

# Ship Spectrometer Tracker

MFL on behalf of SHiP Spectrometer Tracker group

- R&D activities:
  - Test beam, North area
  - Dubna: larger diameter straws
- Simulation:
  - FairSHiP, evolution of geometry
  - Garfield++
- Brainstorming (to he or not to he)
  - other technologies ?

→ For analysis results of first testbeam in 2015, see Katerina & Valdimir's talk (BTW, Polytech St Petersburg applying to become associate of SHiP)

## Detector R&D: Test beam

**Goal:** measure drift time distributions (incl. efficiency) with well defined tracks and with known wire-vs-straw offset.

Variable parameters: straw-wire offset, HV, gas pressure

- Set up a tracker telescope to define tracks with  $< \sim 100 \mu\text{m}$  vertical precision on DUT (device under study)
  - Now using ITEP delay wire chambers (kindly provided by Pavel Shatalov), 4 chambers instead of 3
- DUT = a few straws (not necessarily 5m) with controlled and optically measured wire offset
  - start with single straw of 5m
- System to measure independently the straw-wire offset

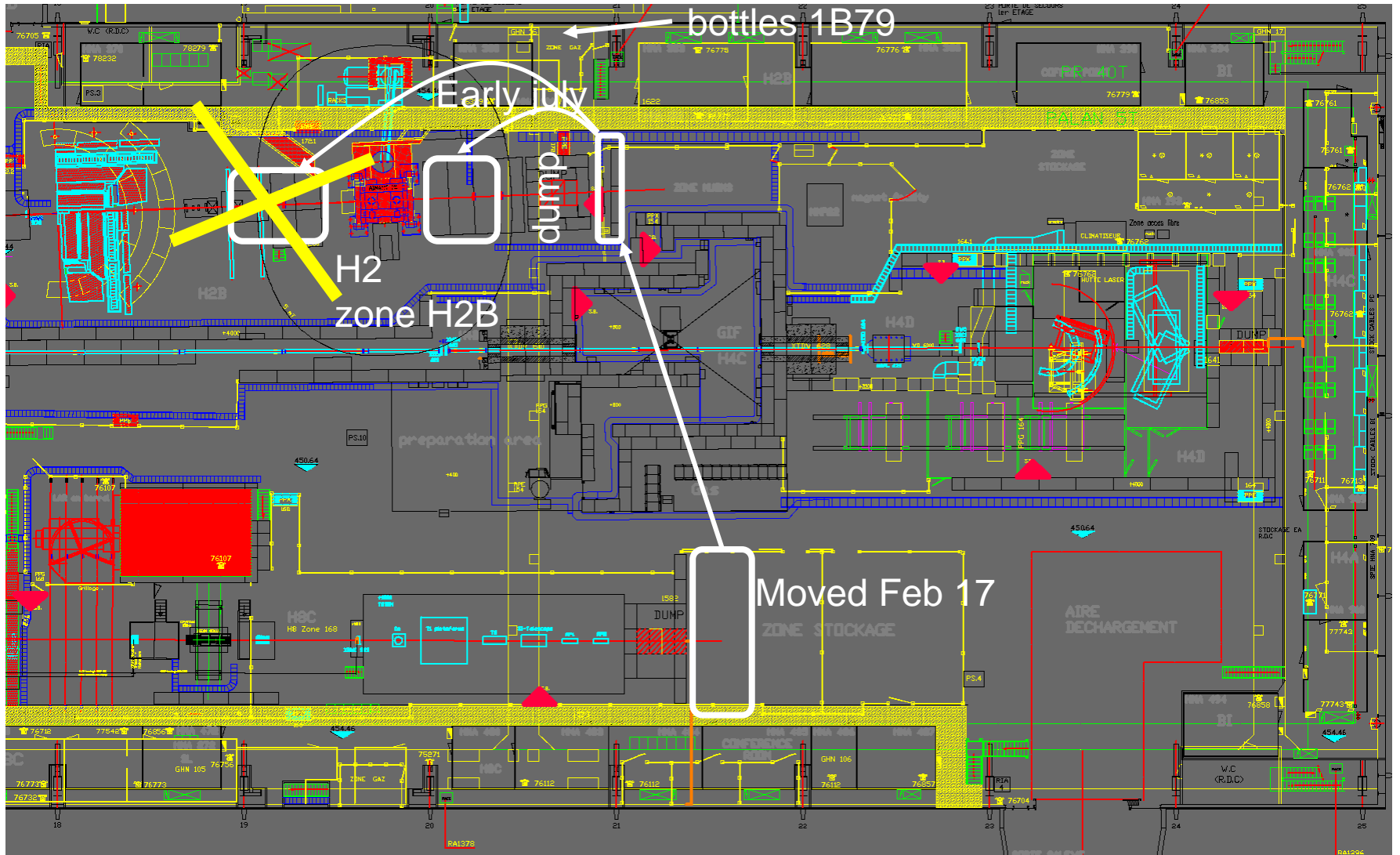
# Detector R&D: Test beam 2016

- Got two weeks in H2 zone, **end of July - start of Aug**, to be shared with other SHiP detectors
  - nice thing: we can enter the zone freely already start of July (NA61)
- Parasitic area at H2 dump, already moved there
  - will use it mostly June - Oct

## Setup:

- (Single) long or short straw
- Install an optical system to monitor wire-straw offset
  - parts/components ordered
  - mechanical design / assembly => ITEP, Alexander Semennikov
- Use 4 DWCs (instead of 3),
  - Optional: if resolution of DWCs turns out to be marginal, possibility to collaborate with an external group with a Si telescope (10cm x 10cm x 8 strip planes, 180 um pitch)

# Detector R&D: test beam area



# Detector R&D: test beam schedule 2016

exact beam conditions for parasitic periods are yet to be checked

