E15/E17 Status

Ryugo S. Hayano*, Tokyo

for J-PARC E15/E17 Collaboration

* E17 spokesperson

K1.8BR beam tuning results

Preparation status

How long do we (E17) need to run?

1. About E15 & E17

E15/E17 Collaboration

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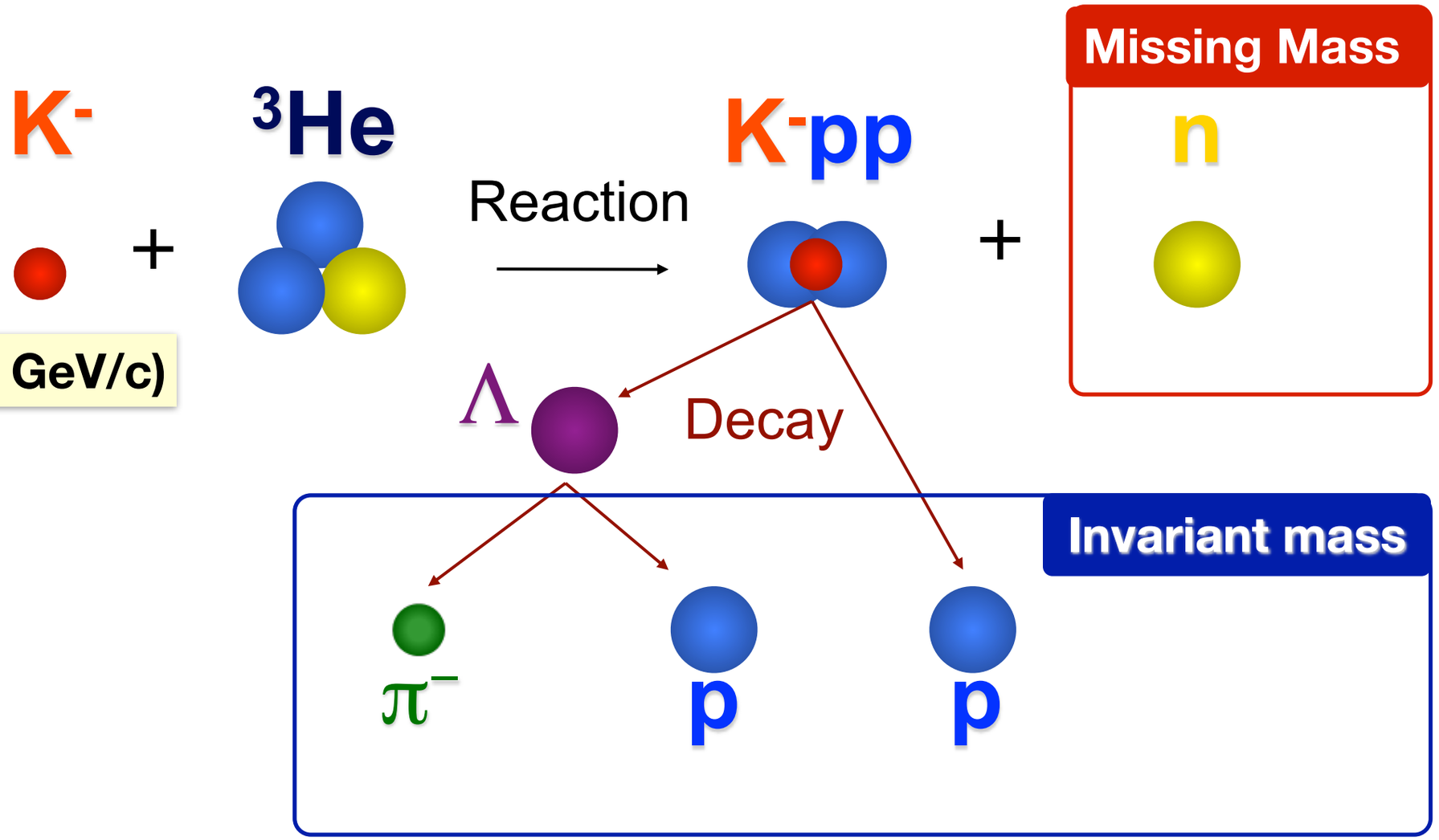
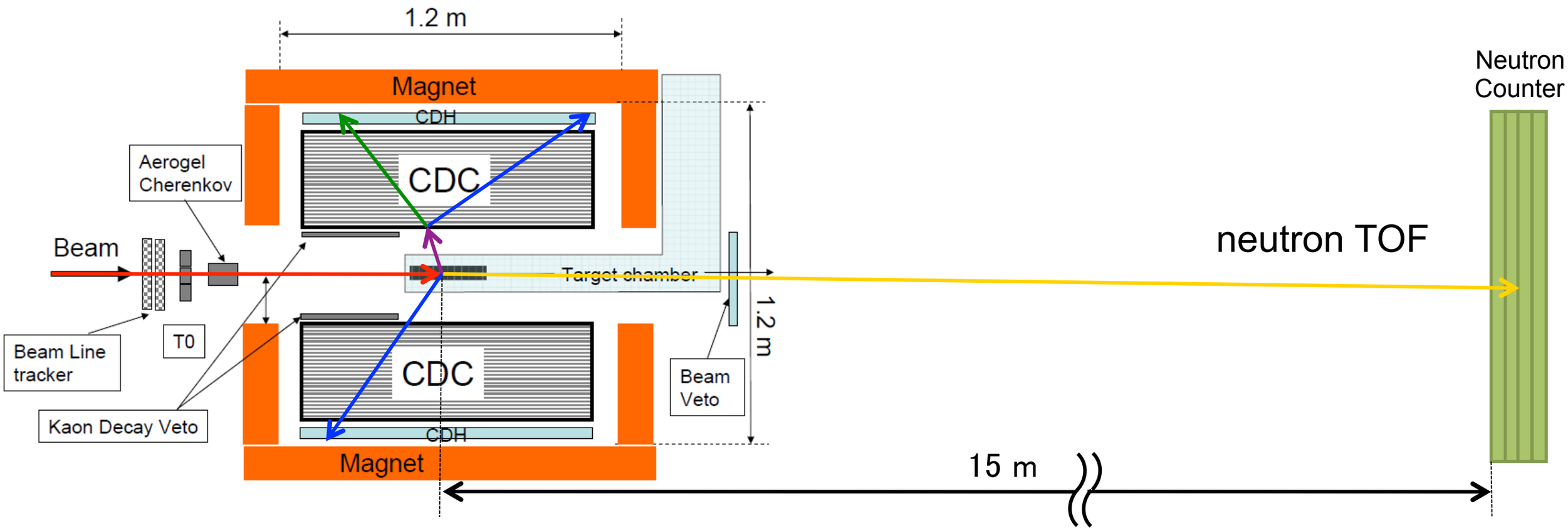
(17) *National Institute of Physics and Nuclear Engineering - IFIN HH, Romania*

E15 : Search for K^--pp

In-flight (1 GeV/c)



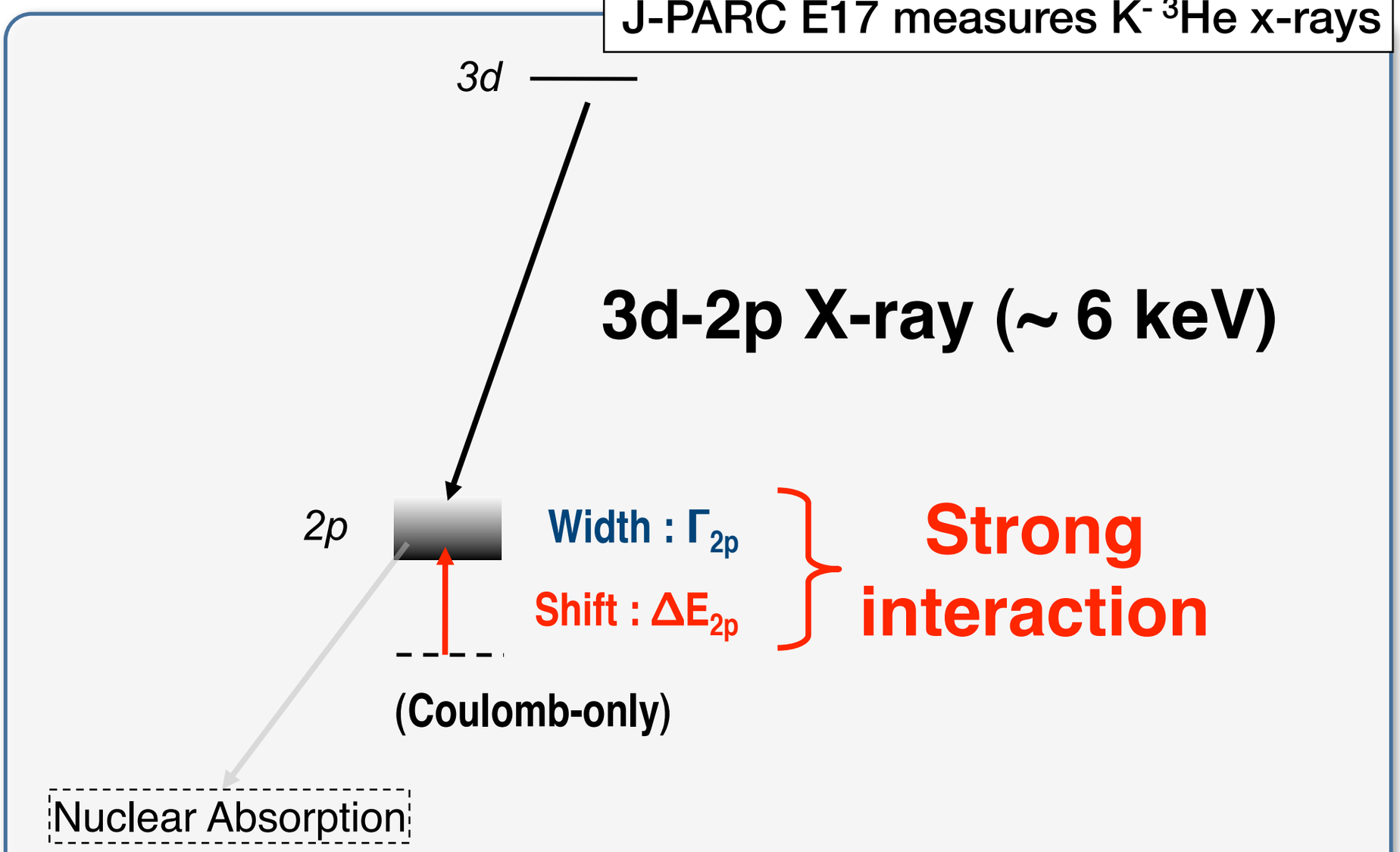
E15 setup



Λp invariant mass

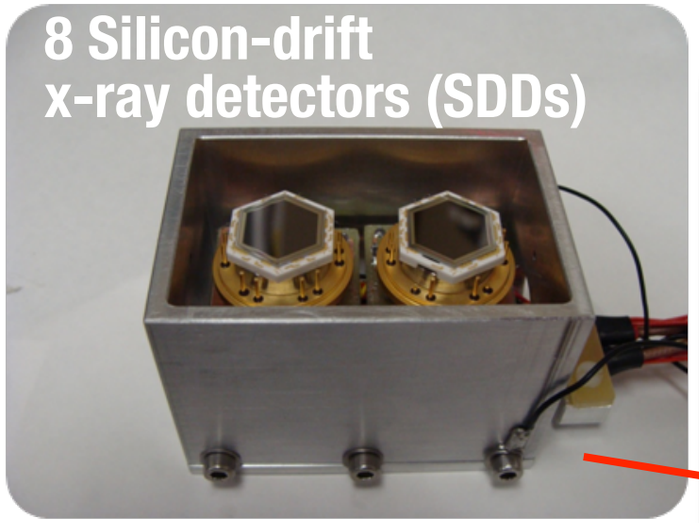
E17 : K^--^{3}He 3d→2p x-rays

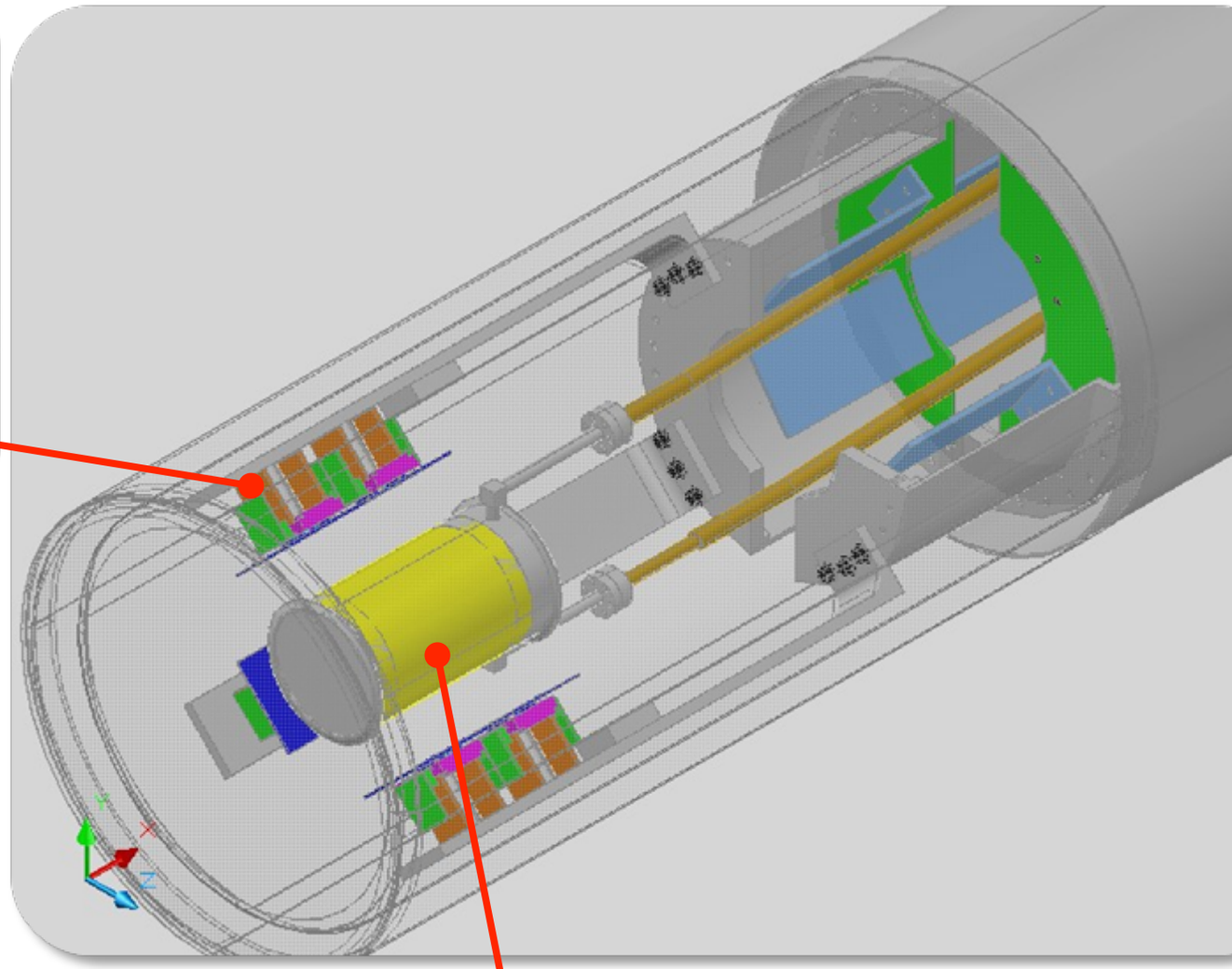
KEK E570 measured K^- ^{4}He x-rays
J-PARC E17 measures K^- ^{3}He x-rays



