Outline of the beam test with Ar beams at CERN-SPS in 2015

TAMURA Tadahisa

for the Testing and Calibration Team

CALET-TIM in Pisa on June , 2015

Beam Tests for CALET at CERN-SPS

- 2009 Readout of BGO, PWO
  - （IMC+）TASC Lead（18 r.l.）＋BGO, PWO (one crystal each)
- 2010 CALET was approved by JAXA (CALET configuration was fixed)
- 2010 CALET prototype Ⅰ
  - IMC 32 SciFis × 8 layers （X-direction）
  - TASC 2 PWOs × 8 layers （X-direction）
- 2011 CALET prototype Ⅱ
  - CHD 4 SciBars（X-direction）
  - IMC 32 SciFis × 8 layers （X-direction）
  - TASC 3 PWOs × 12 layers （X-direction）
- 2012 CALET Beam Test Model (STM and BBM)

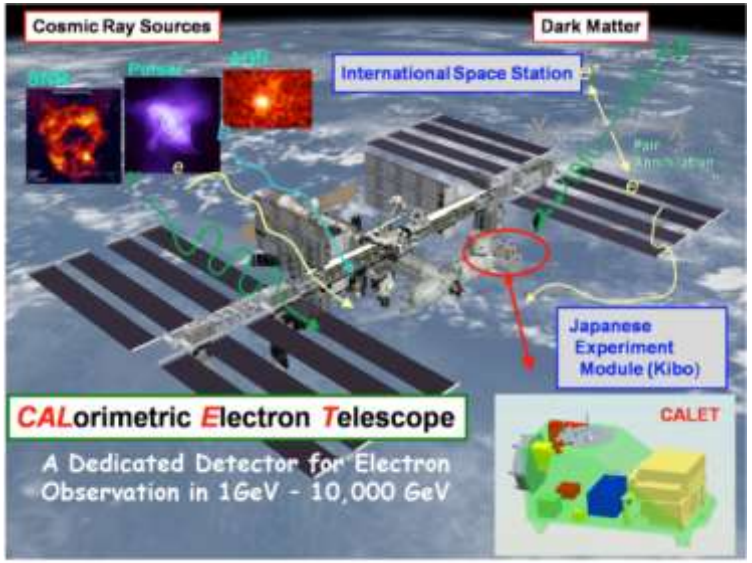
  to verify and understand the simulations with which

  CALET was designed and its performance was evaluated.
- 2013 CHD (BBM) component Test by lead beam runs
- 2015 CALET Beam Test Model (STM and BBM)

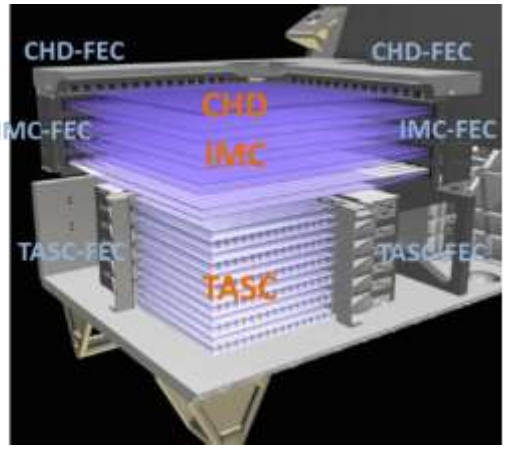
  to compare our simulation with experimental data about energy resolutions for heavy ions

Heavy Ion tests of RE25(CALET)

- Testing and calibration of the heavy-ion energy and charge resolution of the CALET cosmic-ray instrument that will fly on the International Space Station in 2015.
- The beam tests will be carried out using a test instrument that is functionally equivalent to CALET.
- CALET will measure the energy spectra and arrival directions of cosmic-ray electrons to ~20 TeV and hadrons to ~1 PeV with exceptional resolution.
- It will measure the spectra of high-energy nuclei to about Z=40.



CALET Payload on ISS



CALET Calorimeter

CALET(RE25) Spokesperson: Shoji TORII (Waseda Univ. , JAXA)

Run Coordinator: Tadahisa TAMURA (Kanagawa Univ.) John Mitchell (NASA GSFC)

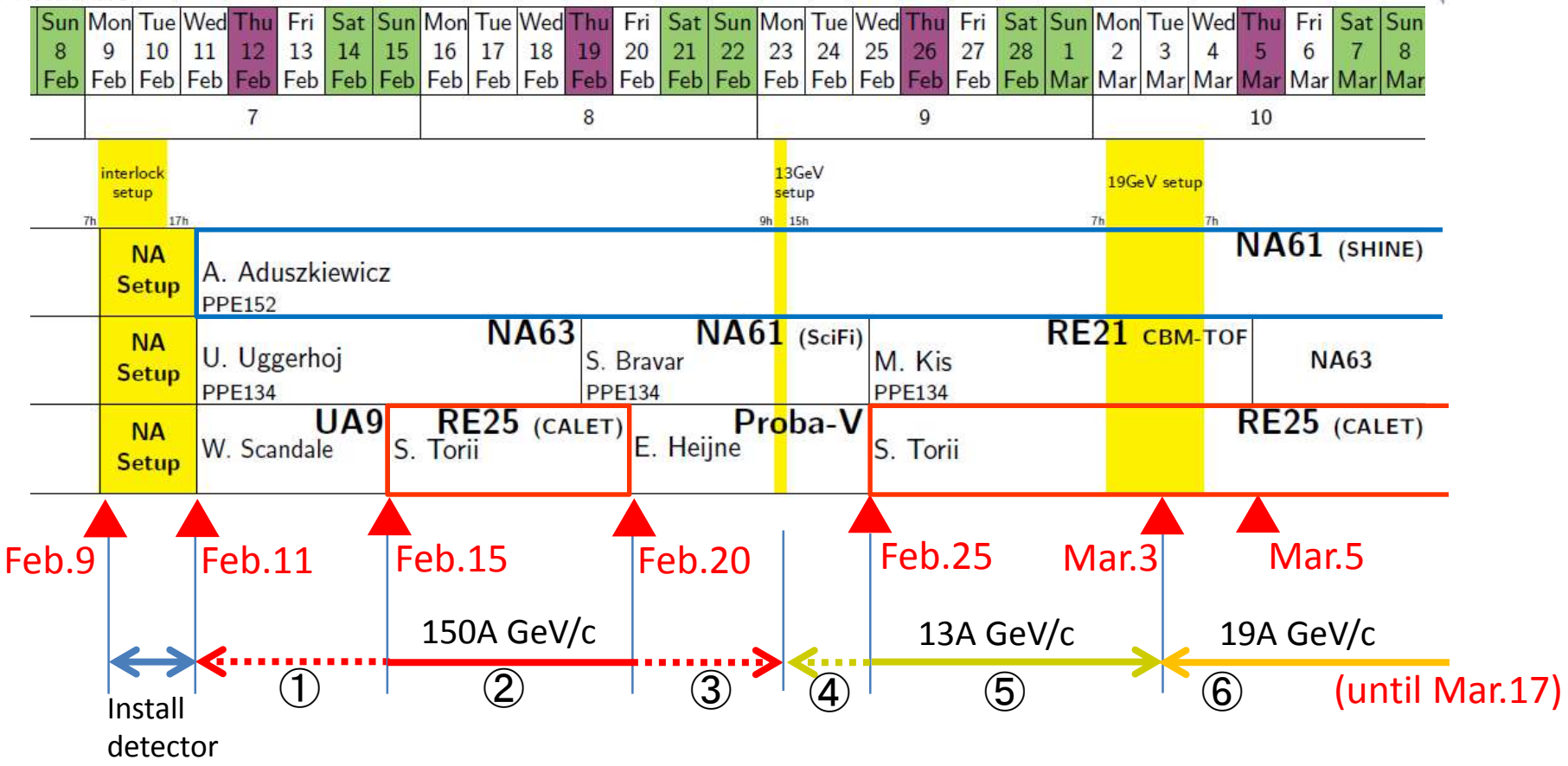
Pier S. Marrocchesi (Siena Univ.) Oscar Adriani (Florence Univ.

