Впечатление от работа със SiPM и бъдещи планове

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30.03.2018

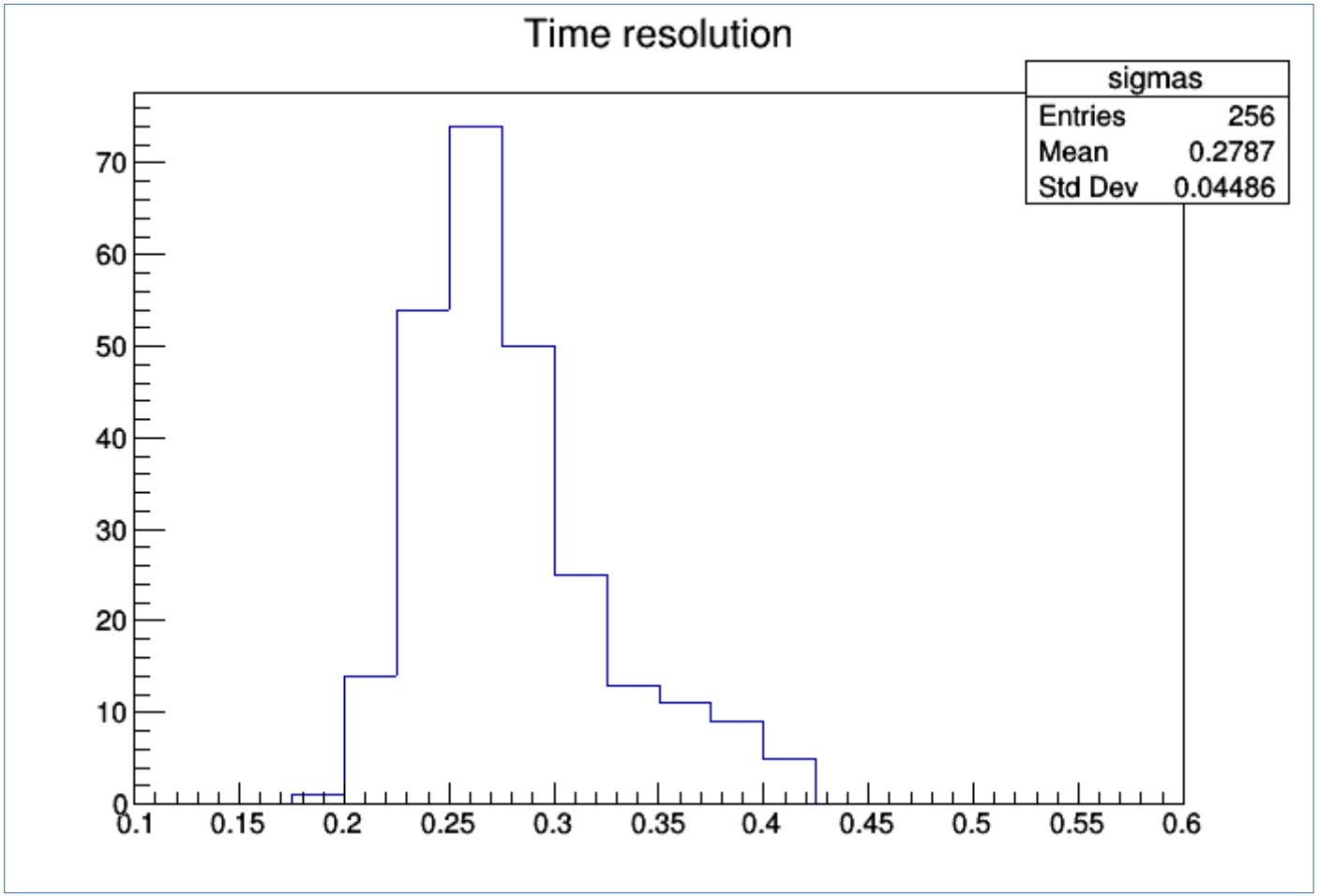
Предимства на SiPM

- Работят при по-ниски напрежения от ФЕУ
- Висока активност за регистрация на фотони
- Голямо усилване ~ 10^6
- Времева стабилност
- Нечувствителни са към магнитни полета

Предимства в детекторите за заредени частици на експеримента PADME

- При предварителните тестове всички SiPM работеха при едно и също напрежение ~ 57 V
- При проведените стрес-тестове, умножителите се държаха стабилно
- Постигнахме времева-резолюция от ~ 300ps