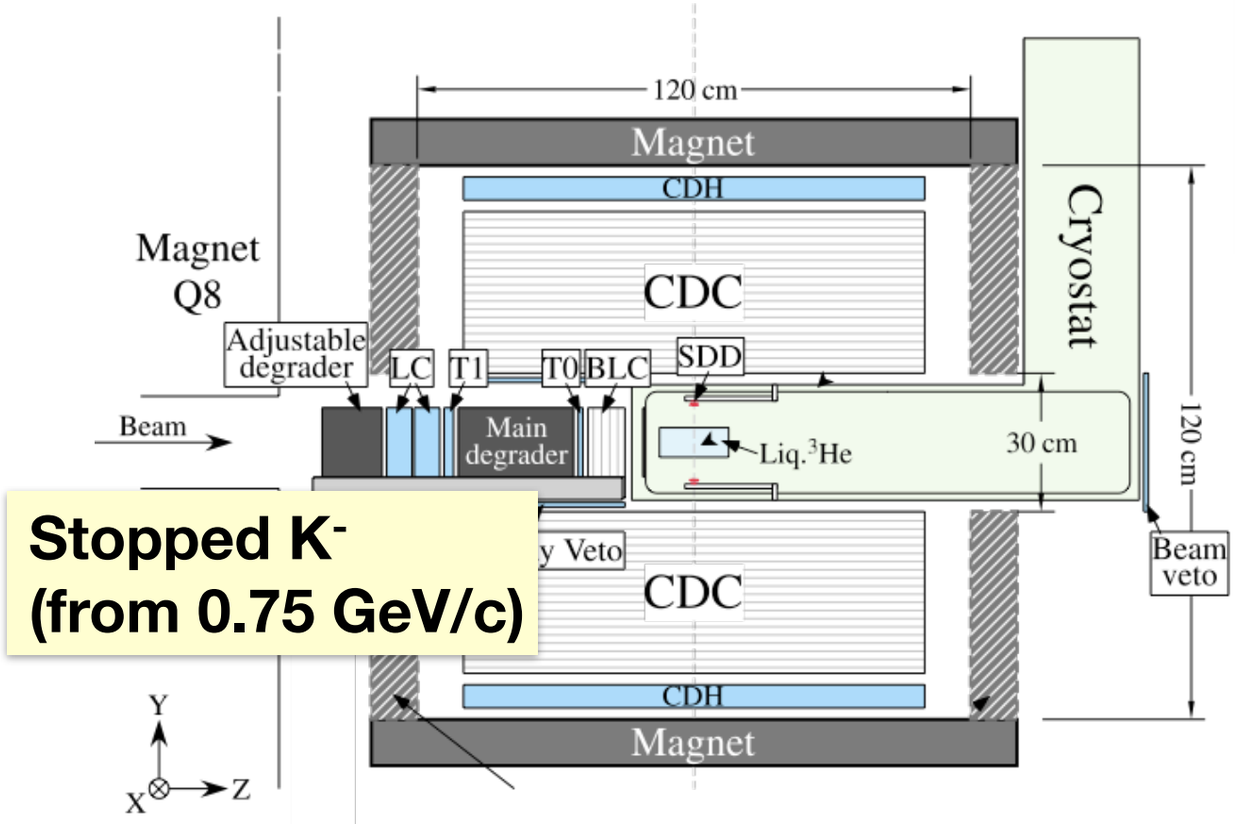
Goal : < 2 eV statistical error in ΔE_{2p}

E17 setup



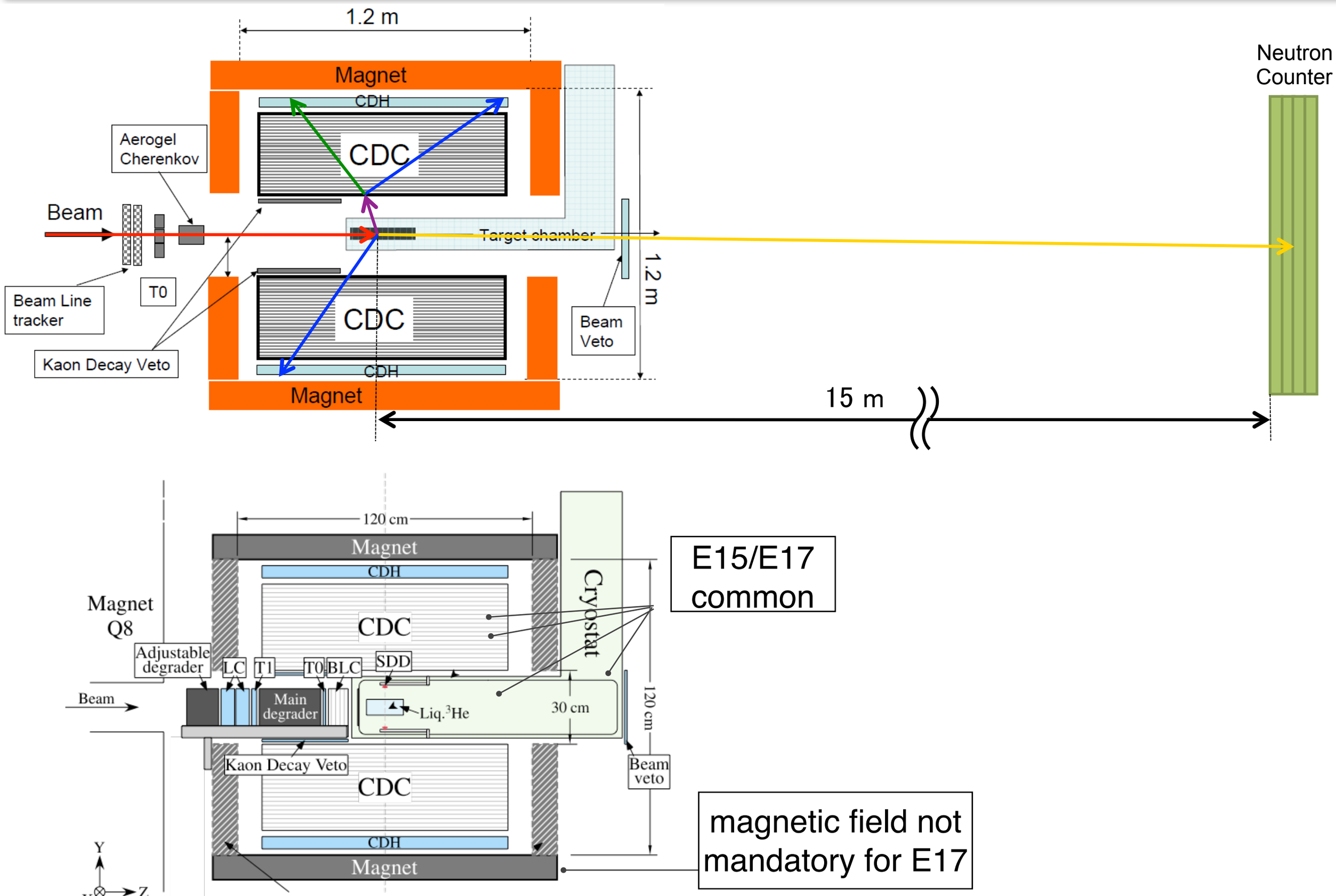


500 cm^3 liquid helium 3 target



Stopped K$^-$
(from 0.75 GeV/c)

E15 setup vs E17 setup comparison

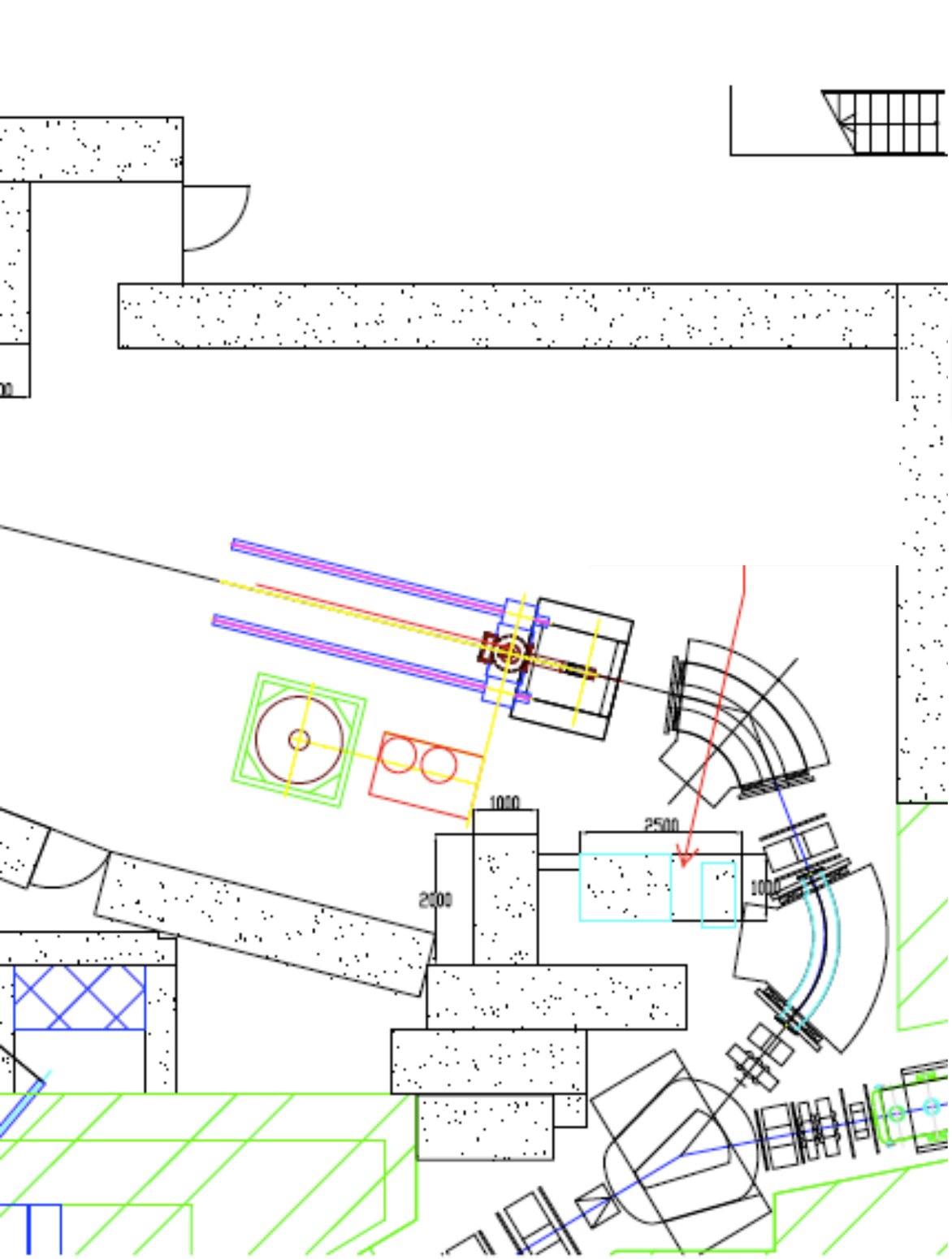


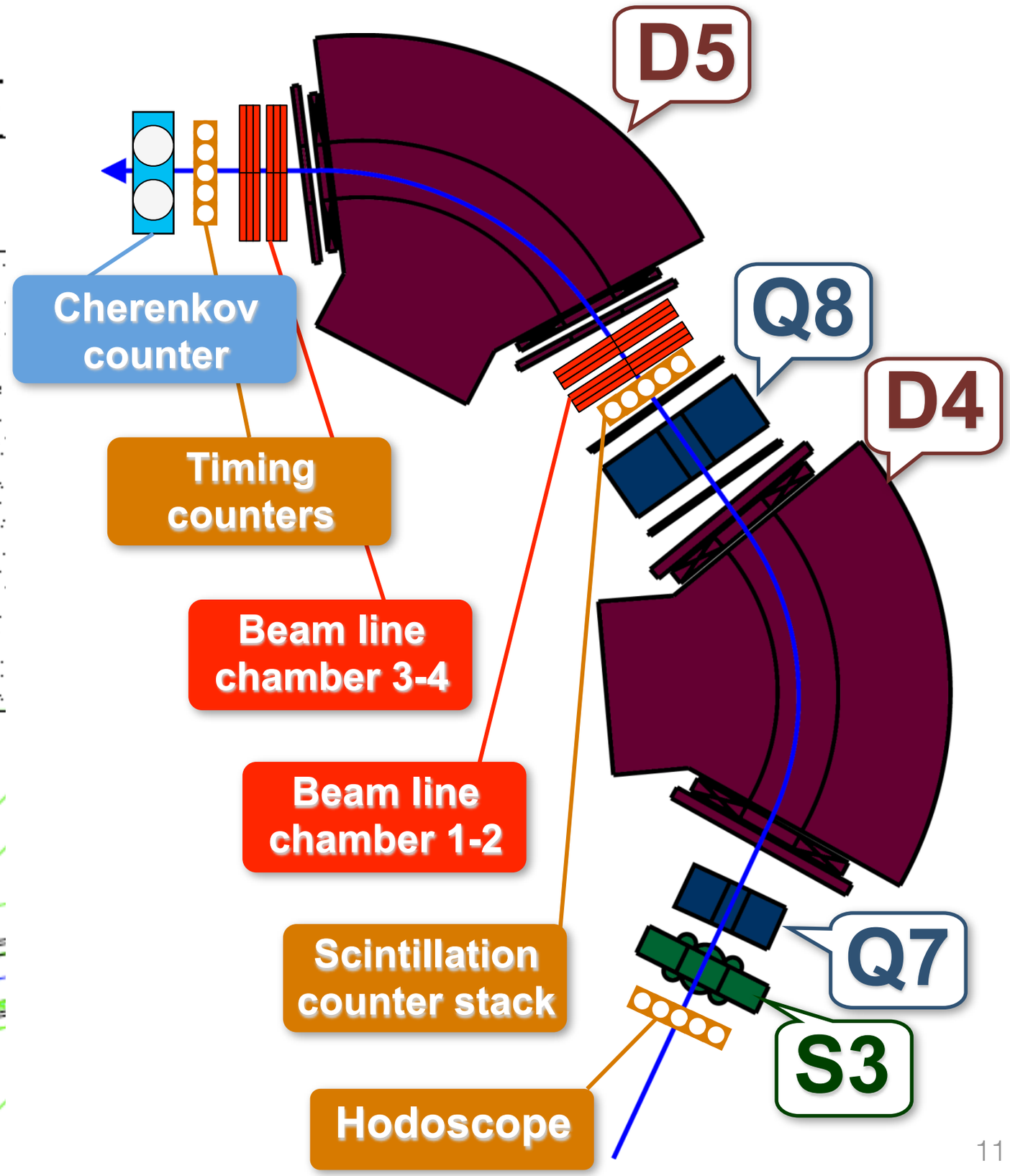
E15 & E17

	E15	E17
Physics	Kaon-nucleus deeply-bound state	Kaon-nucleus strong int. potential
Beam	1 GeV/c in-flight K^-	0.75 GeV/c→stopped K^-
Beamtime (as proposed, excluding beam tuning & commissioning)	5.5 weeks at 270 kW 1500 kW*week	5 weeks at 27 kW 135 kW*week
Target	Liquid Helium 3	
Beamline	K1.8BR	
Assumed schedule	E17 runs first (10% beam intensity), then E15	

2. K1.8BR tuning

K1.8BR beamline



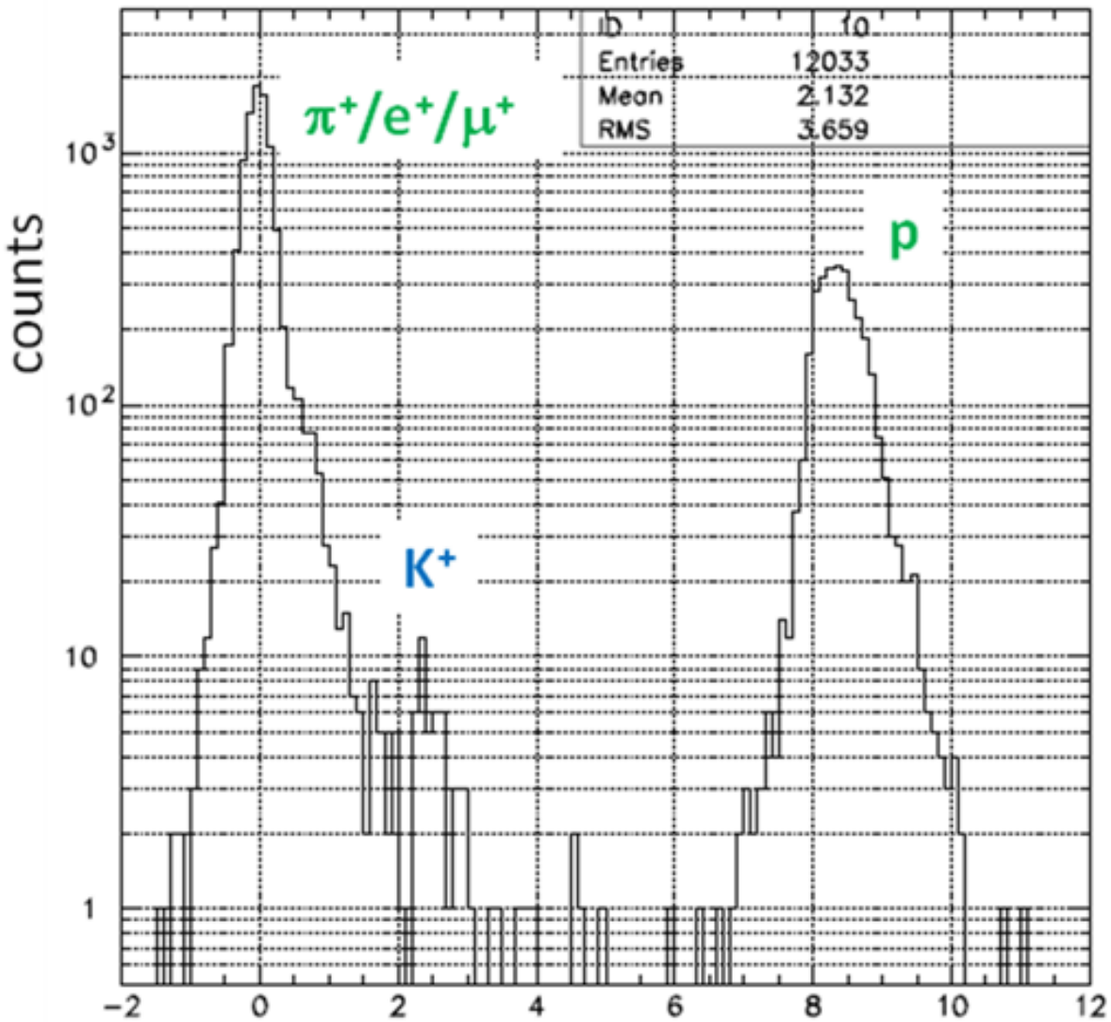


First K^+, JFY2008
K^+/π^+ ~ 1/500

Confirmation of kaons in the K1.8BR beam at the Hadron Facility, J-PARC.

