RIKEN

2008 / 06 / 06

Present status of J-PARC E15/E17

M. Iwasaki

Advanced Meson Science Lab.

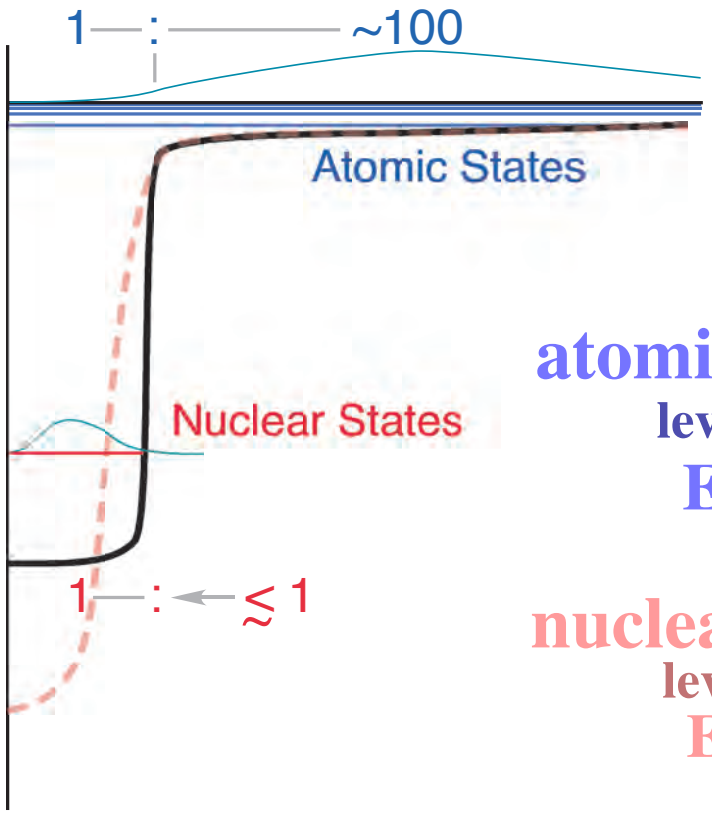
5th J-PARC PAC meeting

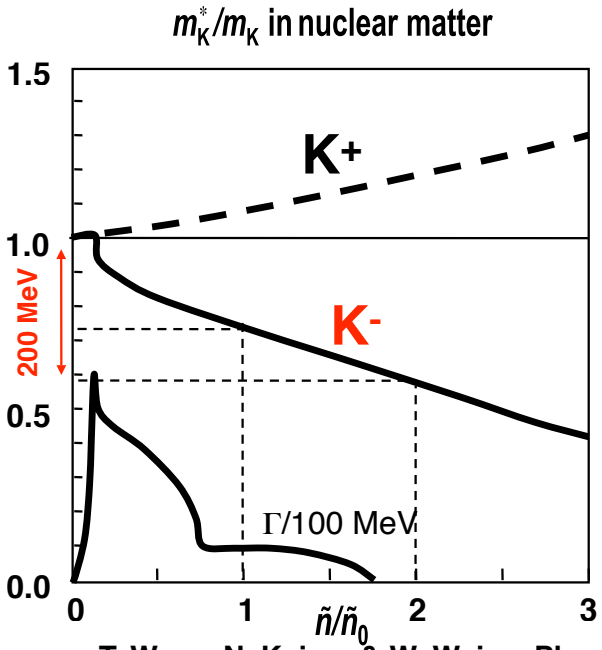
RIKEN NiSHiNA CENTER

独立行政法人 理化学研究所
仁科加速器研究センター

Study of $\bar{K}N$ interaction by E17 / E15

sharing resources: area, setup etc.