more parasitic ?

## SPS user schedule for 2016



schedule issue date: 31-May-2016

Version: 2.2

LHC Exp.
  PS/SPS Exp.
  INT Exp.
  Other Exp.

		Apr				Mai				Jun				Jul				Aug				Sep				Oct				Nov				Dec																	
Week		13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50												
Machine																																																			
North Area	T2 - H2	TT20 Setup 16	RE10 CREAM 7	CMS GEM / RPC 14	NA61 PSD/ScFI/DRS 14	CMS GEM 7	Calice (Sdhal) 14	LHCb RICH 7	NA61 VD 7	NA61 FTPC 21	SHiP 14	ALICE ITS 7	RD51-BESSIII 7	HERD 7	CMS HGCALE 7	NA61 neutrino 42	NA61 pp 21	CMS HGCALE 7	NA61 SHINE 28																																
	T2 - H4	TT20 Setup 16	GIF 19	NA63 14	RD51 & GIF 14	CMS ECAL 21	NA64 14	PHOTACHANNEL 7	RD51 ECAL 7	RD51 & GIF 14	RE25 CALET 7	GIF 14	ColoCube 7	CMS ECAL 7	RD51 & GIF 14	NA64 28	RE10 CREAM 7	ATLAS ZDC 7																																	
	T4 - H6	TT20 Setup 16	ATLAS AFP 6	RD42 7	CMS Outer Tracker 7	CERF 7	ATLAS ITK 14	ATLAS BCM/ITK 7	RD42 7	Clic pix 7	ATLAS AP 14	ATLAS Strip Trk 7	ATLAS NSW 7	AIDA WP7 7	ATLAS BCM/ITK 7	Clic pix 7	RD42 & Monopile 7	ALICE FOCAL 7	ATLAS AFP 14	CMS Outer Tracker 7	Clic pix 7	ALICE PHOS 7	ALICE & ATLAS muons 7	ATLAS ITK 14																											
	T4 - H8	TT20 Setup 16	TOTEM Timing 8	LHCb 21	ATLAS Timing 7	TOTEM 7	ATLAS Tilecal 14	JA0 Totem 7	ATLAS PPS 7	ATLAS TRT 7	TOTEM PPS 7	FE14 Pix 7	ATLAS 14	UA9 Totem 7	ATLAS Tilecal 14	RD52 DREAM 14	LHCb 21	UA9 csm 6	RE25 DAMPE 6	RE25 CALET 7	NUCLEON 6																														
	T4 - K12	TT20 Setup 22	parasitic possible with access to H2D																																																
	T6 - M2	TT20 Setup 22	SHiP dedicated beam time																																																
		NA58 COMPASS 201																																																	

