The First beam of the J-PARC Hadron Experimental Hall

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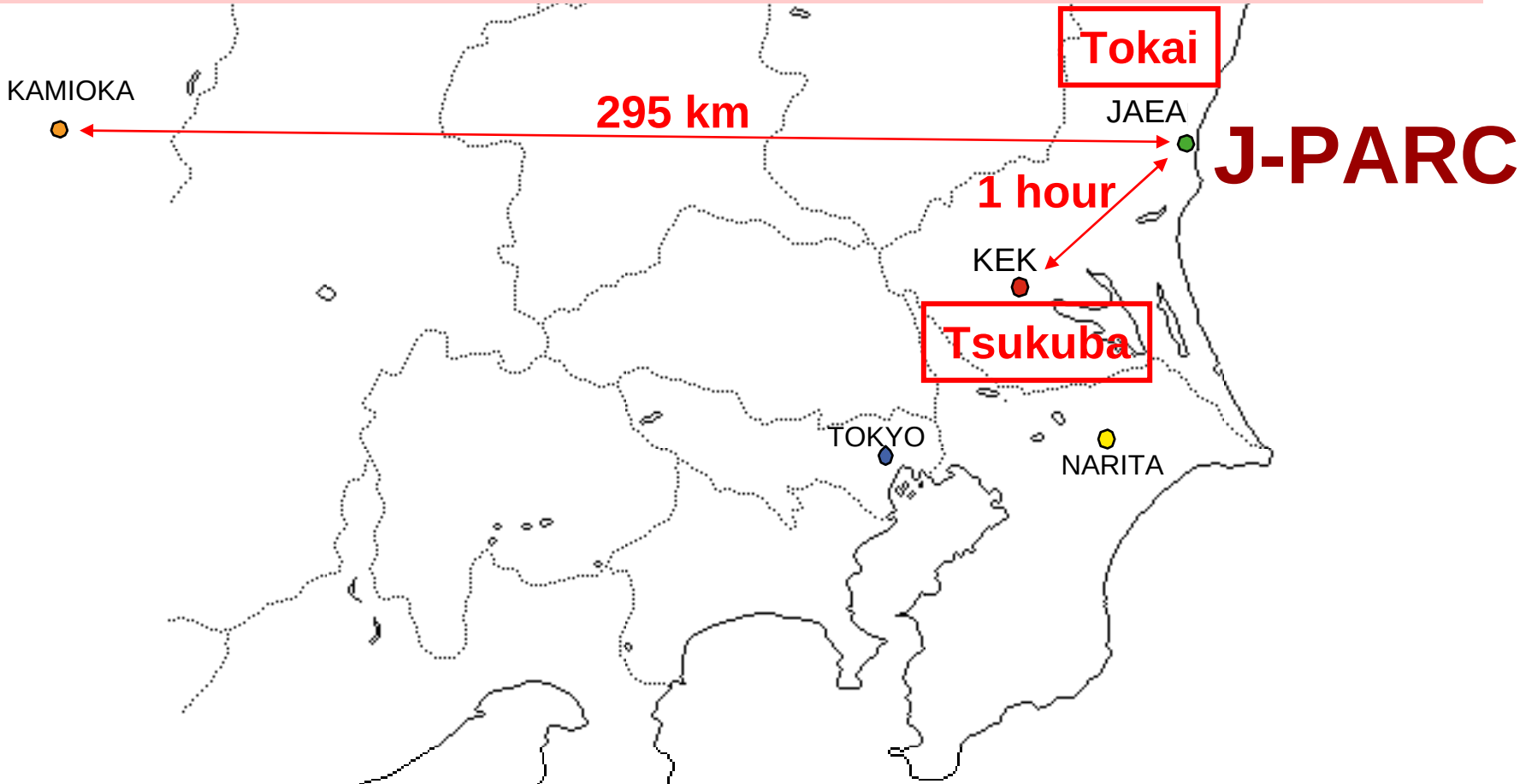
Location of J-PARC at Tokai