T. Waas, N. Kaiser & W. Weise, Phys. Lett. B379 (1996) 34.

atomic states

level shift and absorption width

E17: K^- ^{3}He $3d$ - $2p$ x-ray

K at rest

nuclear states

level energy and decay width

E15: ^{3}He(K^-, n) missing & invariant mass

K @ 1 GeV/c

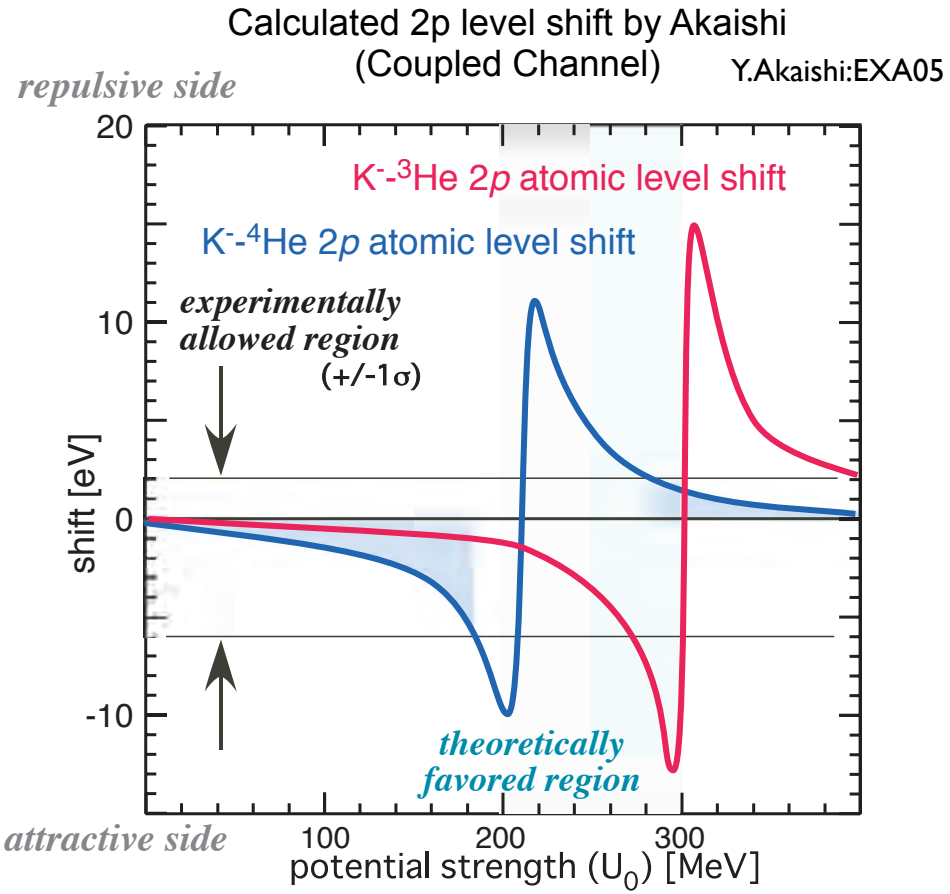
strongly attractive in I=0 channel

$\bar{K}N$ study by atomic states

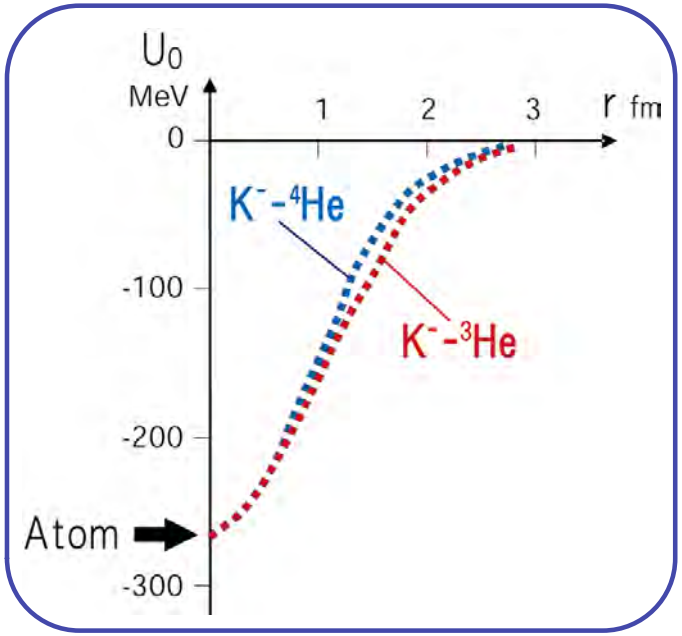
K at rest

level shift and absorption width

E17: K^- ^{3}He 3*d* - 2*p* x-ray



U_0: real part of the K^--He local potential

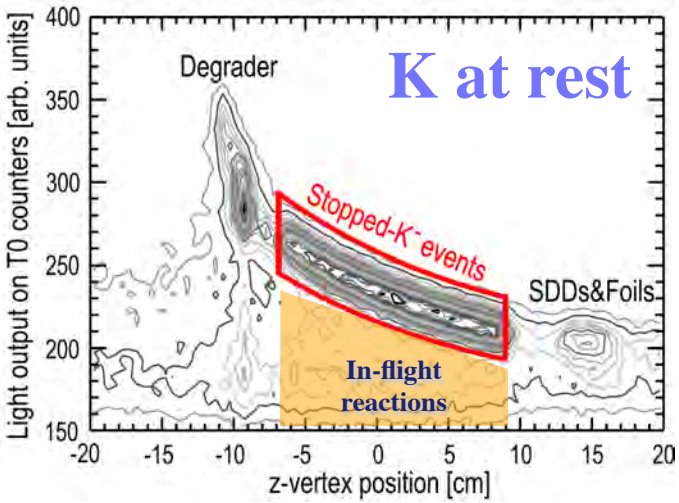


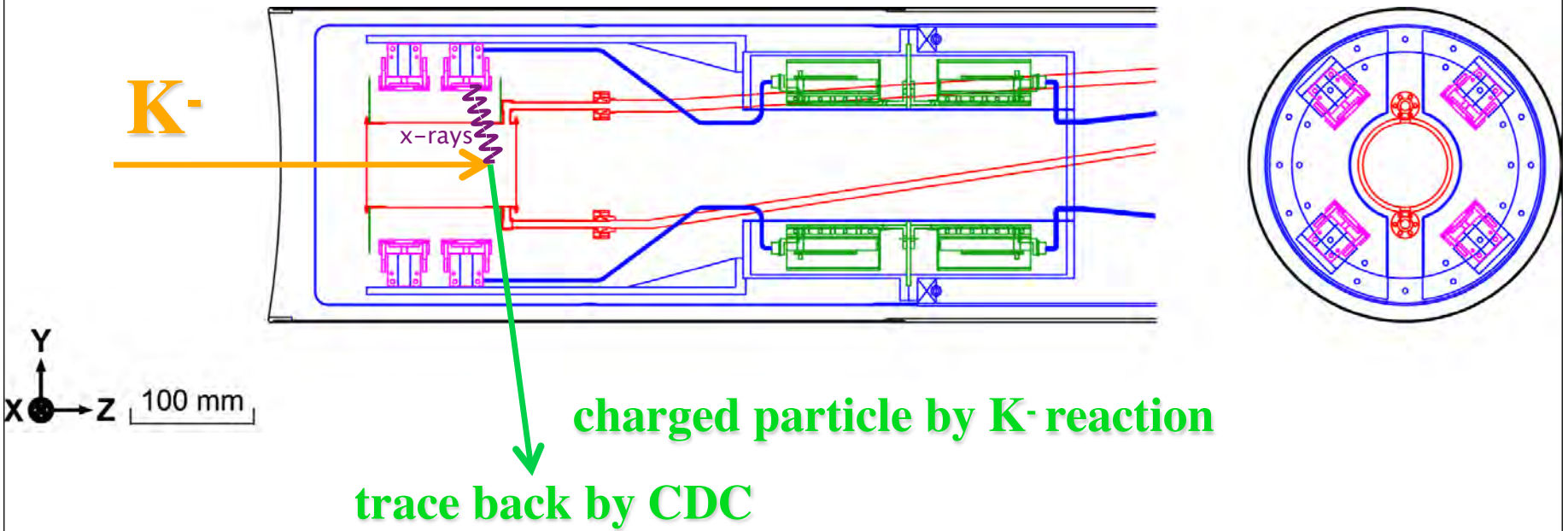
$\bar{K}N$ study by atomic states

level shift and absorption width

E17: K^- ^{3}He $3d$ - $2p$ x-ray

application of well proven experimental method in KEK PS-E570



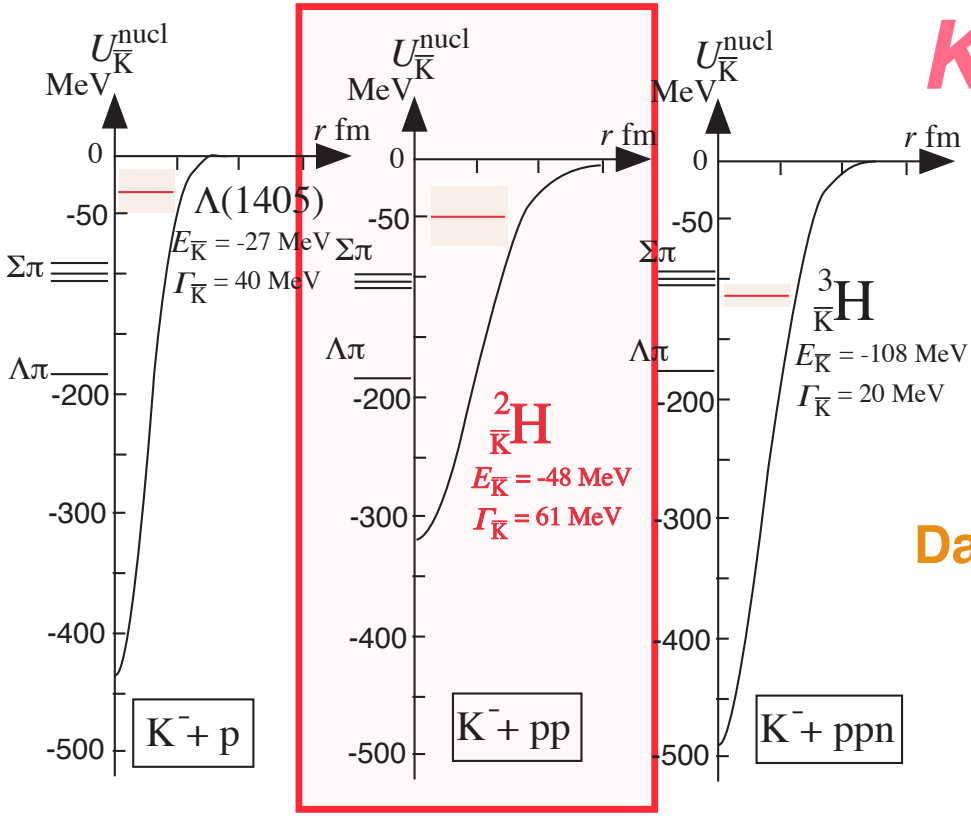


$\bar{K}N$ study by nuclear states

K @ 1 GeV/*c*

level energy and decay width

E15: ^{3}He(K$^-$, n) missing & invariant mass



T. Yamazaki, Y. Akaishi / Physics Letters B 535 (2002) 70

K$^-$pp

- **simplest system**
  - less excited states
  - less ambiguity
    - *full kinematical reconstruction*
- **minimum absorption**
  - multi-nucleon absorption

Data from FINUDA group

M. Agnello et al.
Phys. Rev. Lett. 94 (2005) 212303

New data from Osaka group

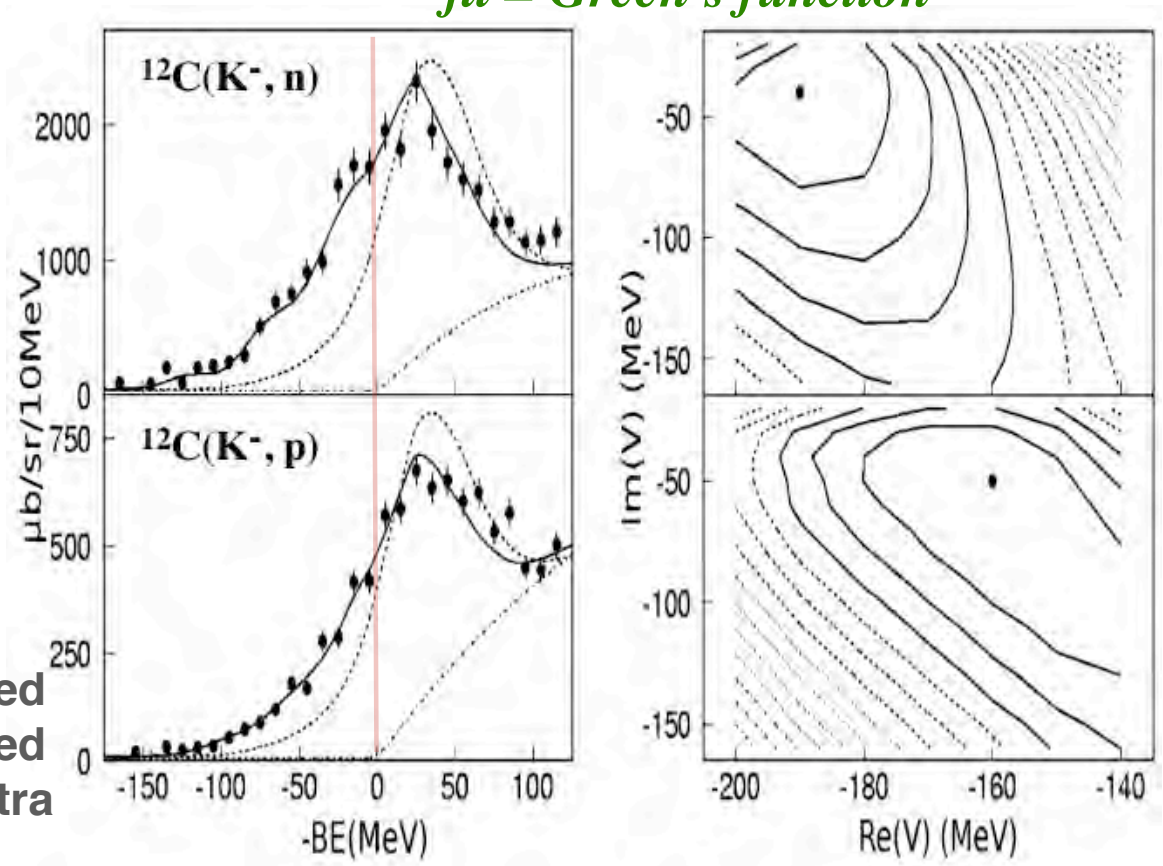
(one of new data : in-flight)

in-flight (K-, n) reaction @ 1 GeV/c

indicating very deep potential
Kaon condensation?

T. Kishimoto et al., Prog. Theor. Phys. 118 (2007) 181

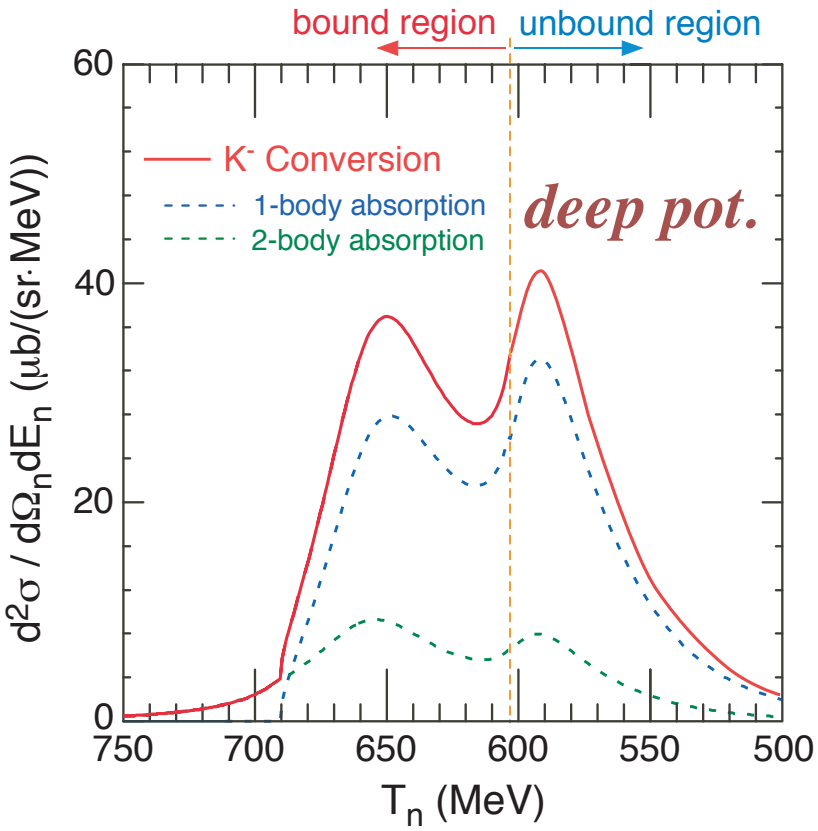
fit = Green's function



- deep & wide KN pot.
  - Re(V) ~ 200 MeV
  - Im(V) ~ 50 MeV
- lower background
  - in-flight ensures ...
  - 2N process suppressed
  - kinematically separated
  - not seen in the spectra

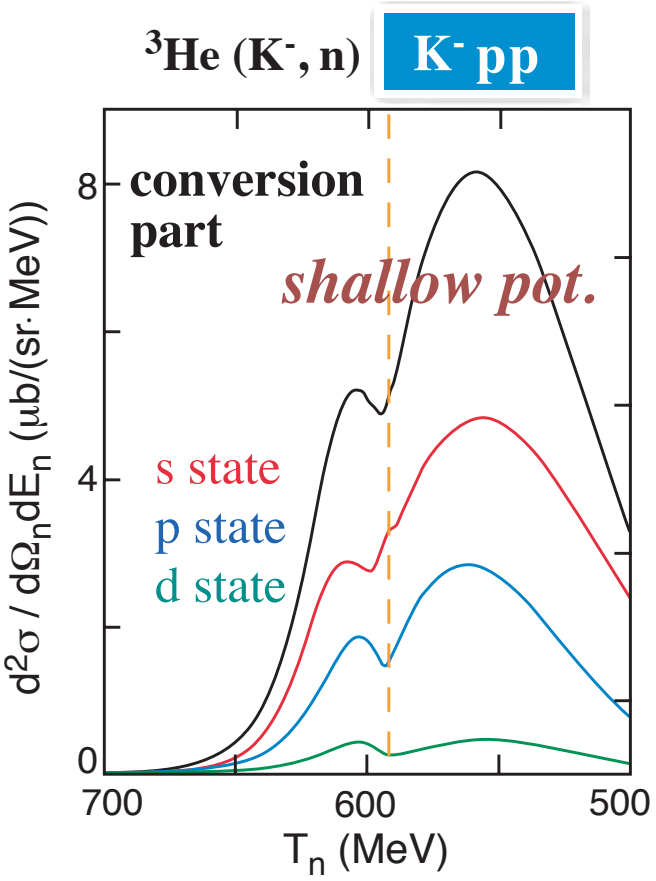
Theoretical progress

- bound state will be seen
- yield 5 ~ 40 μb / (sr MeV)
- resolution must < 20MeV