Времева резолюция

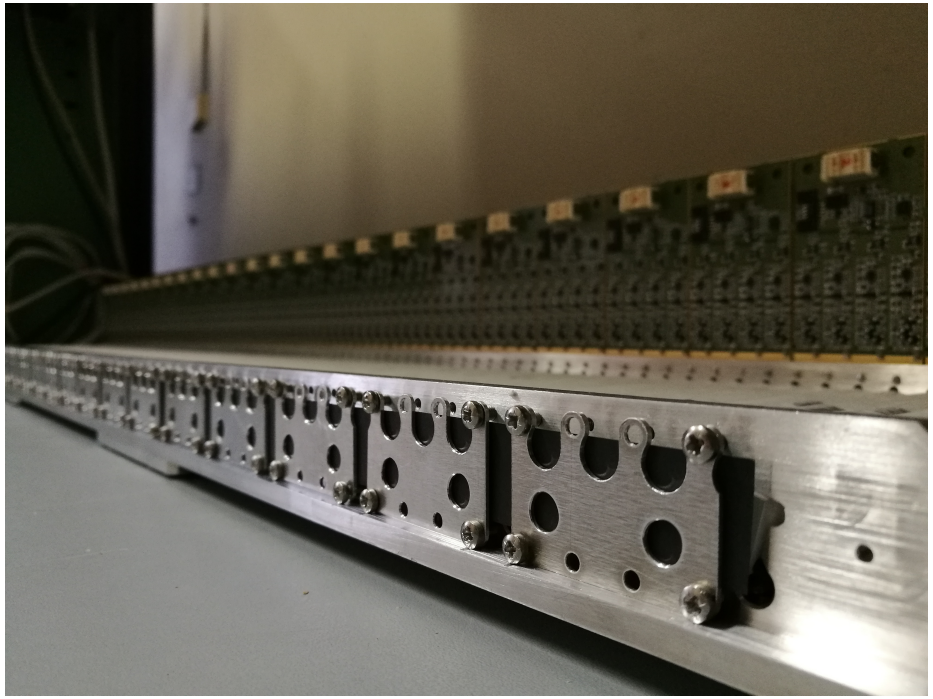


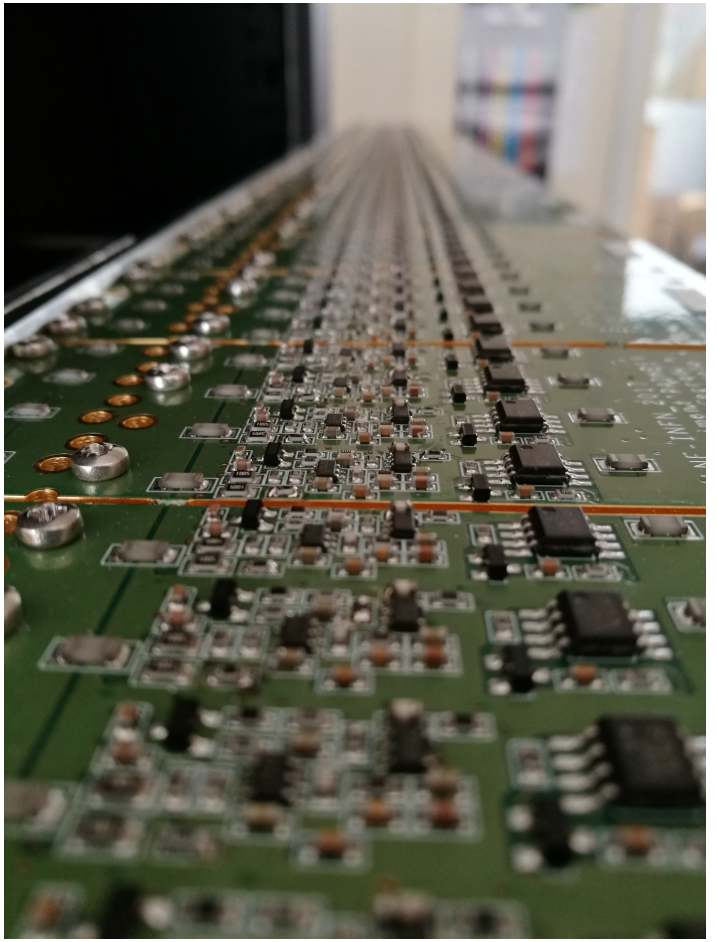
All channel resolutions below 500 ps (actually ~300 ps)
Individual SiPM resolution spread – within 5-7 %

Недостатъци на SiPM

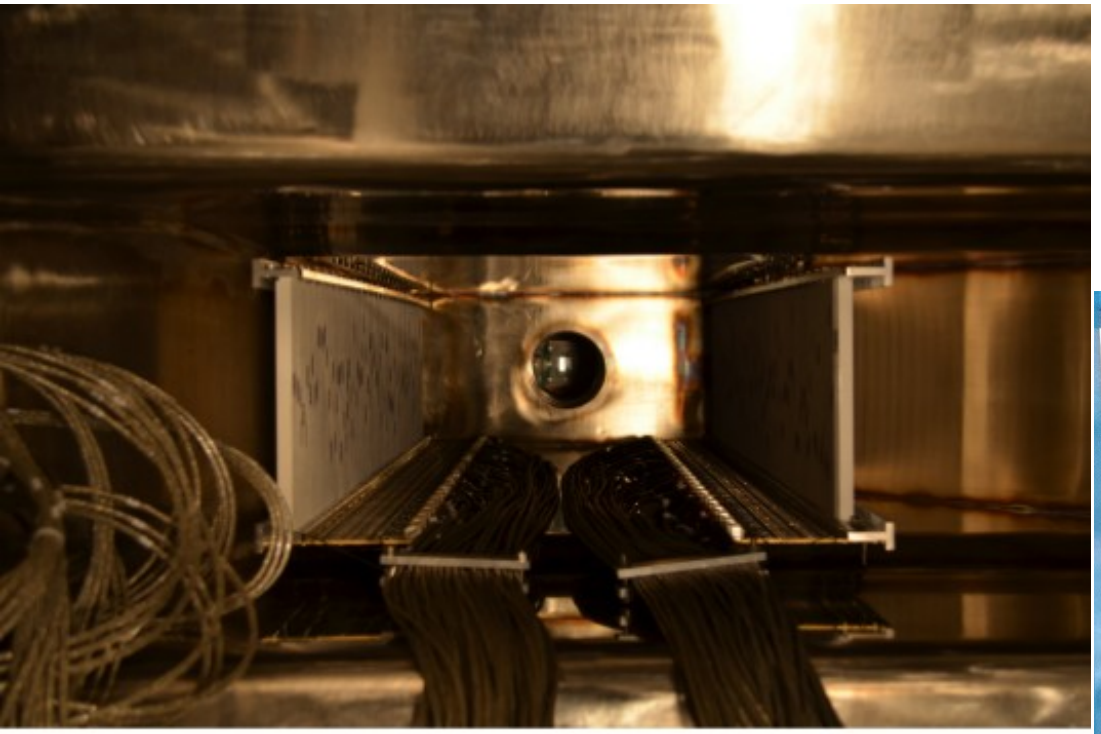
- Тъмен ток (създаване на двойка заредени частици в резултат на термични процеси и в остсътвие на падащ фотон)
- Вторични импулси (зарядите не релаксират напълно)
- Оптично преплитане (сигнал в една микроструктура създава паразитно сработване в друга)