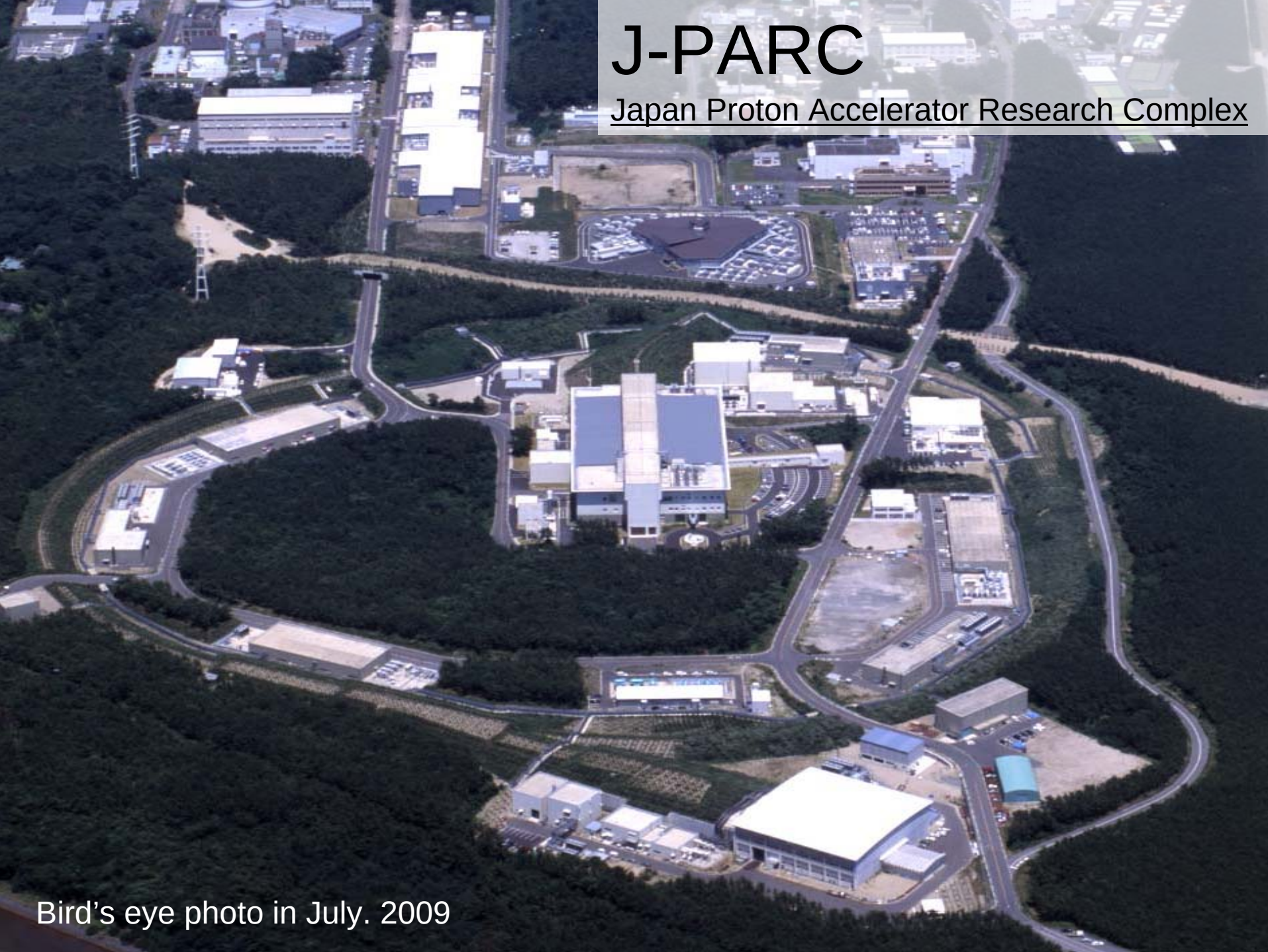
J-PARC = Japan Proton Accelerator Research Complex

