

SHiP straw tracker prototype tests

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Prototypes produced in 2015:

- short (40 cm), single straw
- long (500 cm), single straw

lab tests

- ◆ signal studies, with ^{55}Fe source
 - ▶ signal shape and attenuation studies
 - ▶ gas gain measurements, as a function of HV, at several values of pressure
- ◆ mechanical stability
 - ▶ wire displacement measurements
 - ▶ do we need straw and wire supports?

tests with beam

Parasitic muon beam was used. Each prototype was placed into a beam telescope consisting of 3 DWCs (from ITEP, Moscow) and trigger scintillation counters.

The goal:

- ◆ measure the coordinate resolution and efficiency
 - ▶ as a function of HV and pressure
 - ▶ with different amplifiers
 - ▶ different gas mixtures
- ◆ see the effect of wire offset

Most of these tests were performed in November-December 2015.

- ◆ no final results yet, the analysis is ongoing
- ◆ tests will be continued in 2016, in more optimal conditions (*e.g.*, with better amplifiers for straw)

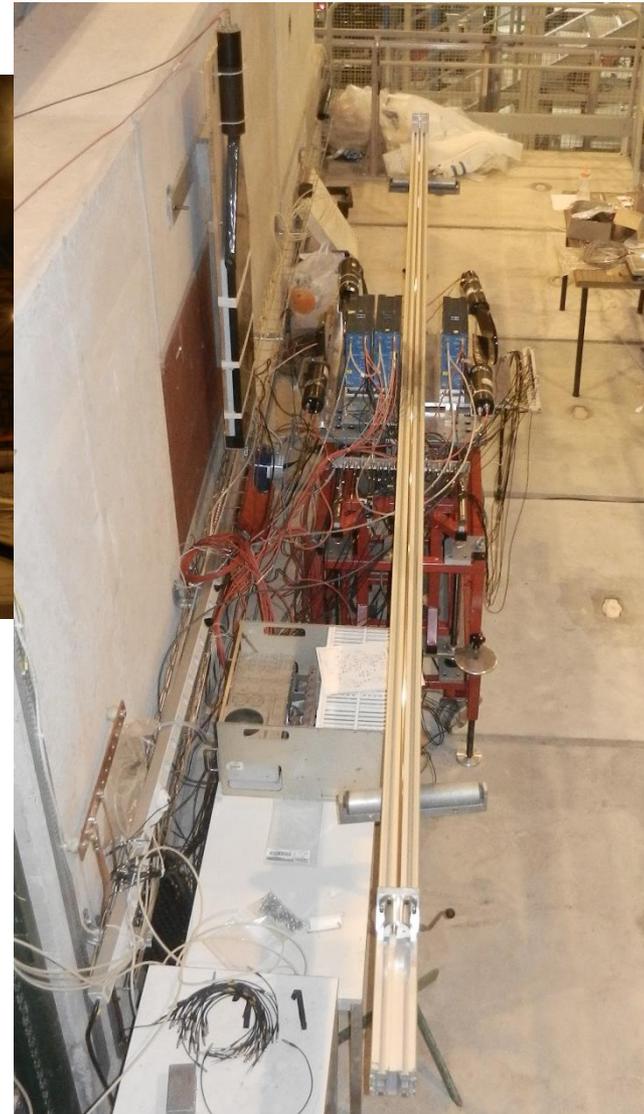
Short prototype



produced in Dubna in March 2015

Long prototype

assembled at the North Hall in November 2015

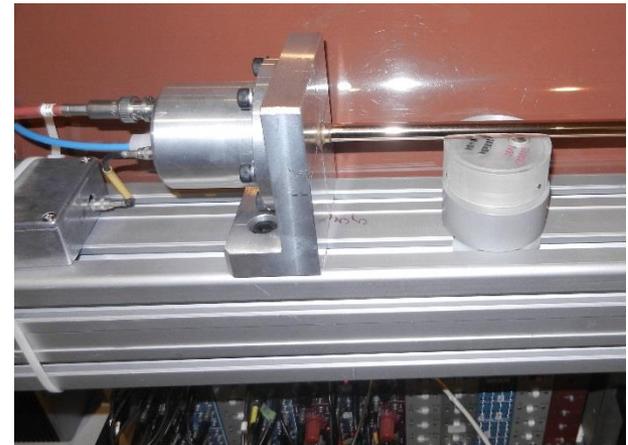


Long prototype

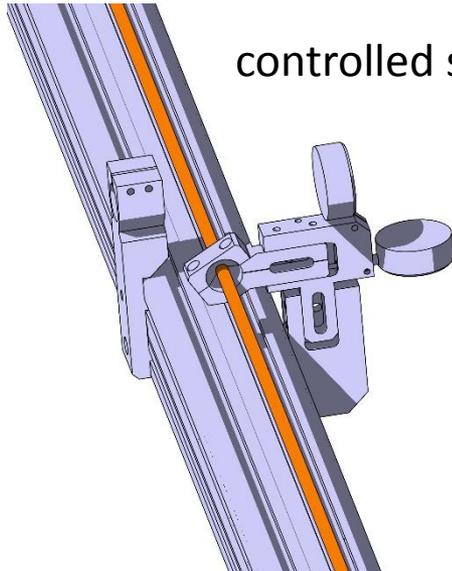
EM shielding



measurements with ^{55}Fe source



controlled straw position wrt wire



long straw, gas gain measurements

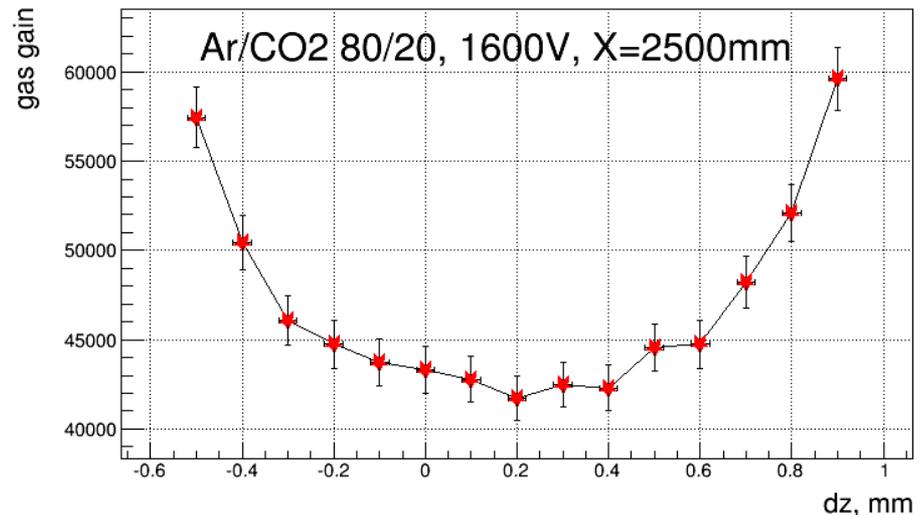
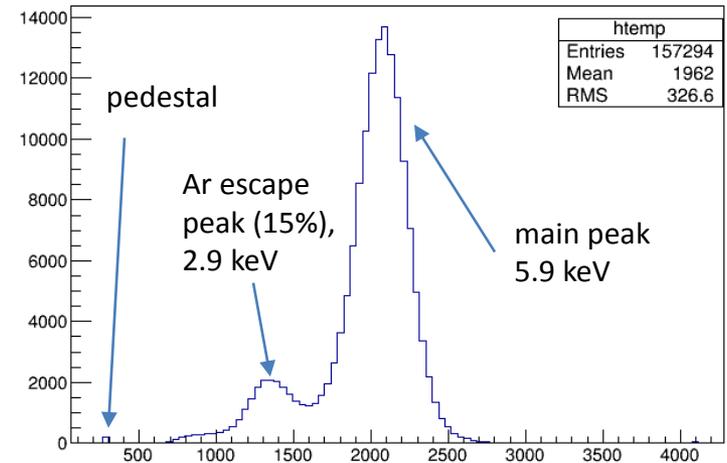
A 5.9 keV γ from ^{55}Fe produces on average ~ 220 electrons.

The gas gain can be determined from simultaneous measurement of signal rate and HV DC current. Correction for the escape peak (~ 1.07) should be applied.

The gas gain was measured as a function of HV, at different values of pressure, at different coordinates along the straw.