J-PARC Center

Joint experimental team, E17 lead by Professor Ryugo Hayano, University of Tokyo and E15, lead by Dr. Masahiko Iwasaki, Riken, has successfully confirmed kaon generation in the secondary beams at the K1.8BR, Hadron Facility, J-PARC. This result was reported by Dr. Takatoshi Suzuki, University of Tokyo, at "Workshop Celebrating the First Beam at Hadron Hall" held on March 25-26 at Tokai.



K^+ identified at K1.8BR
in the unseparated,
1.1 GeV/c,
+ polarity,
TOF spectrum

T. Suzuki @ J-PARC WS, March, 2009

K1.8BR beam study of year 2009

dates	time	Beam intensity	Production target	Momentum/polarity/ condition	study
2009/10/22~23	18:00~22:00 1:00~4:00	0.05 Tp pp (40 W)	Ni	±1.1 GeV/c Unseparated->±100 kV ->unseparated	$K^{\pm}$ confirmation Trigger study
2009/11/15	01:15~09:30	0.07 Tp pp (56 W)	Ni	+0.75 GeV/c unseparated	NIM Scaler tune Trigger study D magnet tune
2009/11/16	05:00~07:00	0.07 Tp pp (56 W)	Ni	+0.75 GeV/c unseparated	Trigger study D magnet tune
2009/11/18	02:30~07:00	0.07 Tp pp	Ni	+0.75 GeV/c	$K^{\pm}$ confirmation $K^{\pm}$ yield study (unseparated)
2009/12/12	01:00~09				K trigger tune $K^{\pm}$ CM scan
2009/12/13	13:40~14				K trigger tune Scaler tune
2009/12/16	07:00~09	(240 W)		unseparated	$K^{\pm}$ yield study for Ni target (unseparated)
2009/12/16	16:20~16:30	0.68 Tp pp (550 W)	Pt	+ 0.75 GeV/c unseparated	Rate study
2009/12/17	04:00~07:00	0.3 Tp pp (240 W)	Pt	±0.75 GeV/c ±200 kV->unseparated	$K^{\pm}$ yield study for Pt target (separated/ unseparated)
2009/12/23	1:00~5:00	0.3 Tp pp (240 W)	Pt&Ni	±0.75 GeV/c ±200 kV	EQ/RQ on $K^{\pm}$ yield study, Pt/Ni comparison

0.04-0.24 kW

(goal 270 kW)

Ni or Pt targets

K1.8BR beam study of year 2009

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2009/12/12	01:00~09:30	**0.2 Tp pp (160 W)**	**Ni**	**±0.75 GeV/c** unseparated ->±200 kV	**$K^{\pm}$ CM scan**
2009/12/13	13:40~14:30	0.68 Tp pp (550 W)	Pt	+ 0.75 GeV/c unseparated	K trigger tune Scaler tune
2009/12/16	07:00~09:40	0.3 Tp pp (240 W)	Ni	±0.75 GeV/c unseparated	$K^{\pm}$ yield study for Ni target (unseparated)
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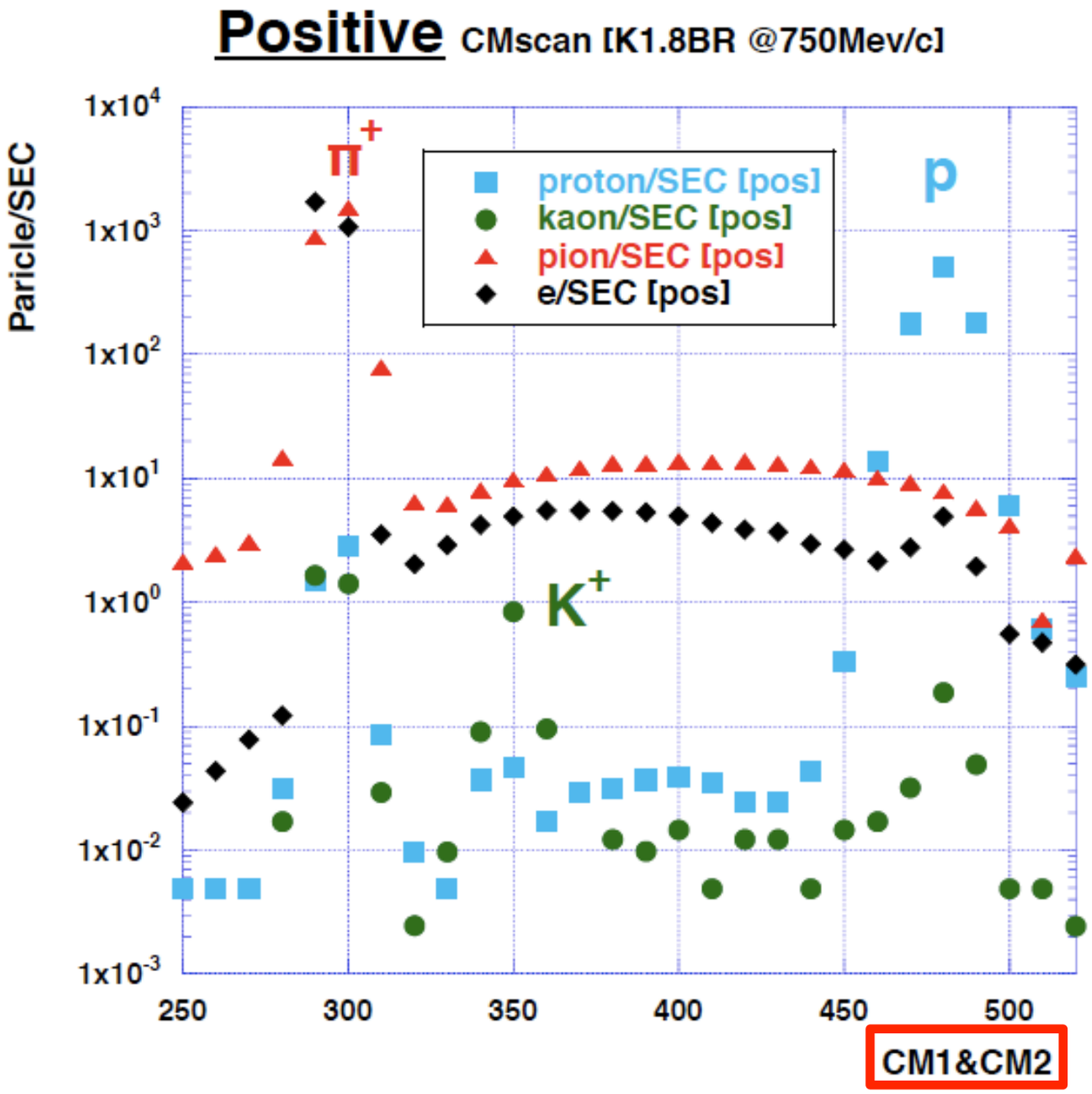
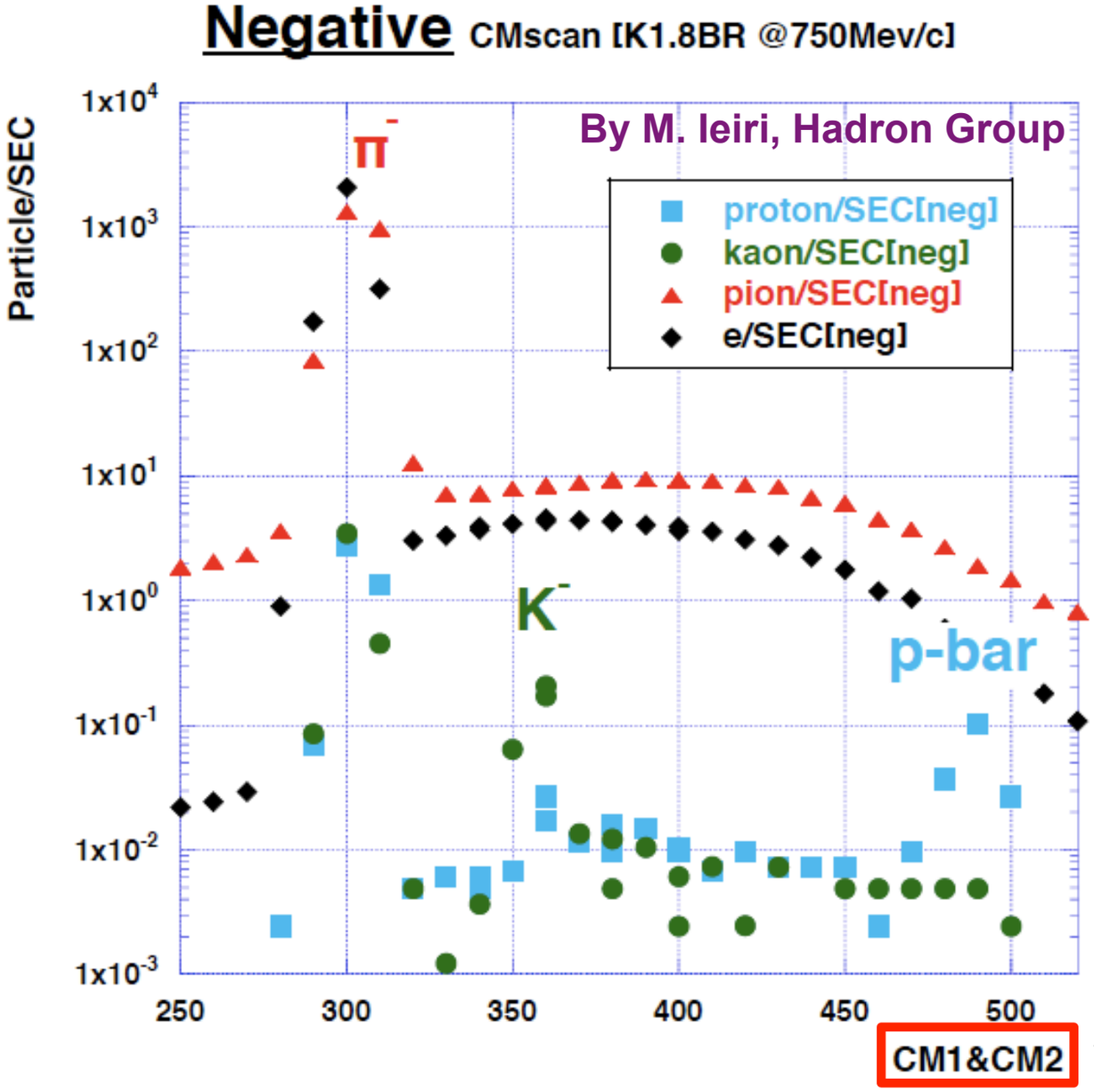
2009/12/17	04:00~07:00	0.3 Tp pp (240 W)	Pt	±0.75 GeV/c ±200 kV->unseparated	$K^{\pm}$ yield study for Pt target (separated/ unseparated)
2009/12/23	1:00~5:00	0.3 Tp pp (240 W)	Pt&Ni	±0.75 GeV/c ±200 kV	EQ/RQ on $K^{\pm}$ yield study, Pt/Ni comparison

K1.8BR K± CM scan (Dec 12. 2009)

Primary: 2×10^{11} ppp
momentum 0.75 GeV/c
Target: Ni
EQ/RQ: OFF

K1.8ES1: ±200 kV
IF-H:±130mm IF-V: -0mm/+4mm
K1.8Mom Slit: ±60mm
K1.8Mass Slit1: ±2.35mm





the 6-m-long separator (ES1) works beautifully!

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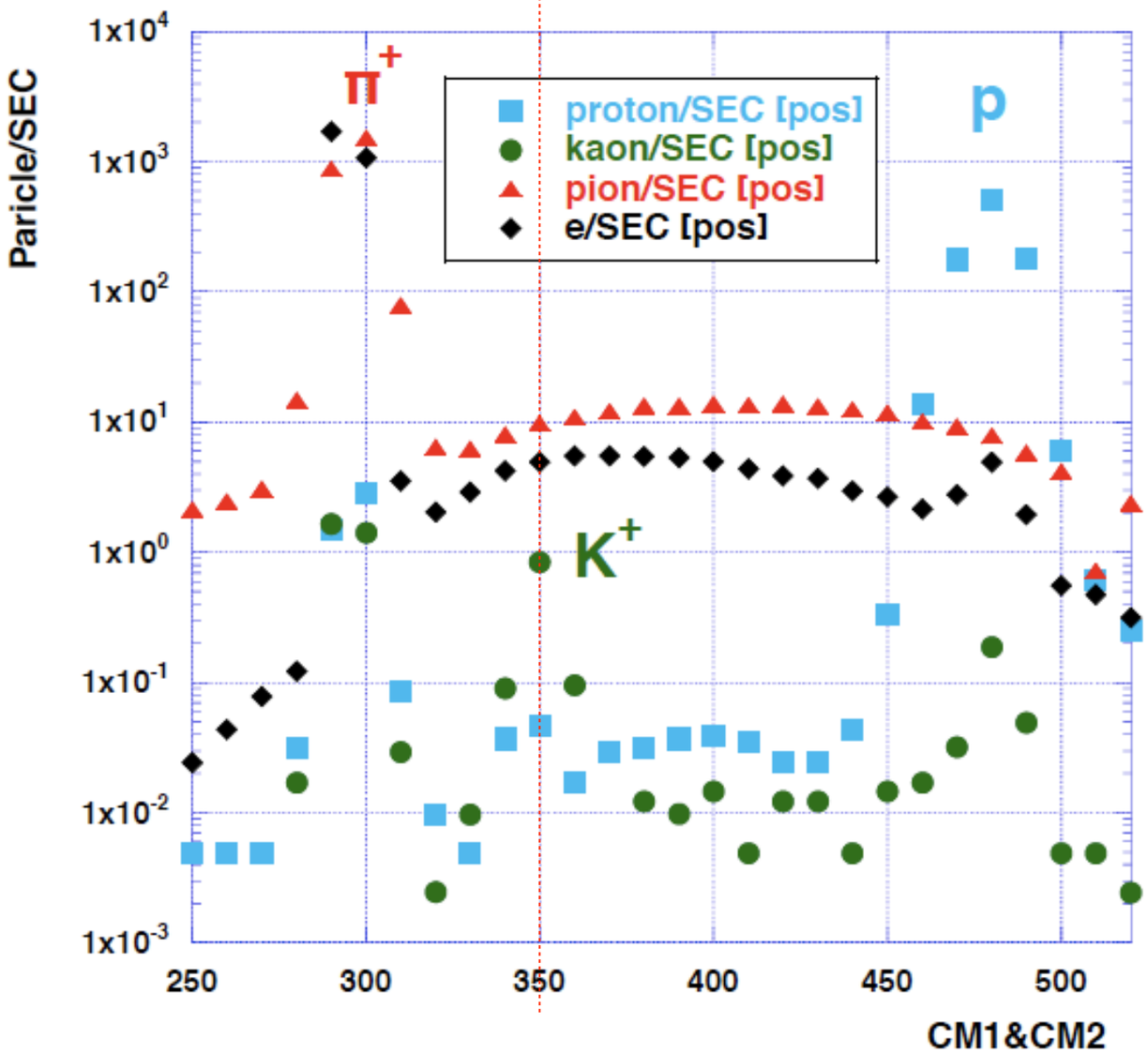