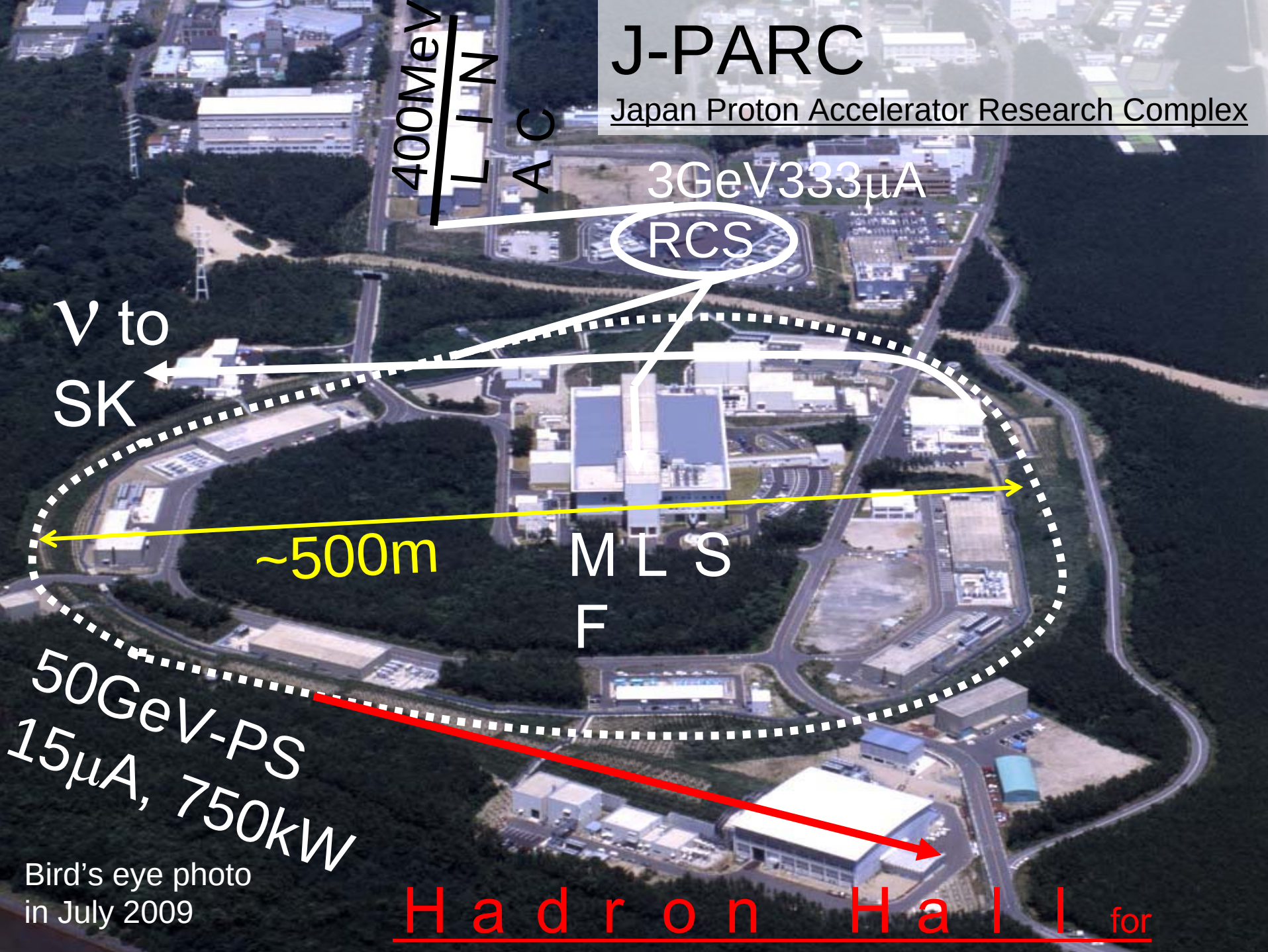


J-PARC

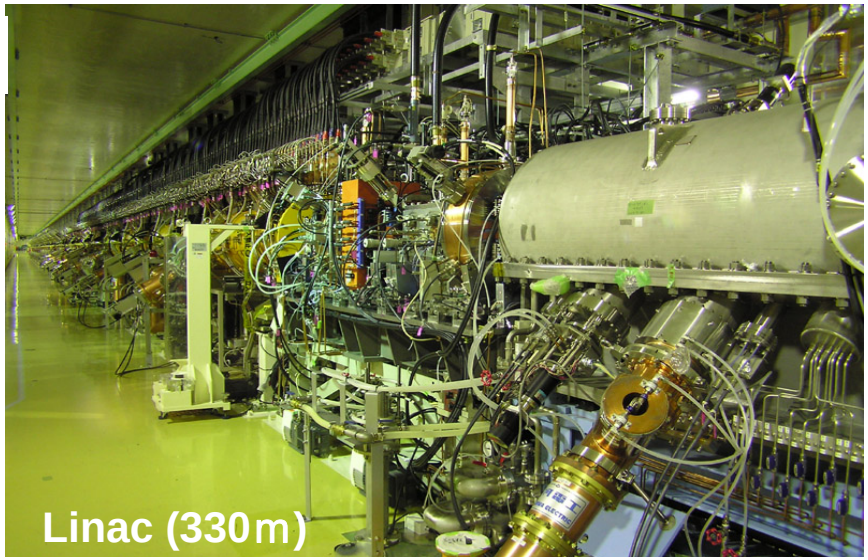
Japan Proton Accelerator Research Complex

Bird’s eye photo in July. 2009


J-PARC
Japan Proton Accelerator Research Complex
Bird’s eye photo in July. 2009


J-PARC
Japan Proton Accelerator Research Complex
400MeV
LINAC
3GeV333μA
RCS
ν to SK
~500m
MLF
50GeV-PS
15μA, 750kW
Bird's eye photo in July 2009
Hadron Hall for