Negotiation with the SPS coordinator

- We need to carry out the ion beam experiment at the highest momentum before CALET launch. That is because we have to understand and confirm our detector performance at energy as high as cosmic rays.
- Our first priority is the maximum momentum of 150A GeV/c.
- It is more important than our preferred date.
- We requested again the SPS coordinator to rearrange the current schedule plan so that we can do our test with 150A GeV/c at least 3 days.
- It is acceptable that our machine time is split into two periods for that purpose.
- The medium momenta are not so much interested if we can study with 150A GeV/c. At least 80A GeV/c is necessary.

schedule issue date: 19-Feb-2015
Version: 1.0

SPS: February 2015



① 150A GeV/c : UA9 (parasitic) pure Ar, 200 k pps (particles/spill)
② 150A GeV/c : CALET (main user) pure Ar, fragments (Z/A=2), 2-3 k pps
③ 150A GeV/c : Proba-V (parasitic) pure Ar, 2-3 k pps
④ 13A GeV/c : Proba-V (parasitic) pure Ar 2-3 k pps
⑤ 13A GeV/c : CALET (main user with Si trk/mtrx) pure Ar, fragments (Z/A=2), 2-3 k pps
⑥ 19A GeV/c : CALET (main user with Si trk/mtrx) pure Ar, fragments (Z/A=2), 2-3 k pps

Modification of detector set up for 2015

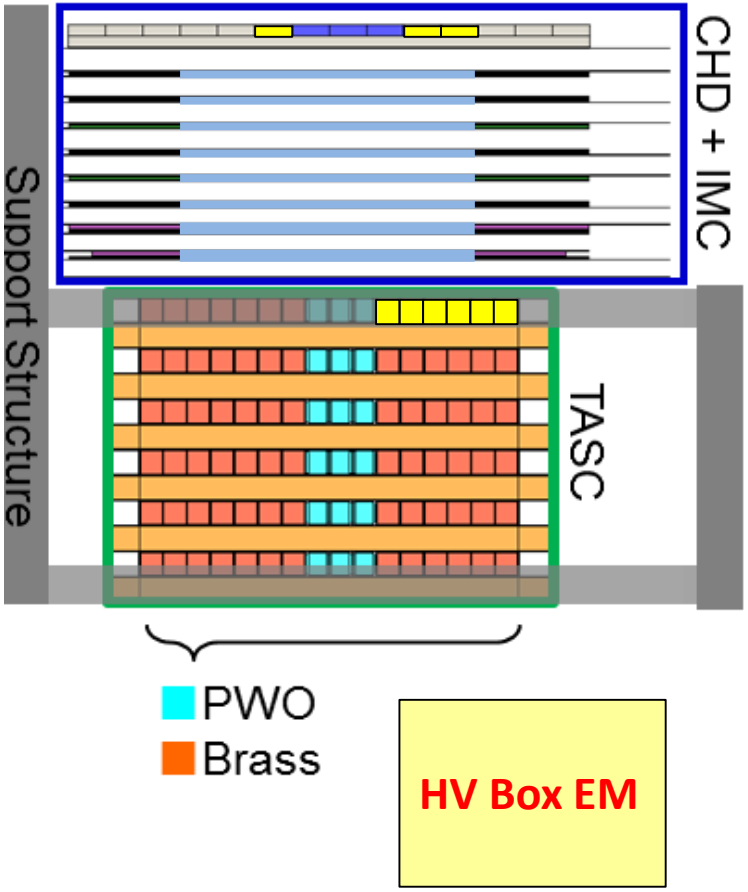
- STM(CHD/IMC, TASC)
- BBM(IMC X4, TASC X1, TASC Y1)

Modification

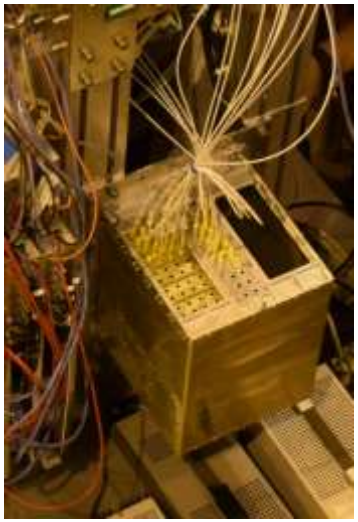
- Number of channels :
  - CHD: X 3ch + Y 3ch
    - → X 6 ch + Y 6 ch
  - TASC: 3ch/layer (tot.36ch)
    - → X1 9ch, Y1 9ch (tot.48ch)

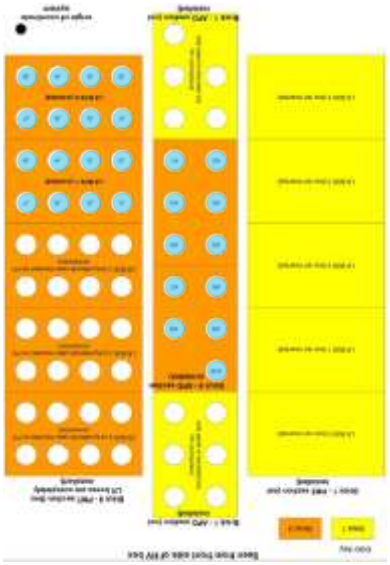
- Electronics:
  - HV Box EM (Engineering Model)

Beam Test Instrument
utilizing BBM/STM



HV Box EM (Engineering Model)