T. Koike, T. Harada, Phys. Lett. B652 (2007) 262

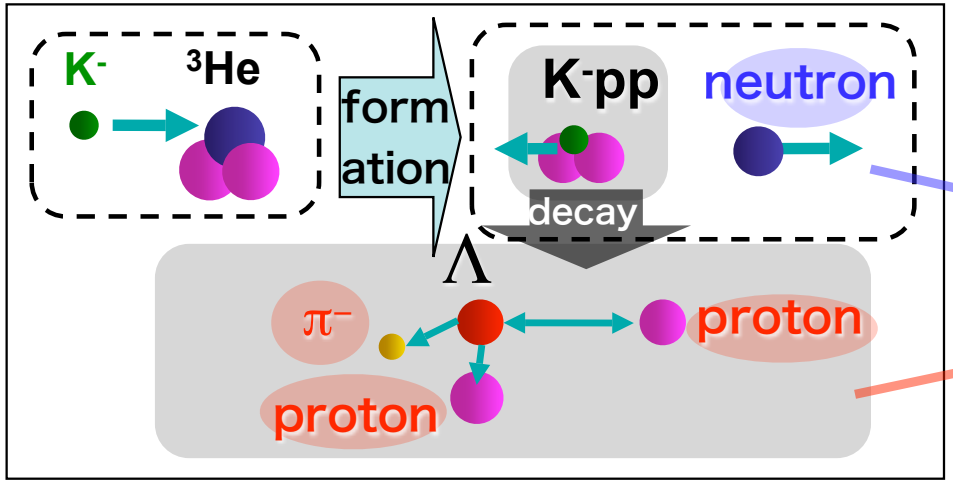
Chiral unitary



J. Yamagata, S. Hirenzaki, H. Nagahiro, D. Jido,
Mod. Phys. Lett. A accepted. Proc. of Chiral07.

KN study by nuclear states level energy and decay width

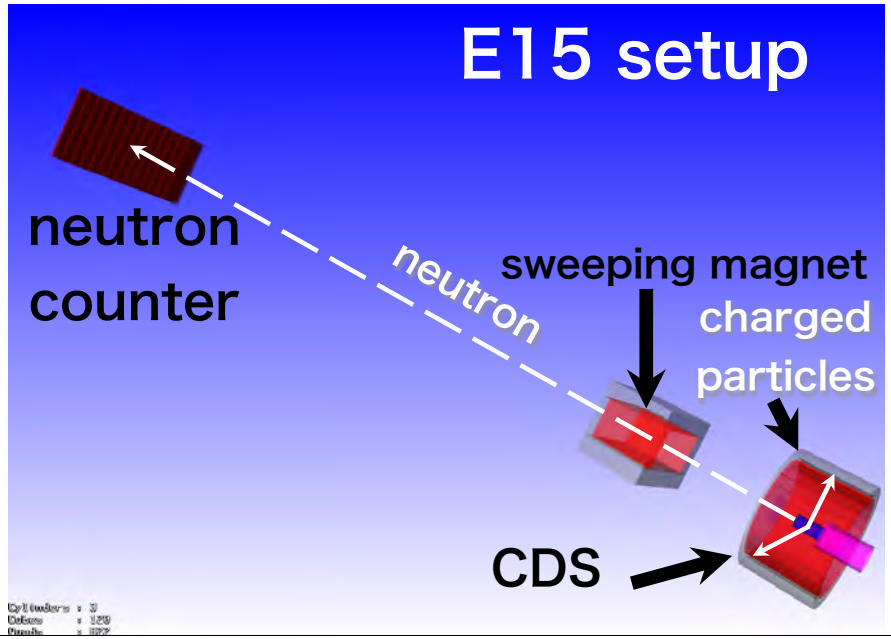
E15: ^{3}He(K$^-$, n) missing & invariant mass



- lightest：K-pp
- observation of

"formation" and "decay"

cf. $\Sigma^{\pm}\pi^{\mp}$p *decay channel can also be tagged* by π^+ π^- tag

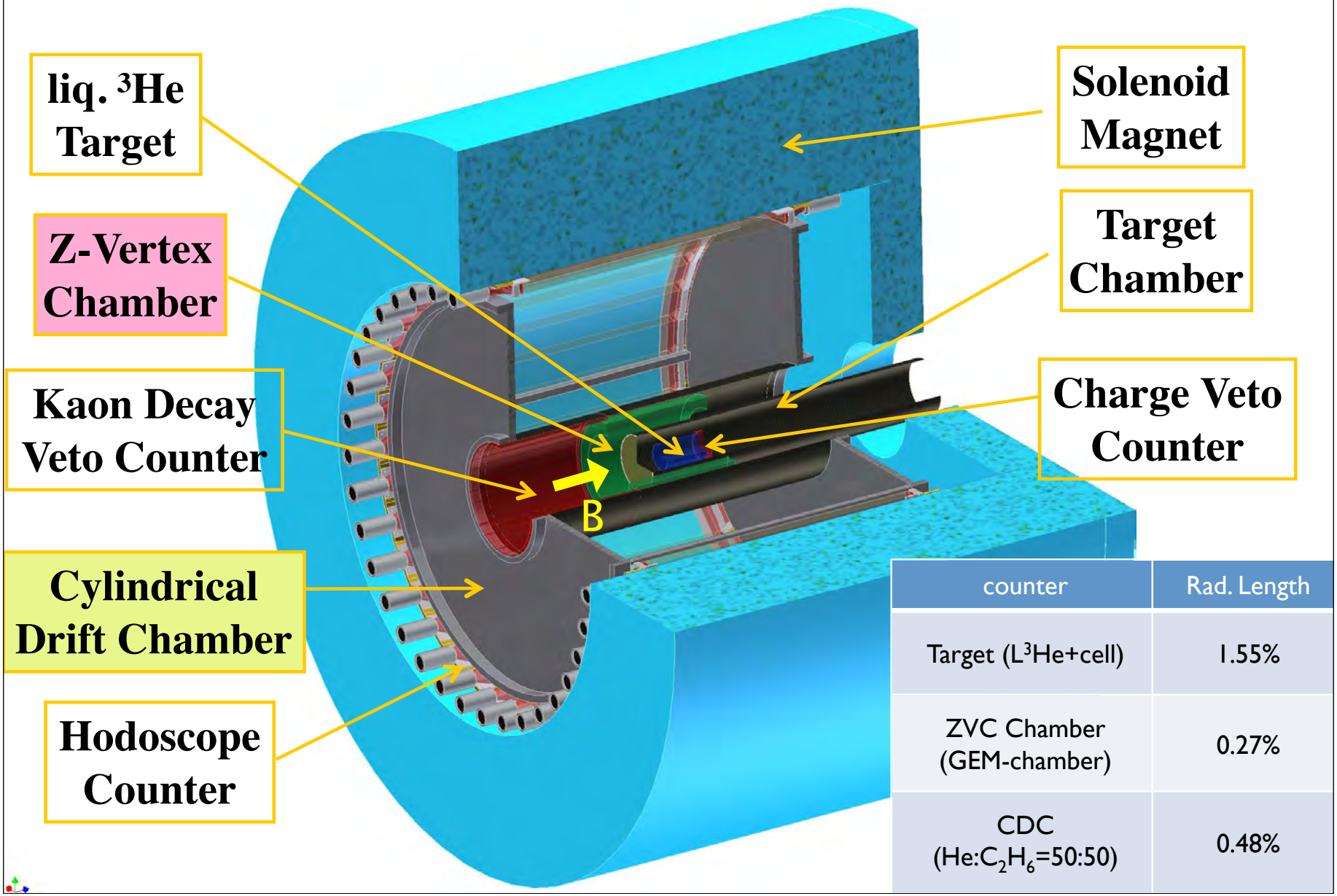


Cylindrical Detector System
1) solenoid
2) CDC
3) hodoscope
^{3}He target
neutron counter
beam line detector

competitor

FOPI @ GSI aiming same physics!

CDS overview

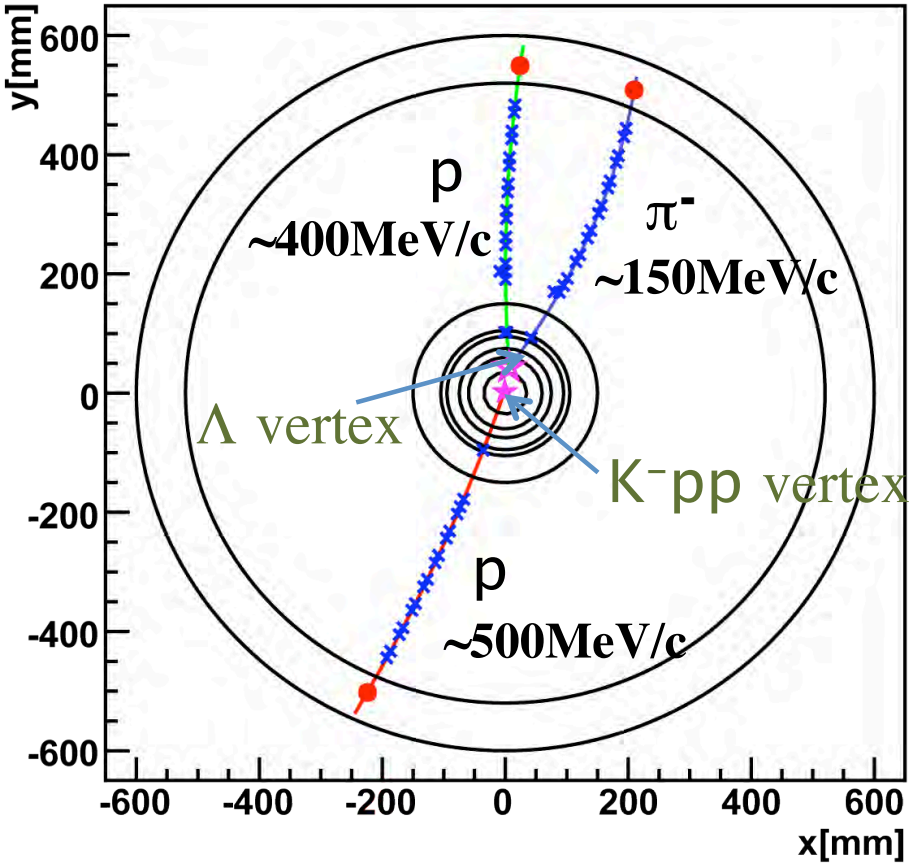


counter	Rad. Length
Target (L^3He+cell)	1.55%
ZVC Chamber (GEM-chamber)	0.27%
CDC ($He:C_2H_6$=50:50)	0.48%