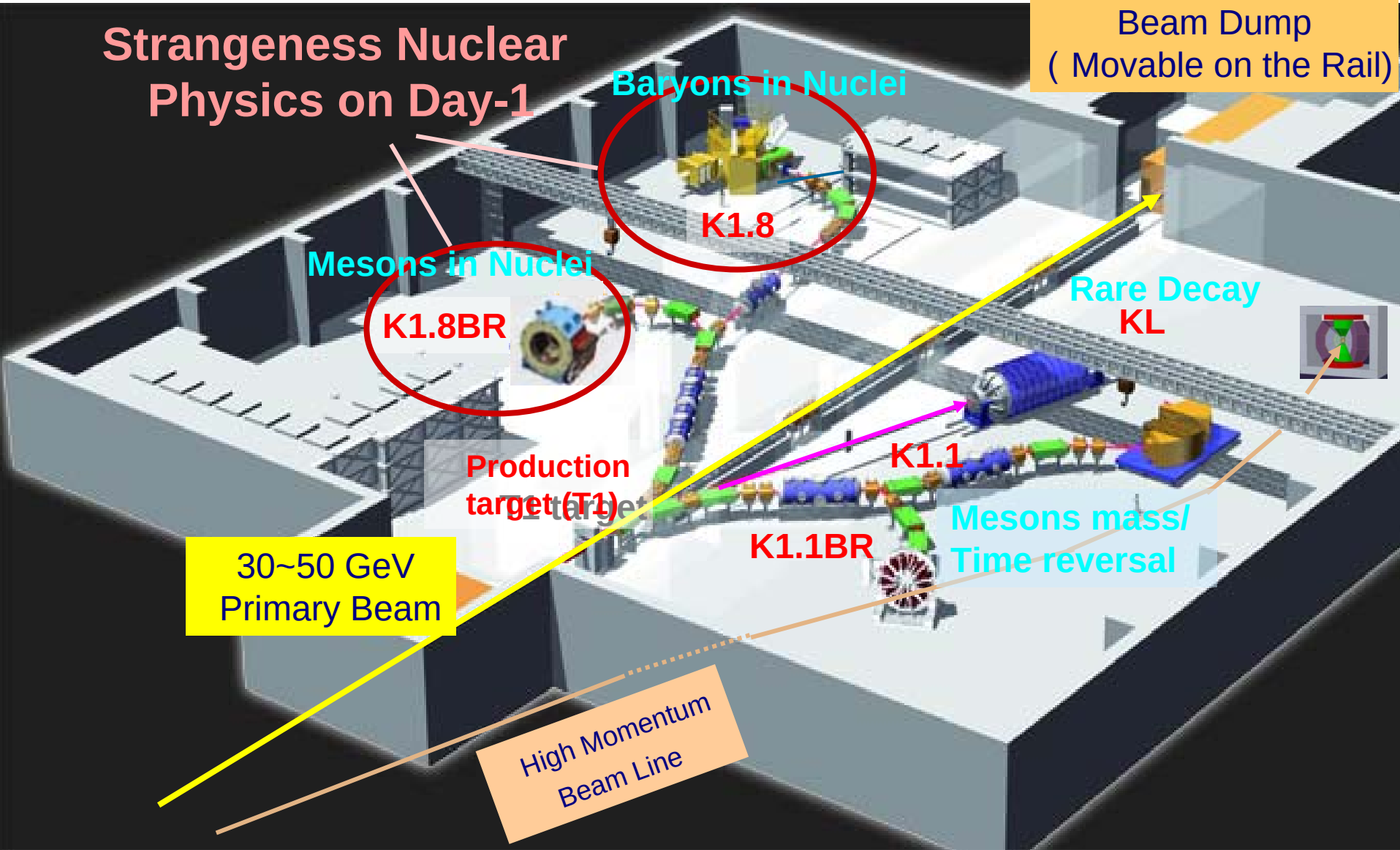
Accelerators



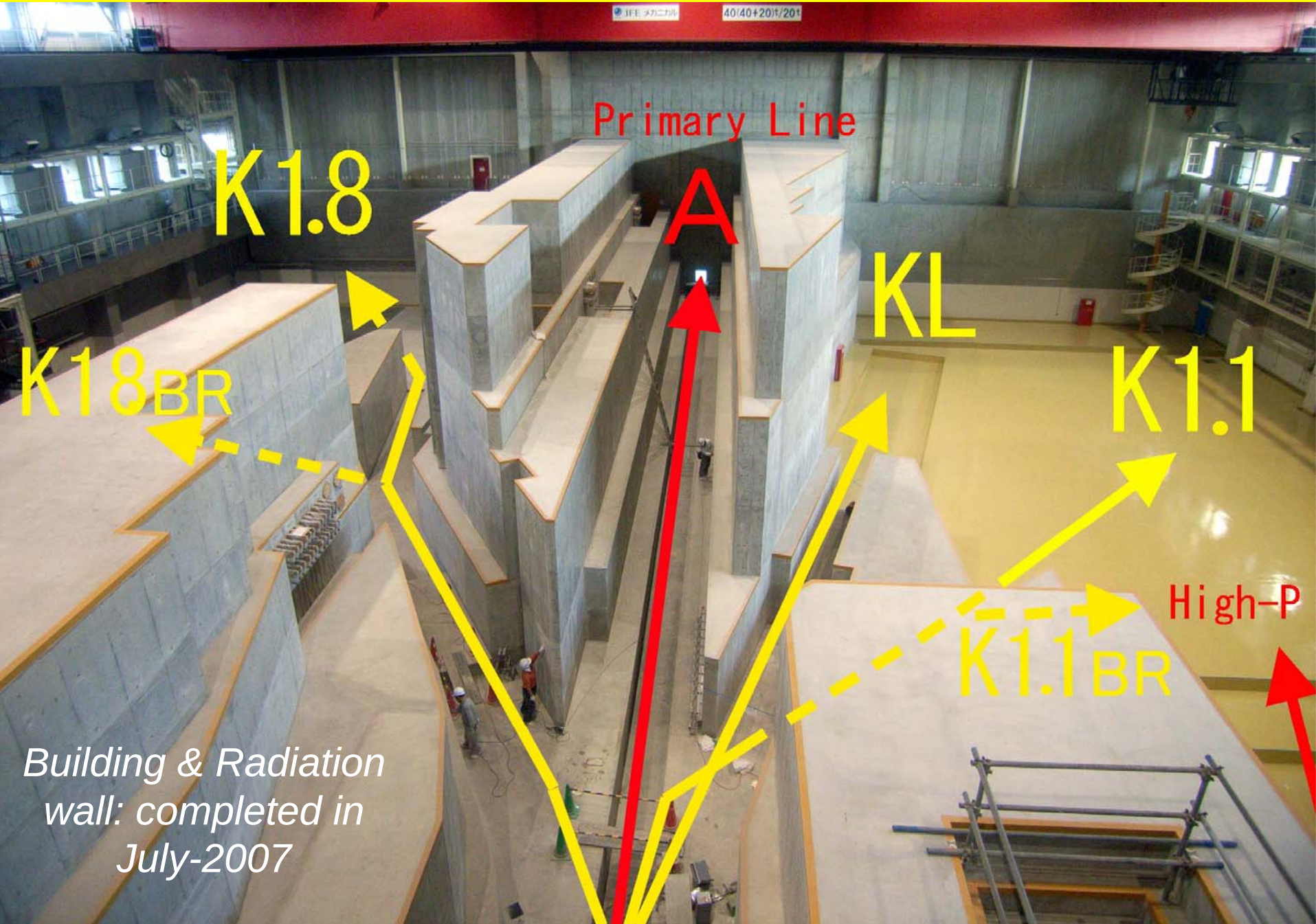
Completed by the end of 2008