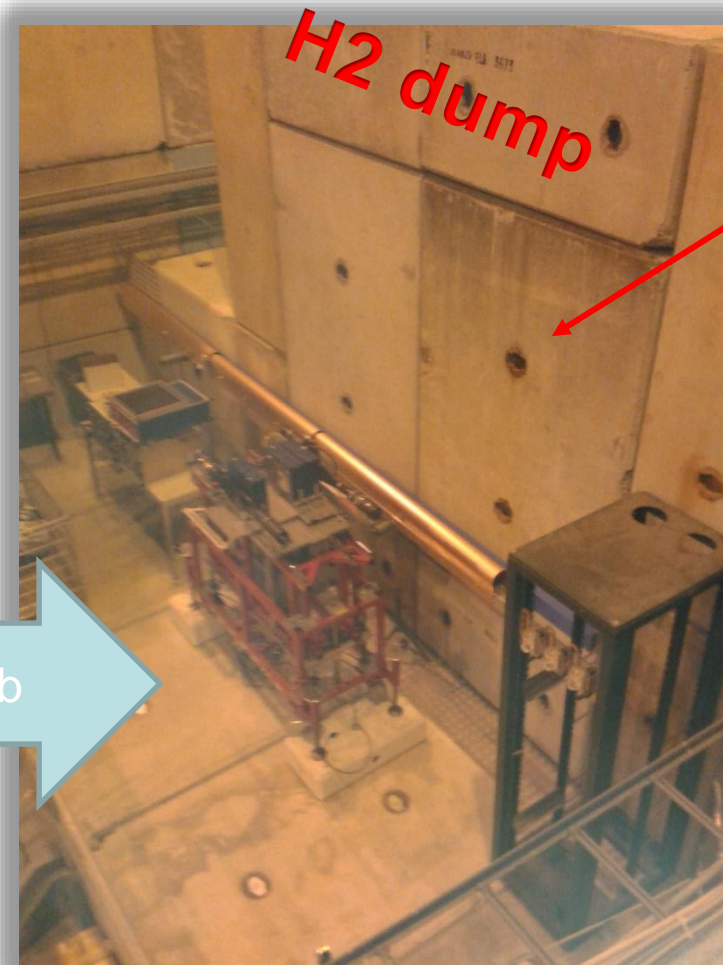
## Detector R&D: the setup (almost complete)

- 1 rack
- bottles will be in 1B79 (just above the dump, on the pathway)
- two plastic tubes pulled to rack (re-usable also for inside H2)



SPS North Hall H8 line

17 Feb



SPS North Hall H2 line

# Detector R&D: Optical setup



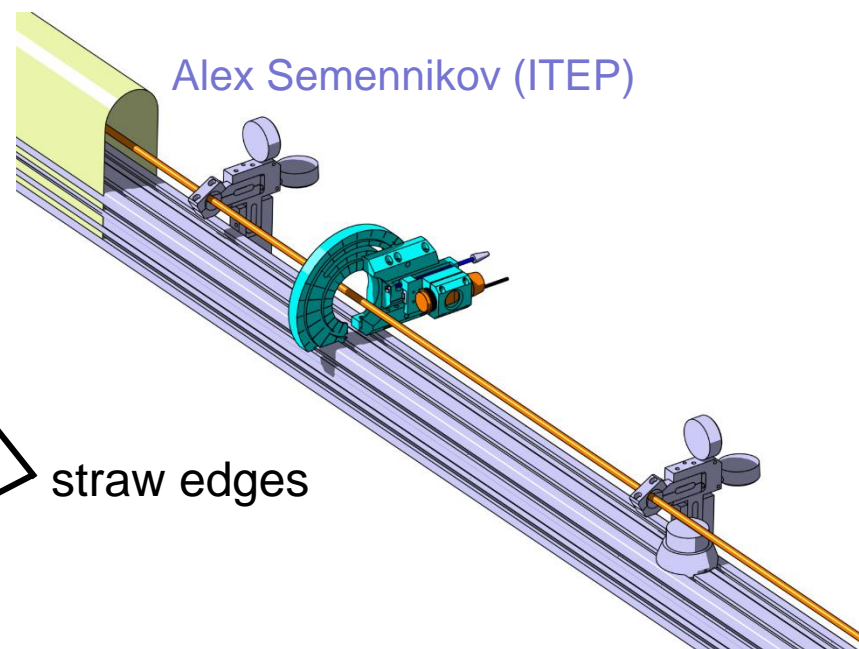
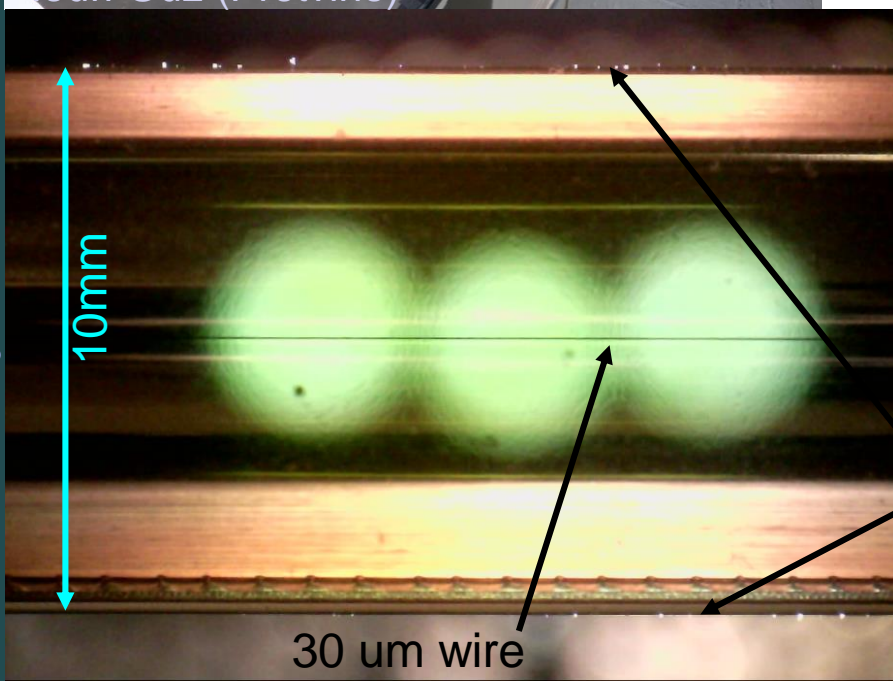
NEW