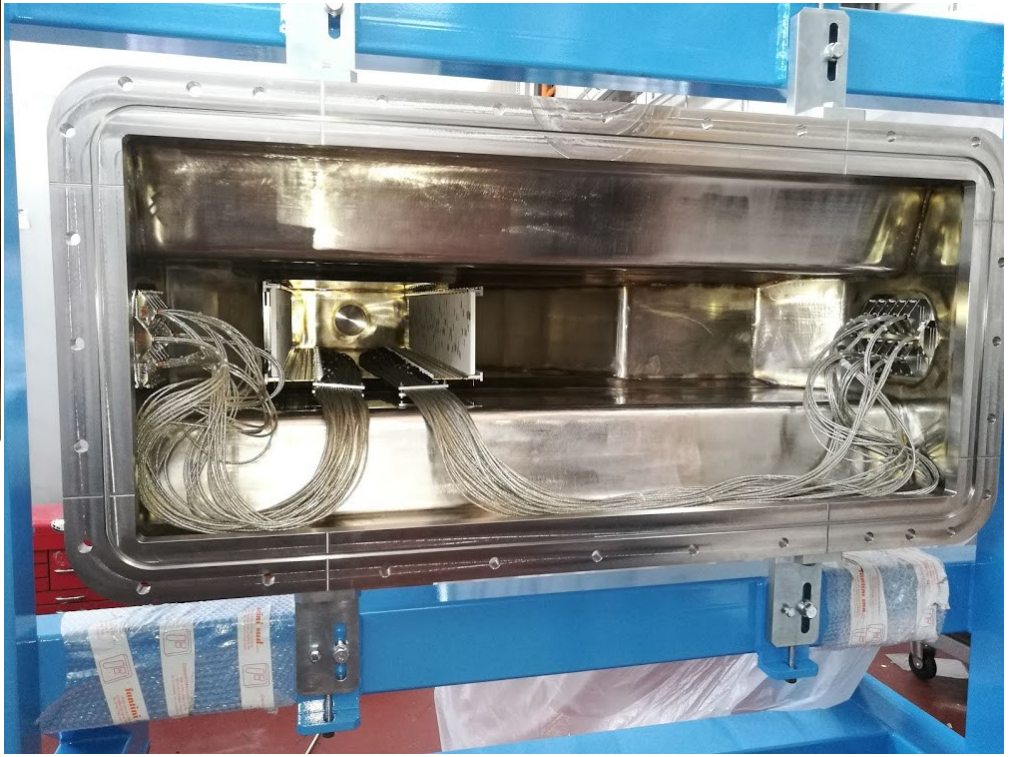
Механична част



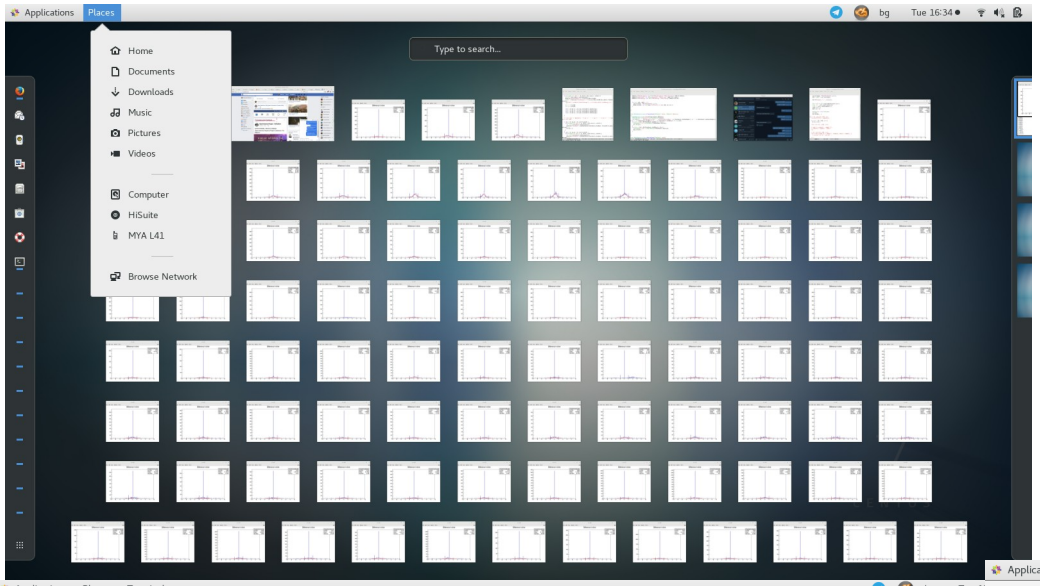


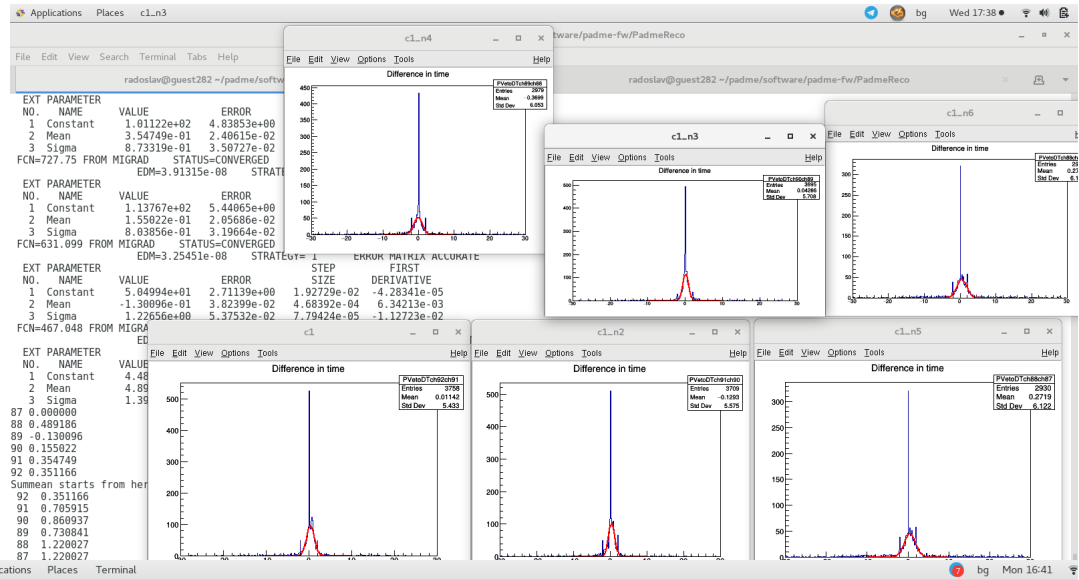
Детекторът е монтиран – но не е калибриран