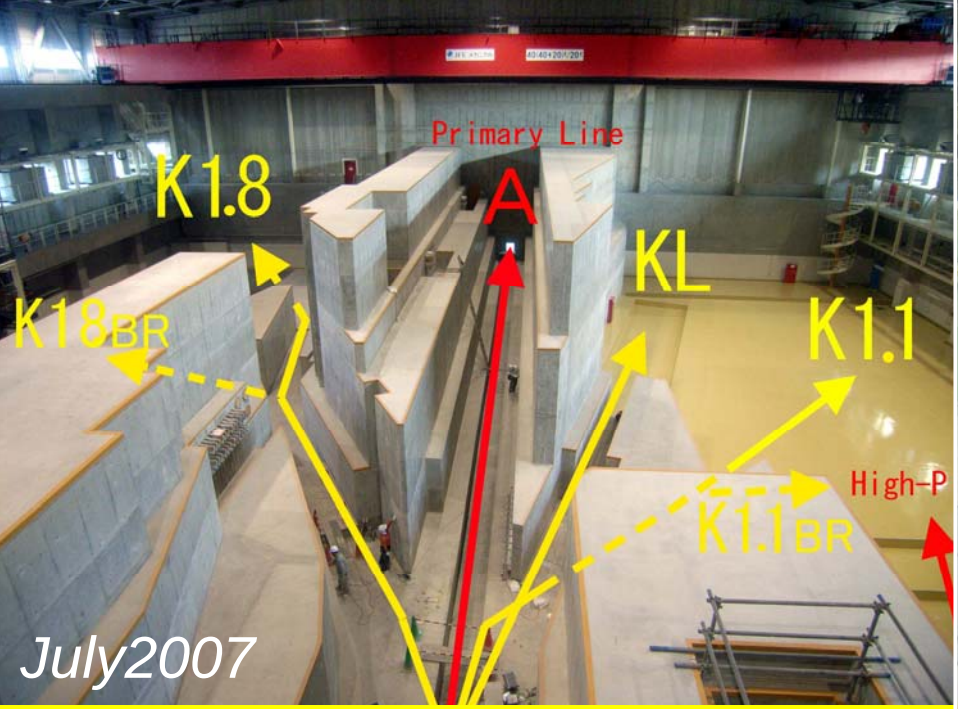
Hadron Experimental Hall

Plan View: Hadron Experimental Hall



Hadron Experimental Hall (Inside)