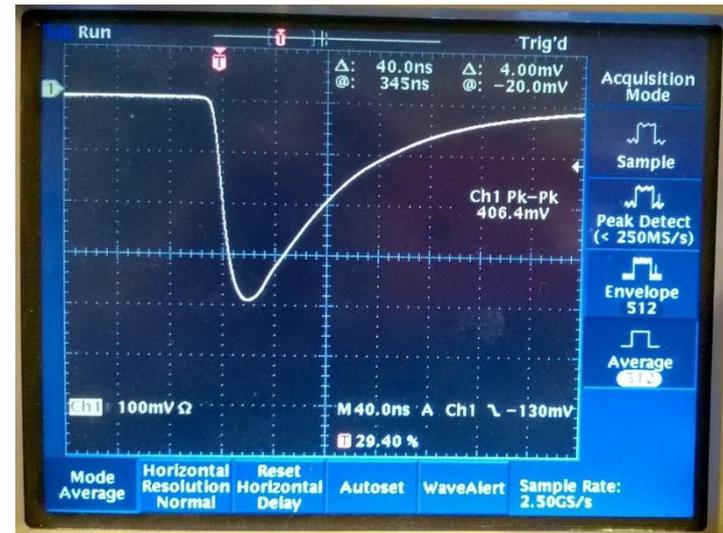
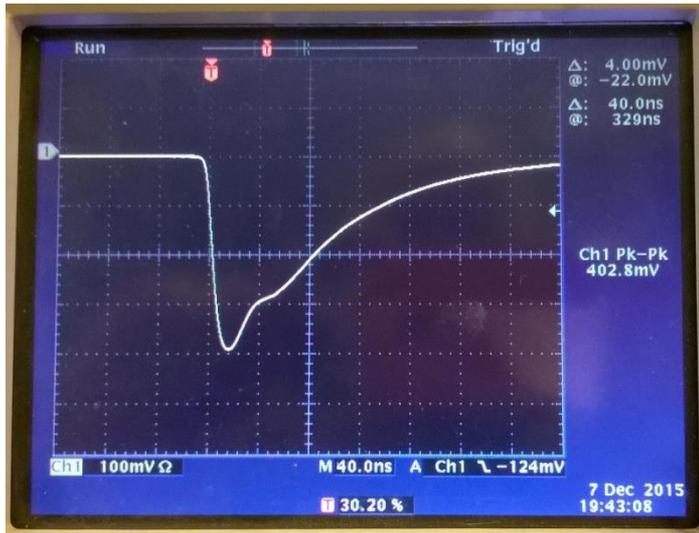
The gas gain dependence on dz (displacement parallel to the beam axis). The wire is centered at $dz \approx +0.2$ mm (minimum of gas gain).

A ^{55}Fe signal spectrum



long straw, signal attenuation measurements

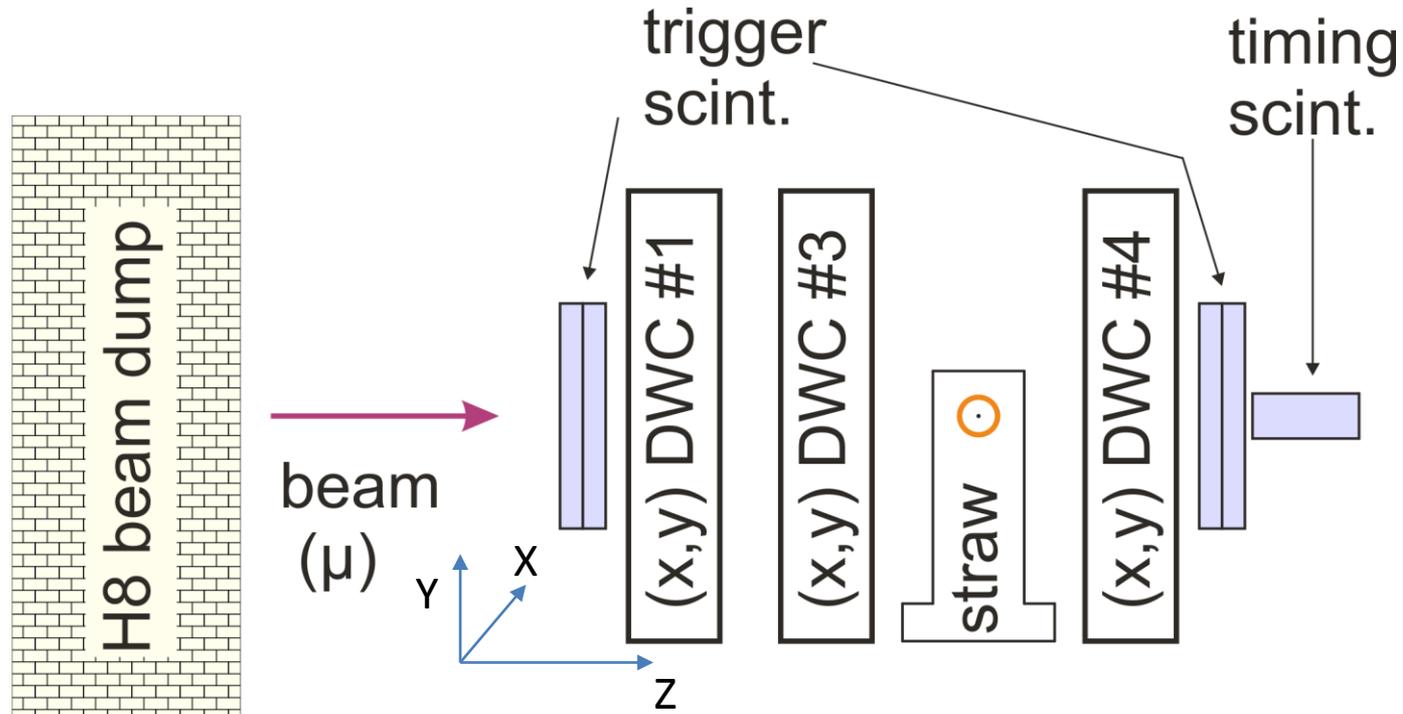
The opposite end of the straw is not terminated