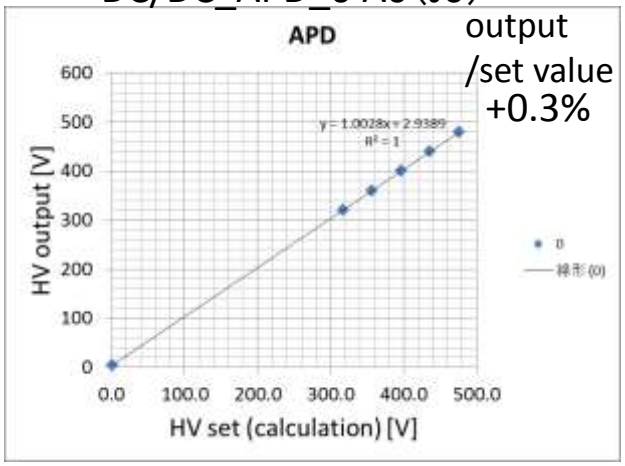




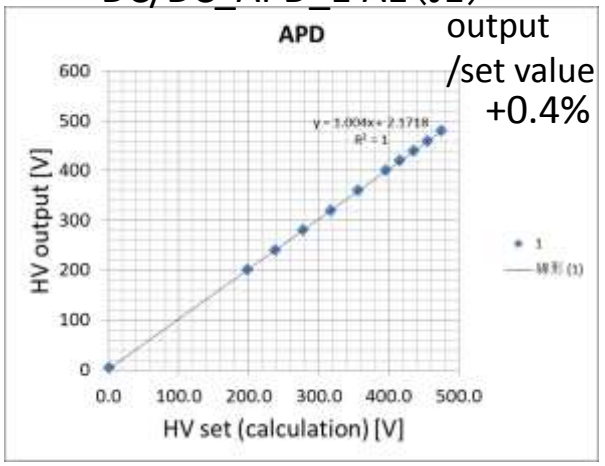
HV output linearity check

for APD

DC/DC_APD_0 A0（J0）

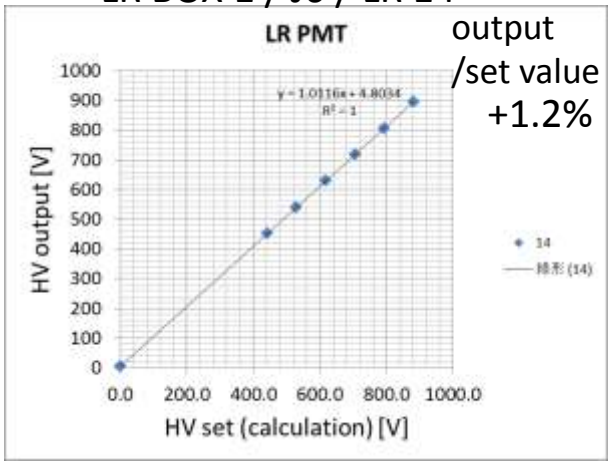


DC/DC_APD_1 A1（J1）

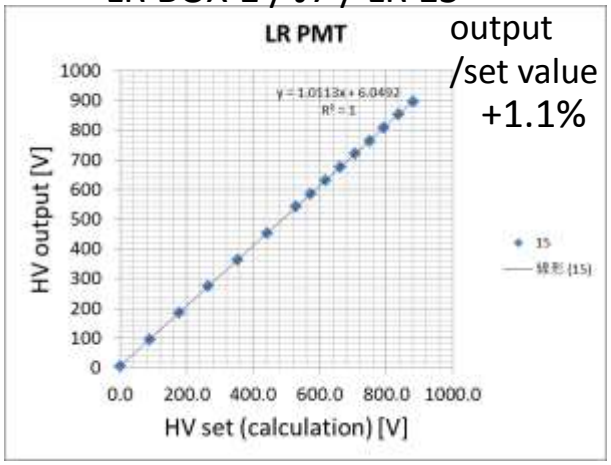


for PMT

LR BOX 1 / J6 / LR 14



LR BOX 1 / J7 / LR 15



Preparation (reassemble, additional ch)