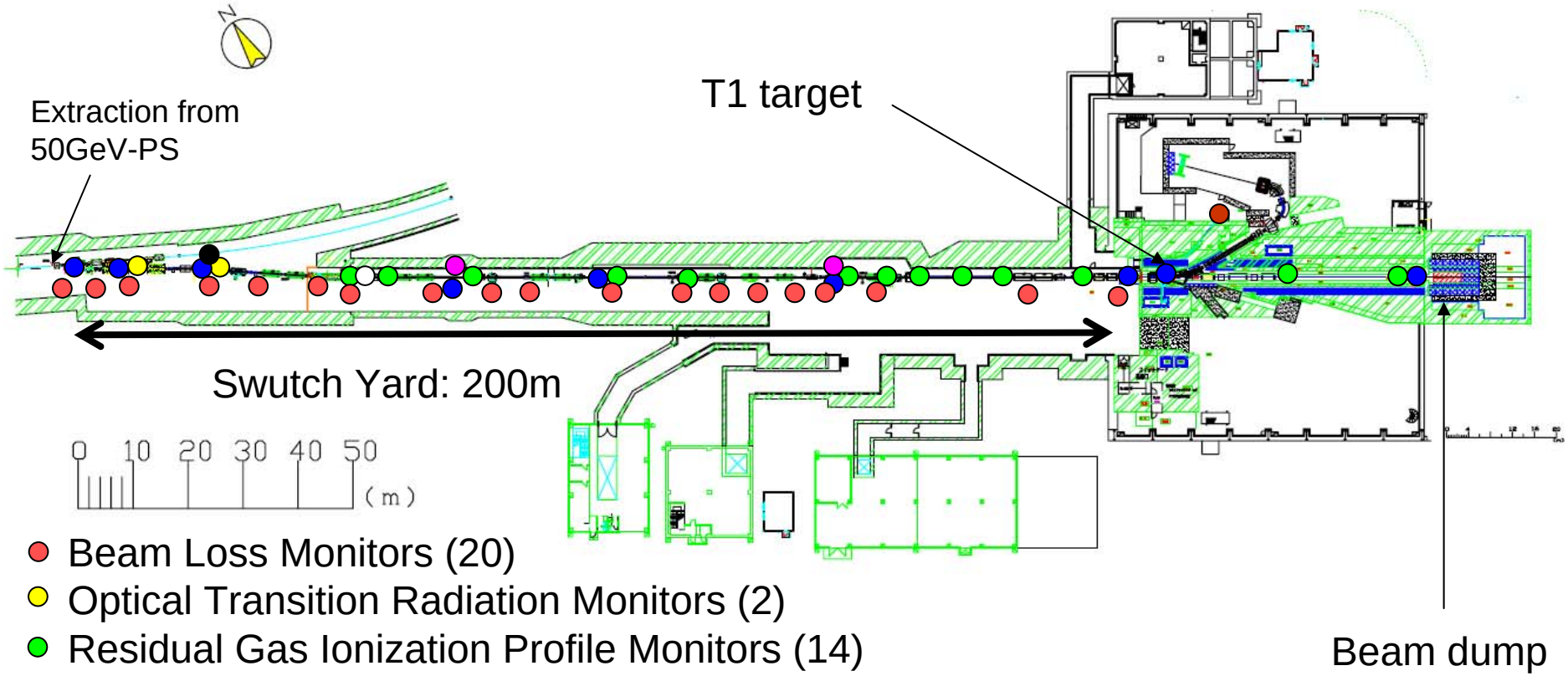




Construction of Hadron Experimental Hall

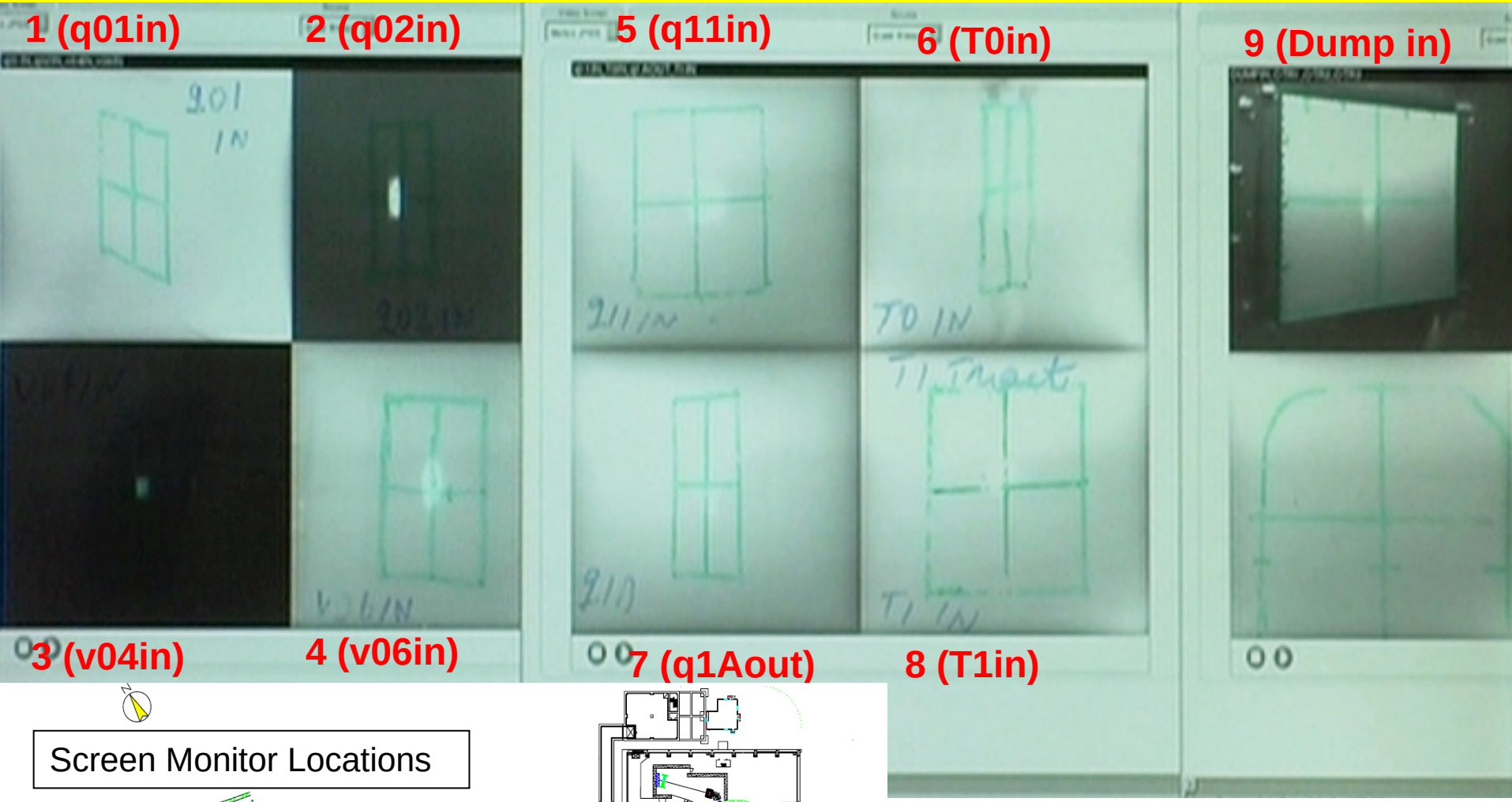
Movie (July 2007 ~ January 2009)

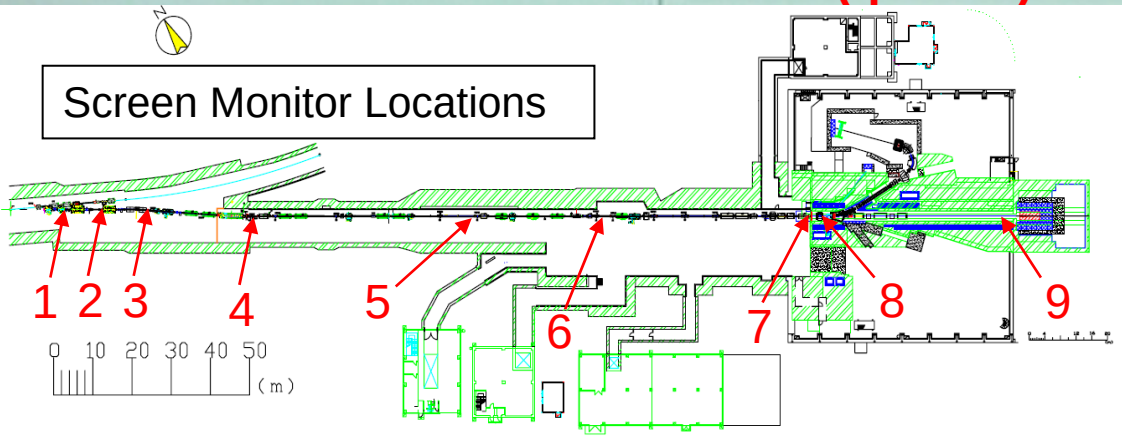
Beam diagnostic devices prepared for the **FIRST BEAM**



- Beam Loss Monitors (20)
- Optical Transition Radiation Monitors (2)
- Residual Gas Ionization Profile Monitors (14)
- Screen Monitors (9)
- Secondary Electron Chamber (2)
- Target Monitor (1)
- Current Transformer (1)
- Spill Monitors (2)