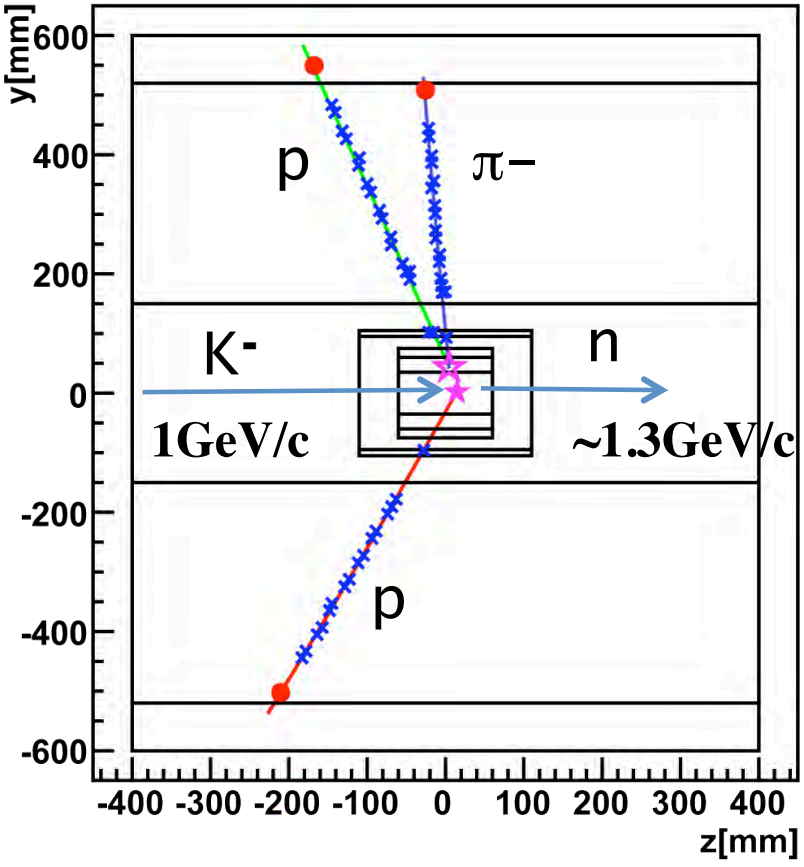
K⁻pp event display

- binding energy = 100MeV
- Geant4 simulation
- with forward neutron

CDS xy-plane

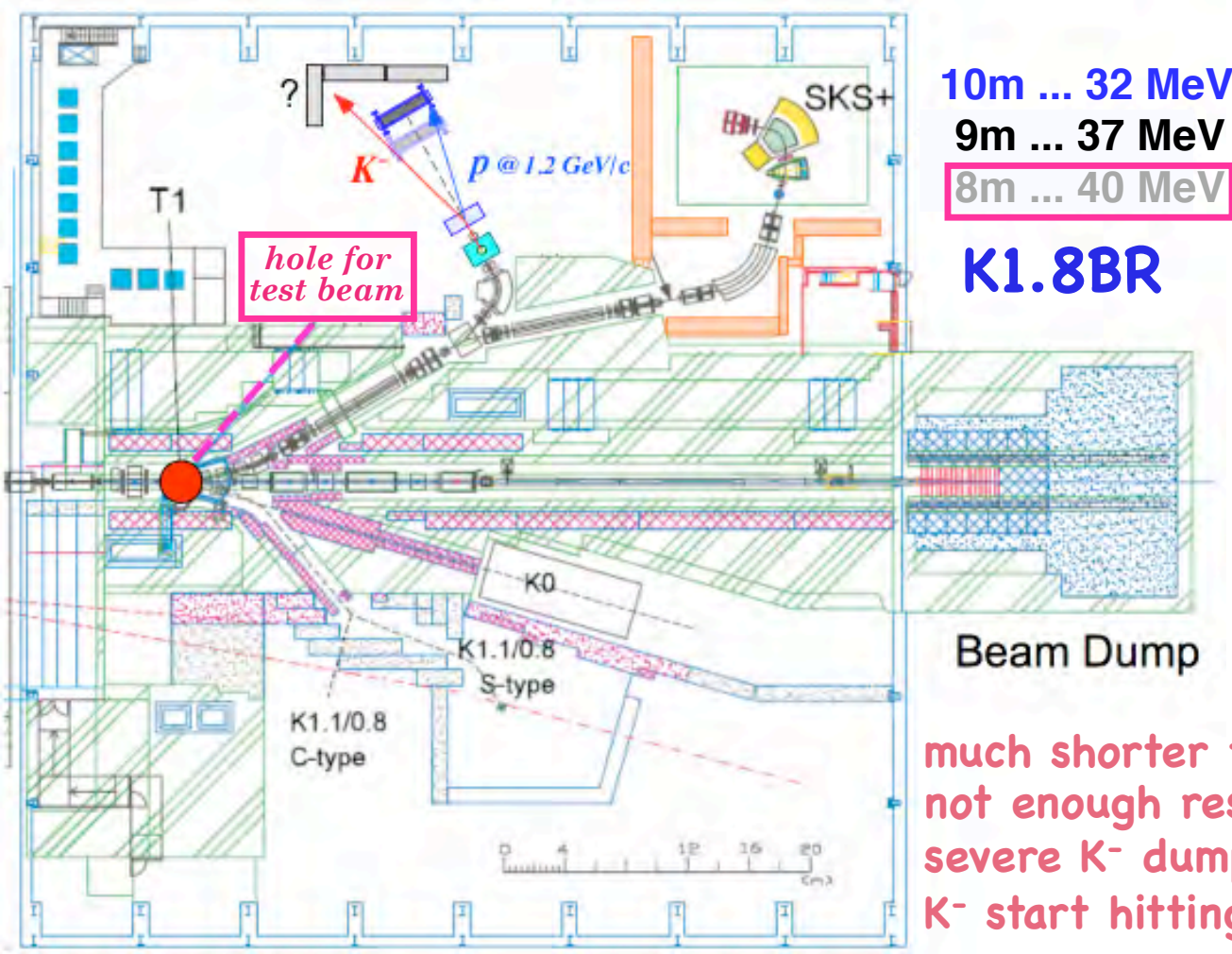


CDS zy-plane



Where to do ... ?

radiation safety not allow us to place NC where we wish ...



10m ... 32 MeV

9m ... 37 MeV (FWHM)

8m ... 40 MeV

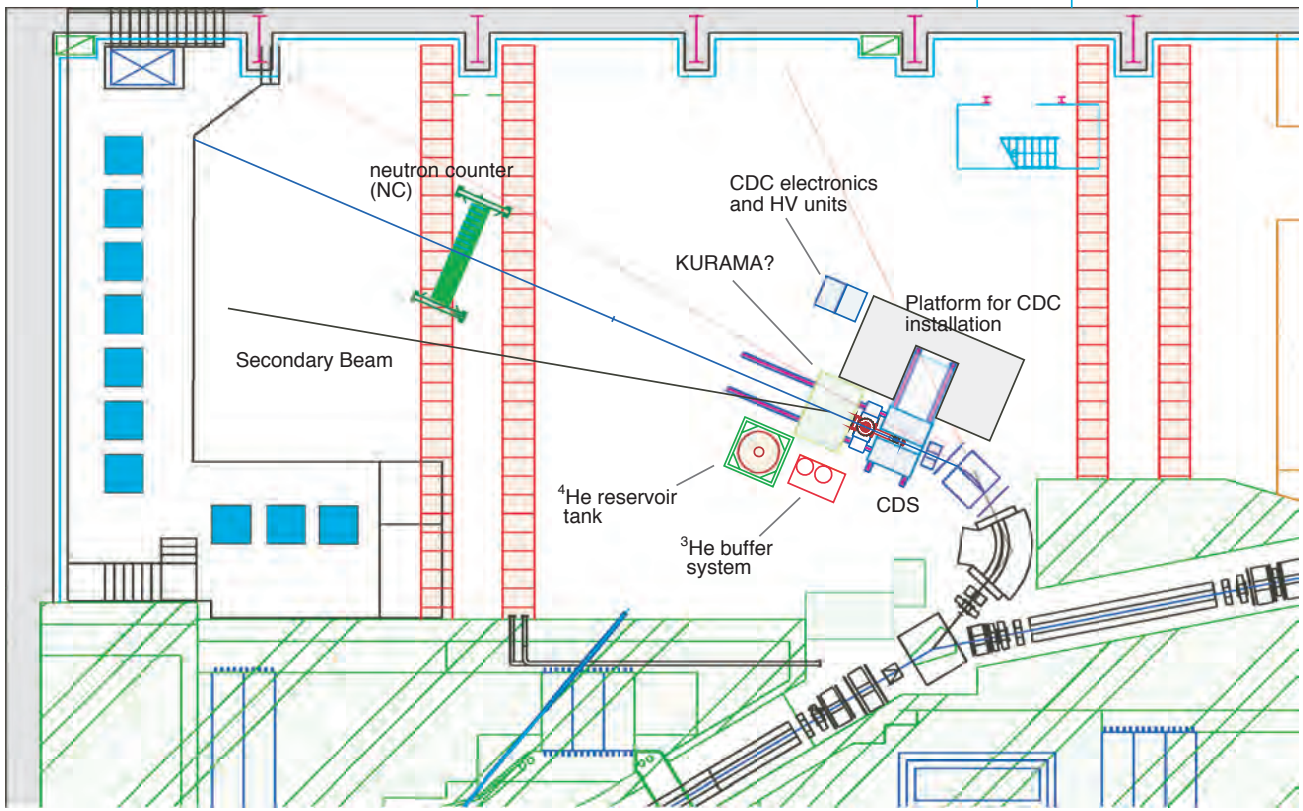
K1.8BR

much shorter than expected
not enough resolution
severe K^- dump background
K^- start hitting NC!

Why not K1.8BR ?

extraction angle modification

enough resolution
small K^- dump background
well separated K^- beam



15m ... 20 MeV

(FWHM)

as in proposal

final shape for E15

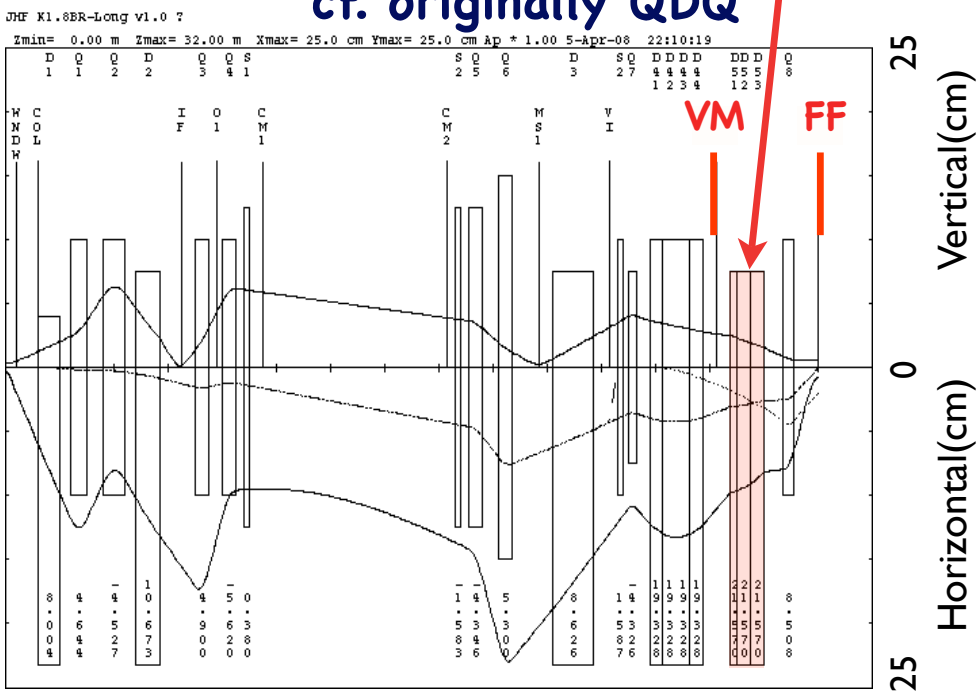
realized until Sept. 2009

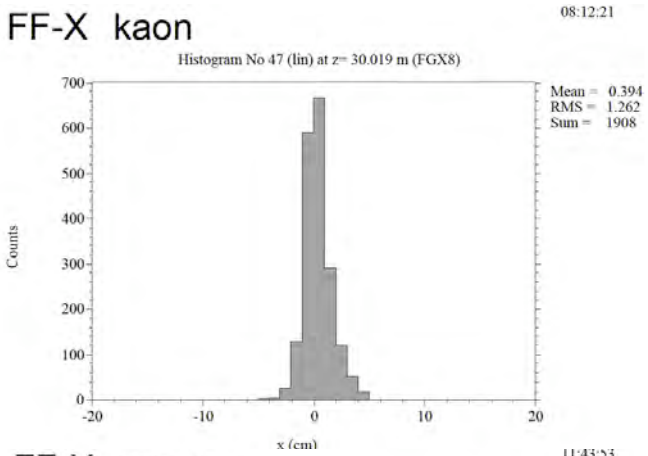
K1.8BR Op.1 proposed by Noumi

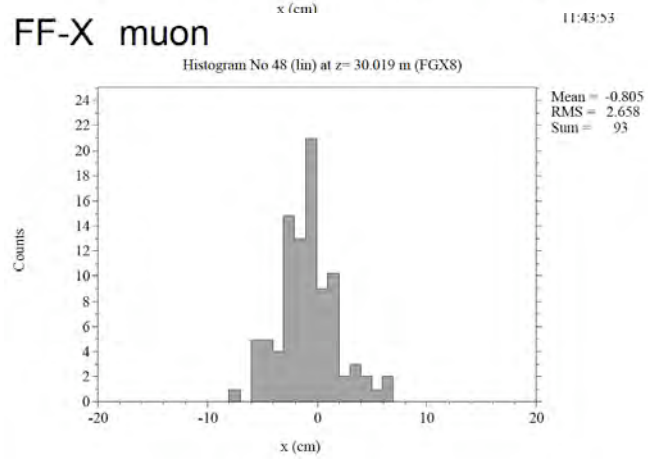
QDDQ configuration

added dipole

cf. originally QDQ







$\Delta p/p \sim 0.7$ % (@ $\Delta\theta \sim 5$ mrad by VM to FF tracking)