Position tuning between SciFi cookie
And MaPMT by transparent cookie

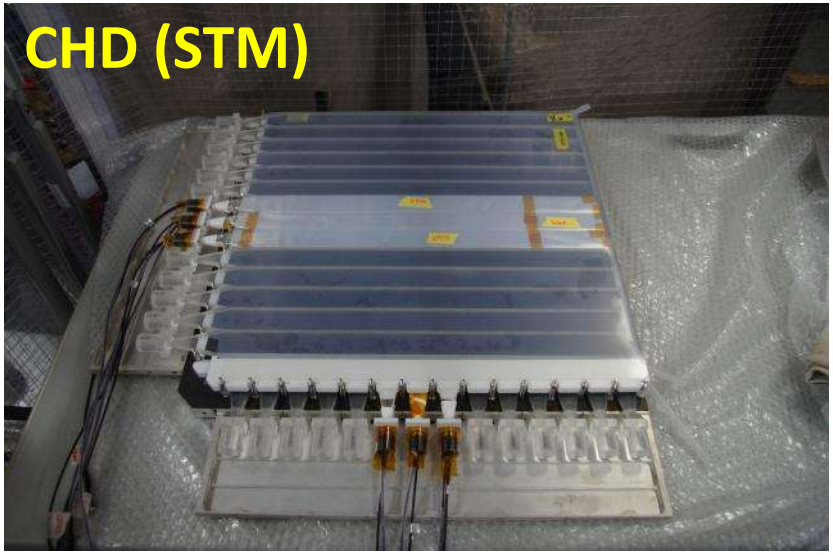
Covering PWO with ESR

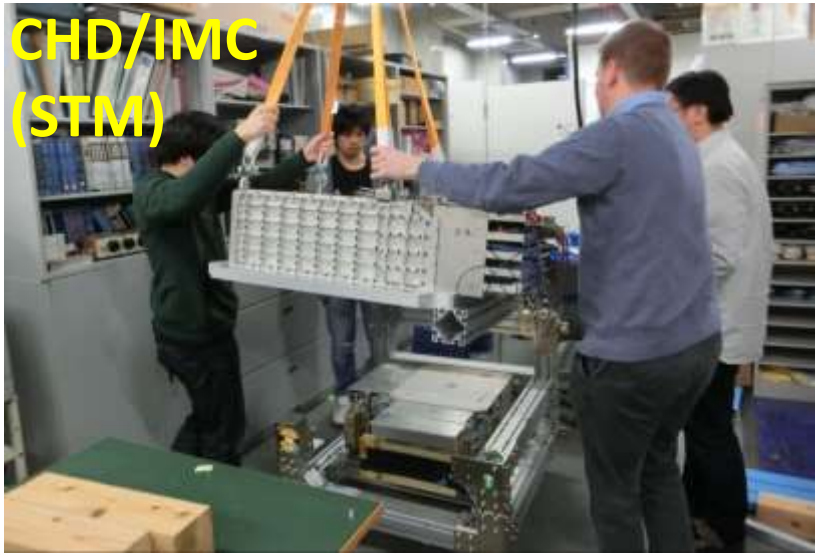
Attachment of APD/PD
to PWO

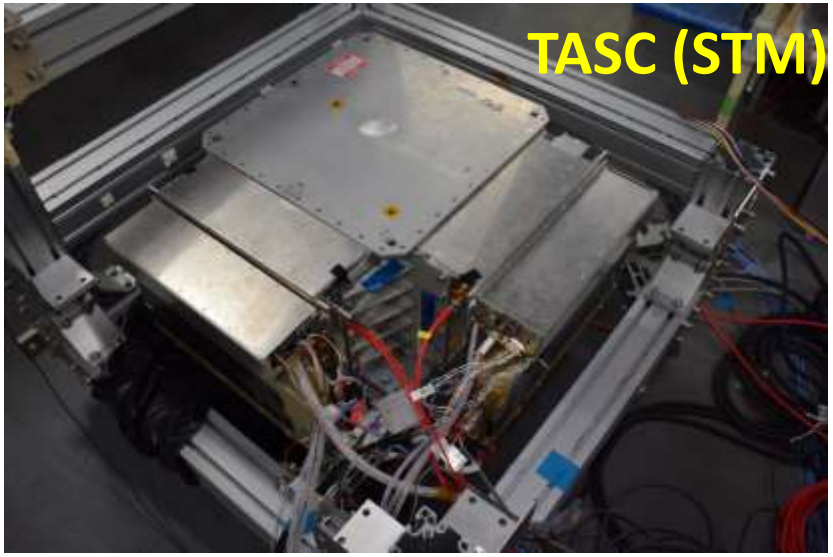
FEC for the additional ch

Installation of PWO's into TASC

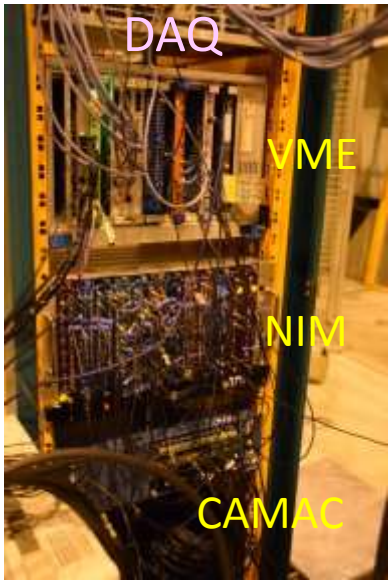
Assembling

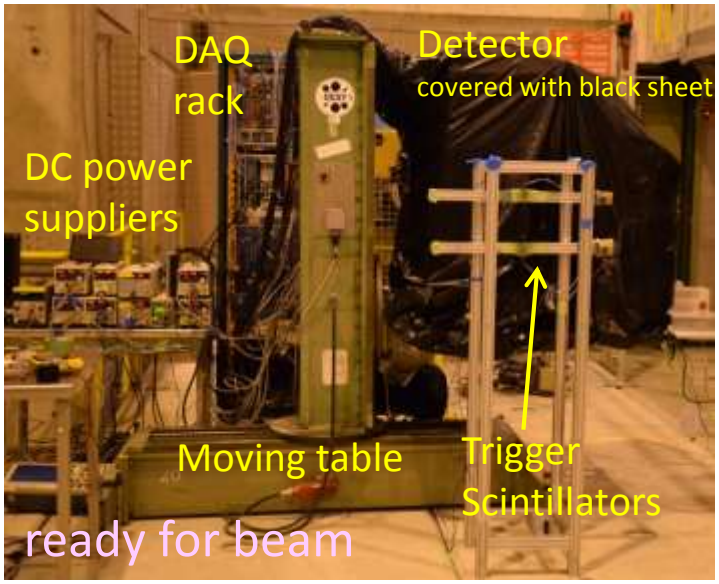




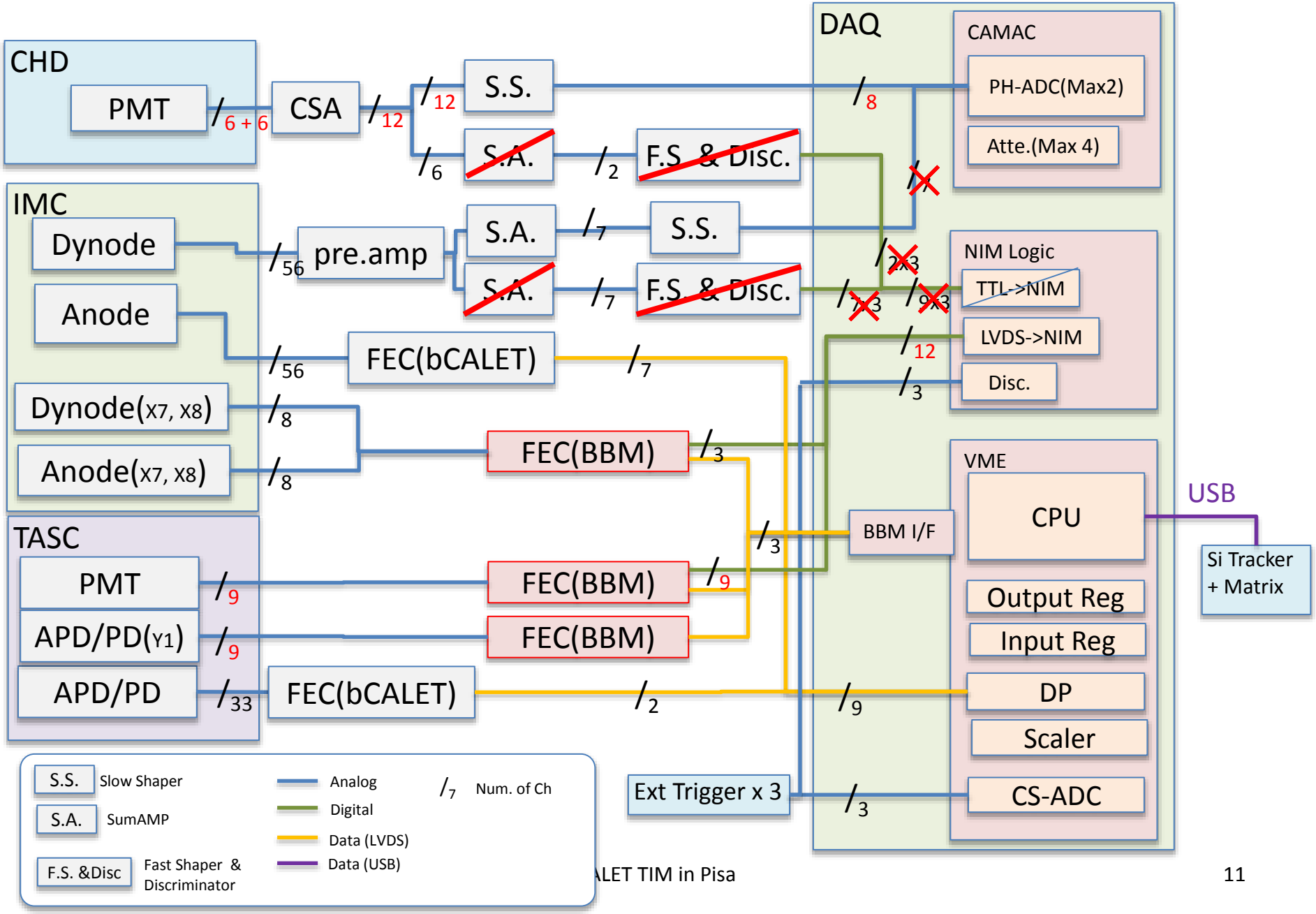