Реконструкция на експеримента

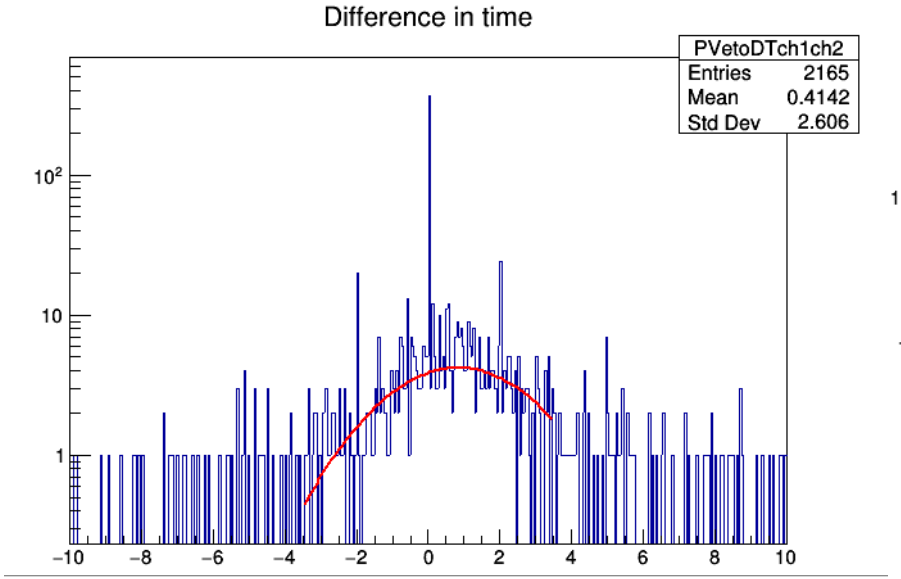


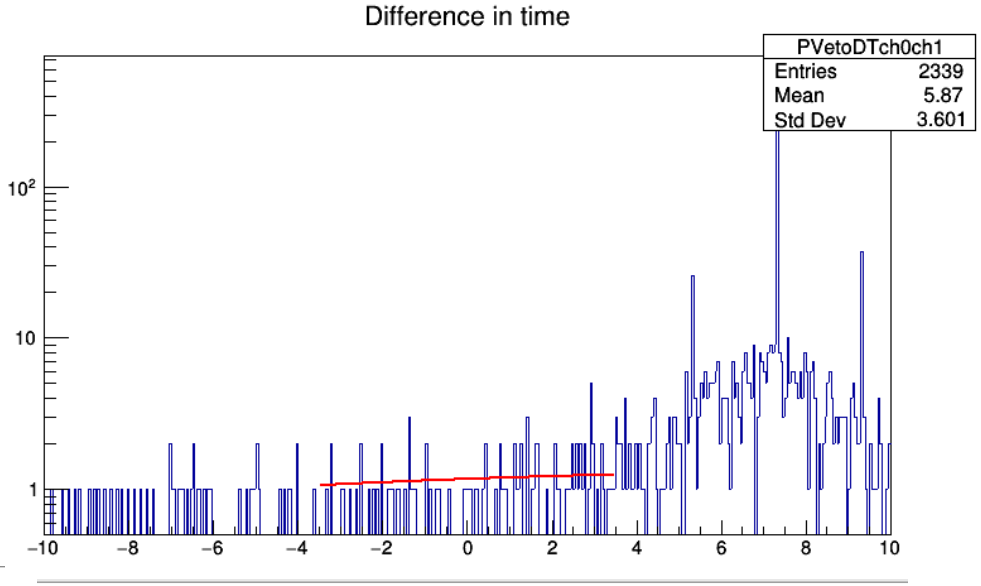


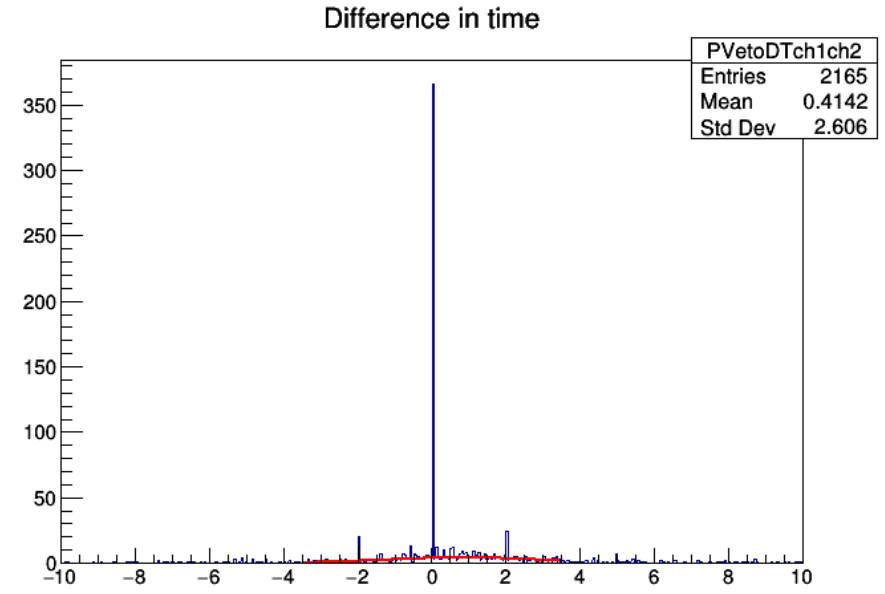

```
Applications  Places  Terminal
radoslav@guest282 ~/padme/software/padme-fw/PadmeReco
File  Edit  View  Search  Terminal  Tabs  Help
radoslav@guest282 ~/padme/software/padme-fw/PadmeReco
radoslav@guest282 ~/coding
SAC: readout is ADC
Processing the map for board:  27   ADC27
Number of ADCs for detector: SAC: 1
TPix: Initializing

 *** Break *** segmentation violation


==========
There was a crash.
This is the entire stack trace of all threads:
==========
#0  0x00007f0a70d5117c in waitpid () from /lib64/libc.so.6
#1  0x00007f0a70ccee52 in do_system () from /lib64/libc.so.6
#2  0x00007f0a755060bf in TUnixSystem::StackTrace() () from /home/software/physics/root6-x86_64-cc7/lib/libCore.so
#3  0x00007f0a7550880c in TUnixSystem::DispatchSignals(ESignals) () from /home/software/physics/root6-x86_64-cc7/lib/libCore.so
#4  <signal handler called>
#5  0x0000000000415a1e in ECalReconstruction::AnalyzeEvent (this=0x4679ea0, rawEv=<optimized out>) at src/ECalReconstruction.cc:163
#6  0x000000000041c018 in PadmeVReconstruction::ProcessEvent (this=0x4679ea0, rawEv=0x46a6ac0) at src/PadmeVReconstruction.cc:206
#7  0x00000000040e65c in PadmeReconstruction::NextEvent (this=0x31056f0) at src/PadmeReconstruction.cc:233
#8  0x0000000000040db43 in main (argc=<optimized out>, argv=<optimized out>) at PadmeReco.cc:145
==========


The lines below might hint at the cause of the crash.
You may get help by asking at the ROOT forum http://root.cern.ch/forum.
Only if you are really convinced it is a bug in ROOT then please submit a
report at http://root.cern.ch/bugs. Please post the ENTIRE stack trace
from above as an attachment in addition to anything else
that might help us fixing this issue.
==========
#5  0x0000000000415a1e in ECalReconstruction::AnalyzeEvent (this=0x4679ea0, rawEv=<optimized out>) at src/ECalReconstruction.cc:163
#6  0x000000000041c018 in PadmeVReconstruction::ProcessEvent (this=0x4679ea0, rawEv=0x46a6ac0) at src/PadmeVReconstruction.cc:206
#7  0x00000000040e65c in PadmeReconstruction::NextEvent (this=0x31056f0) at src/PadmeReconstruction.cc:233
#8  0x0000000000040db43 in main (argc=<optimized out>, argv=<optimized out>) at PadmeReco.cc:145
==========

radoslav@guest282 ~/padme/software/padme-fw/PadmeReco $
```