Time table

		2008							2009								
		6	7	8	9	A	B	C	1	2	3	4	5	6	7	8	9
beamline	beamline drift chamber mentenance																
	– mounting structure fab.																
	PID cherenkov counter design																
	– fablication + test																
	installation of beamline detectors																
	TOF wall design and construction																
	– installation to K1.8BR																
	beam tuning with beamline detectors																
	installtion of dev. For K stop run																
CDS	Pre-Amp prototype production																
	– fablication																
	CDC full system test at J-PARC																
	CDH element fablication																
	Solenoid magnet installation																
	CDH and CDC installtion																
	final full system test																
	Z-chamber design																
	Z-chamber constraction																
	Z-chamber test																
^{3}He target	target element design + fablication																
	cooling test and modification																
	SDD installation + cooling test																
	final systemtest to K1.8BR																
NC	mounting NC counter																
	installation of NC in K1.8BR + test																

start beam tune!

able to start E17

able to start E15

Beam tune

most devices are ready
(from previous exp.
/ well proven)

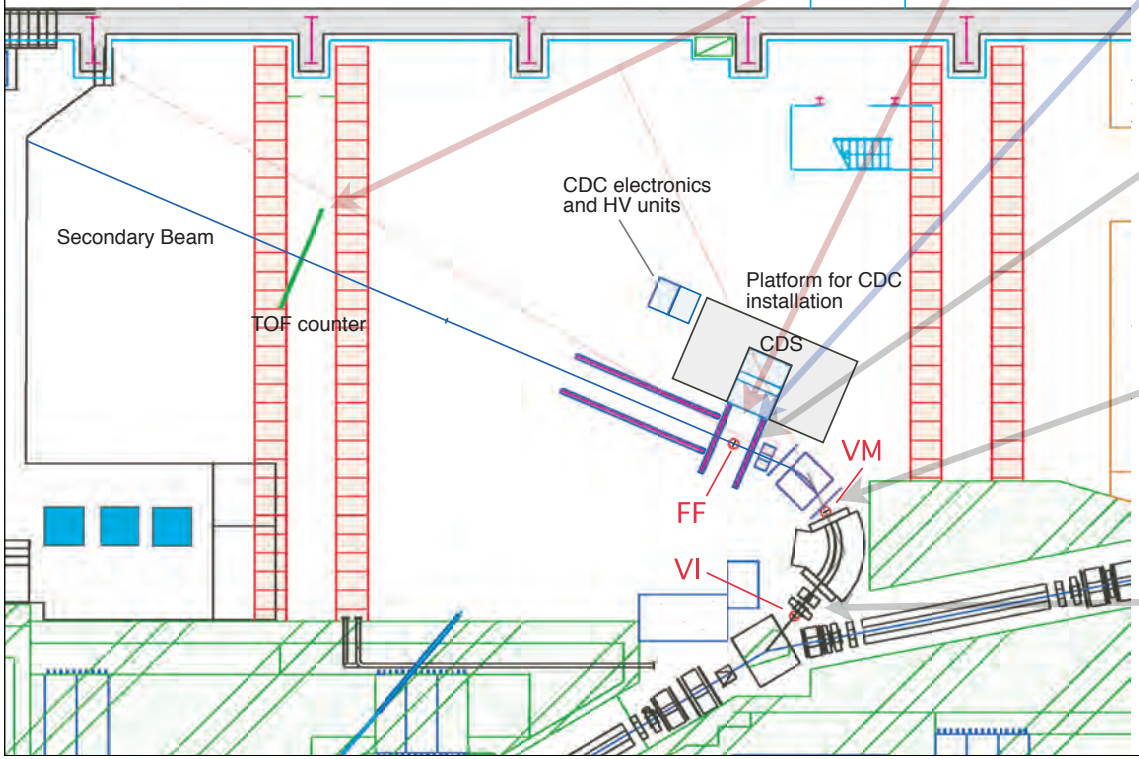
- realize on-line beam tuning by
- based on scaler (hardware)
- beam profile by simple chamber analysis

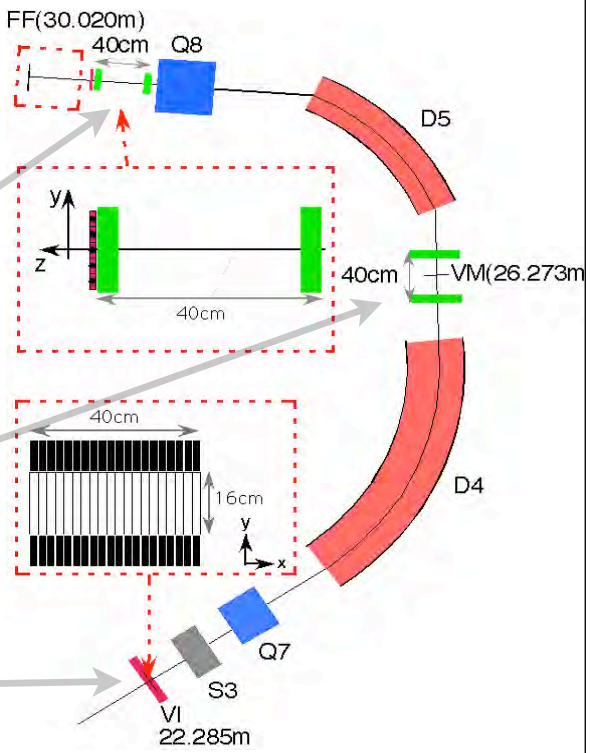
TOF

	0.7 GeV/c t (nsec)	1.0 GeV/c t (nsec)
e	50.03	50.03
μ	50.60	50.31
π	51.03	50.52
K	61.31	55.83
p	84.22	68.74
d	149.18	107.51

PID by Cherenkov

0.7 / 1.0 (GeV/c)	Water (n=1.33)	Aerogel (n=1.05)	Gas (n=1.003?)
e	Y / Y	Y / Y	Y / Y
π (μ)	Y / Y	Y / Y	N / N
K	Y / Y	N / N	N / N
p	N / N	N / N	N / N



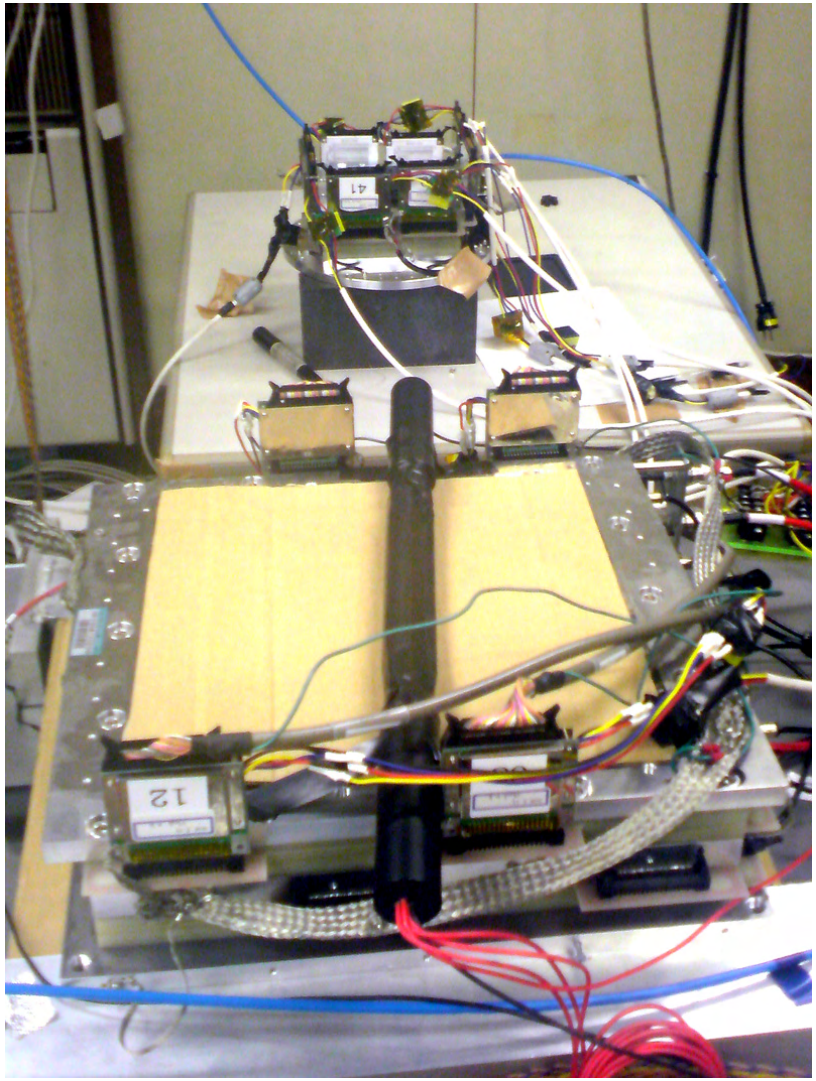


realized until Jan. 2009

Device for Beam tune

most devices are ready

(from previous exp. / well proven)