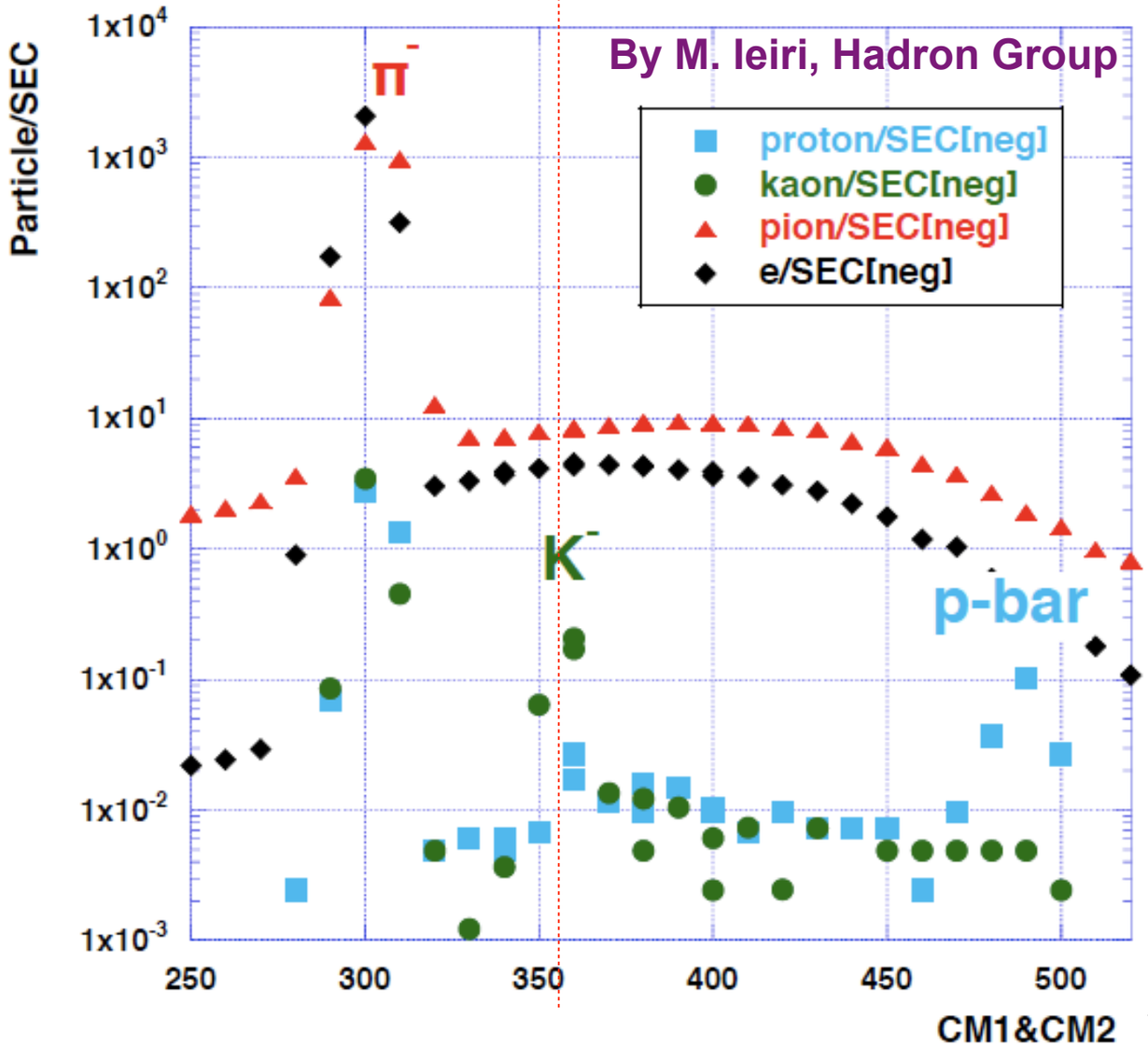

K1.8BR beam study of year 2009

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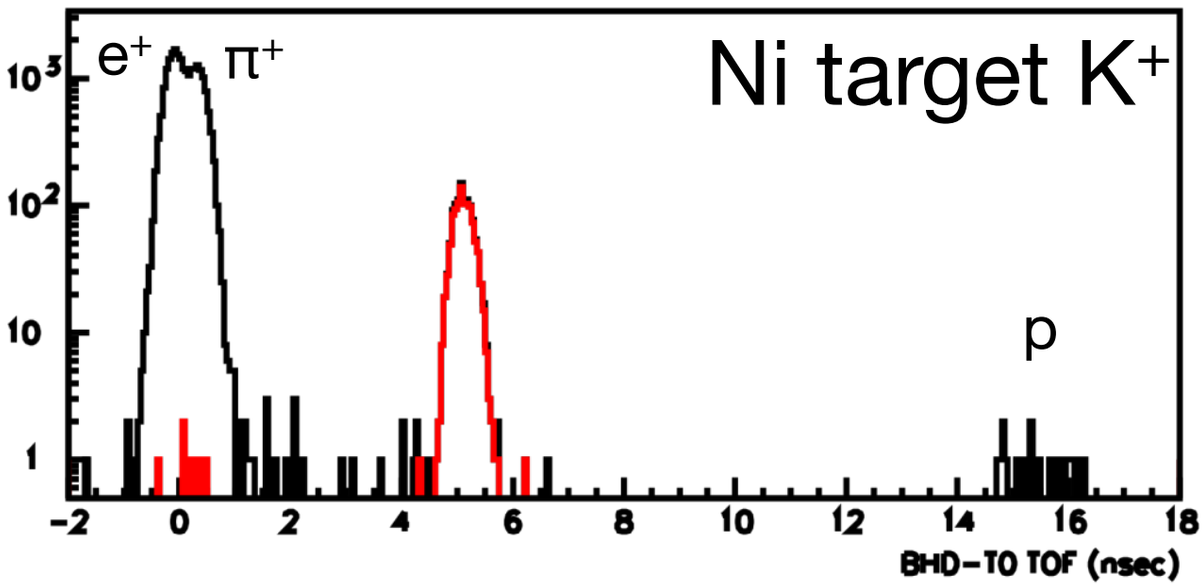
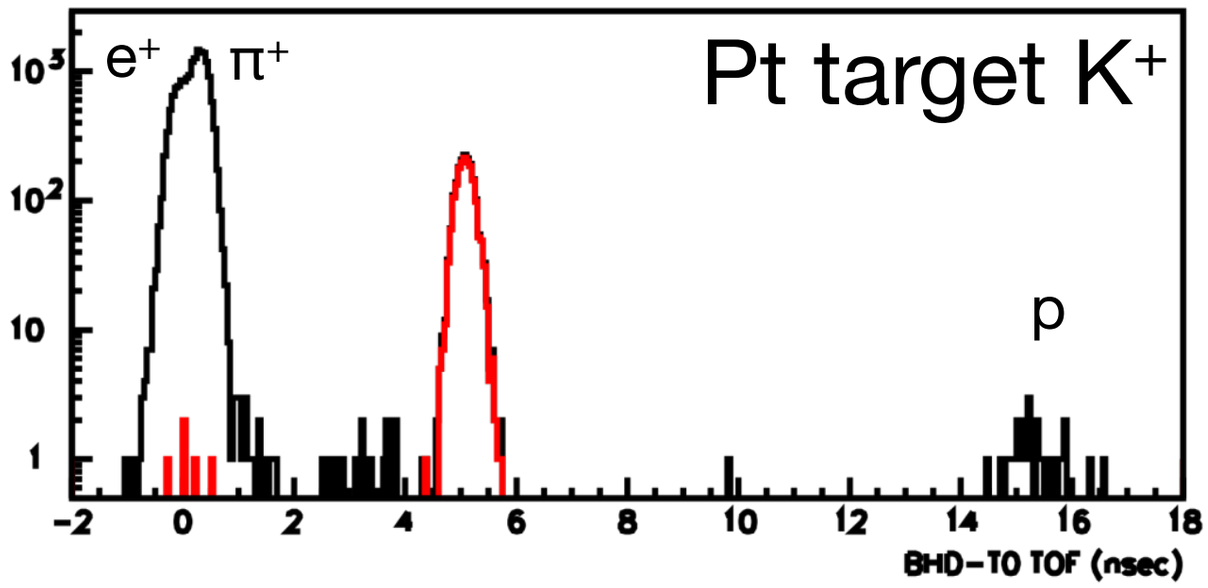
2009/12/16	16:20~16:30	0.68 Tp pp (550 W)	Pt	+ 0.75 GeV/c unseparated	Rate study
2009/12/17	04:00~07:00	0.3 Tp pp (240 W)	Pt	±0.75 GeV/c ±200 kV->unseparated	$K^{\pm}$ yield study for Pt target (separated/ unseparated)
2009/12/23	1:00~5:00	**0.3 Tp pp (240 W)**	**Pt&Ni**	**±0.75 GeV/c ±200 kV**	**$K^{\pm}$ yield, Pt/ Ni**

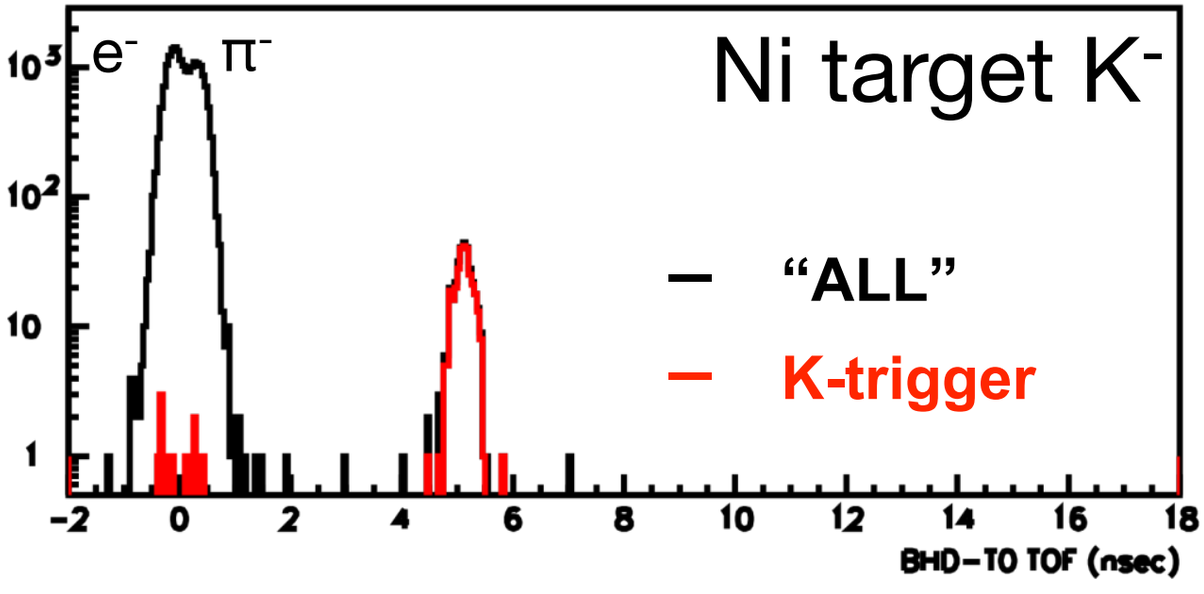
$K^{\pm}$ yield, Ni vs Pt (Dec 23, 2009)

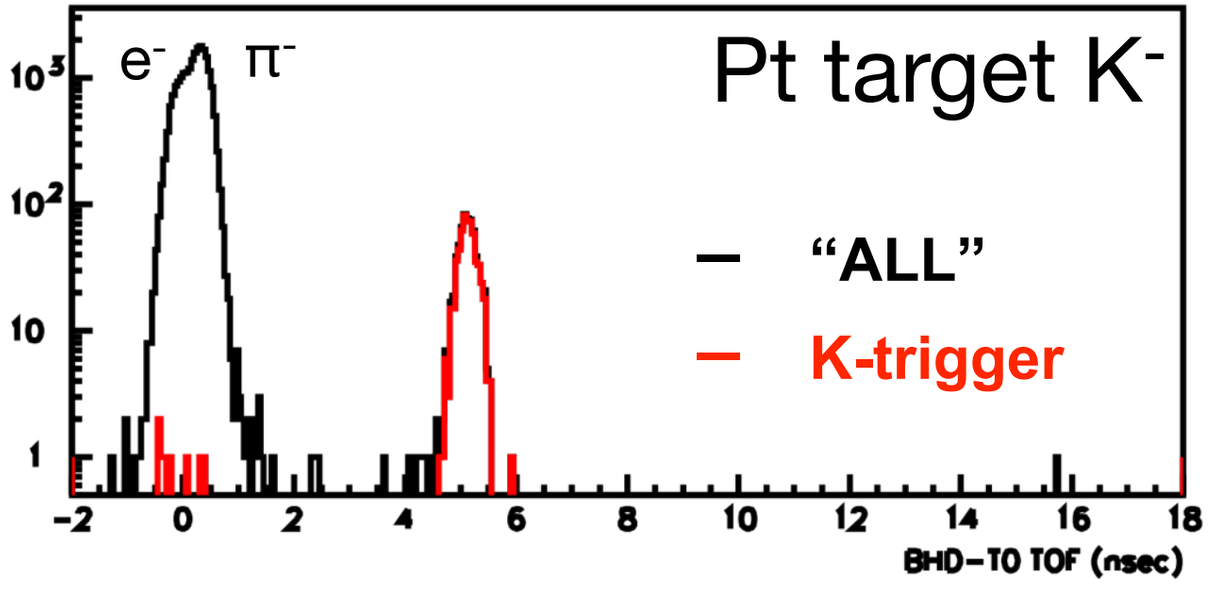
Primary 3×10^{11} ppp (0.24 kW),
momentum :±0.75 GeV/c
EQ/RQ: ON

K1.8ES1: ±200 kV CM1=CM2=350(K^+)/355(K^-)
IF-H:±130mm (wide open) IF-V: -0mm/+4mm->-2mm/+6mm
K1.8Mom Slit: ±180mm (wide open)
K1.8Mass Slit1: ±2.35mm ->±4.7mm (x2 design value)