Installation at H8



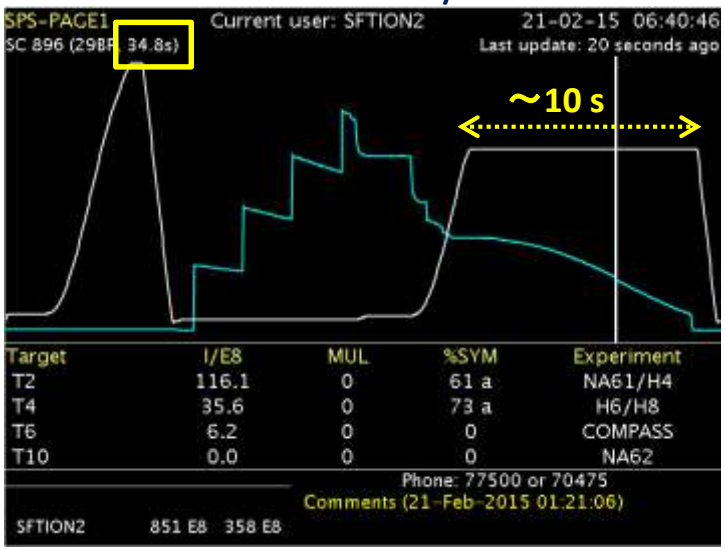


DAQ system in 2015

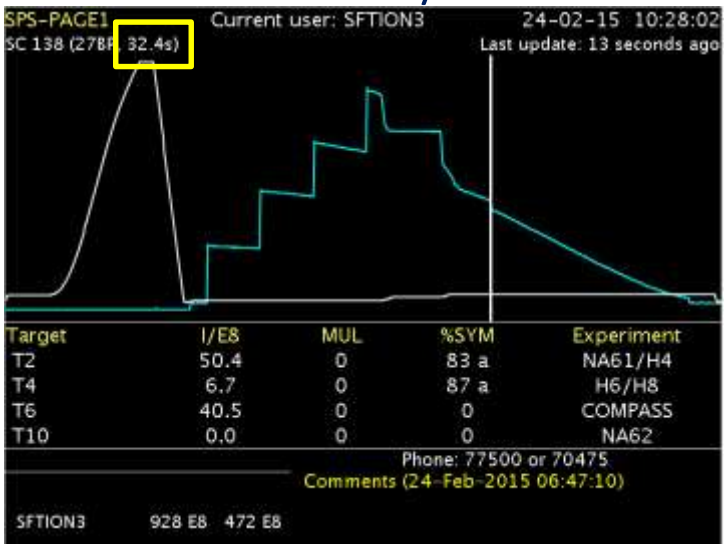


Beam cycles （SPS Page-1）

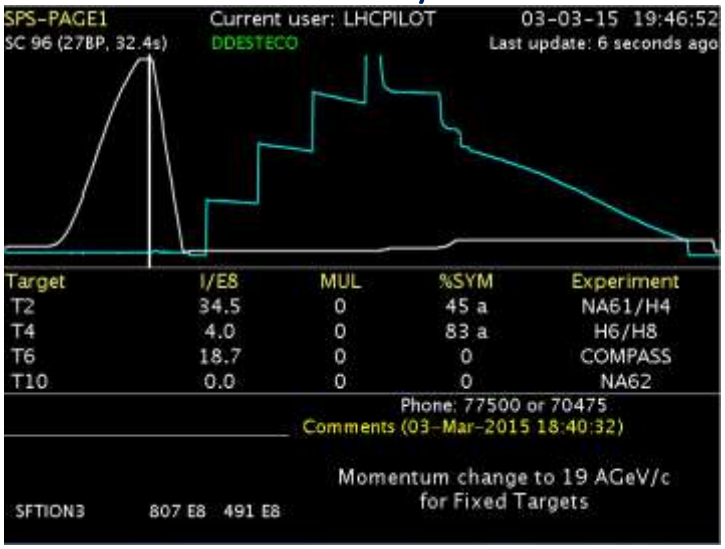
150A GeV/c



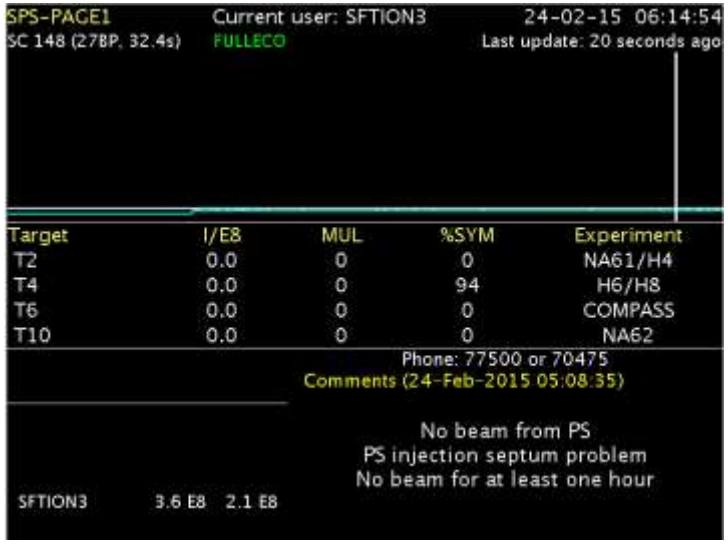
13A GeV/c



19A GeV/c



No Beam ・・・



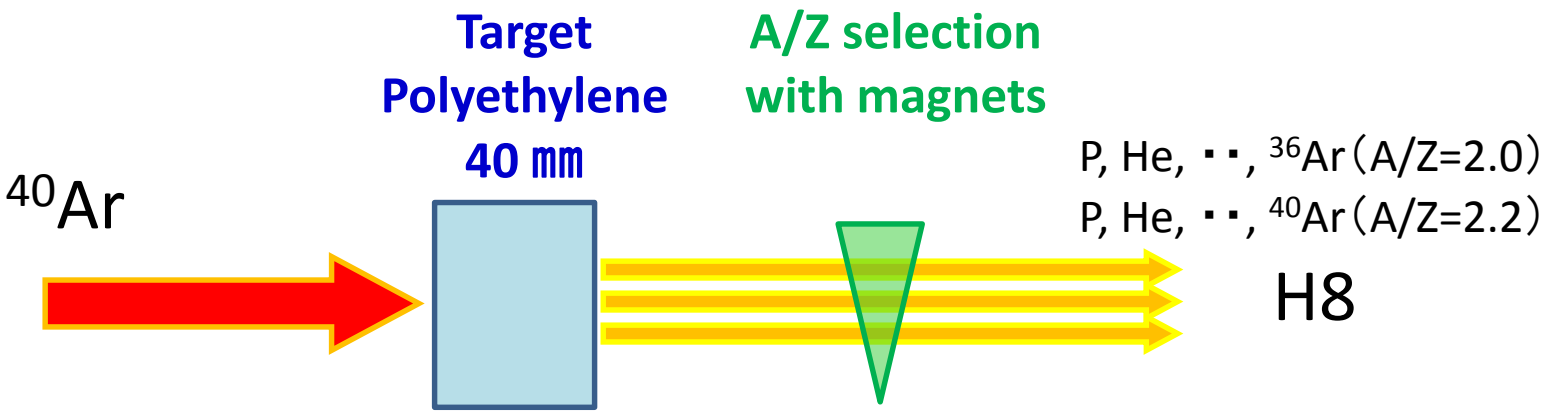
Ar beam

Primary beams

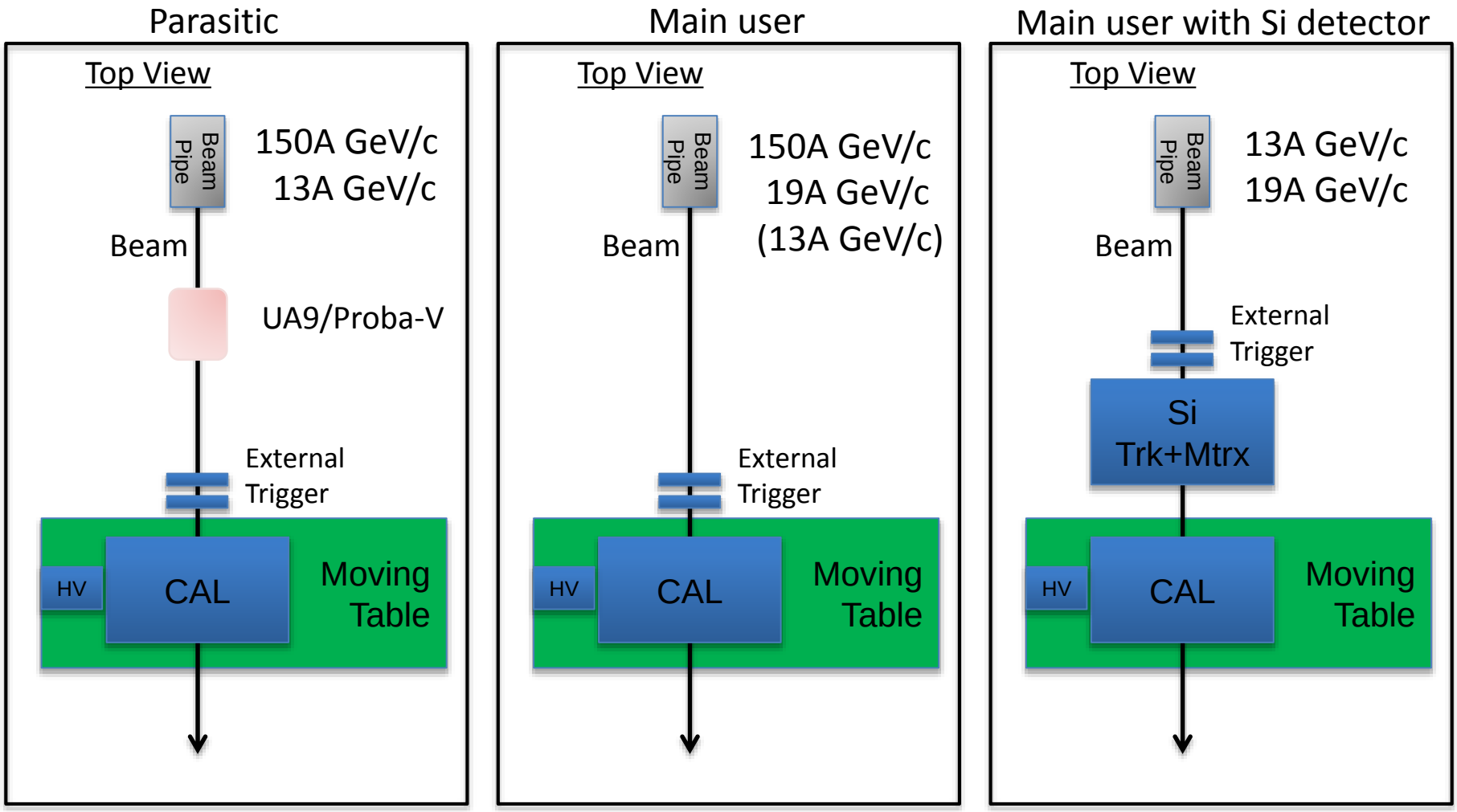
^{40}Ar

(magnets, collimators)