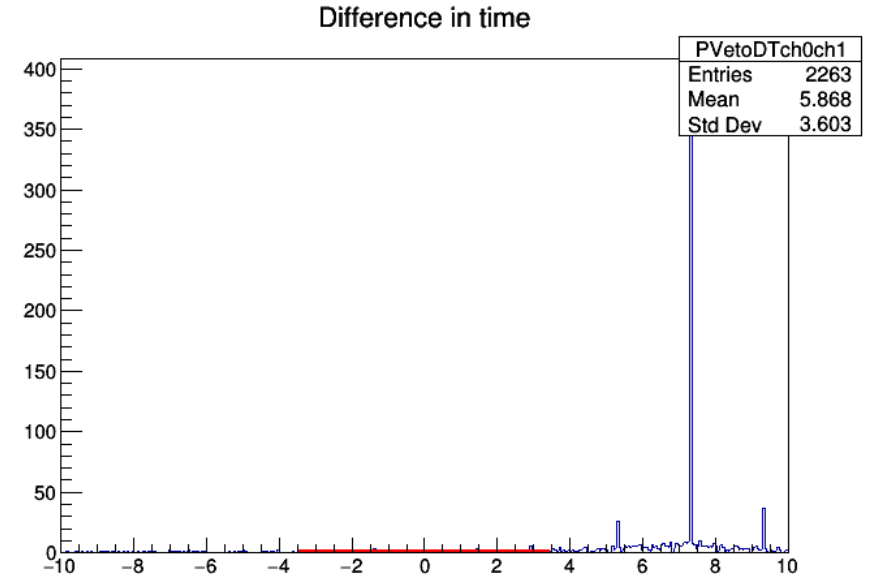
```
Applications  Places  Terminal
radoslav@guest282 ~/padme-fw/PadmeReco
File  Edit  View  Search  Terminal  Tabs  Help
radoslav@guest282 ~/padme-fw $ ./PadmeReco.cc -i data/run_0000000_20181003_200540_lvl1_03_046.root
bash: ./PadmeReco.cc: No such file or directory
radoslav@guest282 ~/padme-fw $ cd PadmeReco/
radoslav@guest282 ~/padme-fw/PadmeReco $ make
Making dependency for file src/PadmeReconstruction.cc ...
In file included from /usr/include/c++/4.8.2/atomic:38:0,
                 from /home/software/physics/root6-x86_64-cc7/include/TFile.h:24,
                 from include/PadmeReconstruction.hh:4,
                 from src/PadmeReconstruction.cc:1:
/usr/include/c++/4.8.2/bits/c++0x_warning.h:32:2: error: #error This file requires compiler and library support for the ISO C++ 2011 standard. This support is currently e
ental, and must be enabled with the -std=c++11 or -std=gnu++11 compiler options.
 #error This file requires compiler and library support for the \
  ^
In file included from /home/software/physics/root6-x86_64-cc7/include/RtypesCore.h:23:0,
                 from /home/software/physics/root6-x86_64-cc7/include/Rtypes.h:23,
                 from /home/software/physics/root6-x86_64-cc7/include/TObject.h:17,
                 from /home/software/physics/root6-x86_64-cc7/include/TBuffer.h:24,
                 from /home/software/physics/root6-x86_64-cc7/include/TDirectory.h:24,
                 from /home/software/physics/root6-x86_64-cc7/include/TDirectoryFile.h:24,
                 from /home/software/physics/root6-x86_64-cc7/include/TFile.h:26,
                 from include/PadmeReconstruction.hh:4,
                 from src/PadmeReconstruction.cc:1:
/home/software/physics/root6-x86_64-cc7/include/RConfig.h:40:3: error: #error "ROOT requires support for C++11 or higher."
 # error "ROOT requires support for C++11 or higher."
   ^
/home/software/physics/root6-x86_64-cc7/include/RConfig.h:42:4: error: #error "Pass `-std=c++11` as compiler argument."
 #  error "Pass `-std=c++11` as compiler argument."
    ^
Making dependency for file src/RecoVRootIO.cc ...
In file included from /usr/include/c++/4.8.2/atomic:38:0,
                 from /home/software/physics/root6-x86_64-cc7/include/TFile.h:24,
                 from include/RecoVRootIO.hh:5,
                 from src/RecoVRootIO.cc:1:
/usr/include/c++/4.8.2/bits/c++0x_warning.h:32:2: error: #error This file requires compiler and library support for the ISO C++ 2011 standard. This support is currently e
ental, and must be enabled with the -std=c++11 or -std=gnu++11 compiler options.
 #error This file requires compiler and library support for the \
  ^
In file included from /home/software/physics/root6-x86_64-cc7/include/RtypesCore.h:23:0,
                 from /home/software/physics/root6-x86_64-cc7/include/Rtypes.h:23,
                 from /home/software/physics/root6-x86_64-cc7/include/TObject.h:17,
```