Typical Beam Profiles measured with Screen Monitors





Jan. 27th 2009


於：　ハドロンビームライン制御
祝ハドロンビームライン
ビーム取り出し・輸送成功
平成21年1月27日　19時35分

Preparation of Experimental Area

Left-hand side from the upstream

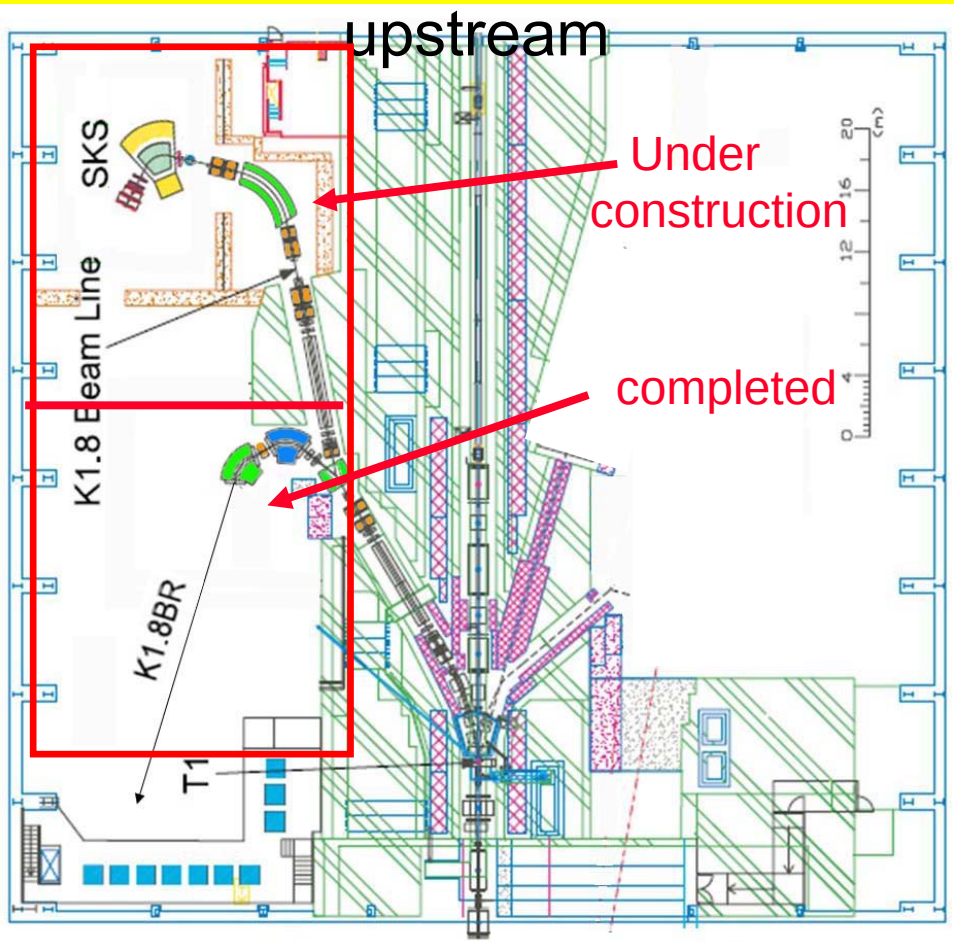
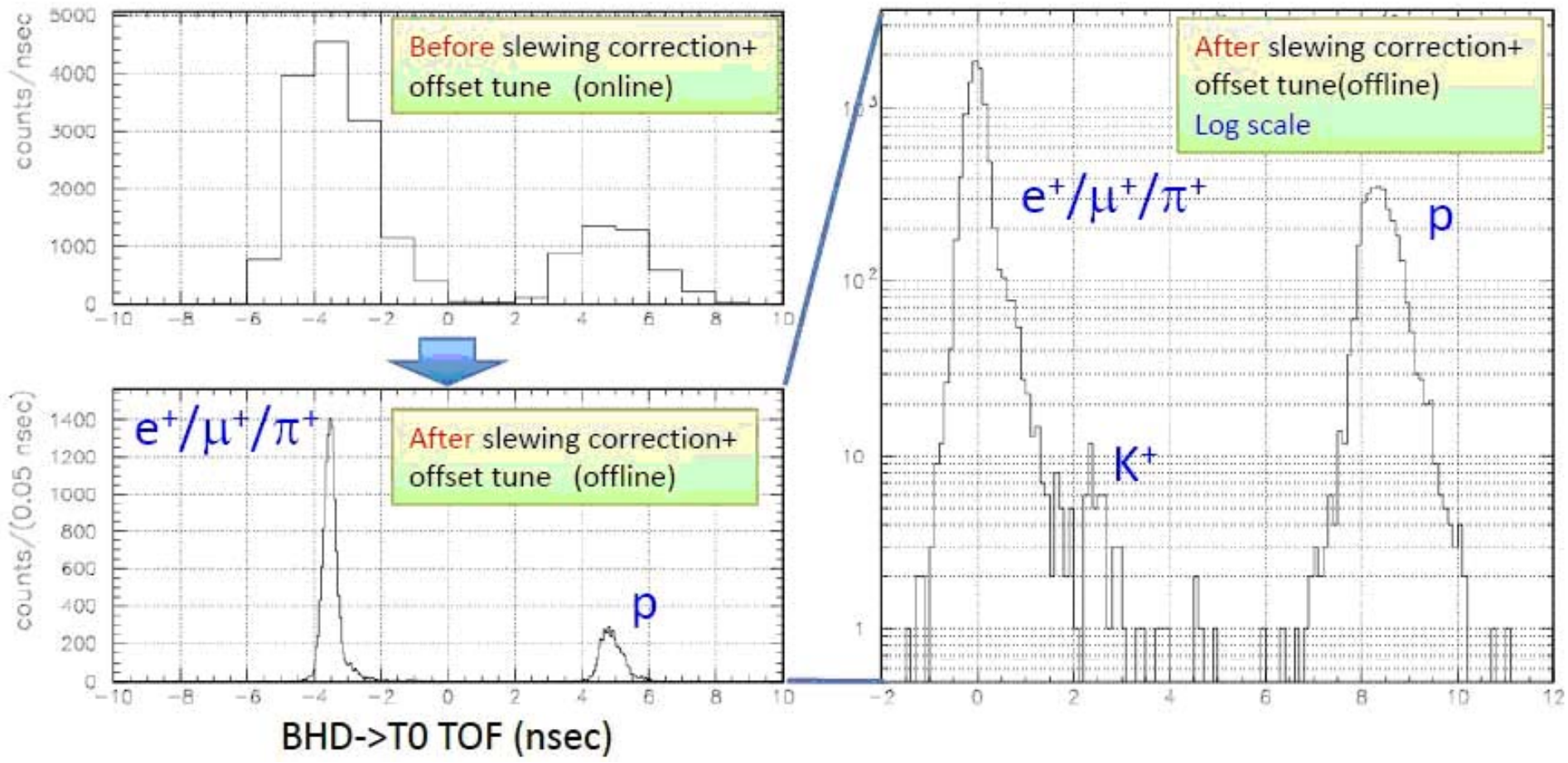