Fragments

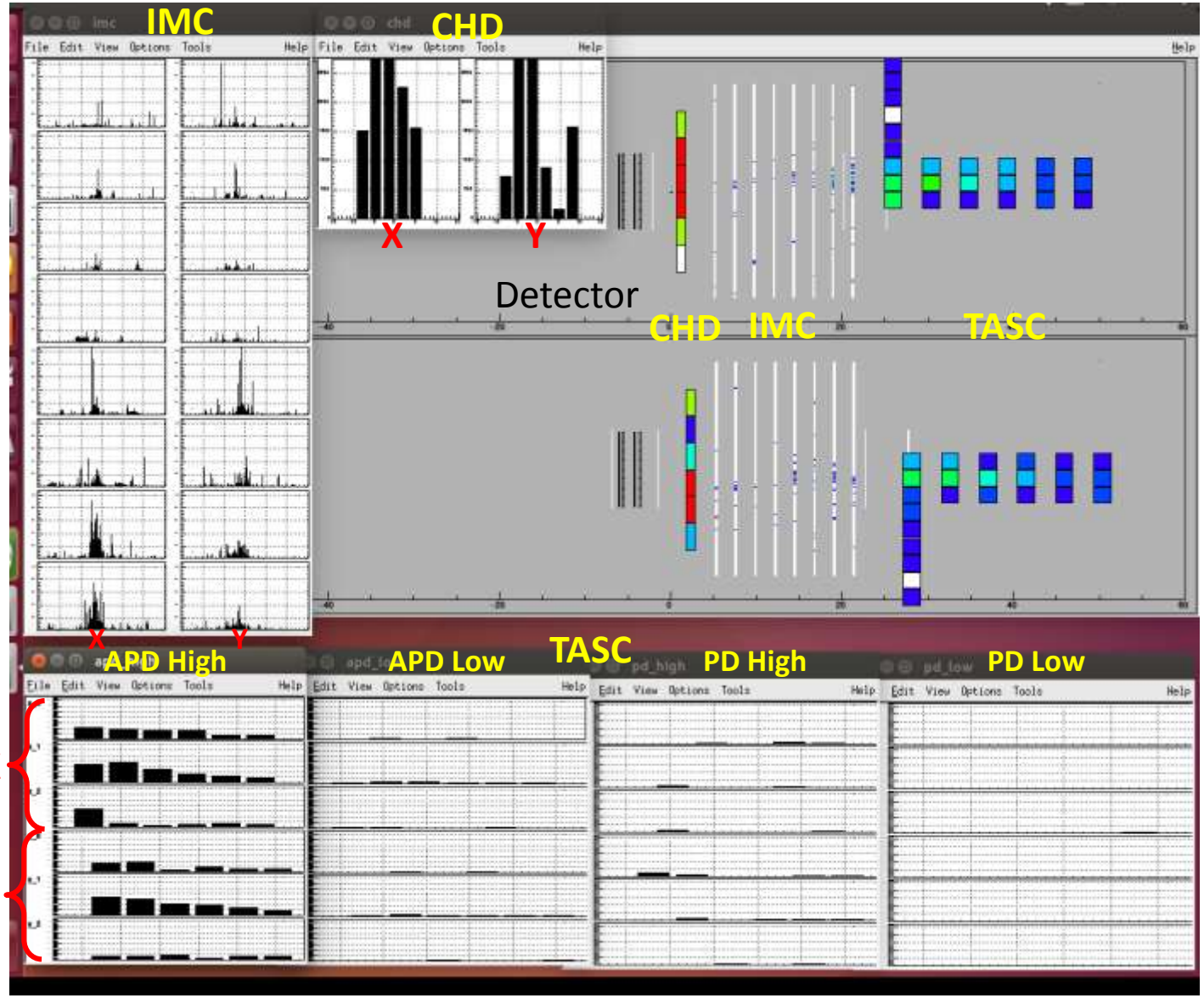


Configuration of detector setting at H8 (2015)

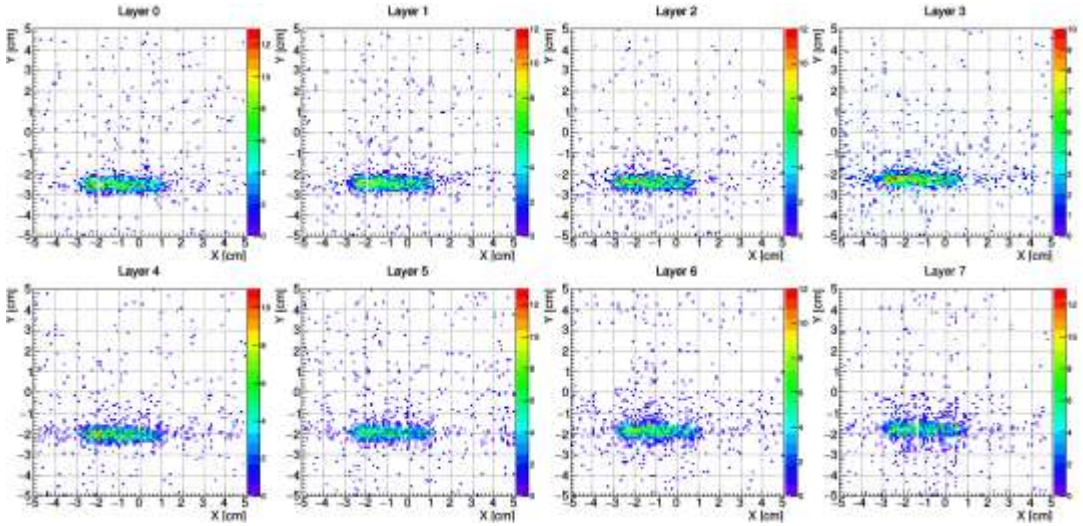


QL (Event monitor)