Основни проблеми при калибровката

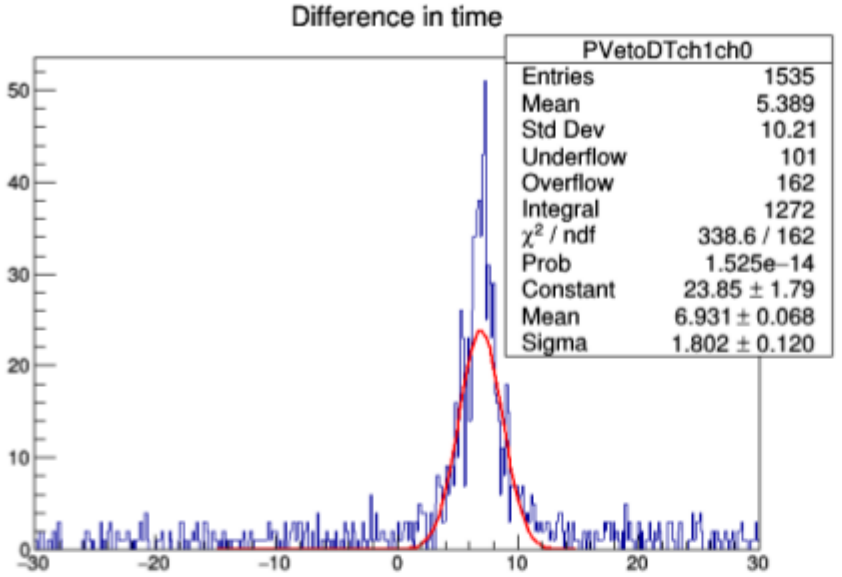


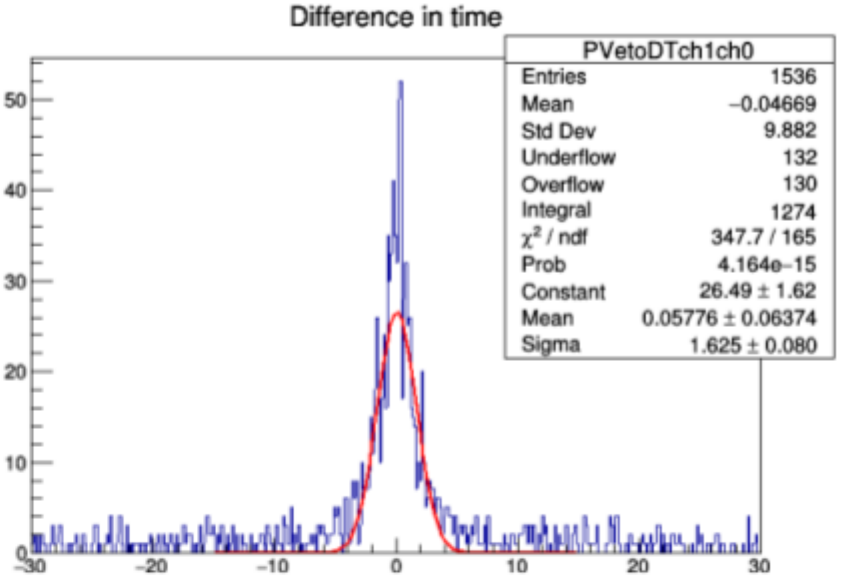


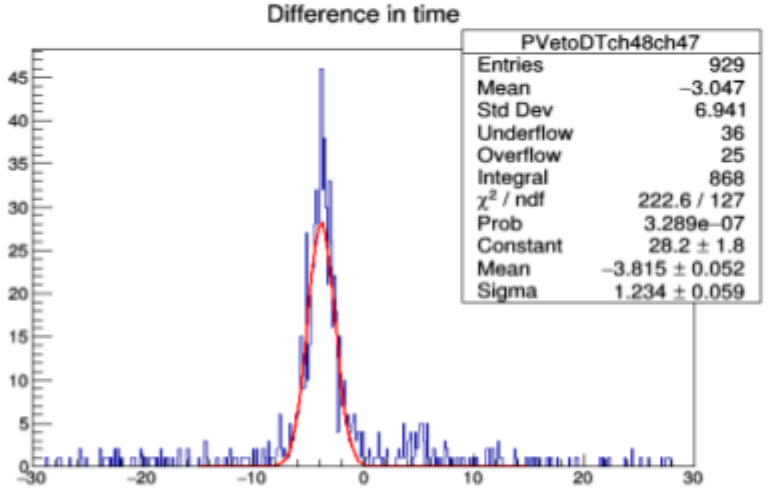


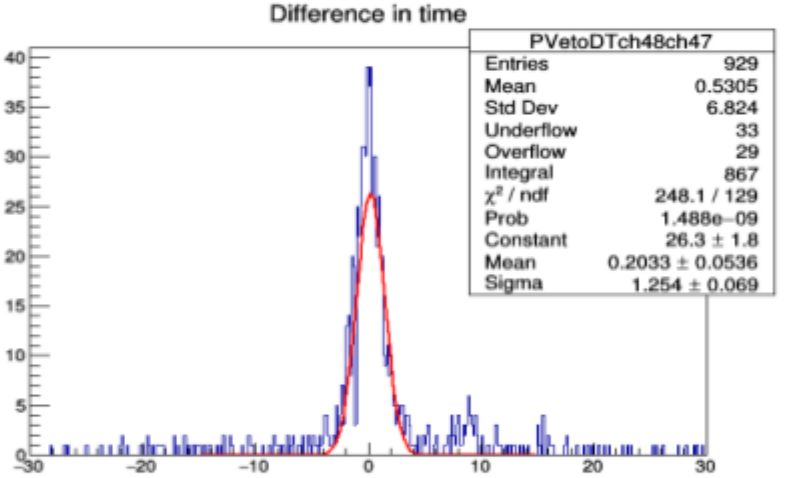


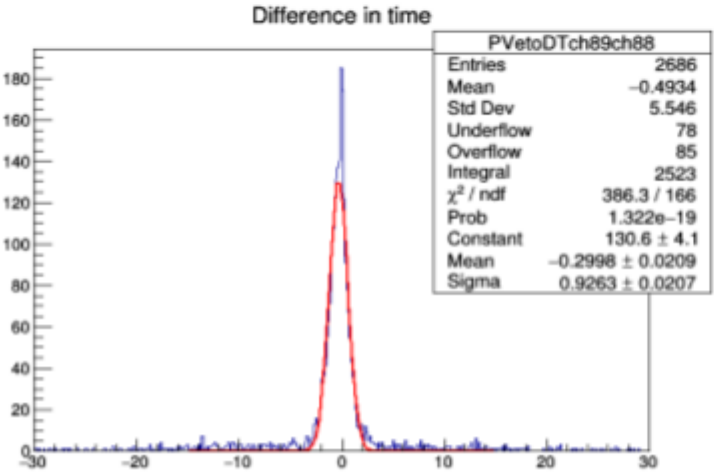
Before and after

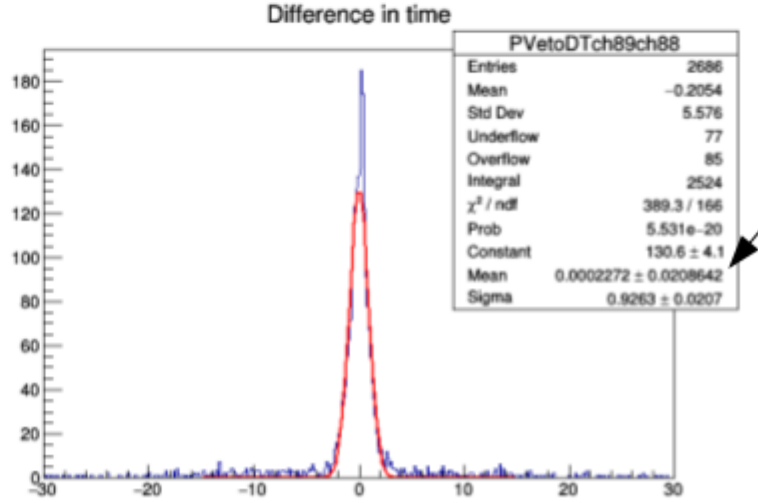






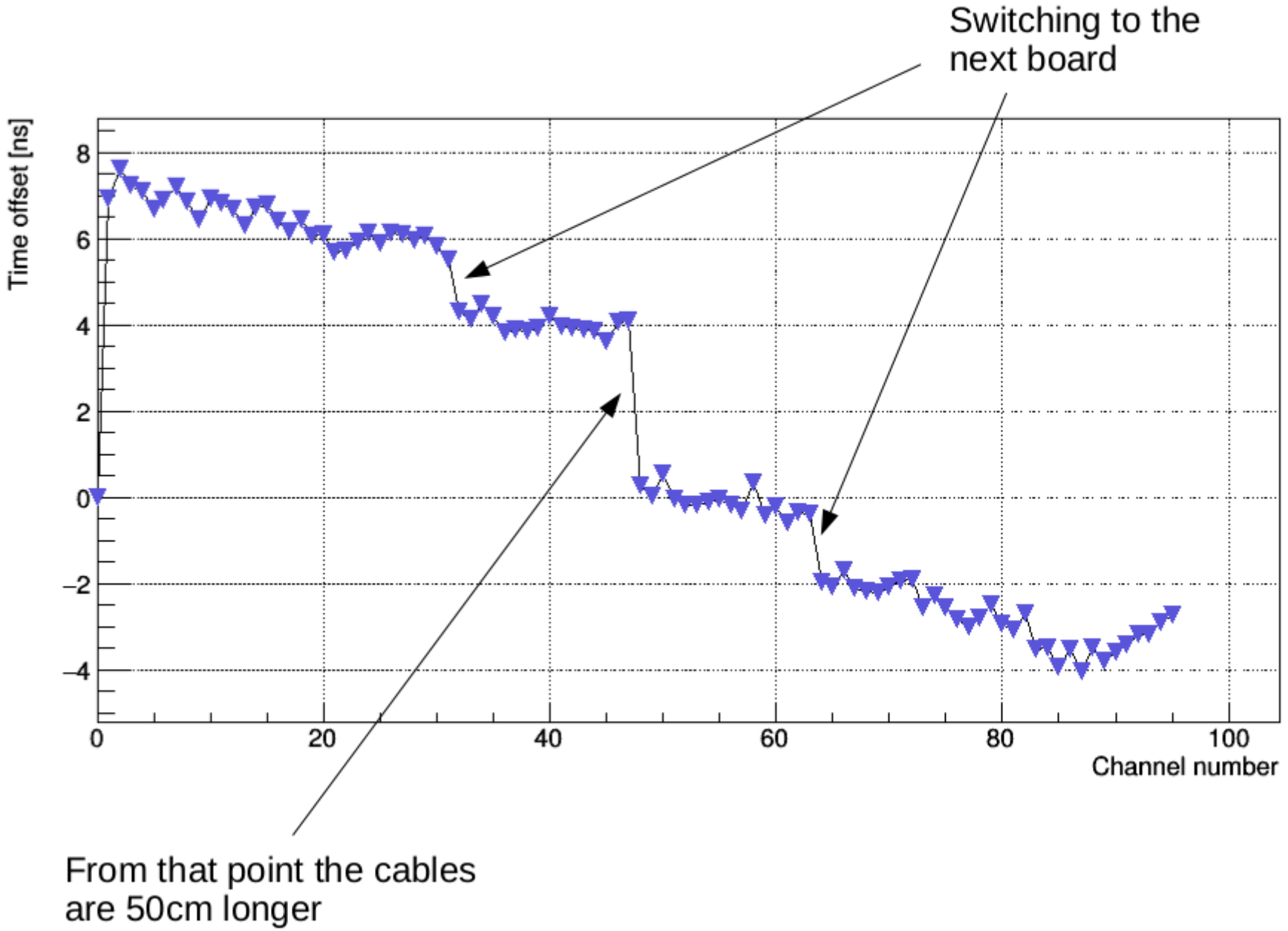




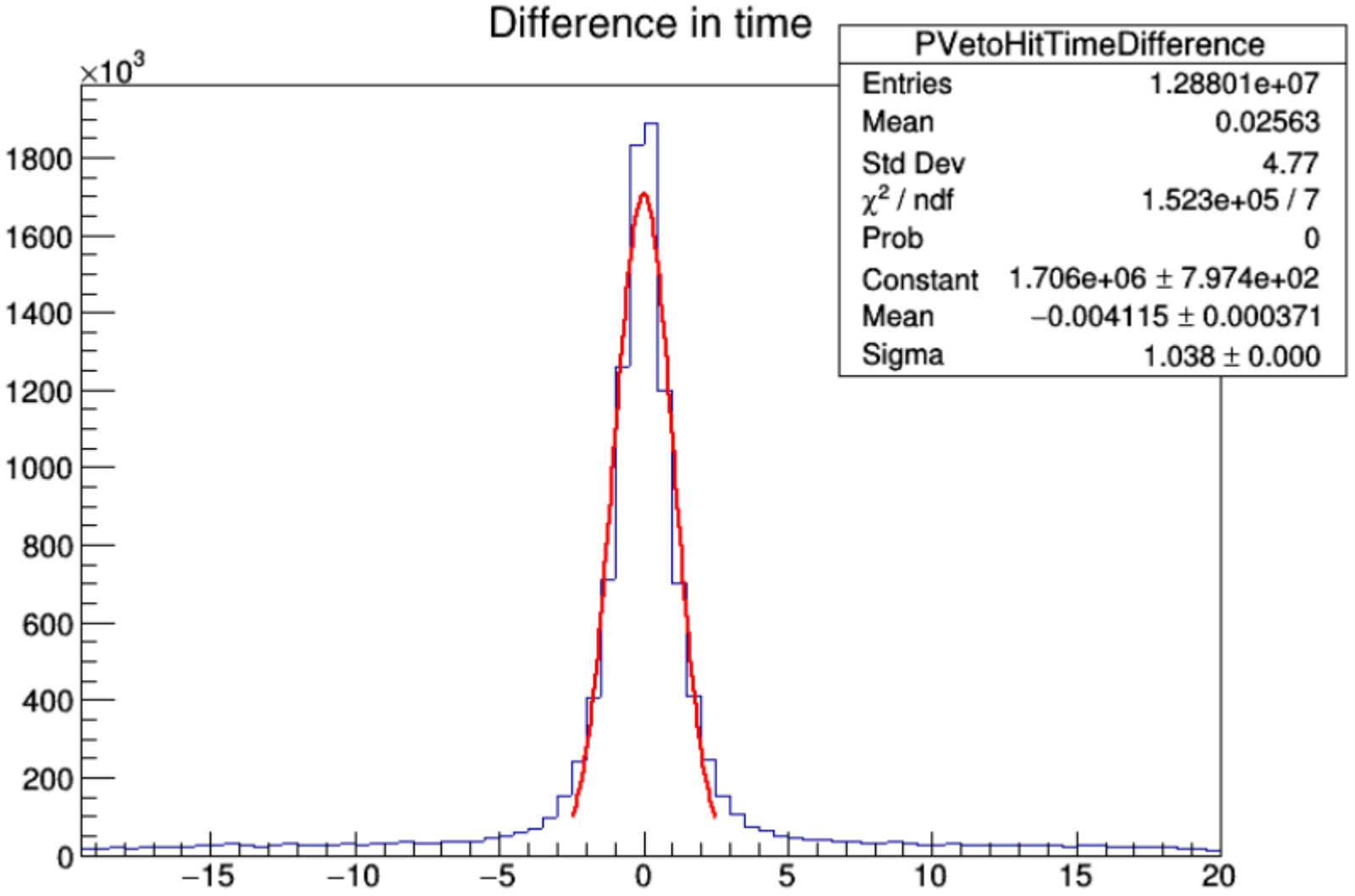


The time difference is reduced by 3 orders

Time offsets for each channel

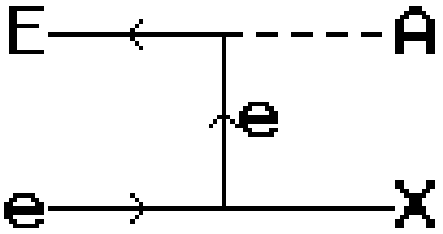


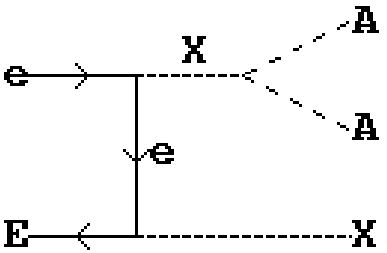
Окончателно ~ 700ps резолюция

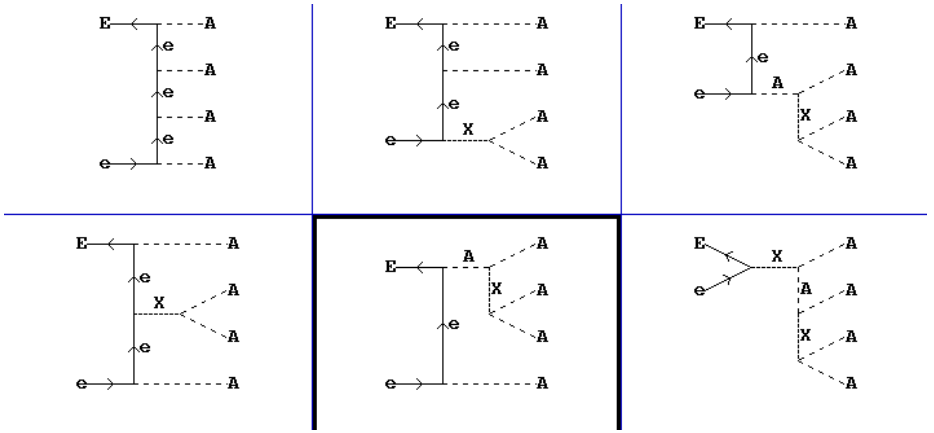


Бъдещи планове

- Аксиони
- Вероятни модели
- Търсене на ALPs на експеримента PADME







Оценка

```
#IT Cross section[pb] Error[%]  nCall     Eff.   chi^2