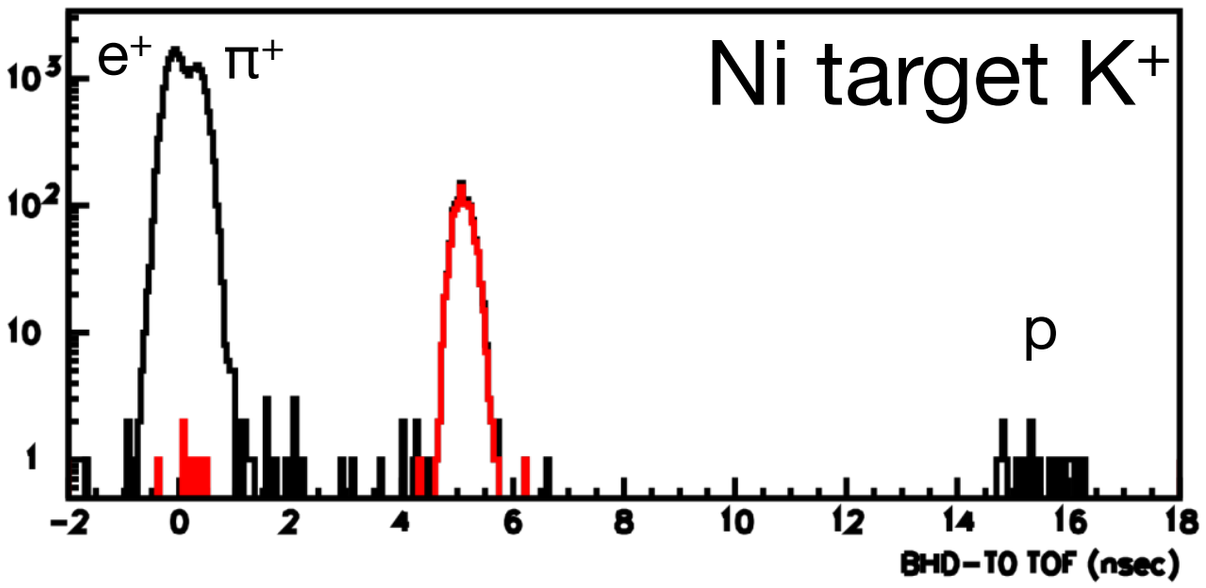


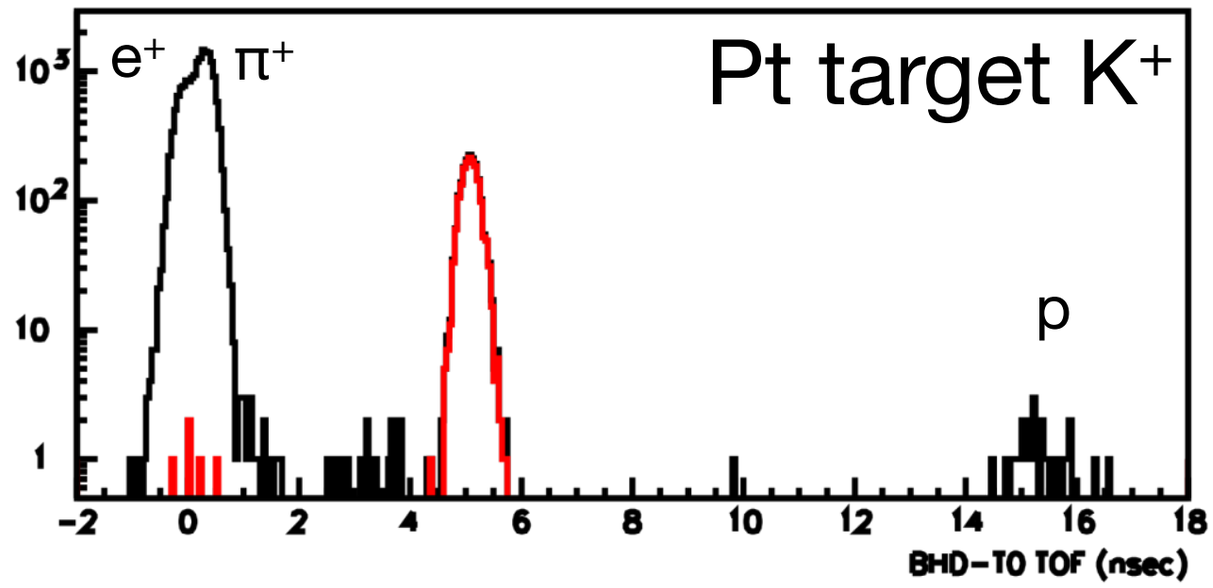


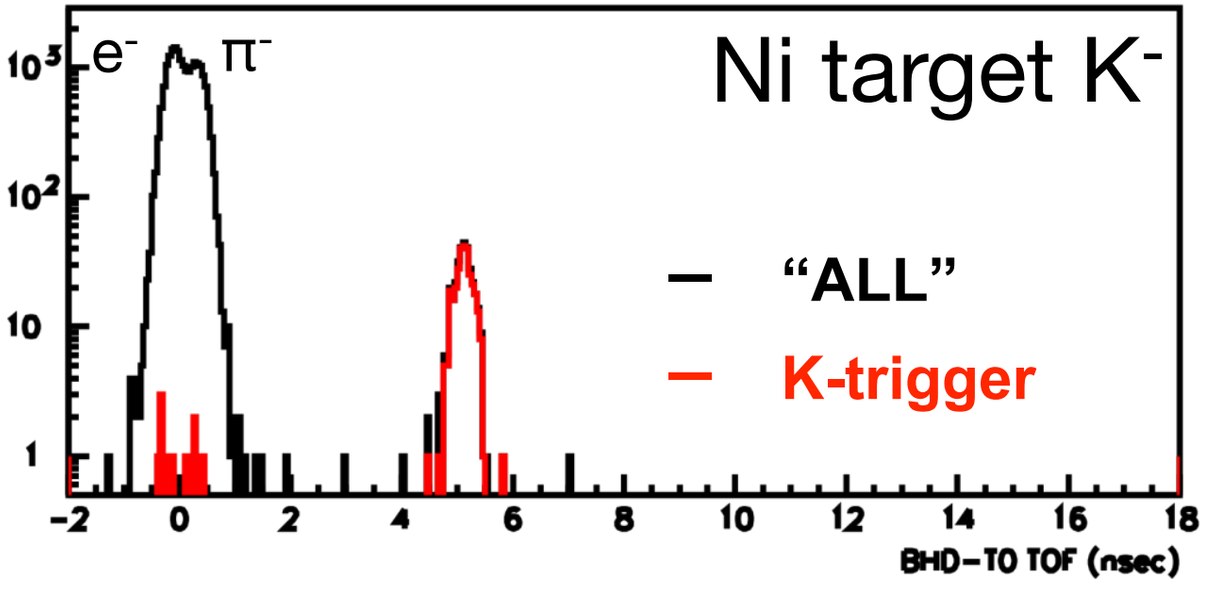
Slit wide open

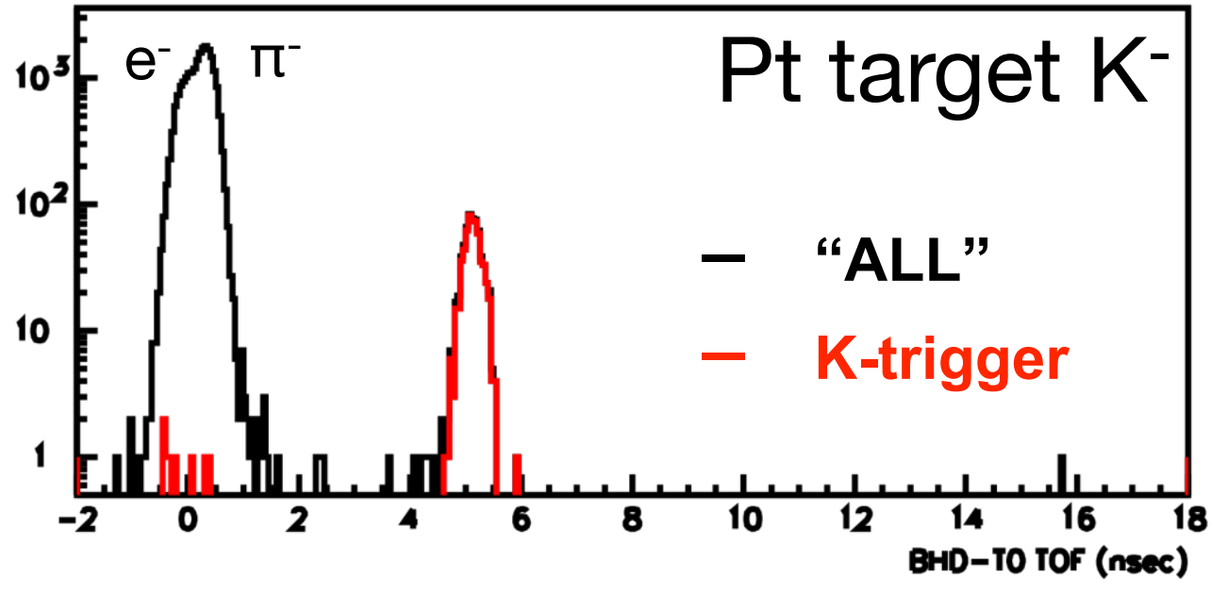
K trigger efficiency >97%, K trigger purity >99%

We are counting ALL the kaons available at K1.8BR









K1.8BR Ni vs Pt (Dec 23, 2009)

0.75 GeV/c
0.24 kW
Momentum slit fully opened
Mass slit x2 wider than the design value

		Ni	Pt	Pt/Ni
K^+	K^+/spill	444	898	2.0
	K^+/π^+ ratio ($x10^{-2}$)	5.3	8.4	1.6
K^-	K^-/spill	120	223	1.9
	K^-/π^- ratio ($x10^{-2}$)	1.7	2.1	1.3

Pt target is x2 better (yield & K/π ratio)

K^+ 900/spill, K^- 220/spill @ 0.24 kW, Pt target

K/π may improve by further tuning

K yield per beam power **not** likely to improve any further

		Ni	Pt	Pt/Ni
K^+	K^+/spill	444	**898**	2.0
	K^+/π^+ ratio ($x10^{-2}$)	5.3	8.4	1.6
K^-	K^-/spill	120	**223**	1.9
	K^-/π^- ratio ($x10^{-2}$)	1.7	2.1	1.3

3. E17 preparation

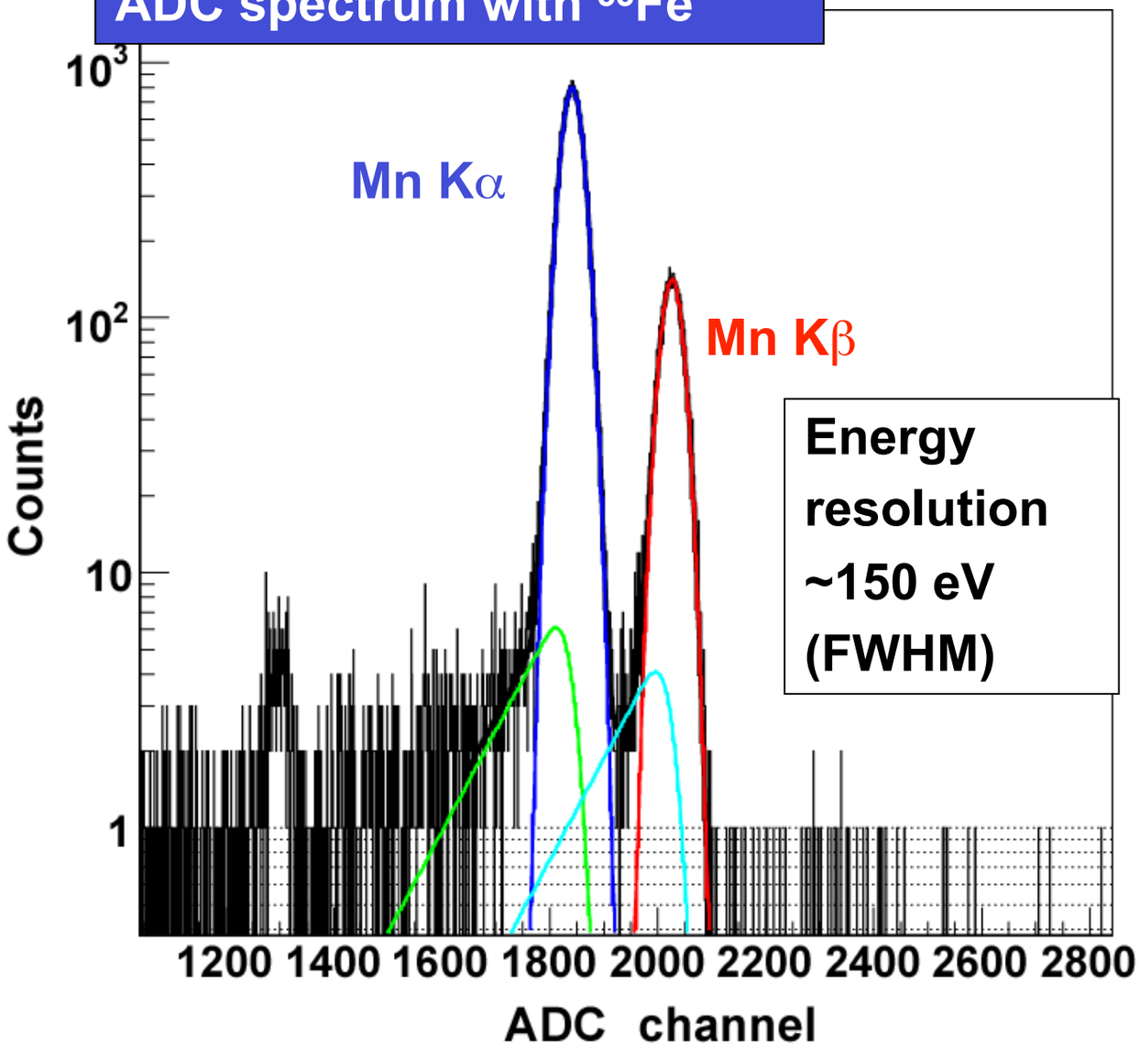
Silicon Drift Detector (SDD)

Study @ test bench

- Operation check of all SDD/preamplifiers
- Basic study (T dependence, timing resolution etc.)

Test bench

ADC spectrum with ^{55}Fe



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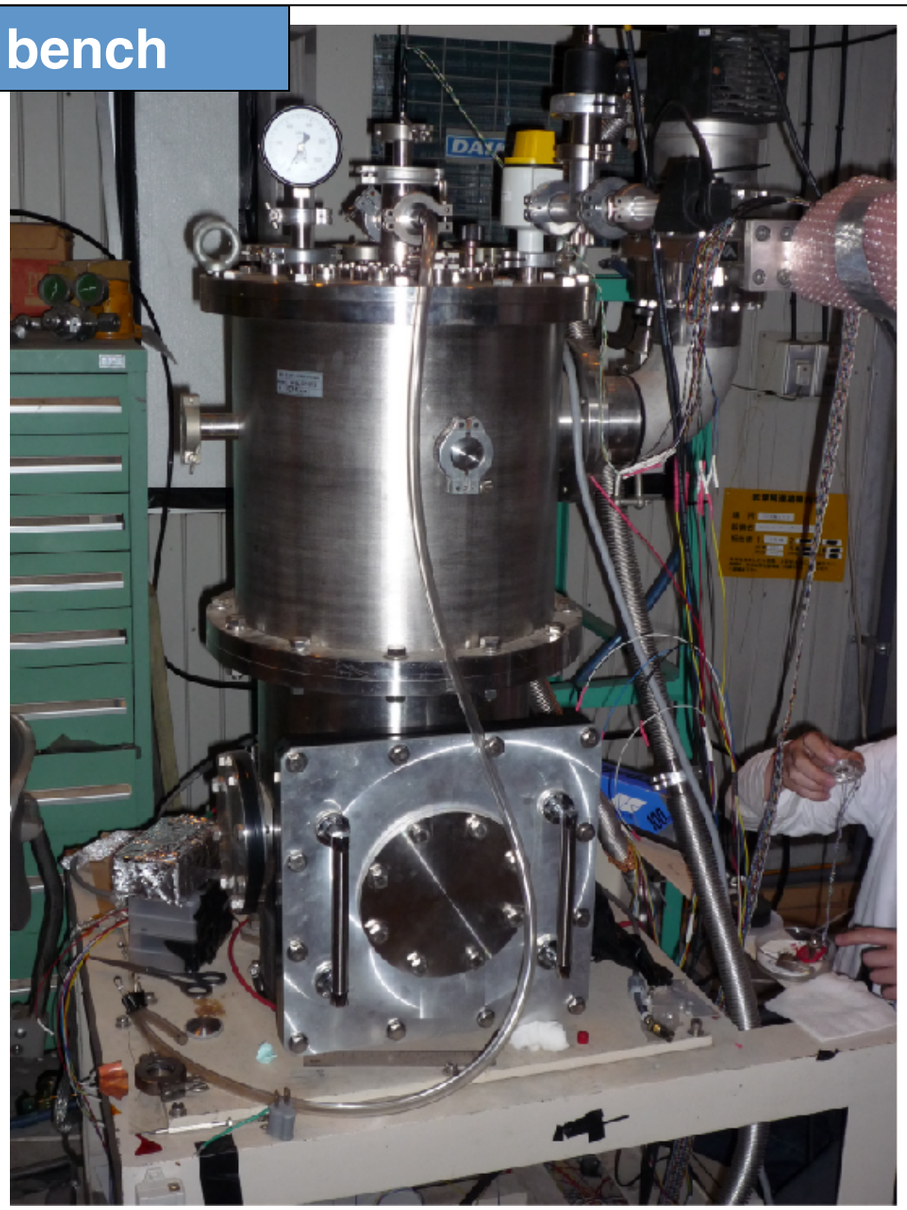
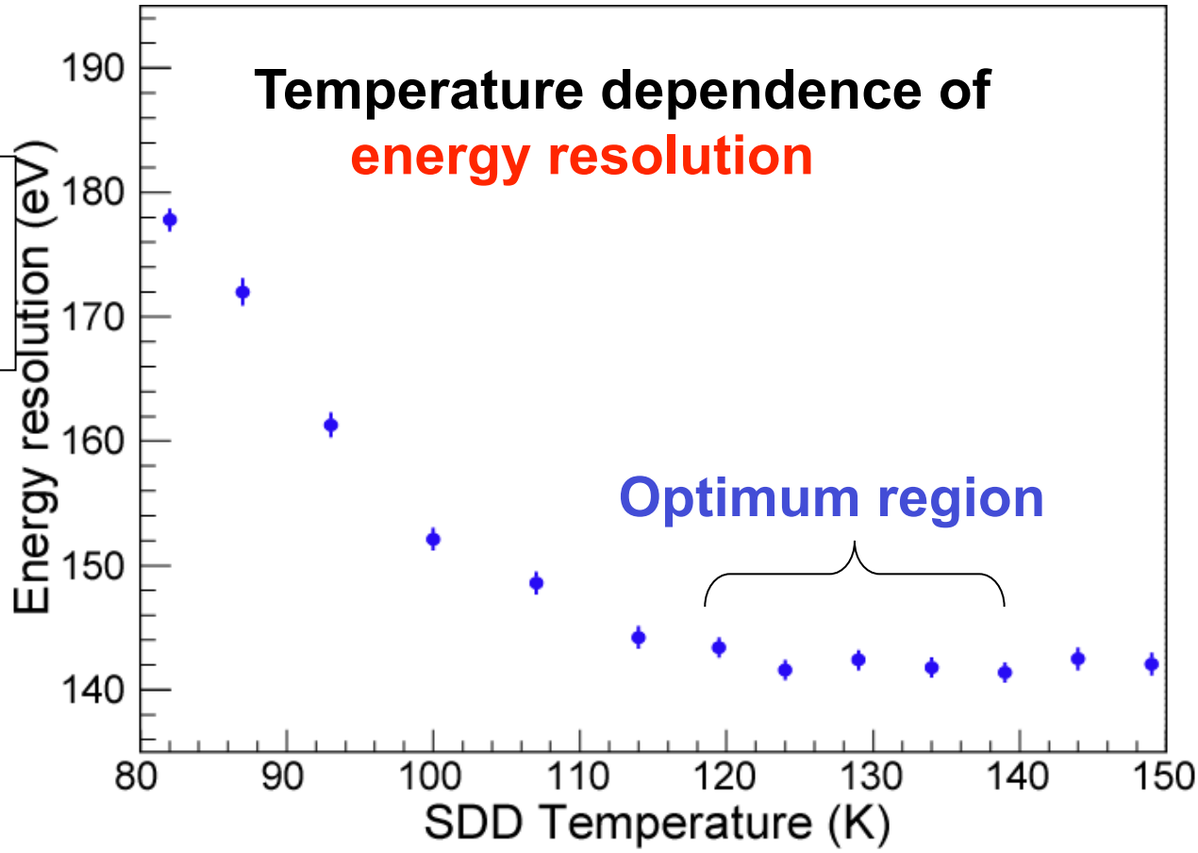
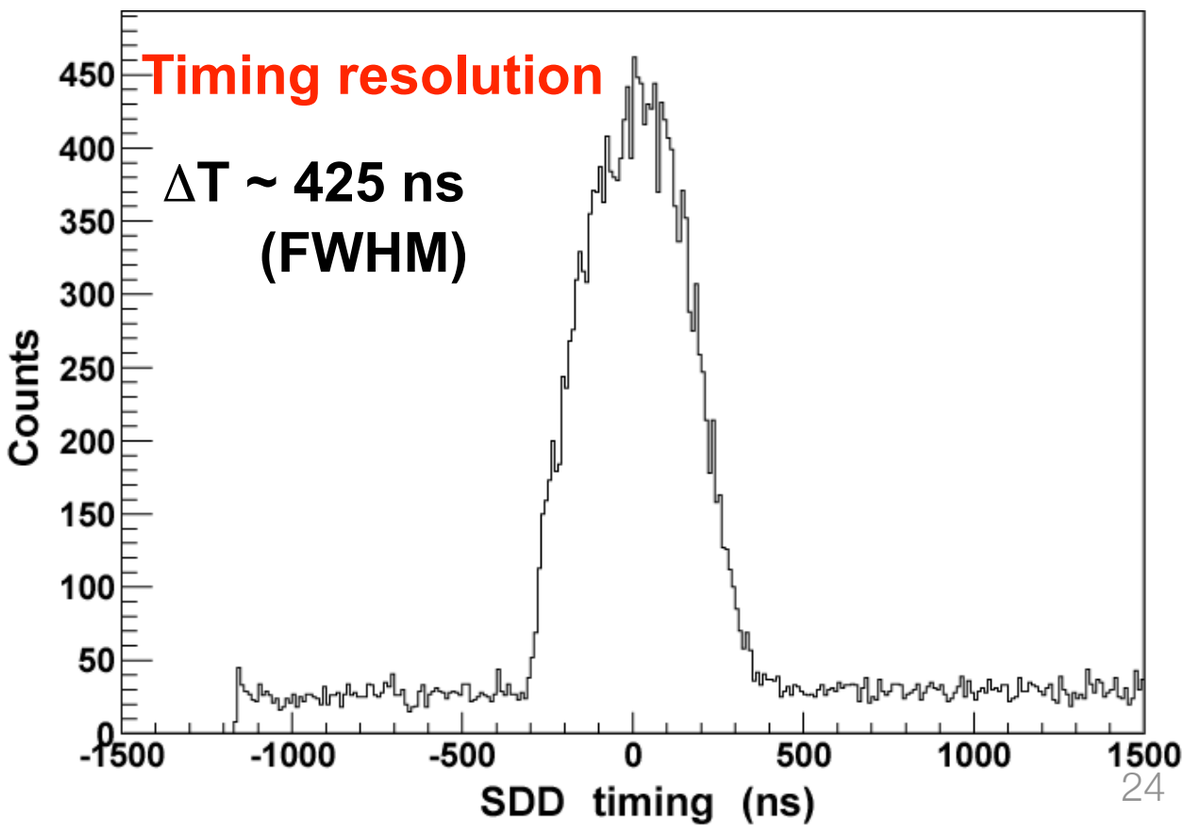
Test bench