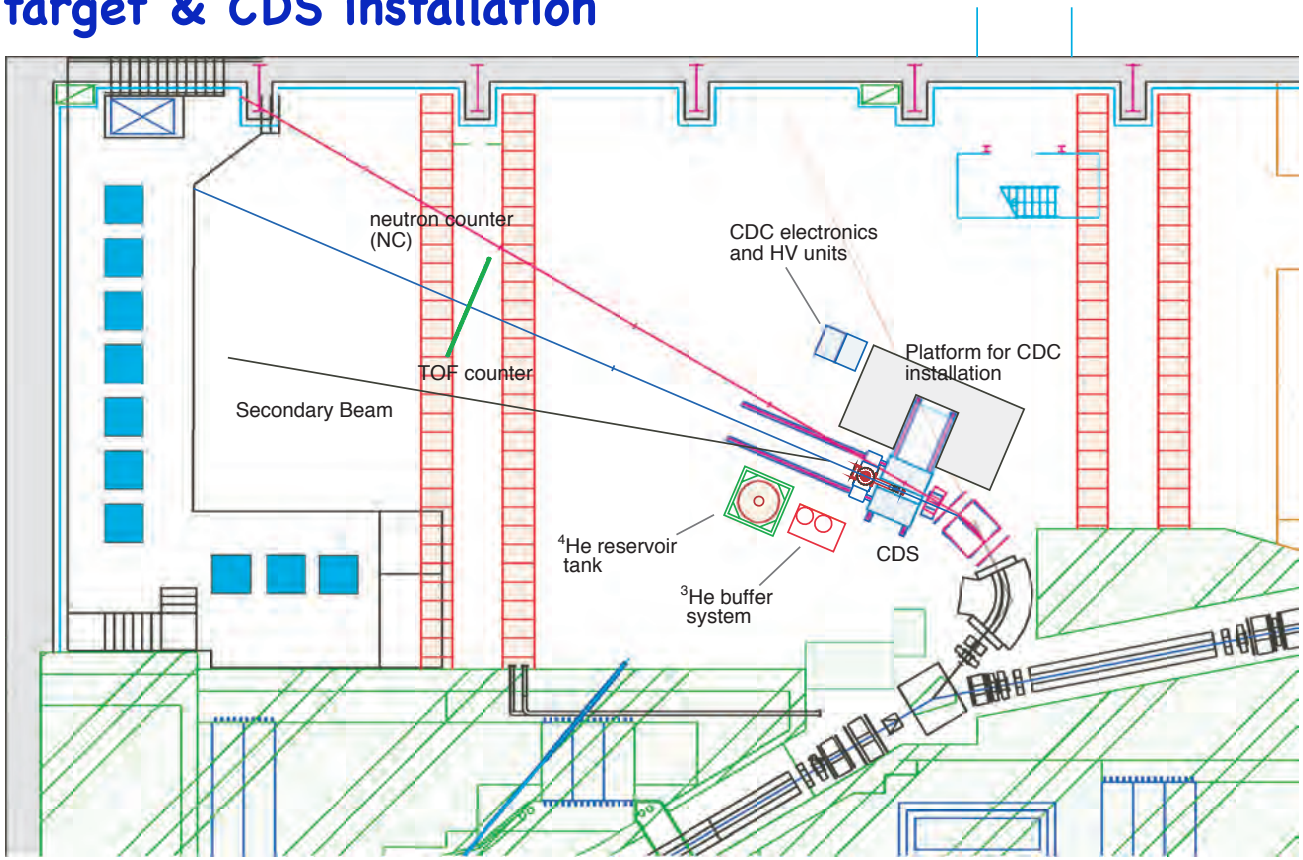


- check/preparation at KEK K5

device for E549 / E570

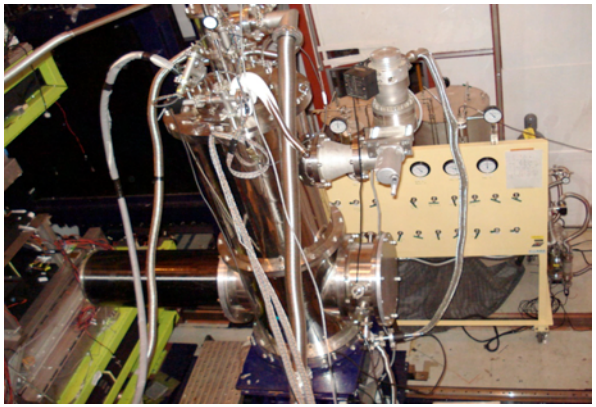
E17 mode

target & CDS installation

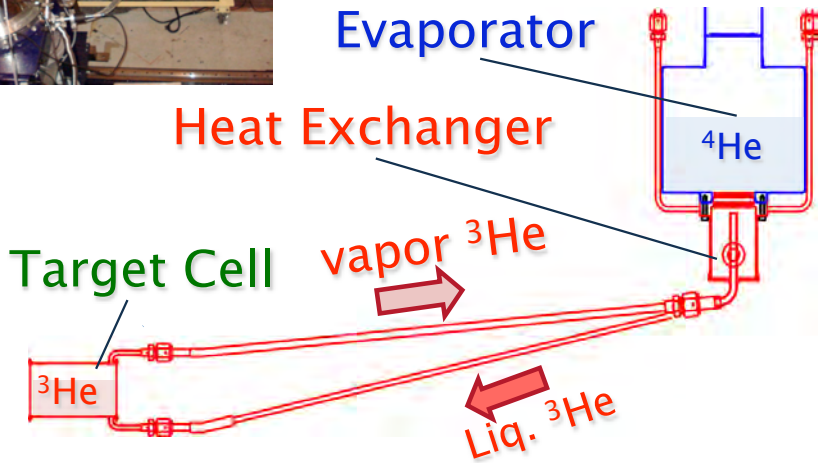


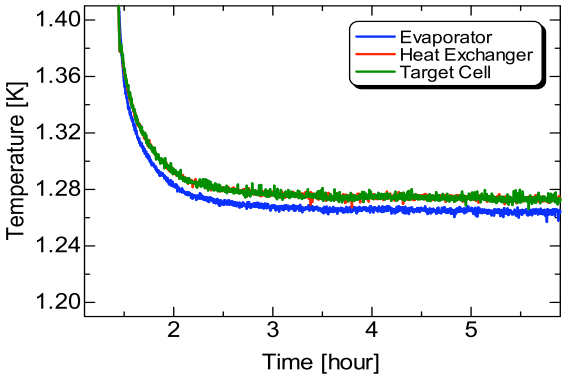
realized until April 2009

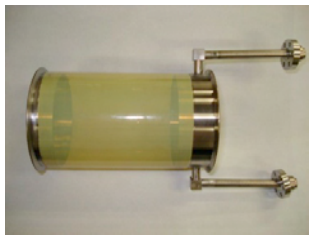
^{3}He target is ready



Temperature in the Target Cell	1.3 K
Pressure in the Evaporator	36 hPa
Liq. ^{4}He Consumption	45 L/day
Heat Load to the 1K Parts	0.19 W