The ^{55}Fe source is near the amplifier. Both direct and (reflected + attenuated over 5+5m) components are visible. The direct component is 402 mV

The attenuation over $L=5$ m is $a = (406/2)/402 = 1.98$;
the attenuation length is $\lambda = L/\ln(a) \approx 7.3$ m (close to expected 6.5 m)

Testbeam setup layout



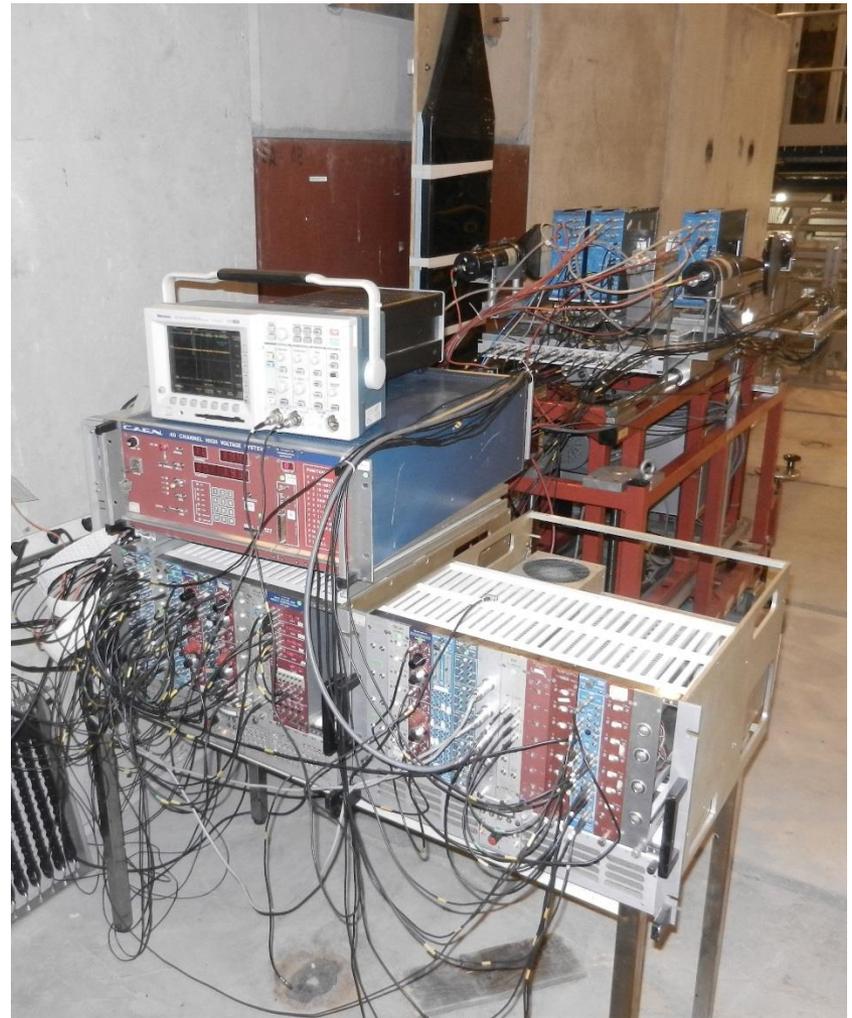
The setup was installed behind the H8 beam dump (muons).
The DWCs have 2 measurement planes, X and Y.