Camera: [dino-lite AM7515MZTL](#), 5Mpx,  
Long-Working  
Distance, Mag 10-140x

Pavel Shatalov (ITEP)  
Iouri Guz (Protvino)

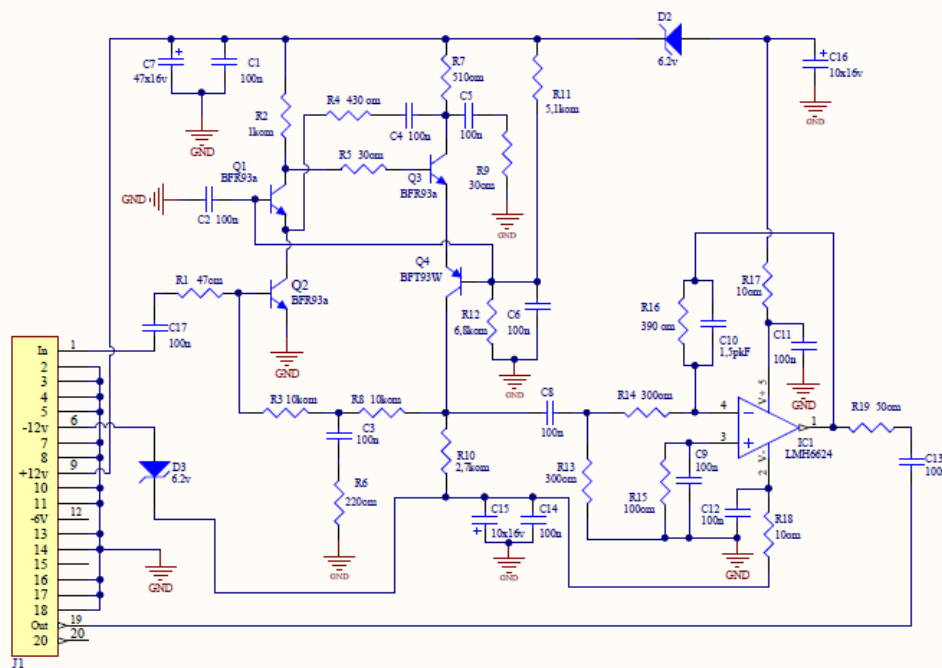
- Laboratory tests with digital camera Dino-Lite AM7515MZTL validated the feasibility of measuring the position of the wire inside a straw.
- Standard software includes suitable tools for online measurement of distances.
- Mechanical support for the camera with adjustable carriage is under construction.