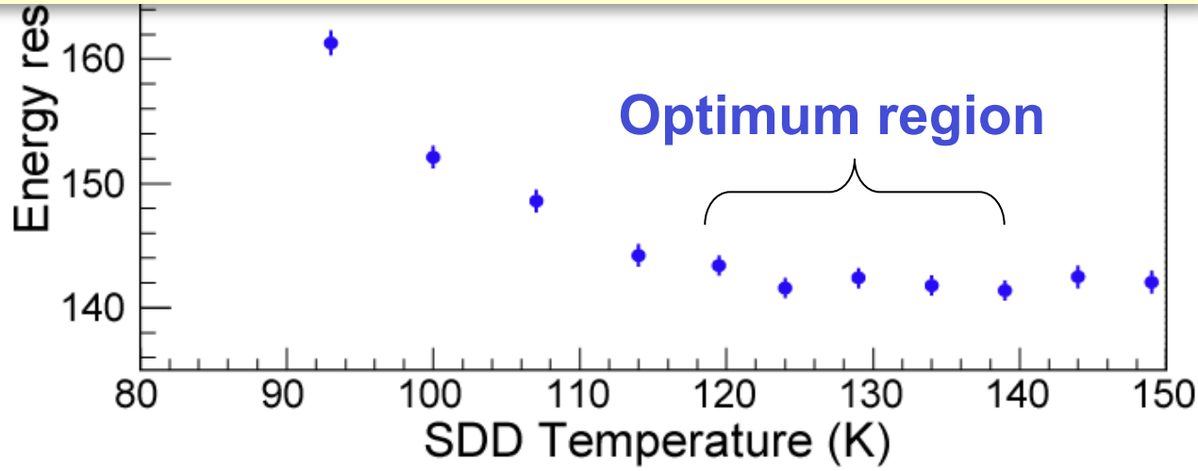


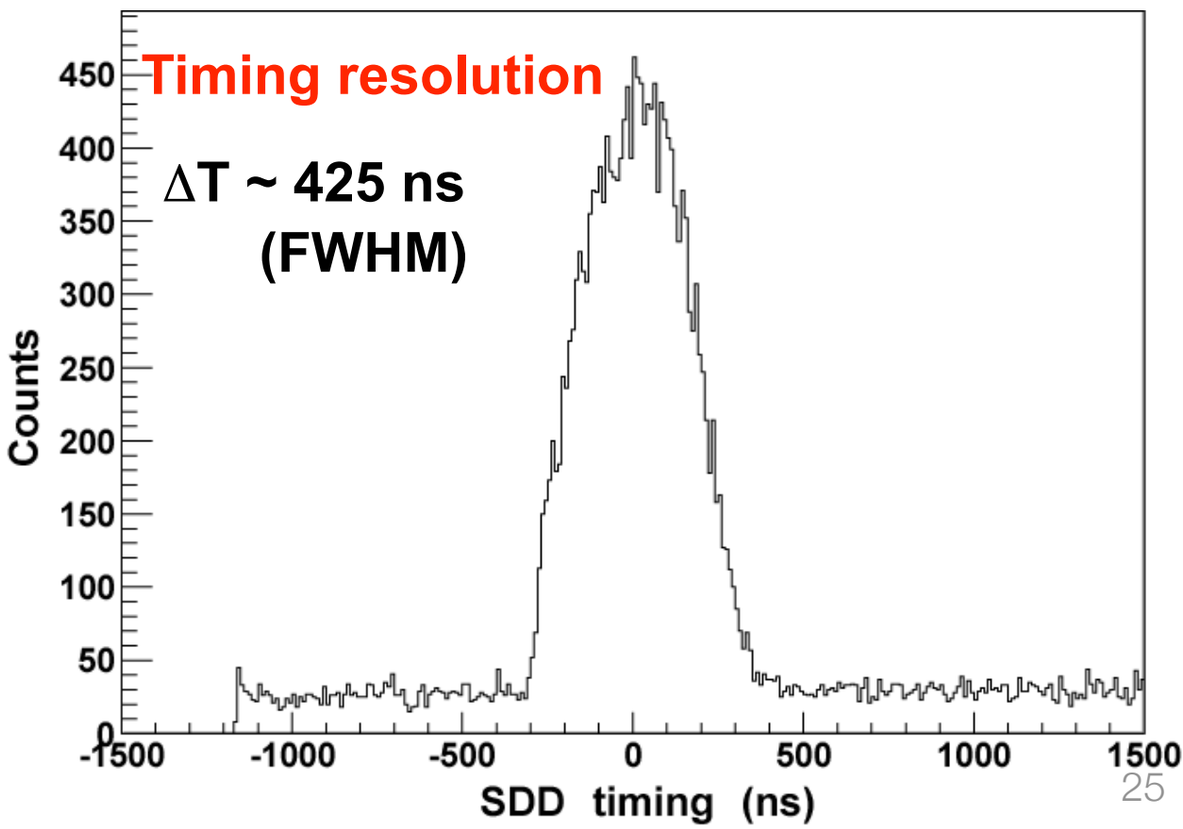


All the 8 SDDs/preamplifiers work fine

Further optimization of the operating condition is in progress

Test bench





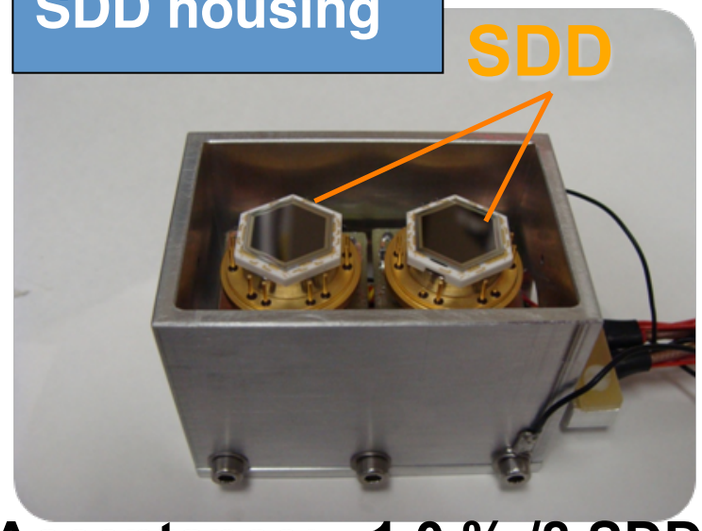
SDDs in the ^{3}He cryostat

LHe3 target status

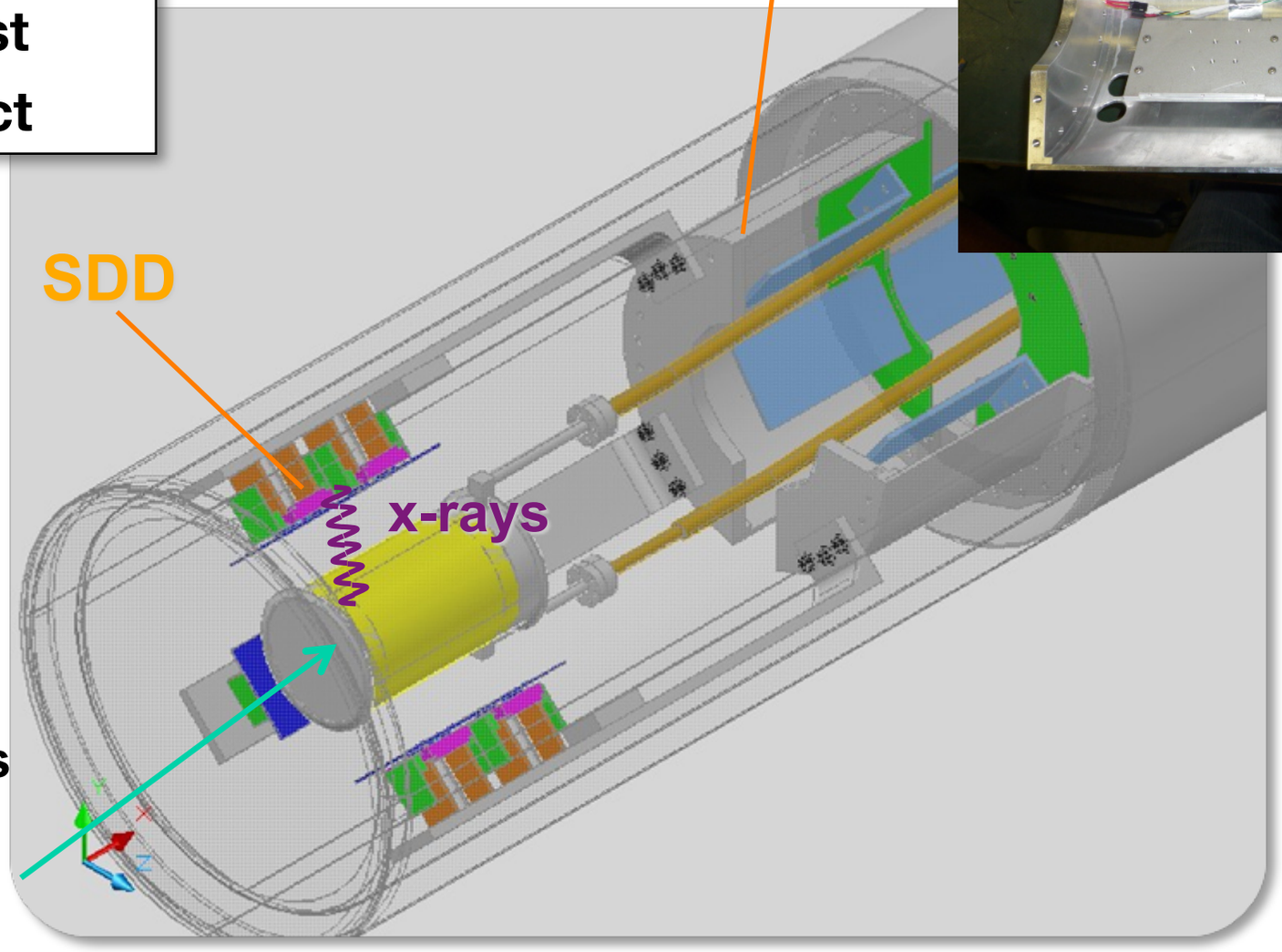
- succeed in condensing ^{3}He gas
- realistic head load test

