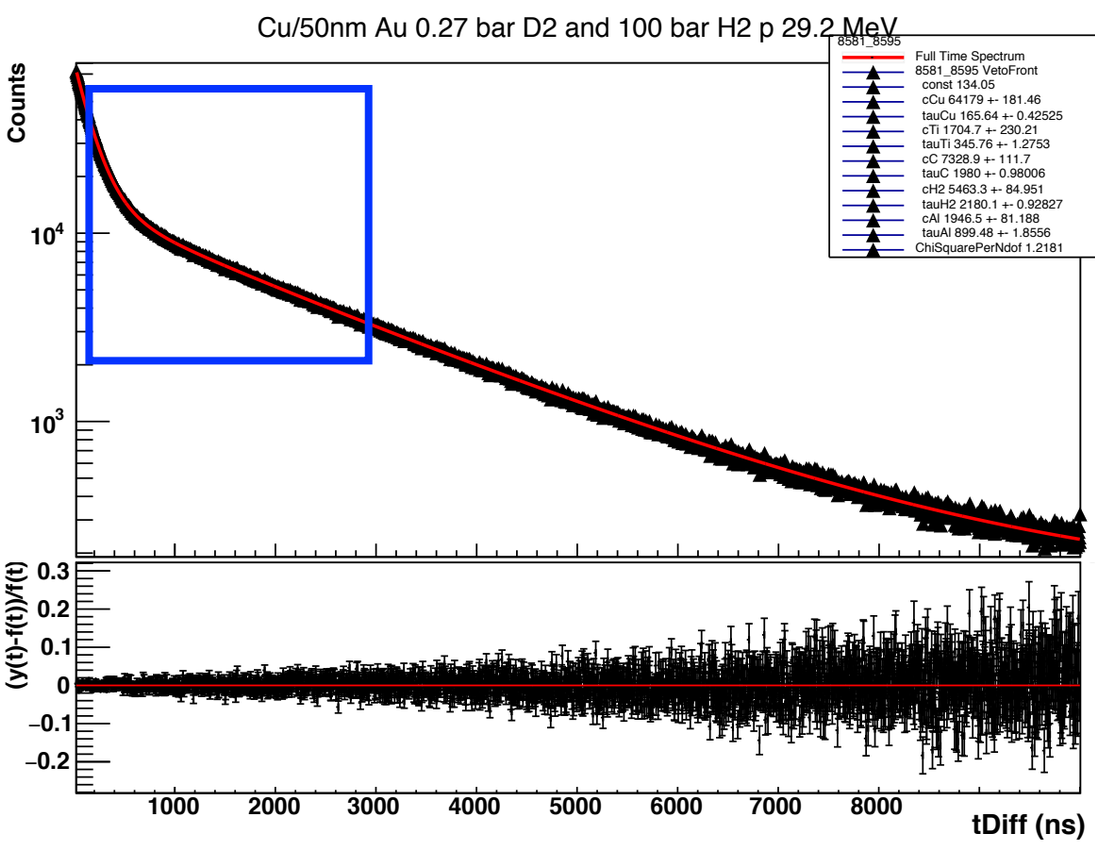
Glassy carbon target holder of target prototypes

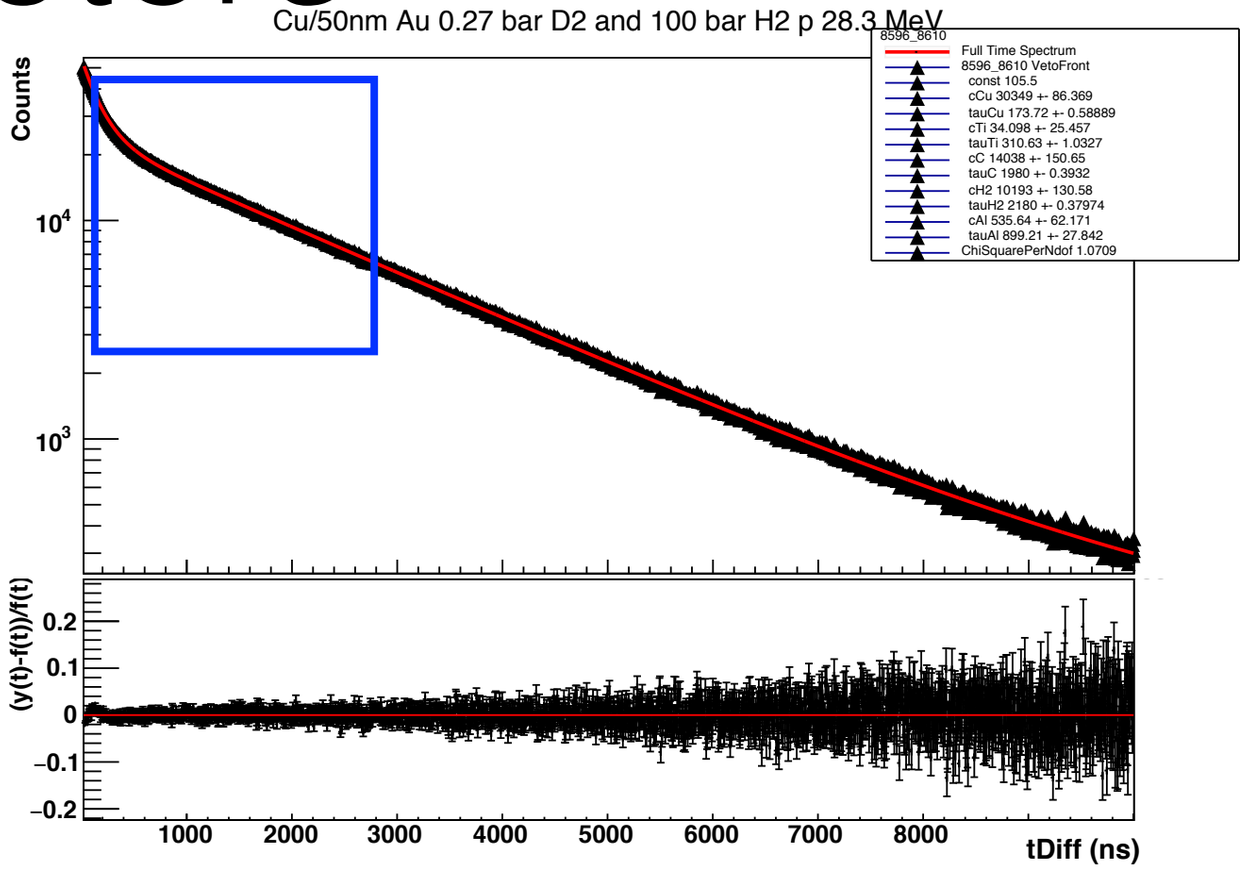
Use Time Spectrum of Veto Detectors





Use Time Spectrum of Veto Detectors





- In the plots you see that for 28.3 MeV the curve decreases slower as for the 29.3 MeV plot
- For higher momentum we have more stops in Cu than in H_2
- Muon lifetime in H_2 almost like the life time of a free muon
- At the moment we try to estimate the stopping position by the shape of the time spectrum

Summary

- Analysis of gold targets does not show any hint of damaged gold target
- Uranium targets agree with our observation regarding organic layers in 2018
- Analysis of fusion time spectrum and muon stops in C, N, Al and Cu have not shown any discrepancies between 2017 and 2018