Alex Semennikov (ITEP)

straw edges

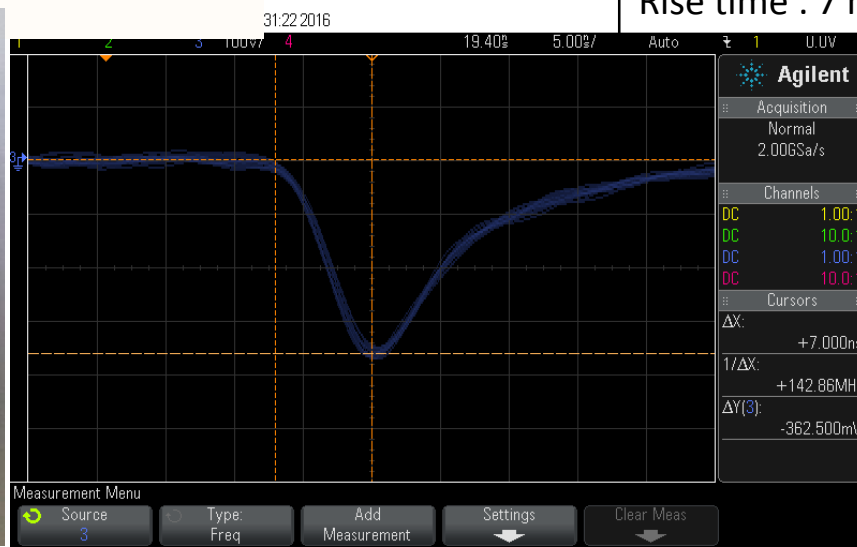
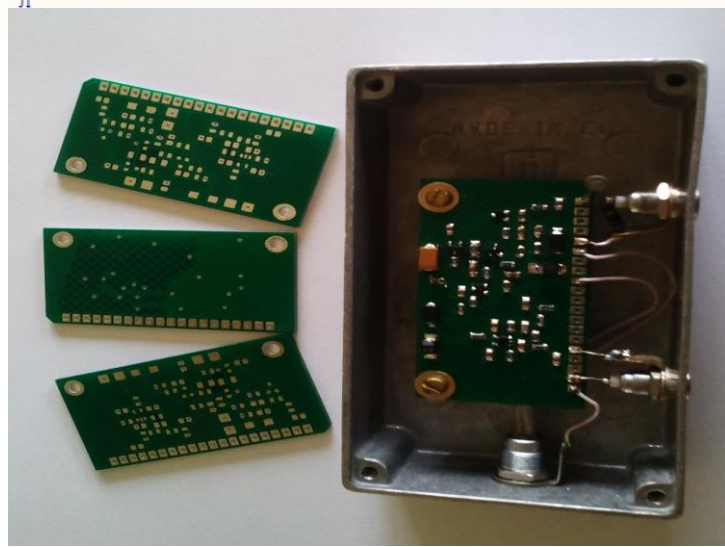
# Detector R&D: Fast amplifier for 5m straw tube



- PCB design is ready
- 5 pilot boards produced
- 2 amplifiers assembled for beam test