First the short straw (40 cm) was tested, then the long one (5 m). They were installed at \sim same Z position.

Readout

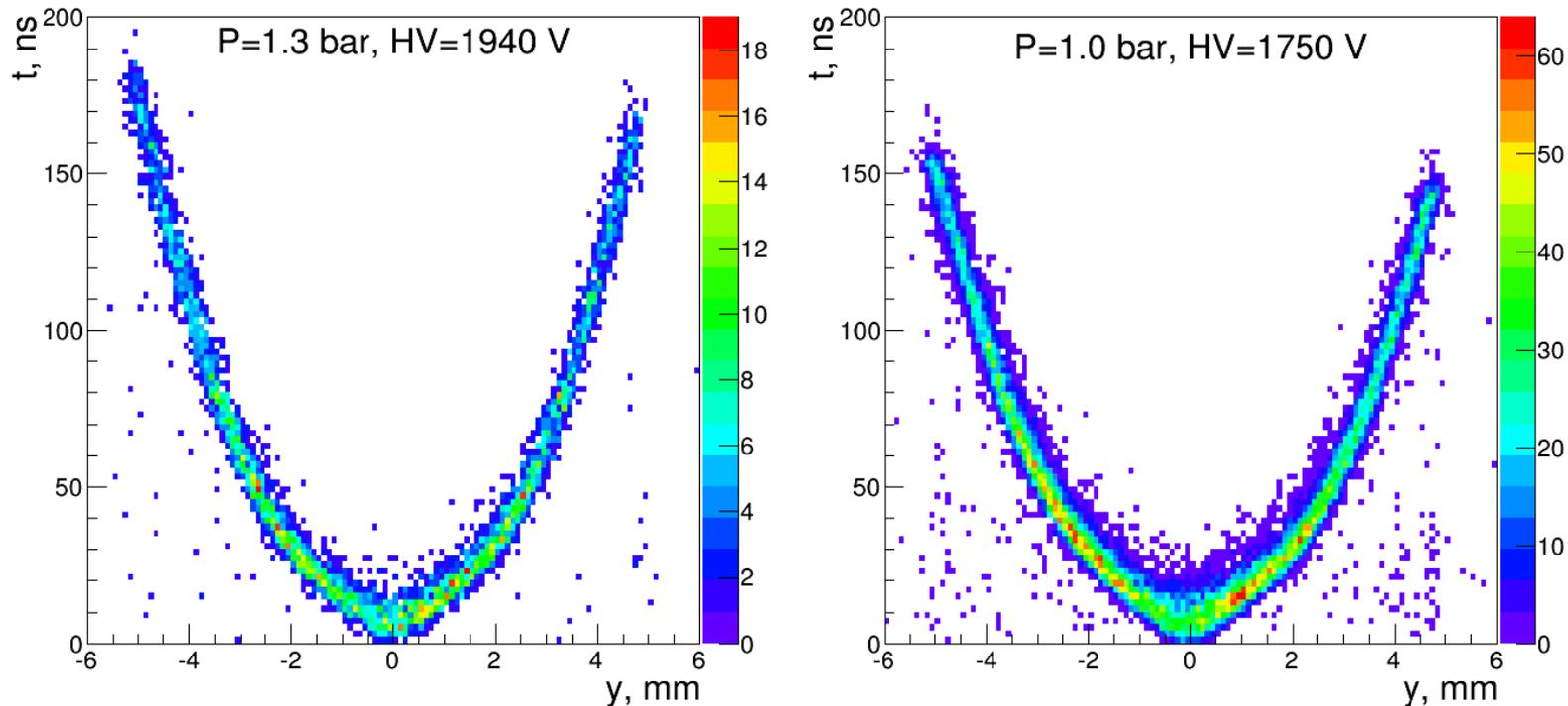
The signal from trigger, DWC and straw was shaped with CAEN V812 constant fraction discriminators and sent to a 32-ch TDC (CAEN V1290A).

The DWC anode signal amplitudes were measured by a 8-ch ADC (LeCroy 1182).