 10       1.6740E+10   4.25E+00    94500
Negative points 0.3%;Bad Precision 3%;
< >       1.3806E+10   2.84E+00   945000            2
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  4       1.3719E+10   3.37E+00    94500
  5       1.4918E+10   3.80E+00    94500
Negative points 1E-16%;Bad Precision 0.02%;
  6       1.4294E+10   3.21E+00    94500
Bad Precision 4%;
  7       1.1660E+10   3.07E+01    94500
Negative points 2E+01%;Bad Precision 2E+01%;
  8       1.5190E+10   5.39E+00    94500
Negative points 1%;Bad Precision 4%;
  9       1.5062E+10   2.41E+00    94500
Negative points 0.2%;Bad Precision 4%;
```

Clr Del Size Read ErrMes

A1 <	A2	A3	A4	Factor <	Lorentz part
G	G	G		GG	m1.m2*(p1-p2).m
G	G	G.t		GG/Sqrt2	m1.M3*m2.m3-m1.
W+	W-	A		-EE	m1.m2*(p1-p2).m
W+	W-	Z		-EE*CW/SW	m1.m2*(p1-p2).m
W+	W-	Z	Z	-(EE*CW/SW)^ 2	2*m1.m2*m3.m4-m
W+	W+	W-	W-	(EE/SW)^ 2	2*m1.m2*m3.m4-m
W+	W-	A	Z	-EE^ 2*CW/SW	2*m1.m2*m3.m4-m
W+	W-	A	A	-EE^ 2	2*m1.m2*m3.m4-m
E	e	X		i*GAE/(2*Me)	G(p3)*G5
A	A	X		-GAX/4	(p1.p2*m1.m2-p1
h	W+	W-		EE*MW/SW	m2.m3
h	Z	Z		EE/(SW*CW^ 2)*MW	m2.m3
h	h	h		-(3/2)*EE*Mh^ 2/(MW*SW)	1
h	h	h	h	(-3/4)*(EE*Mh/(MW*SW))^ 2	1
h	h	Z	Z	(1/2)*(EE/(SW*CW))^ 2	m3.m4
h	h	W+	W-	(1/2)*(EE/SW)^ 2	m3.m4
M	m	h		-EE*Mm/(2*MW*SW)	1
E	e	h		-EE*Me/(2*MW*SW)	1
L	l	h		-EE*Ml /(2*MW*SW)	1
C	c	h		-EE*Mc/(2*MW*SW)	1

#IT	Cross section[pb]	Error[%]	nCall
1	3.5633E+09	4.77E+00	94500
2	5.6566E+09	1.26E+01	94500
3	6.2206E+09	8.32E+00	94500
4	6.6233E+09	3.95E+00	94500
5	7.0688E+09	3.26E+00	94500
< >	5.8265E+09	3.30E+00	472500