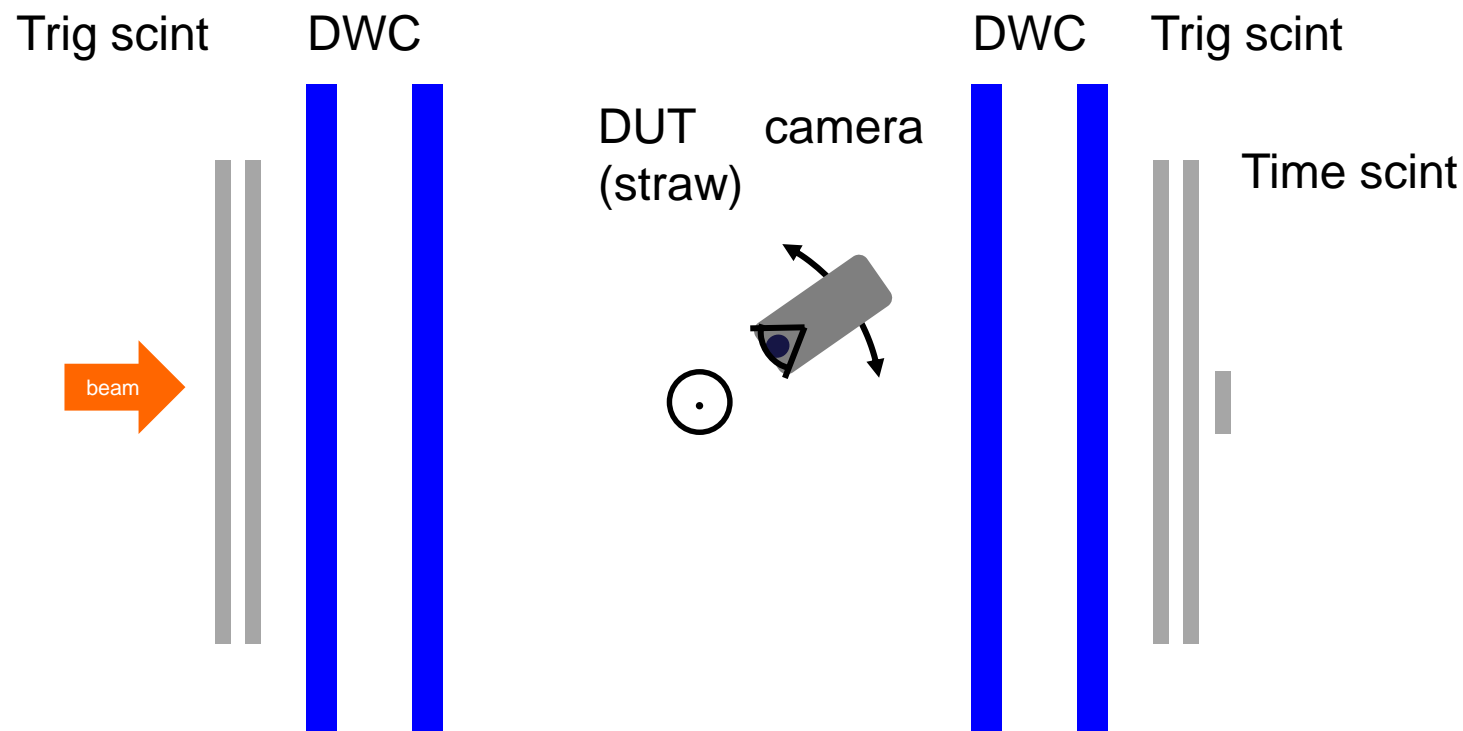
Preamp circuit design by Vladimir Vaniev, IHEP Protvino  
 PCB design and assembly by Anatoli Zhokhov, ITEP.

Sensitivity: 6 mV/fQ  
 Rise time : 7 nsec





# Detector R&D: sketch of foreseen setup



+ VME DAQ  
 $^{55}\text{Fe}$  source  
Floating nA meter  
Pressure-meter  
etc...

# Detector R&D: larger diameter straws

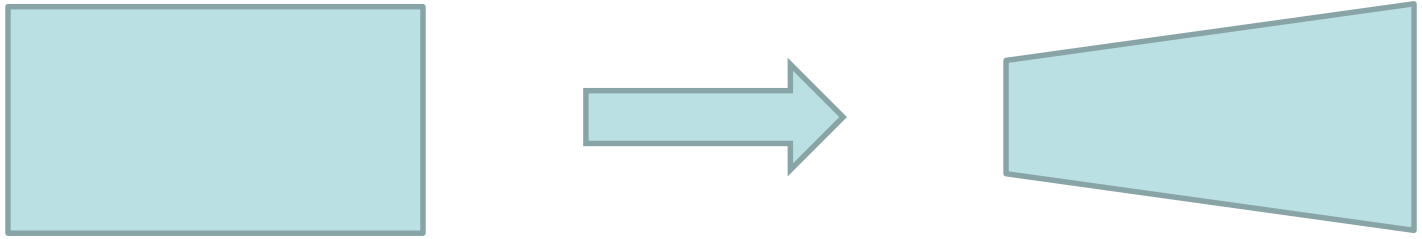
NEW

- developments from Dubna (Temur Enik, Sergej Movchan)
  - Will first produce short «toy» straws of 20 & 30mm with Al tube.
- considering order of small roll of Cu+Au coated 36um PET
  - needs decision on dimensions (width of cutting)
  - Diameters: 10, 20 & 30mm ... or ?