A sample event of ^{40}Ar primary beam of 13A GeV/c



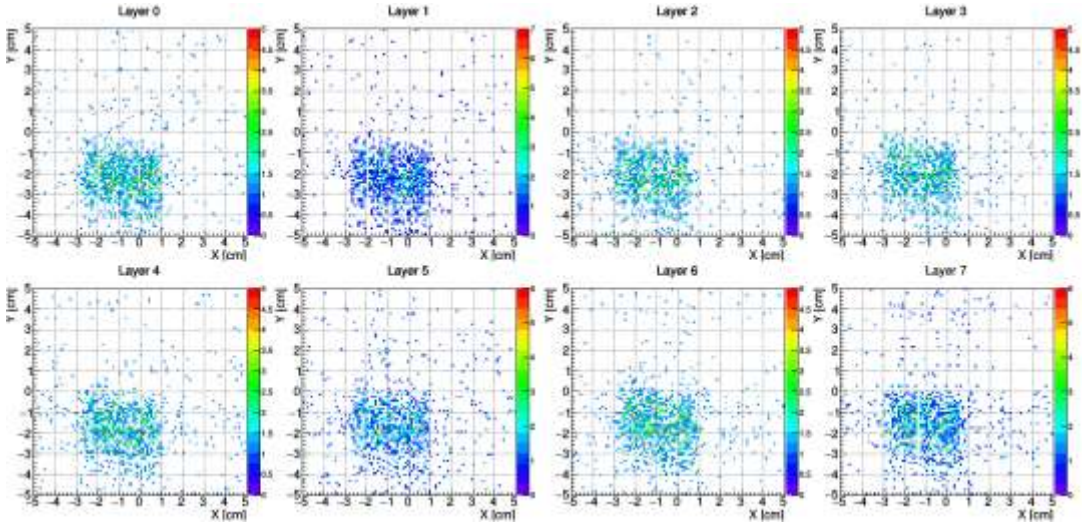
Beam Profiles @ IMC (for Beam tuning)



Beam tuning

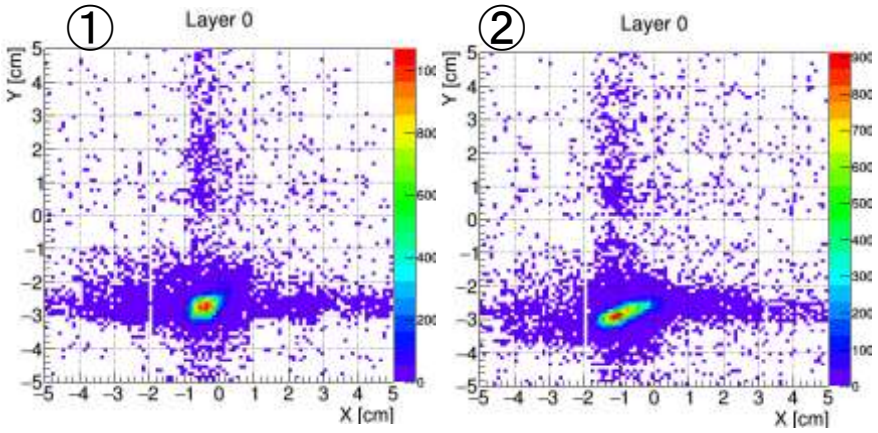
to get fragments of 13A GeV/c

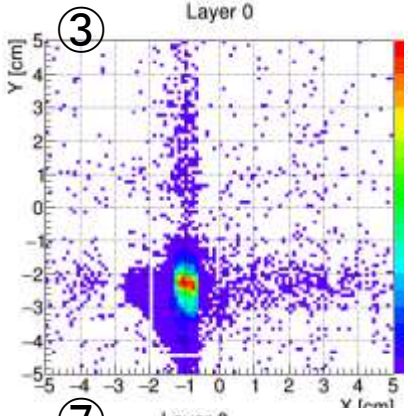
About 3 hours later

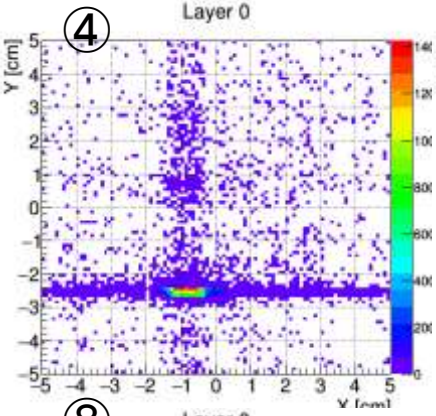


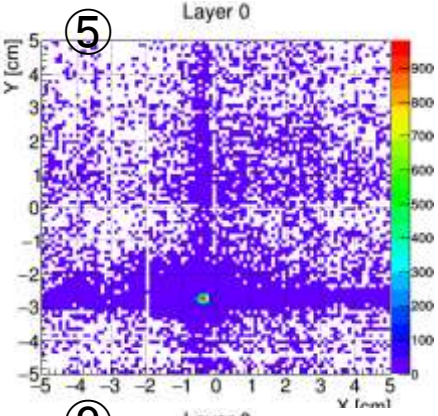
Beam profile (IMC top layer)

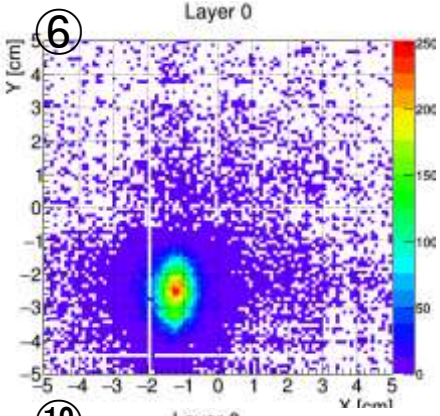
	Beam file		RunNo
①	H8A.UA9.002	150 AGeV Ar-40	258
②	H8A.CALET.001	150 AGeV fragments(A/Z=2.2)	285
③	H8A.CALET.003	150 AGeV fragments(A/Z=2.0)	377
④	H8A.CALET.005	150 AGeV fragments(A/Z=2.0)	389
⑤	H8A.ProbaV.000	150 AGeV Ar-40	445
⑥	H8A.ProbaV.001	13 AGeV Ar-40	533
⑦	H8A.CALET.008	13 AGeV Ar-40	549
⑧	H8A.CALET.009	13 AGeV fragments	570
⑨	H8A.CALET.010	19 AGeV Ar-40	702
⑩	H8A.CALET.012	19 AGeV fragments	692