Short straw test

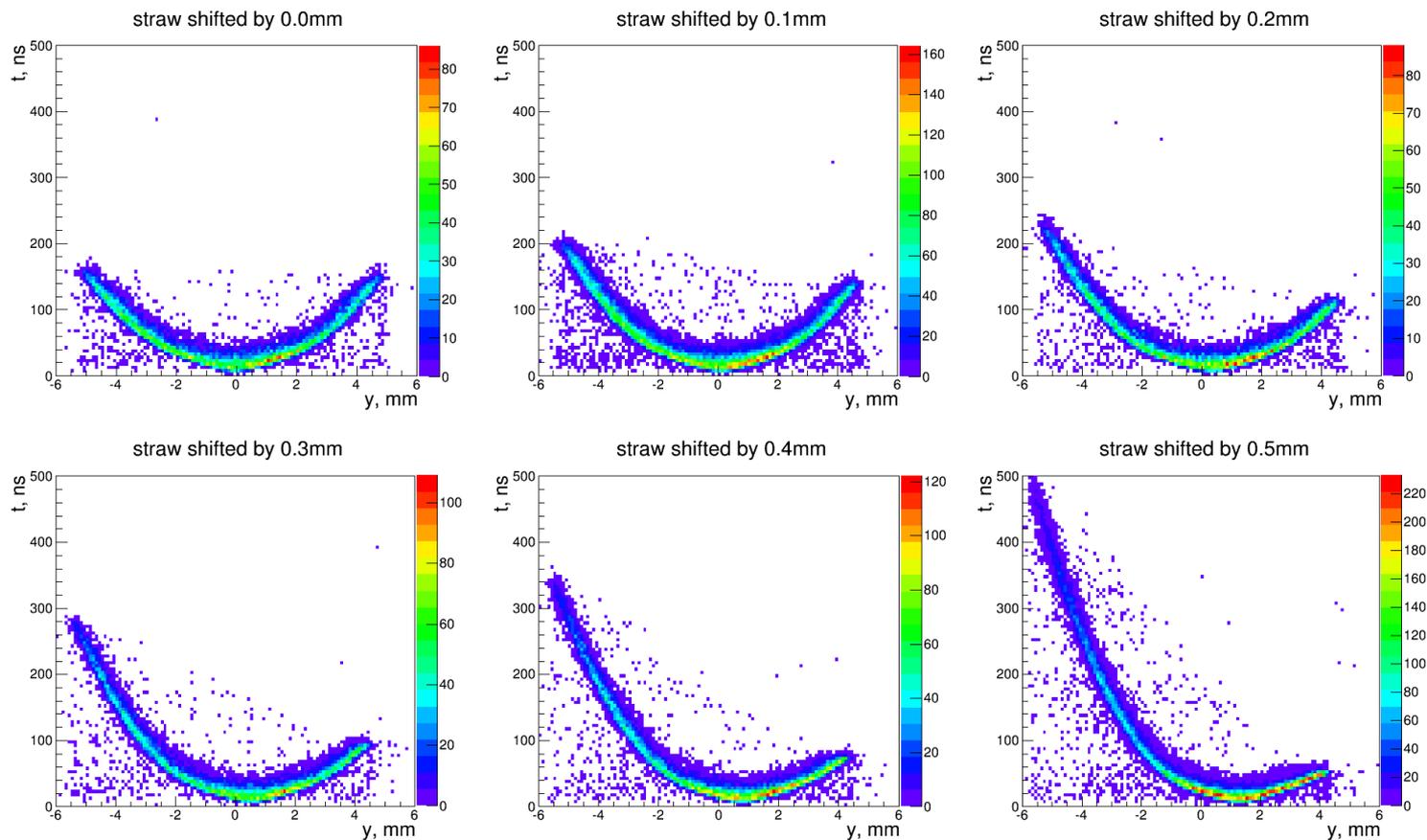
Here are V-shapes (drift time vs y coordinate) for the short straw. Left – 1.3 bar; right – 1.0 bar.



The straw coordinate resolution can be determined from these data (the analysis is ongoing, V. Soloviev).

long straw test

V-shapes for the 6 values of straw y-displacement (0.0 to 0.5 mm, 0.1 mm step). Please note the displacement of wire accompanying displacement of the straw (position of wire = minimum of V-shape): the HV effect.



conclusions

A series of lab (with ^{55}Fe source) and beam tests with straw detector prototypes were performed, aiming to study

- ◆ signal shape and attenuation with 5m long straw
- ◆ gas gain as a function of HV, at several values of pressure and wire offsets
- ◆ coordinate resolution and efficiency
 - ▶ as a function of HV and pressure
 - ▶ with different amplifiers
 - ▶ different gas mixtures
- ◆ mechanical stability
 - ▶ wire displacement measurements

The analysis is ongoing.

The programme of tests to be continued in 2016.