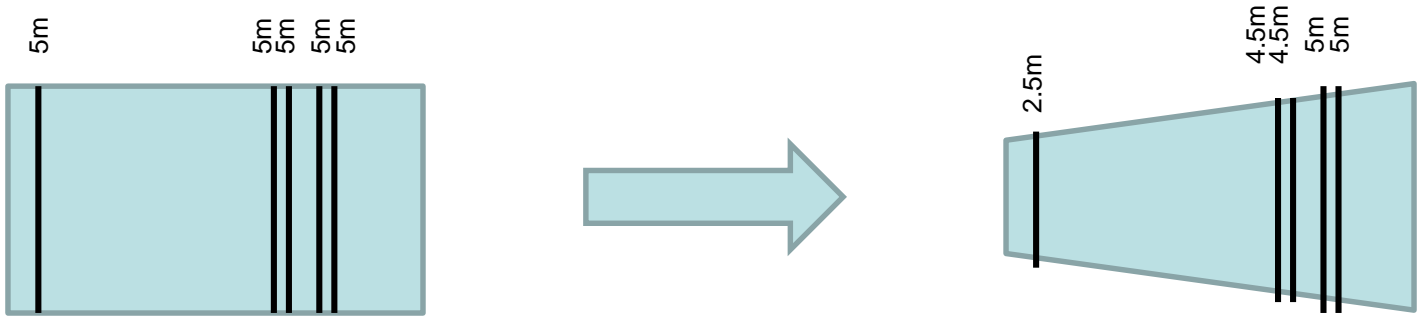
# Simulation: evolution (top view)

NEW

- SHiP volume



- What about SST ?



it is assumed that the magnet gap remains flat (parallel)

# Simulation: SST proper, work ahead

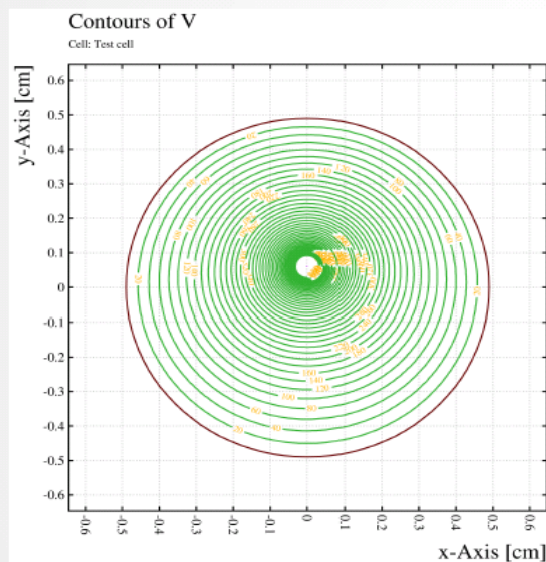
- Stereo angle optimization
- Straw diameter studies
  - Garfield++
  - SST performance (tracking & vertexing)
- T\_zero treatment
- Realistic signal description
- Digitization
- Misalignments, distortions
  - How much wire offset can we cope with ?
  - How many holding points needed along X ?

# Simulation: Garfield => Garfield++

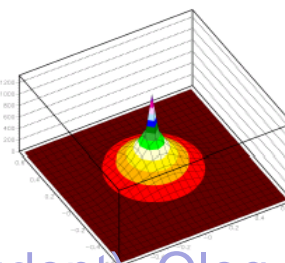
NEW

## Straw tube geometry and fields

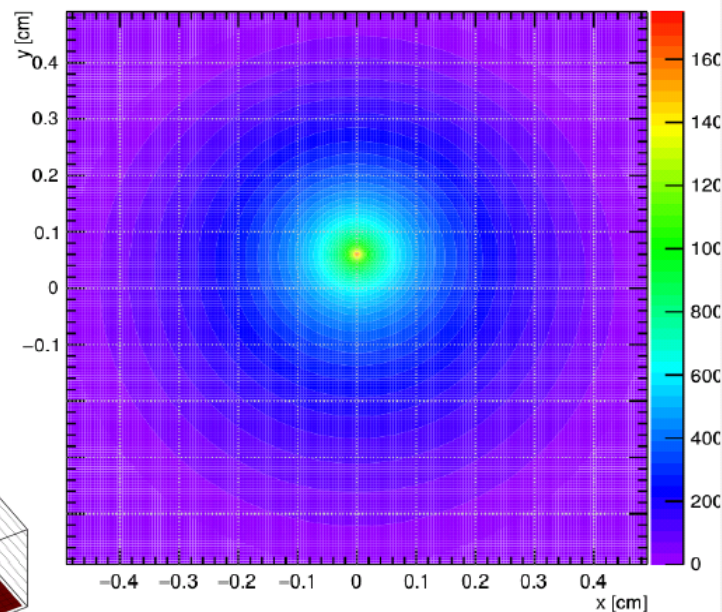
- Garfield



- Anode wire is shifted



- Garfield++

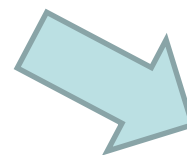


Daniil Sukhonos (master student), Oleg Bezshyyko  
Taras Shevchenko National University of Kyiv