  → negligible effect

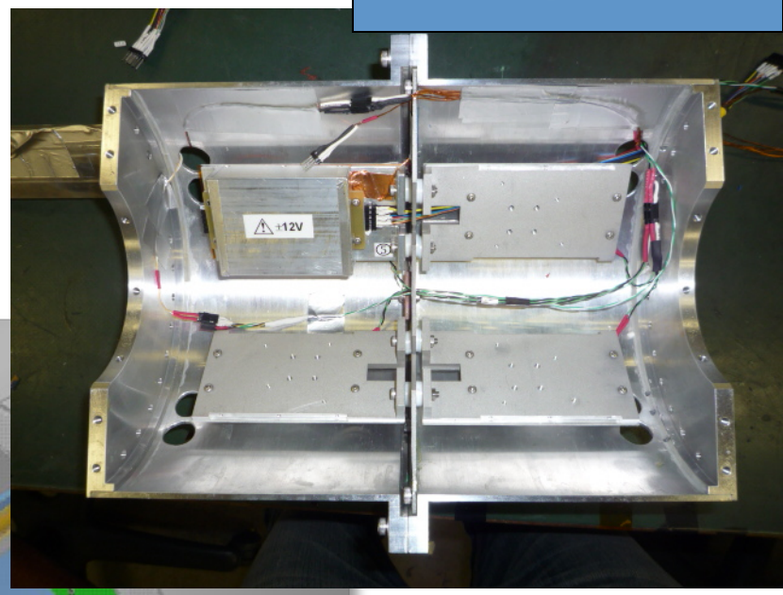
SDD housing



Acceptance: ~1.0 % /8 SDDs



Preamp box



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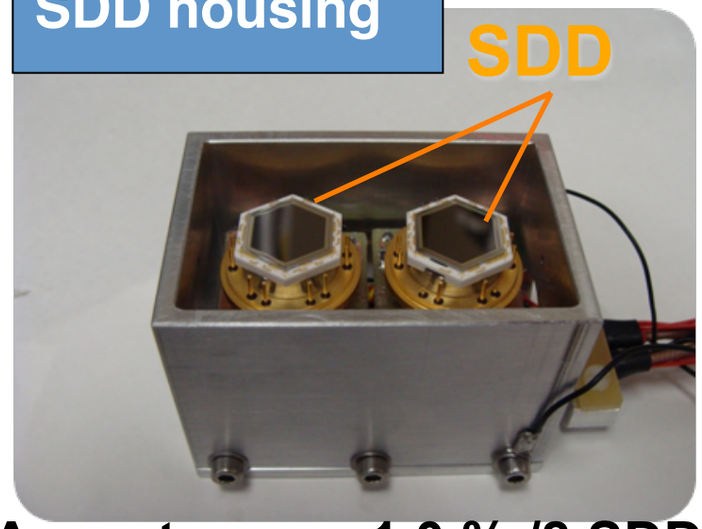
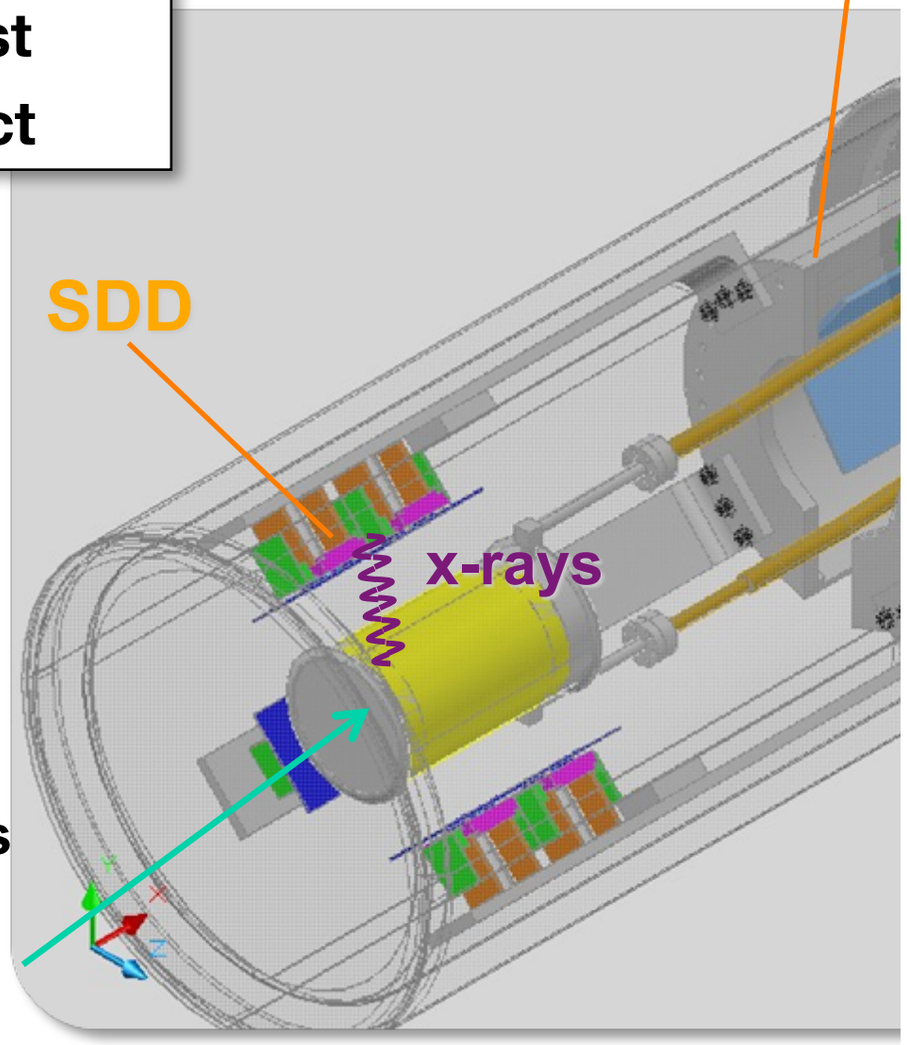
  → negligible effect

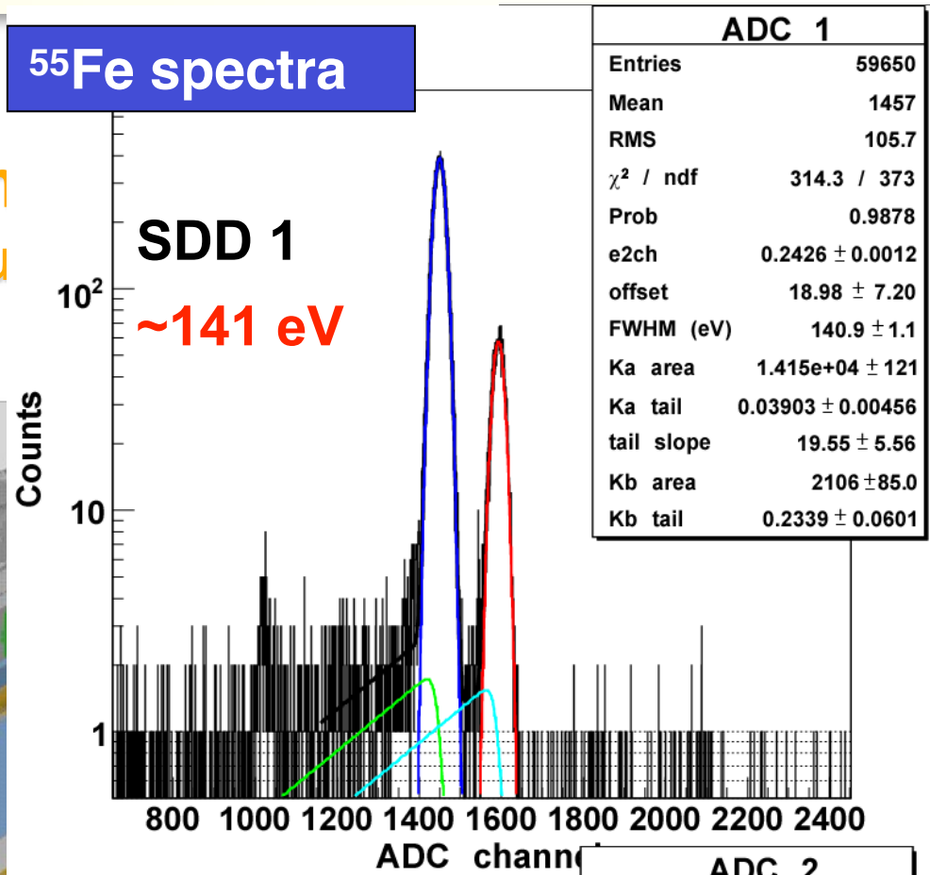
SDD housing

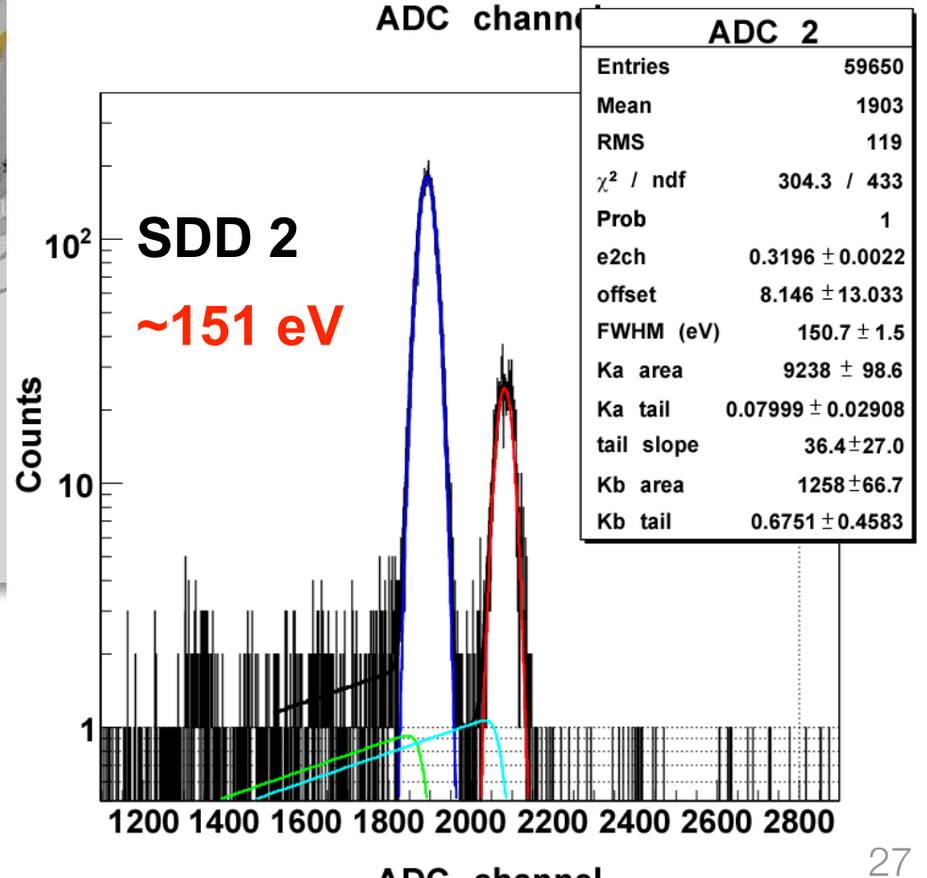


Acceptance: ~1.0 % /8 SDDs



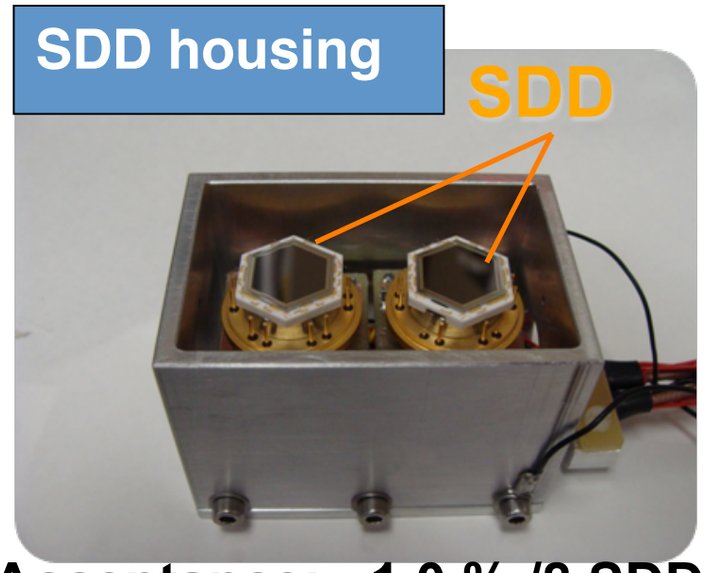
^{55}Fe spectra



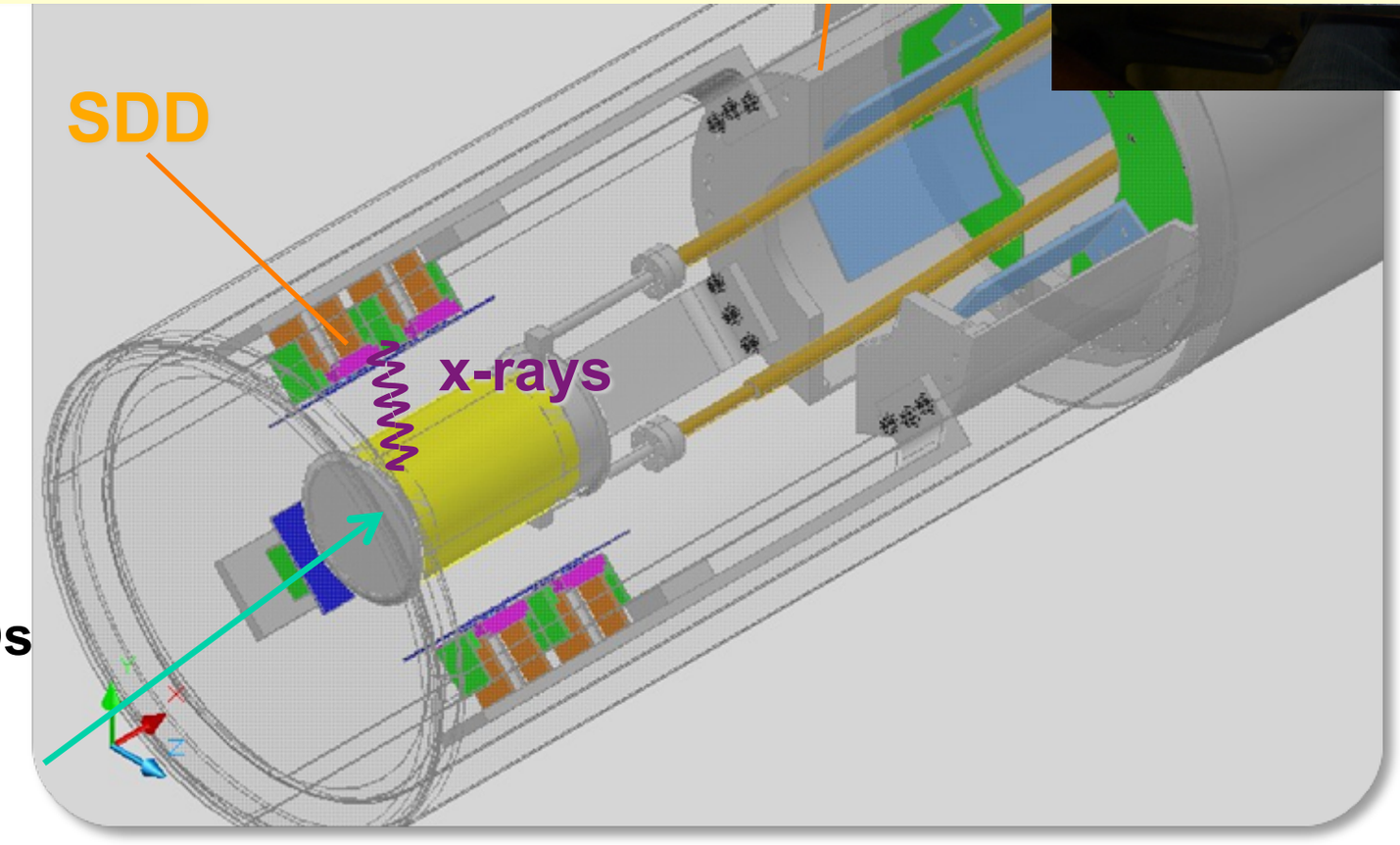


Succeed in operating SDDs in the LHe3 cryostat (preamplifiers work in vacuum)
Achieved good resolution of ~ 150 eV (@ 6 keV)