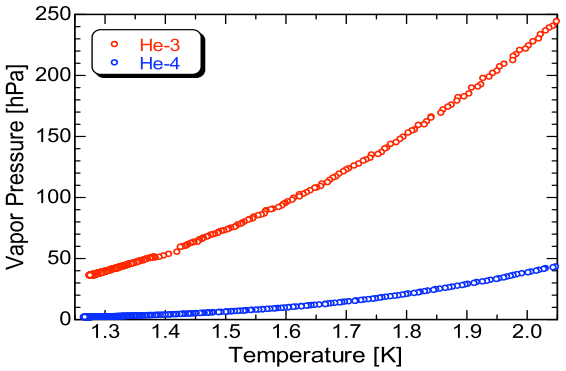




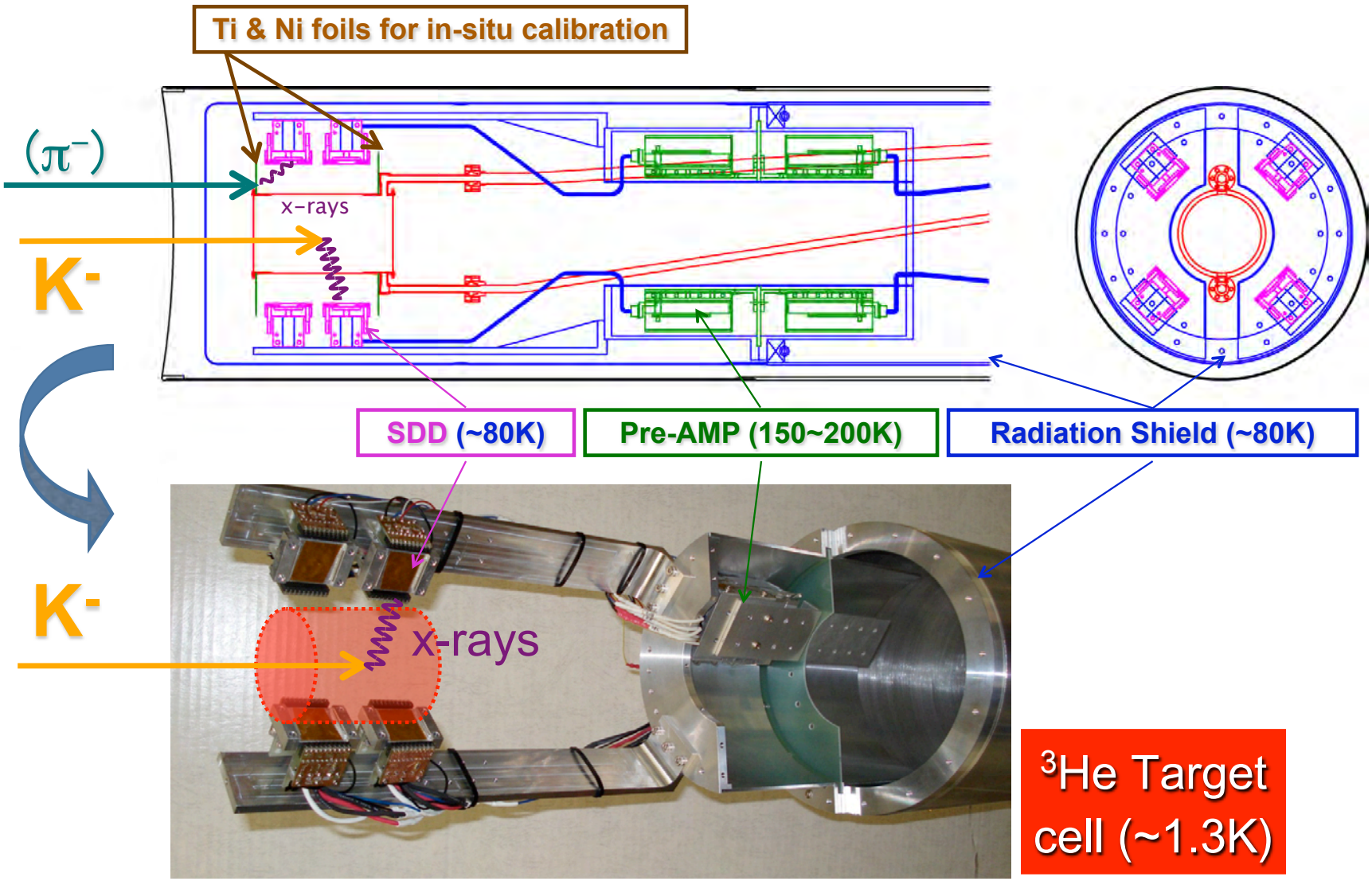


Pressure Tight (>1atm)
Impurity-free (Fe, Cu,..)
High Radiolucency @6.3 keV

Frame: Pure Titanium
Cylinder: MICTRON (para-type aramid film)TORAY

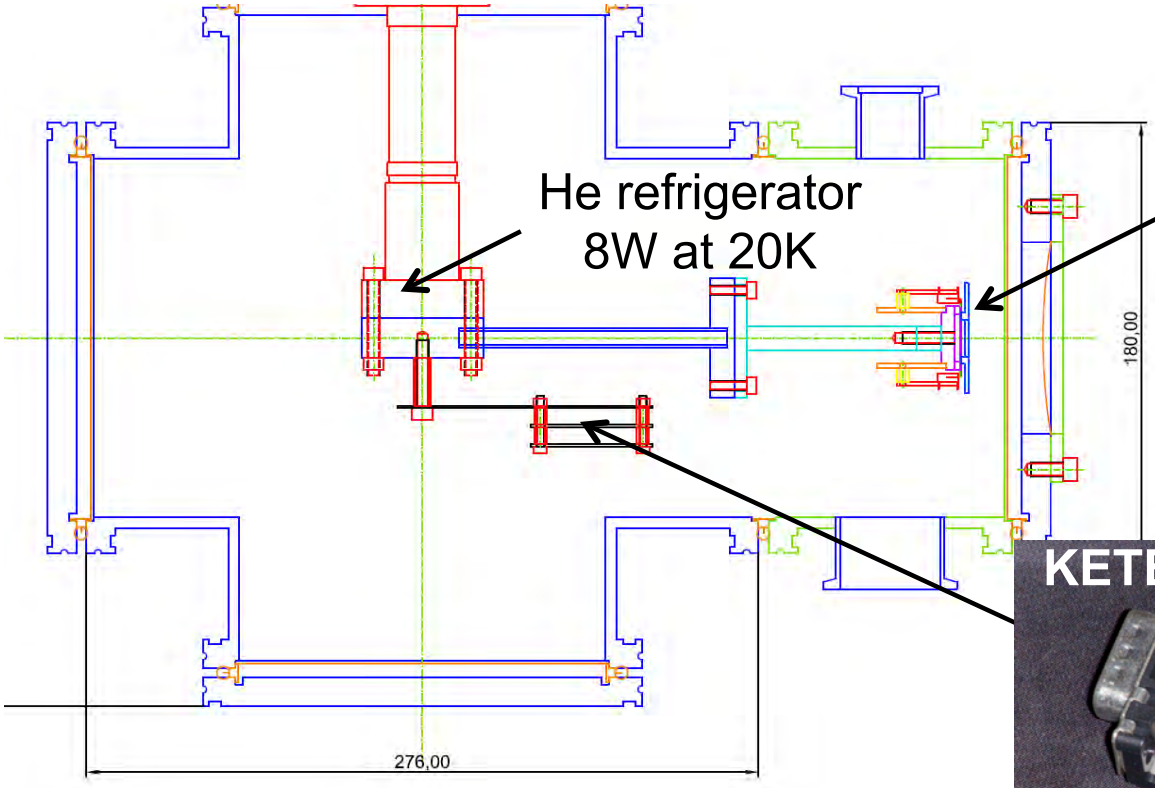


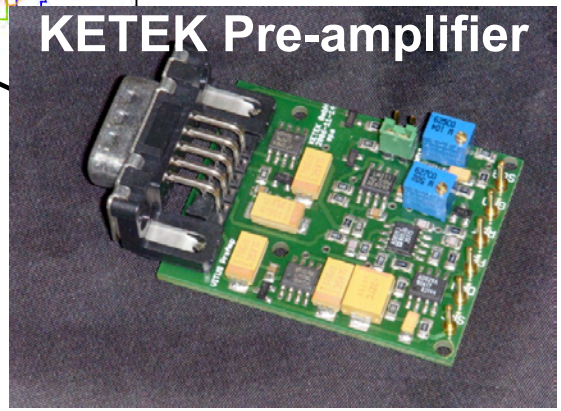
SDD support work / PreAmp test



SDD test at SMI

- SDD test of peak stability and energy resolution under 70 ~ 170 K
  using an ^{55}Fe source
- pre-amplifier board test in vacuum under 70 ~ 200 K

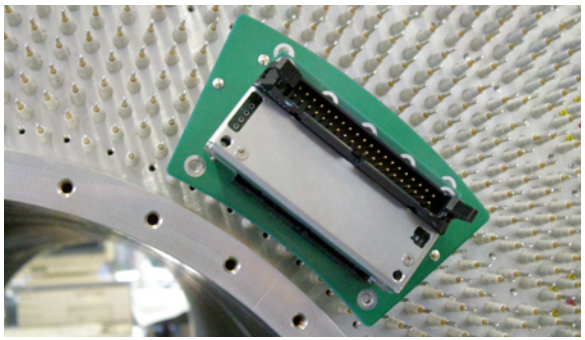




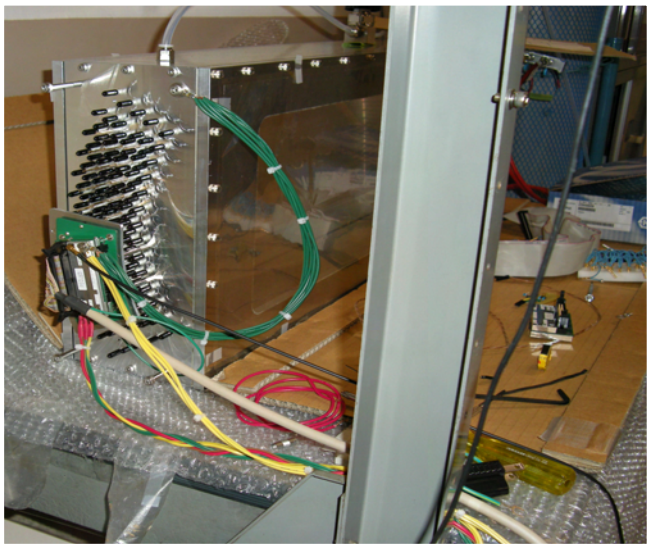
•test bench at SMI (Vienna, Austria)

CDC status

- PreAmp Discri. board
  test board on April/2008



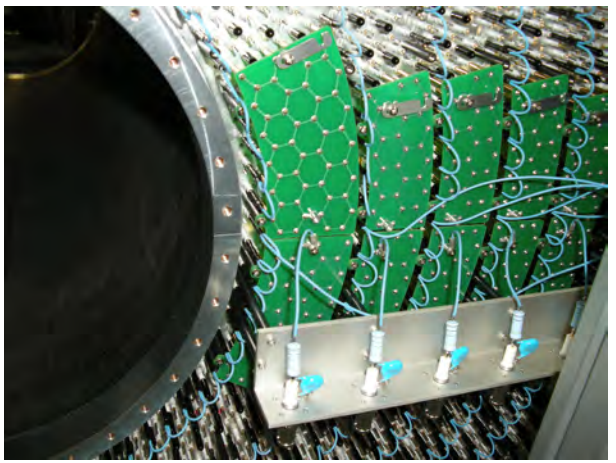
board on CDC for mounting test



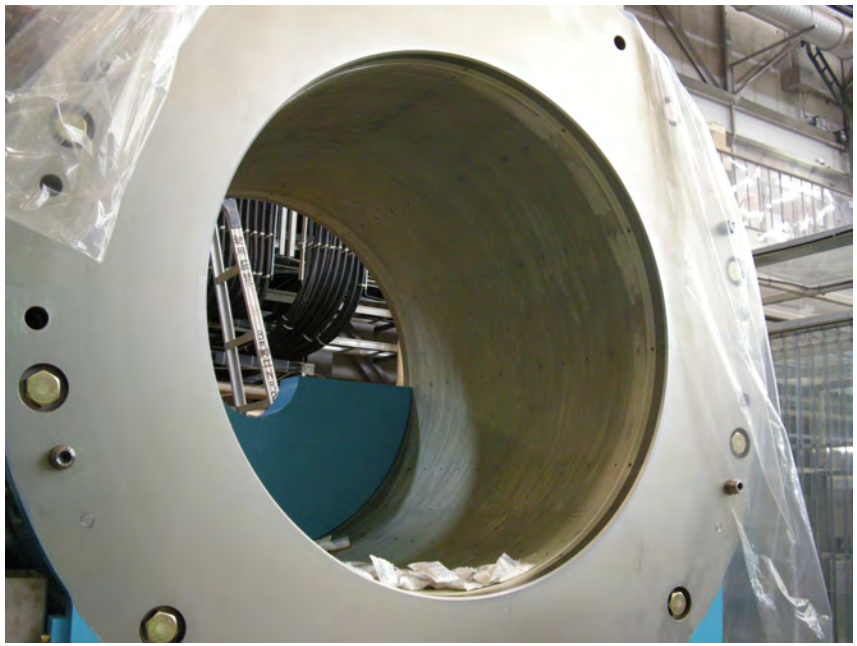
board test on proto-type

- H.V. circuit board
  completed on Feb/2008

opposite side



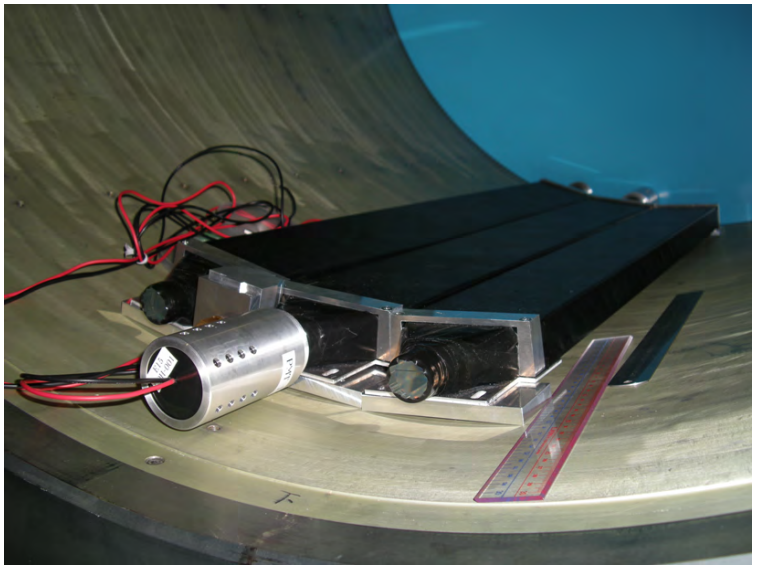
Solenoid magnet & CDH

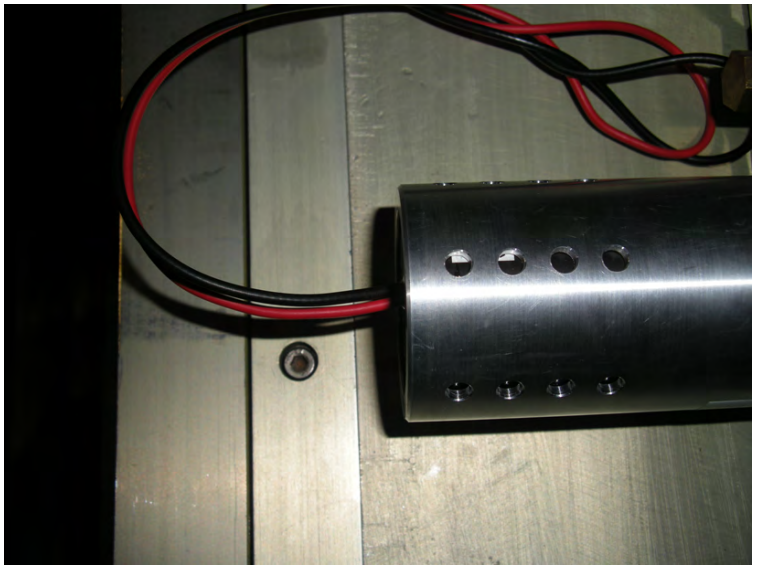


CDH/CDC support structure

- design Jul.
- fabrication Aug.