**And now ,  
for your entertainment ...**

## Brainstorm: to he or not to he...

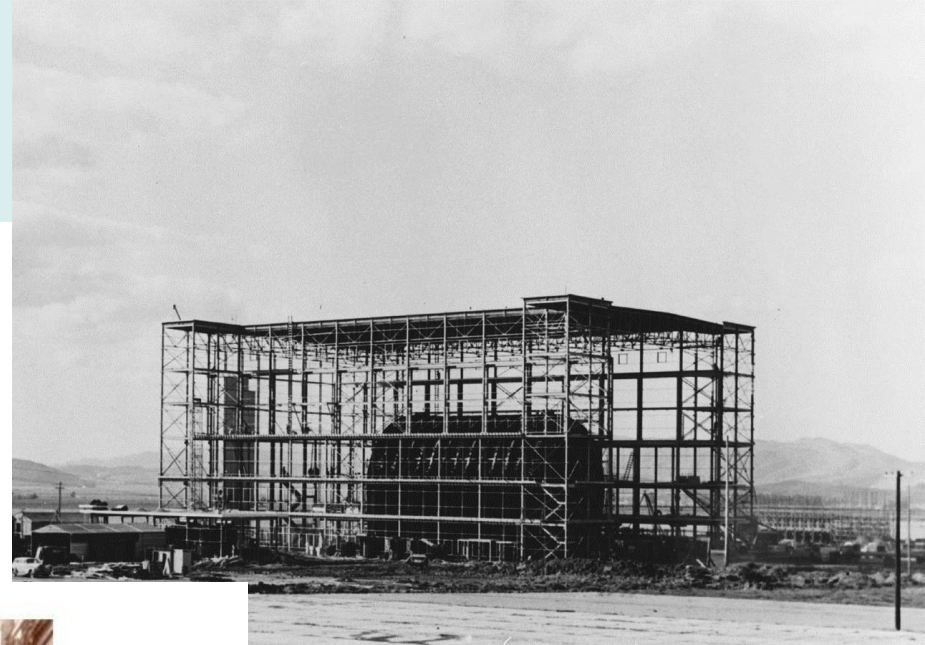
- If decay volume = vacuum
  - vacuum/gas barrier over large surface area
  - straw option seems to be the best technology
  
- If decay volume = 1 atm Helium
  - Other technologies could compete with straw option
  - TPC
    - Different geometries possible
  - Drift / wire chamber



Groups welcome to undertake study to compare performance vs straw option

# Biggest vac chamber ever ?

- “Materials Testing Accelerator”
- 25 m long, 18 m diameter

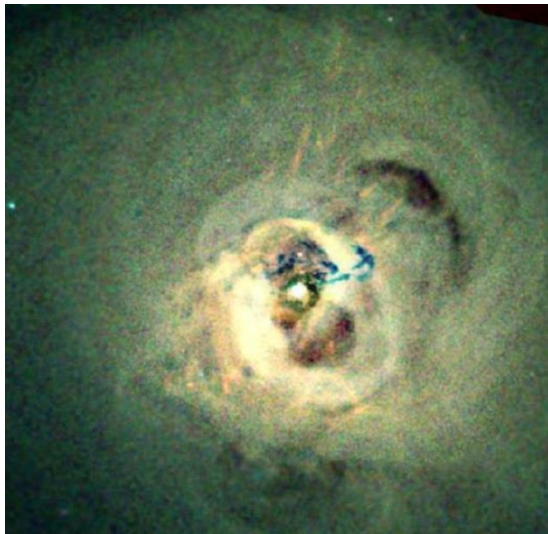


The Materials Testing Accelerator (MTA), built, in the early 1950s, at a site that would later become the Lawrence Livermore Laboratory. The purpose of the machine was to produce nuclear material, but it never produced any (due to uncontrollable sparking).





# News from Astro-H



A picture ~~by~~ <sup>of</sup> Hitomi (Astro-H)

## Hitomi satellite tracking