cf. ~180 eV @ E570



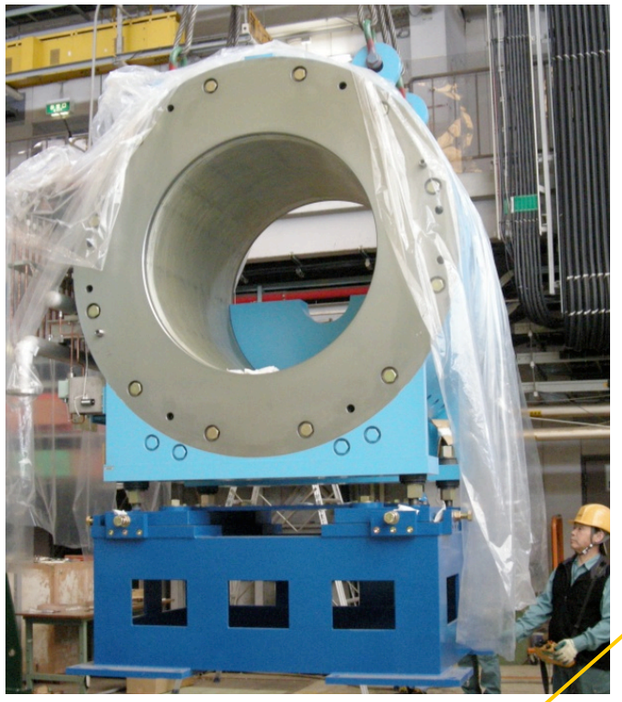
Acceptance: ~1.0 % /8 SDDs

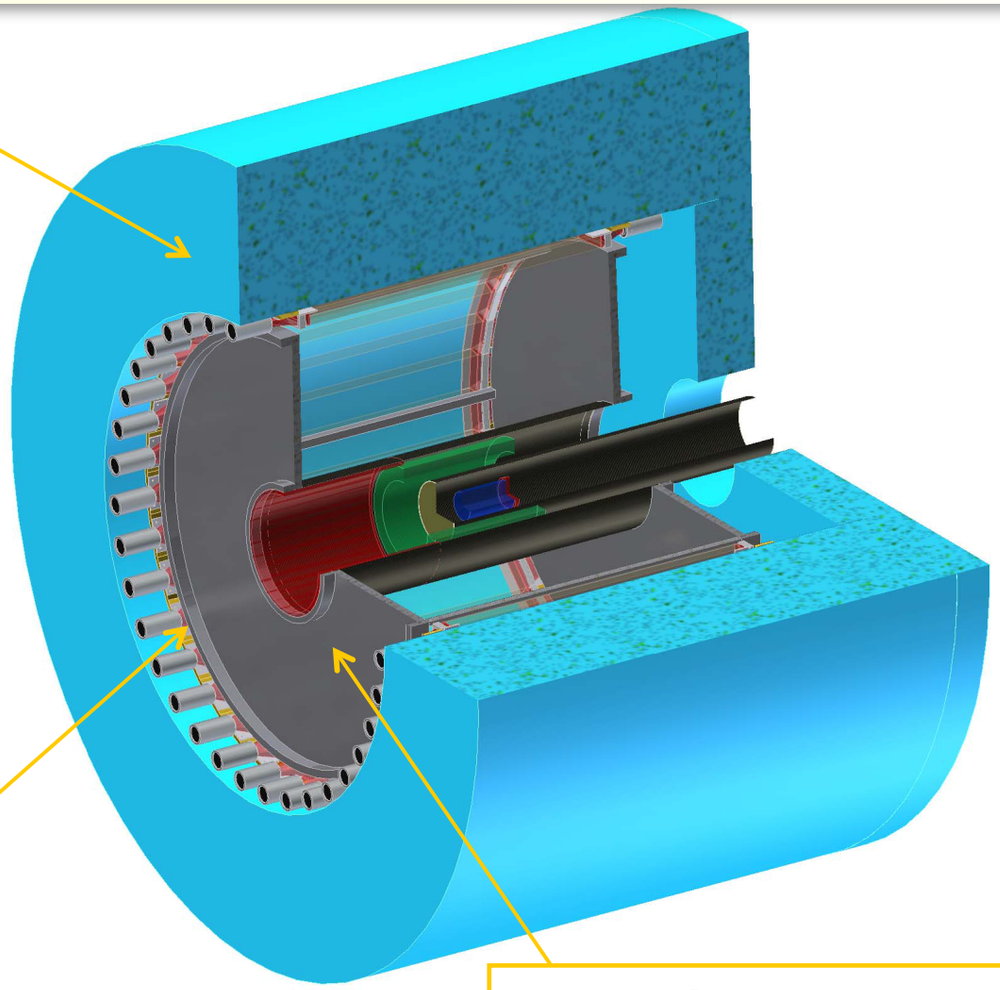


4. E15 preparation

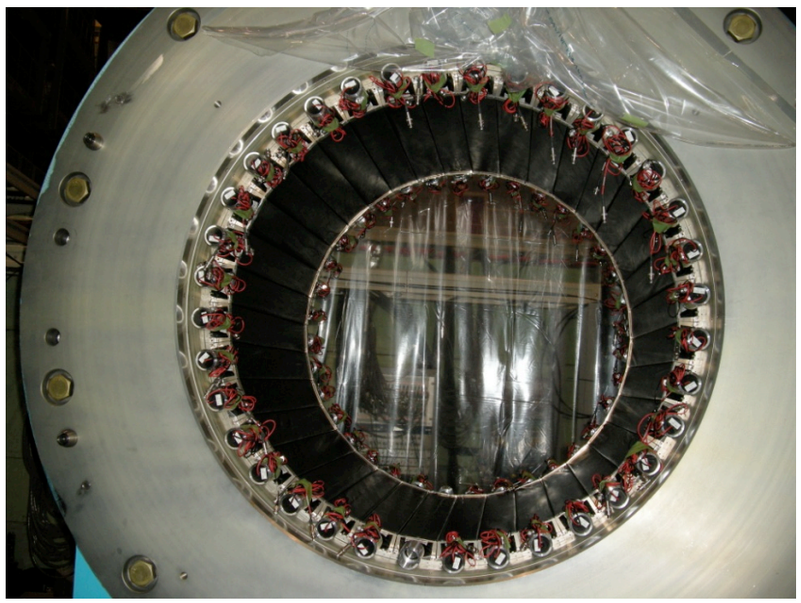
Cylindrical Detector System (CDS)

Solenoid Magnet





Hodoscope Counter



Cylindrical Drift Chamber

Cylindrical Detector System (CDS)

CDC & CDH have been successfully installed inside the Solenoid Magnet

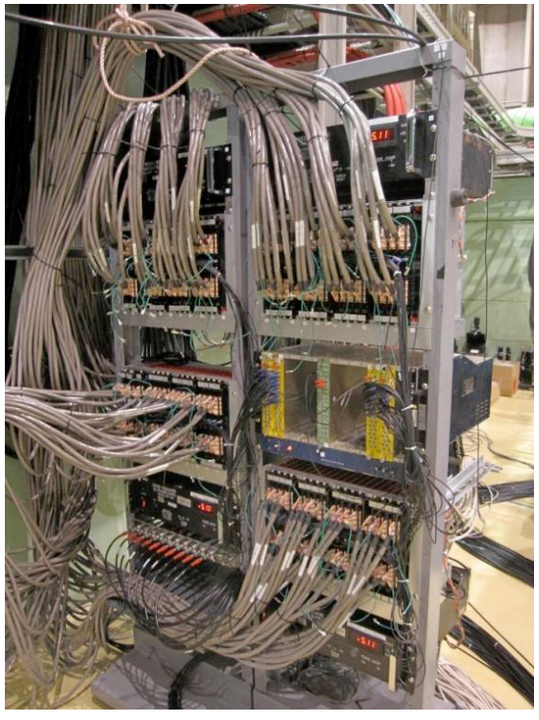
CDC readout chain

CDC with all preamp cards and cables

LVDS

8m cables

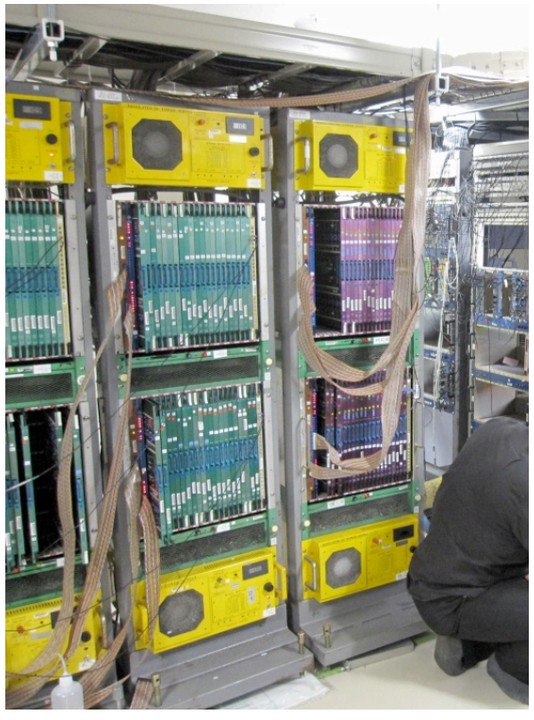
LVDS→ECL converters at the exp. hall



ECL

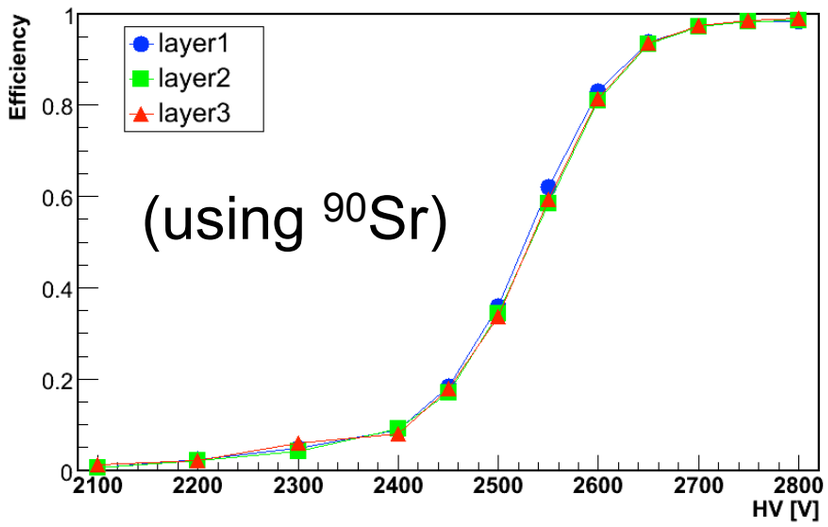
60m cables

TDC's in the counting room

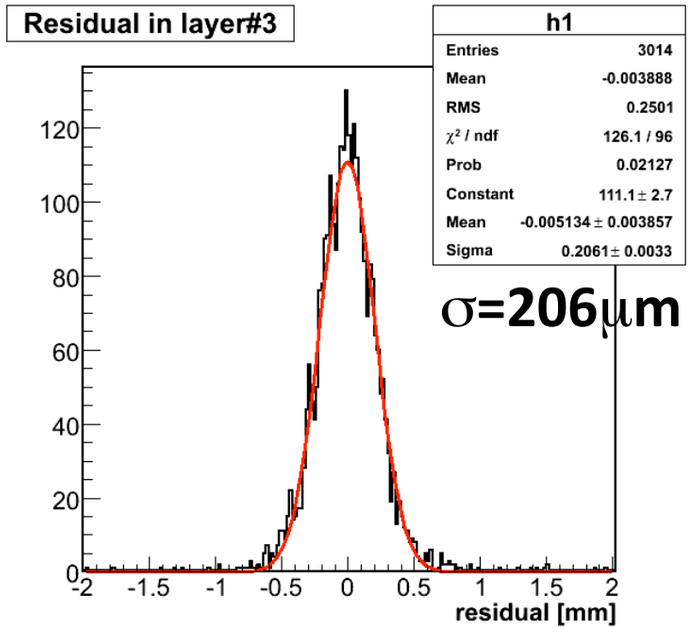


CDC Study with Cosmic Rays

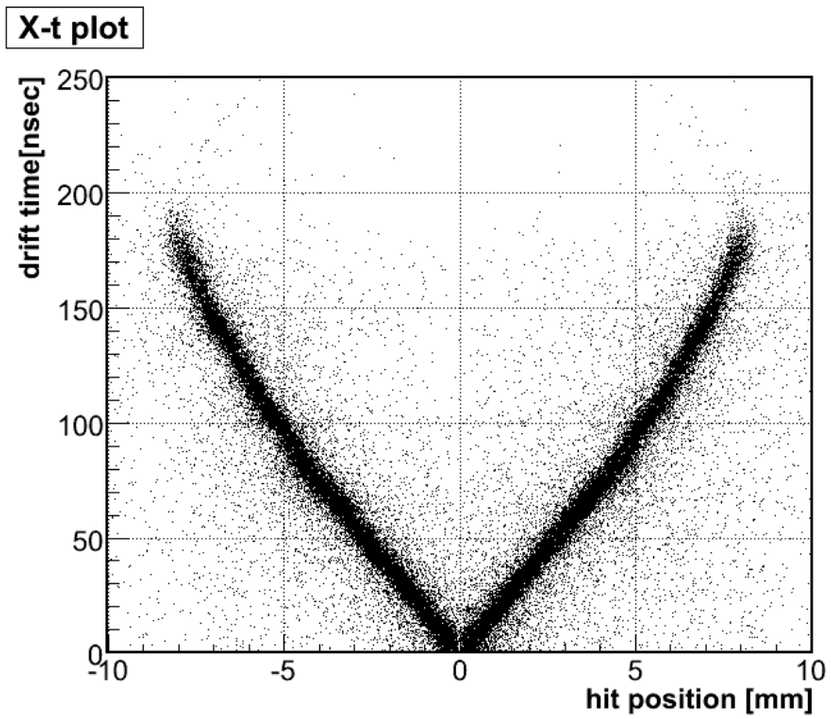
efficiency



residual



x-t relation



Intrinsic spatial resolution ~200μm

CDC has achieved the design performance

5. E17 Beamtime requirement

We need 30 weeks (1kW, Ni target)

Proposal: 135 kW-weeks → estimate the current requirement

	In proposal	Now	Now/ Proposed
Vertex detector solid angle (for fiducial cut)	“VDC”s used for E570, Ω=30%	CDC, Ω=60%	x 2
SDD solid angle	x3 larger than E570	x7.7 larger than E570	x 2.6
K- yield		~87% of the proposal	x 0.87
Total			x4.5

Now : 135/4.5 = 30 kW-week is needed to finish E17

6. Summary

SUMMARY

- **K1.8BR tuning nearly completed**
  - Yield: **500 K^-/spill/kW** @ 0.75 GeV/c with Ni target
  - ES1 works very well; we can take data with ~100 kW beam even with the present spill time structure
  - Further studies planned in run#29 & 30 (comparison of measured and calculated optics)
- **E17 is ready to run in Fall 2010**
  - needs 3 days for stopped-K^- optimization, and 7 days of detector commissioning (as in the proposal)
- **Completion of E17 will take 30 weeks**
  - Assumption: 1 kW DC beam, Ni target
- **Pt target is preferred over Ni (x2 gain)**

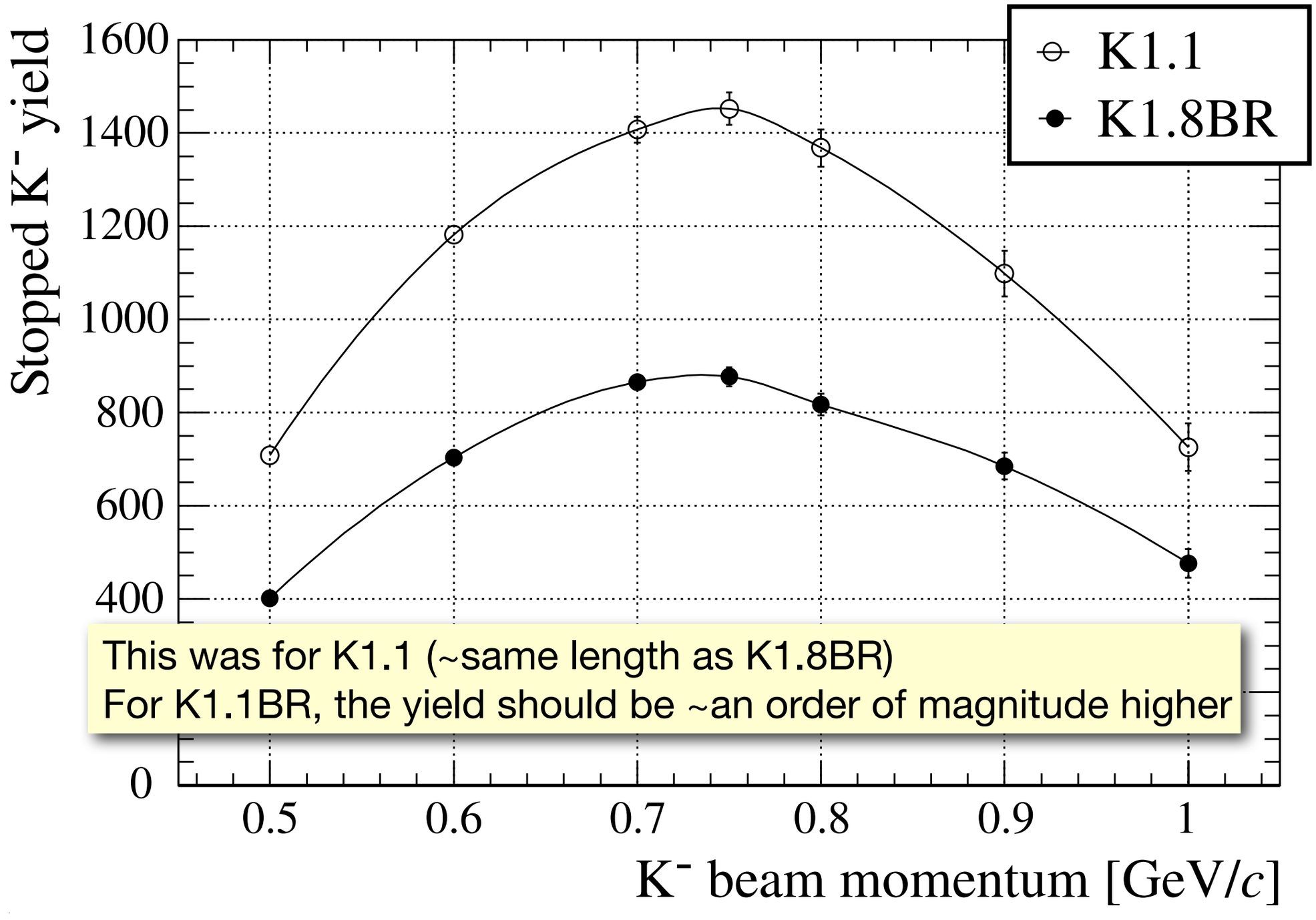
extra

K1.8BR/K1.1 comparison, from E17 proposal

E570: ~400 stopped K^- / spill

yield per spill

(flat top 0.7s, repetition 3.53s assumed)



This was for K1.1 (~same length as K1.8BR)
For K1.1BR, the yield should be ~an order of magnitude higher

K1.1BR?

- **K1.8BR is ~30m long, K1.1BR is ~20m**
  - At 0.75 GeV/c, K- intensity @ K1.1BR is expected to be higher than at K1.8BR by about x10
  - But K/π ratio would be worse due to the short separator length
- **E17's running time can be shorter at K1.1BR**
  - In this case, E15 will stay at K1.8BR with the CDC.
  - E17 tracking will be done with the old planer chambers
  - lose the vertex-cut solid angle by 50%, but rate is still higher by about x5
  - K1.1BR and SKS can run simultaneously. This increases the "throughput" of the hadron hall