Prototype CDH placed in Solenoid

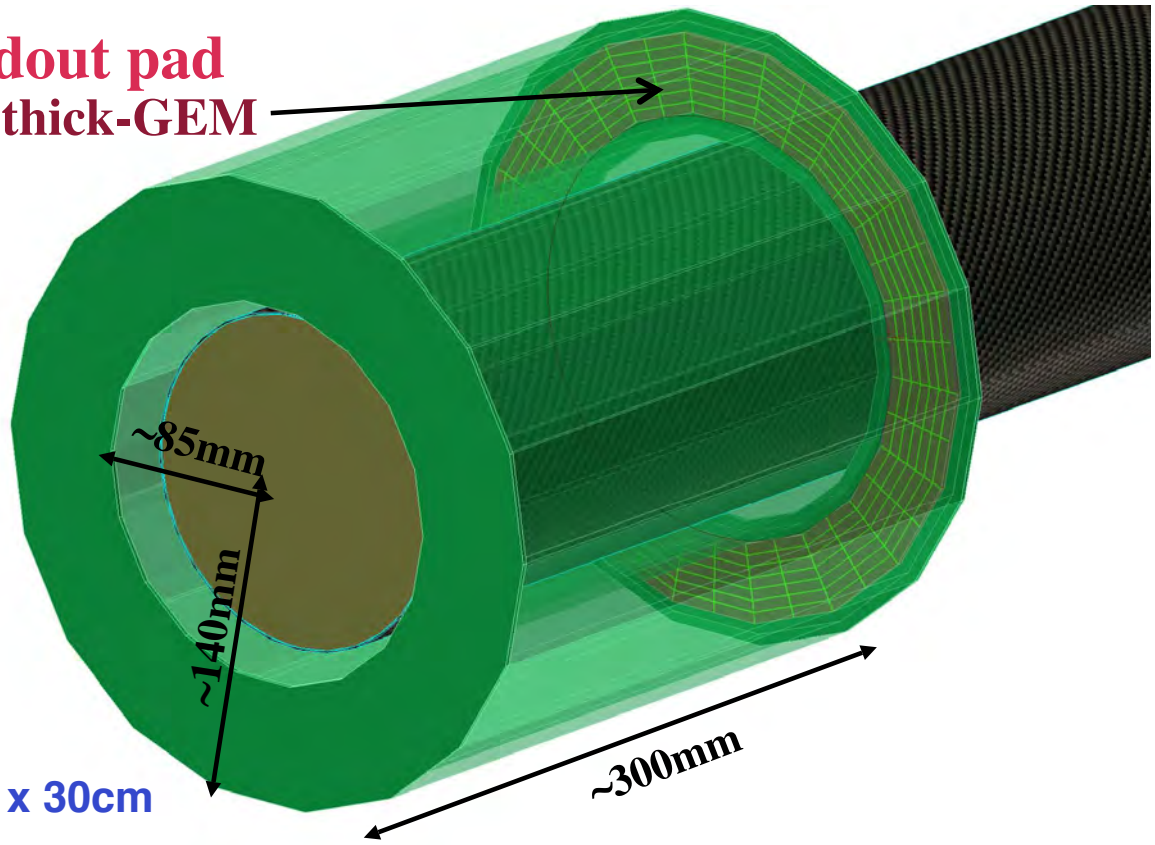




ZVC design work

TPC based z-vertex chamber (ZVC)

GEM and readout pad
double stage thick-GEM

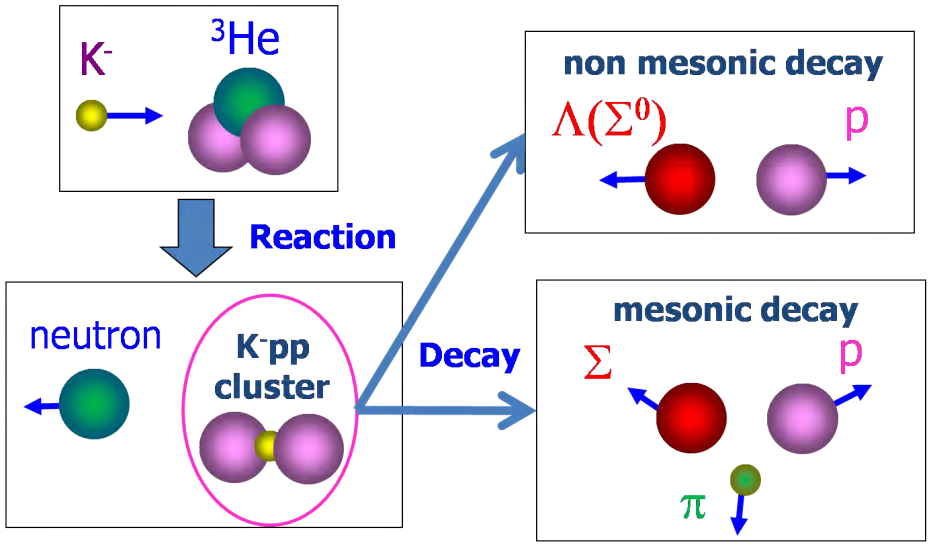


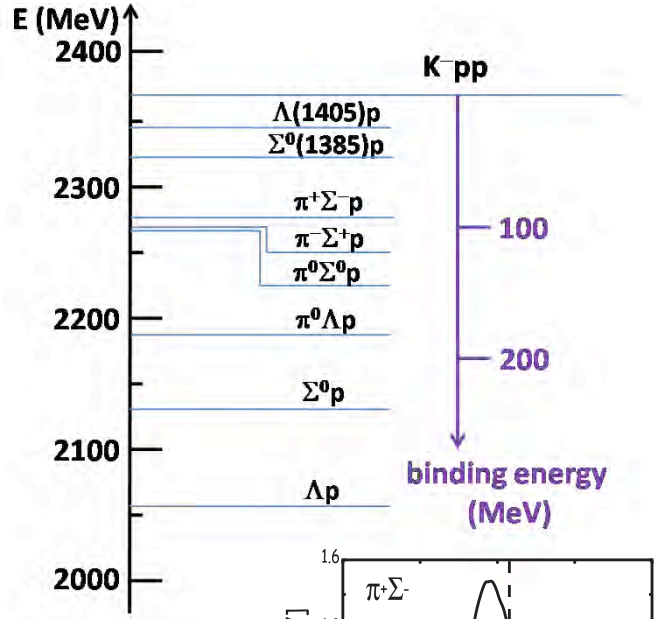
HV : 6.5kV
drift: 150V/cm(P10) x 30cm
amp: + 2kV(GEM)

read-out : 36 ch x 3 layer = 108 ch

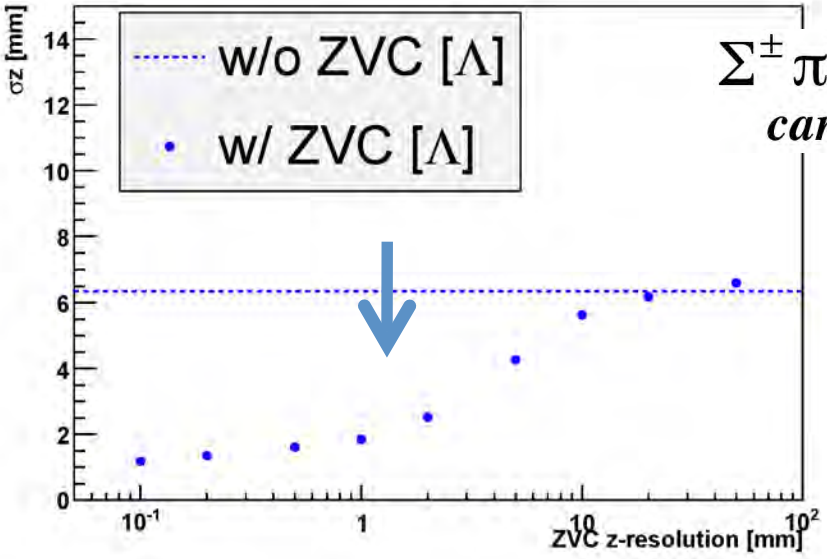
acceptable hit rate few kHz/spill

mesonic decay mode

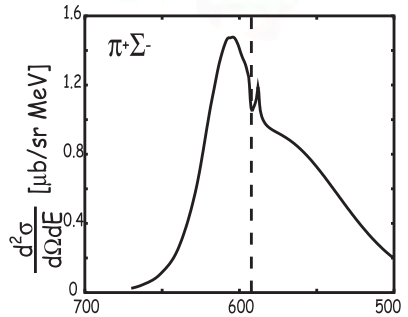


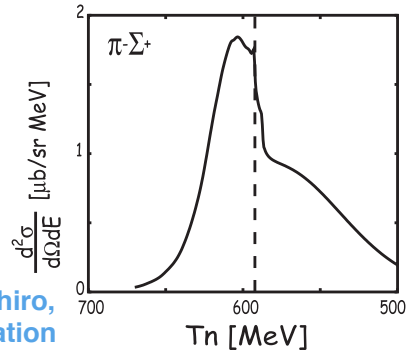


ZVC (z-chamber) allows Σ-ID!



$\Sigma^{\pm}\pi^{\mp}$p *decay channel can also be tagged* by π^+ π^- tag





Chiral unitary shallow pot.

J. Yamagata-Sekihara, H. Nagahiro, D. Jido, S. Hirenzaki, in preparation

Summary

... to be ready for the first DC beam ...

- realize E17 & E15 as cascade exp. at K1.8BR
  - KN interaction : need to be studied!
  - clarify the situation of deeply bound kaonic state
    most of the theory at present give bound state
    width will be as wide as > 30 MeV
  - E17 need a longer beam time for beam line extension

- utilize well proven device / circuit
  device from previous exp.
  proven circuit ... TKO based UNIDAQ

- both E17/E15 preparation is in good shape
  target date : April 2009! cf. previously : Sep. 2009

updated E15/E17 member list

Shuhei Ajimura [1], George Beer [2], Hyoungchan Bhang [3], Paul Buehler [4], Luigi Busso [5,6], Michael Cargnelli [4], Junsei Chiba [7], Seonho Choi [3], Catalina Curceanu [8], Diego Faso [5,6], Hiroyuki Fujioka [9], Yuya Fujiwara [10], Tomokazu Fukuda [11], Carlo Guaraldo [8], Ryugo S Hayano [12], Toshihiko Hiraiwa [13], Albert Hirtl [4], Masami Iio [9], Mihai Iliescu [8], Takashi Ishikawa [12], Shigeru Ishimoto [14], Tomoichi Ishiwatari [4], Kenta Itahashi [9], Masaaki Iwai [14], Masahiko Iwasaki [9,10], Bertalan Juhasz [4], Paul Kienle [4,15], Johann Marton [4], Yasuyuki Matsuda [12], Yutaka Mizoi [10], Ombretta Morra [5,16], Tomofumi Nagae [13], Hiroyuki Noumi [1], Hiroaki Ohnishi [9], Shinji Okada [8], Haruhiko Outa [9], Dorel Pietreanu [8], Atsushi Sakaguchi [17], Fuminori Sakuma [9], Masaharu Sato 9, Michiko Sekimoto [14], Diana Sirghi [8], Florin Sirghi [8], Philipp Schmid [4], Shoji Suzuki [14], Takatoshi Suzuki [12], Hideyuki Tatsuno [12], Makoto Tokuda [10], Dai Tomono [9], Akihisa Toyoda [14], Kyo Tsukada [9], Ebarhard Widmann [4], Toshimitsu Yamazaki [9,12], Heejoong Yim [3], Johannes Zmeskal [4]

[1]Research Center for Nuclear Physics, Osaka University, Japan
[2]University of Victoria, Canada
[3]Seoul National University, South Korea
[4]Stefan Meyer Institut fur subatomare Physik, Austria
[5]INFN Sezione di Torino, Italy
[6]Universita' di Torino, Italy
[7]Tokyo University of Science, Japan
[8]Laboratori Nazionali di Frascati dell'INFN, Italy
[9]RIKEN, Japan
[10]Tokyo Institute of Technology, Japan
[11]Osaka Electro-Communication University, Japan
[12]University of Tokyo, Japan
[13]Kyoto University, Japan
[14]High Energy Accelerator Research Organization (KEK), Japan
[15]Technische Universitat Munchen, Germany
[16]INAF-IFSI, Sezione di Torino, Italy
[17]Osaka University, Japan

standing matters

- long beam time at full intensity (as requested)

  beam scheduling with other experiments at K1.8

- sweeping magnet (KURAMA?)

  ~ 0.7 T·m sweeping magnet with wide aperture
  KURAMA(0.6 T·m): scheduling with other experiments
  (GC availability: negotiation with SKS group)

- D5 (~2.4 T·m: 14D230 or 8D230?(3 T·m)) preparation

  need a commitment from beam channel group

- liquid helium retrieval line and re-liquify system

  need further discussion

- $^{3}He(K^{-}, p)$ spectroscopy?

  need further work

Thank you!