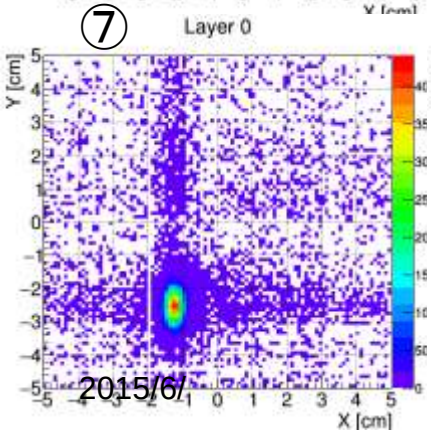


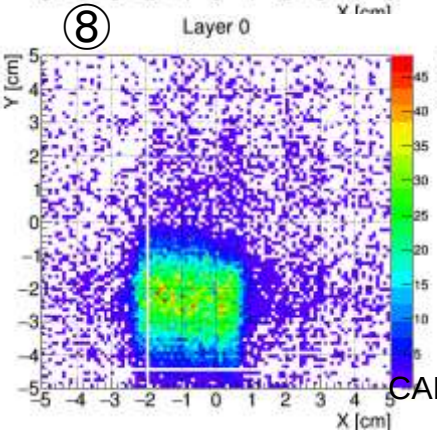


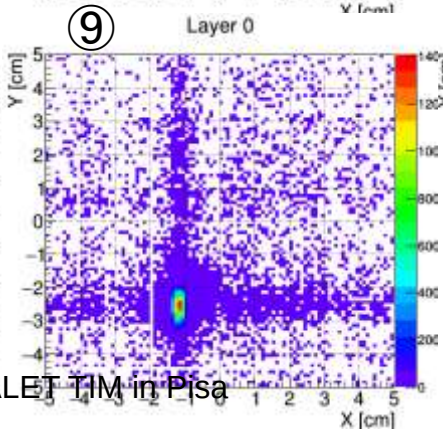


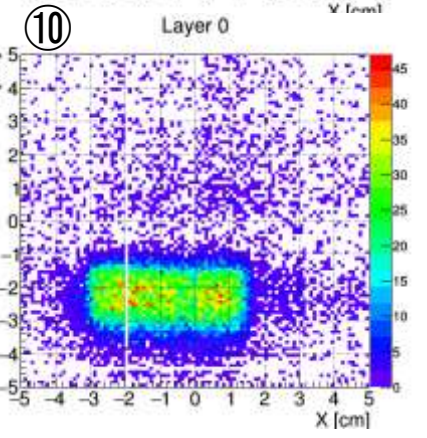












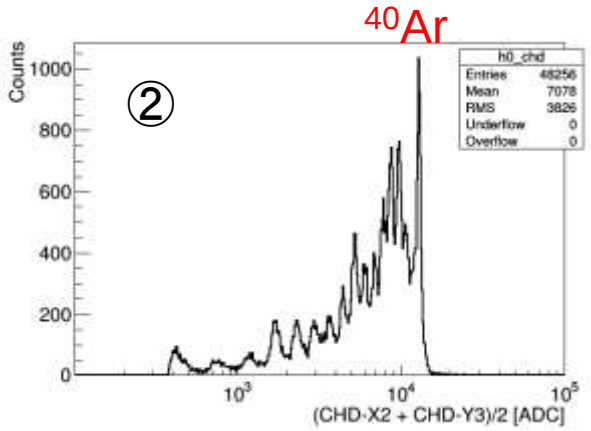
Data summary

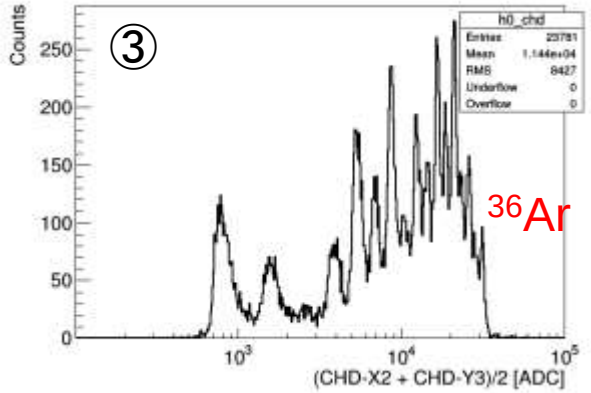
Energy	Beam	Position	Events	Comments
150A GeV/c	^{40}Ar	Center	148k	parasitic behind UA9 (except high intensity runs)
	^{40}Ar	Scanning	543k	parasitic behind UA.9 (except high intensity runs)
	^{40}Ar	Scanning	870k	parasitic behind Proba-V
	Fragments	Center	1,706k	main user
	Fragments	Scanning	900k	main user
13A GeV/c	^{40}Ar	Center	524k	parasitic behind Prova-V
	^{40}Ar		51k	main user with Si tracker
	Fragments	Center	2,019k	main user with Si tracker
19A GeV/c	^{40}Ar	Center	100k	main user with Si tracker
	Fragments	Center	525k +α	main user with Si tracker
	Fragments	Scanning	100k	main user with Si tracker

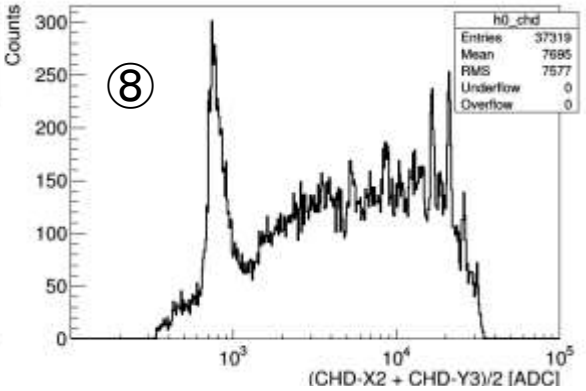
Tot. 7.5 M events

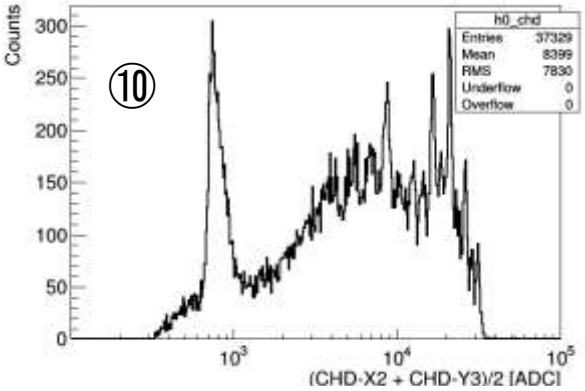
Fragments (CHD)

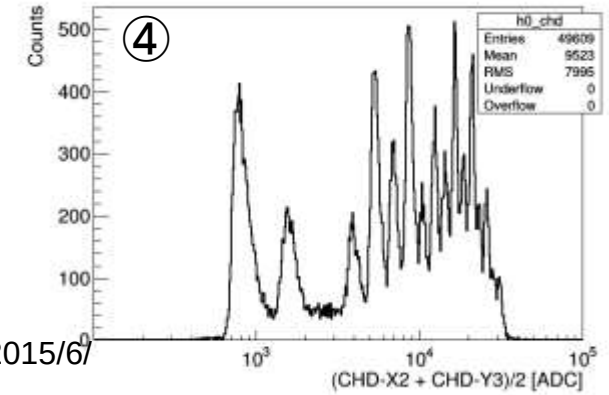
	Beam file		Run	HV
②	H8A.CALET.001	150 AGeV fragments (A/Z=2.2)	285	-400V
③	H8A.CALET.003	150 AGeV fragments (A/Z=2.0)	377	-450V
④	H8A.CALET.005	150 AGeV fragments (A/Z=2.0)	389	-450V
⑧	H8A.CALET.009	13 AGeV fragments (w Cerenkov)	570	-450V
⑧’	H8A.CALET.009	13 AGeV fragments (w/o Cerenkov)	638	-450V
⑩	H8A.CALET.012	19 AGeV fragments	692	-450V

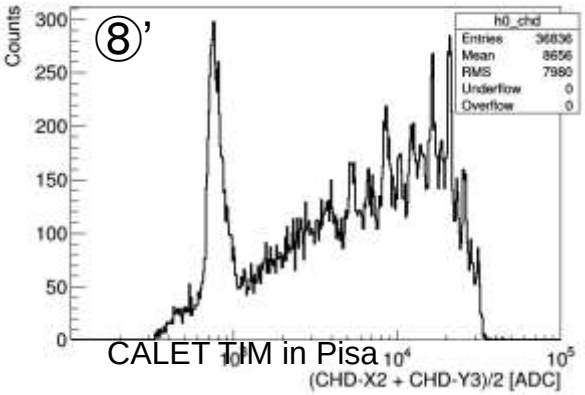


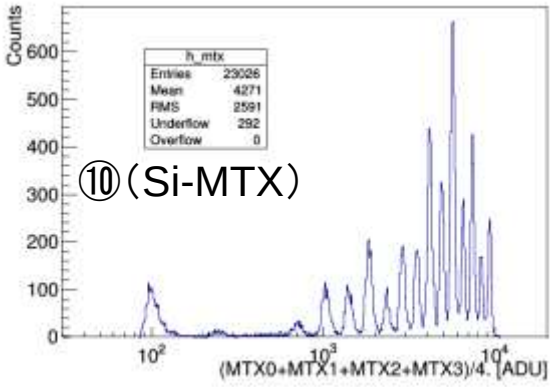












External CHD paddles

A setup of external CHD scintillator paddles to study effects of quenching and delta rays