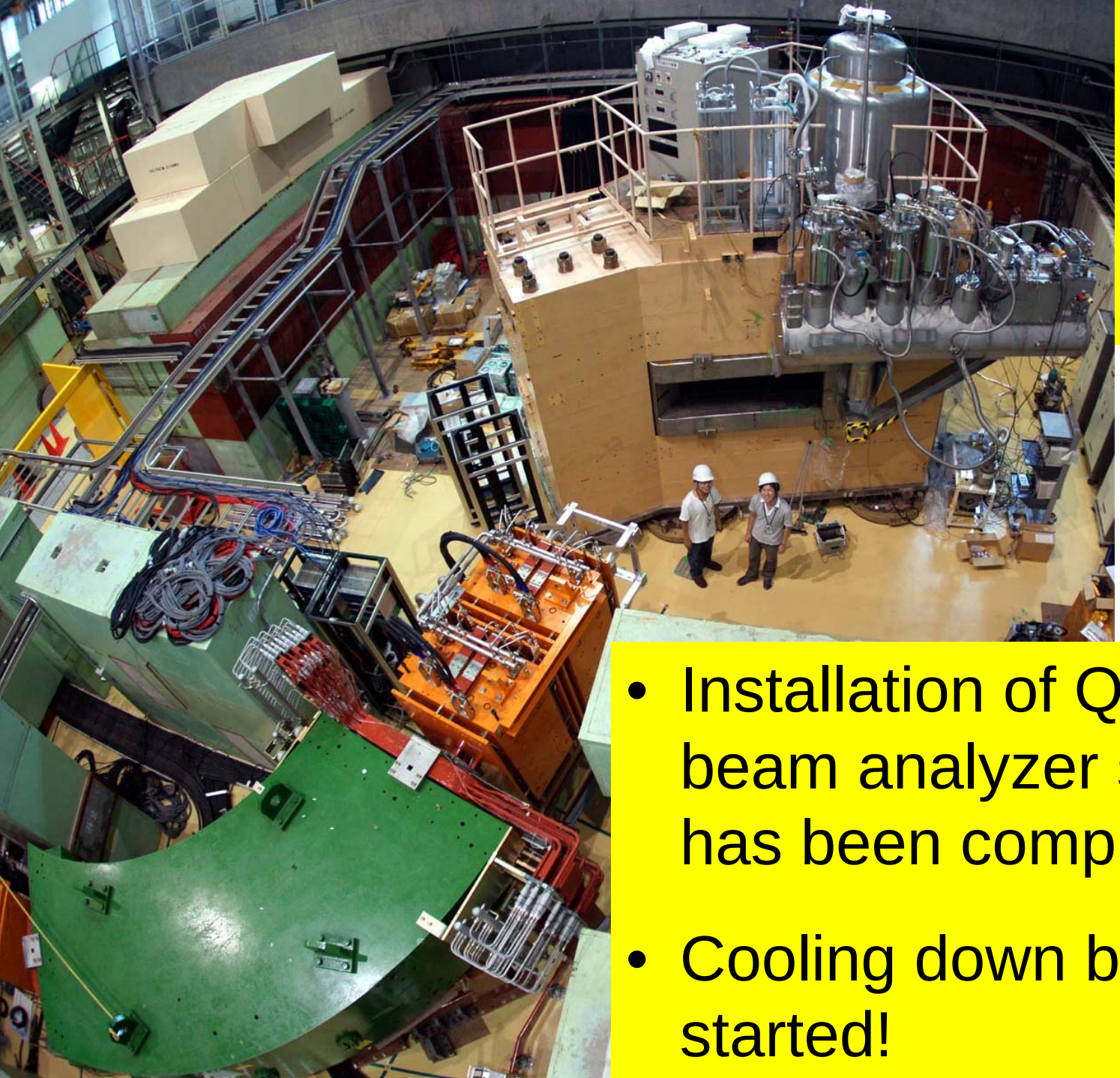
Photo taken June 2009

K1.8BR Experimental Area

K^+ Identification with expected yield



With Electro Static Separator(ESS),
π/K ratio will be unity

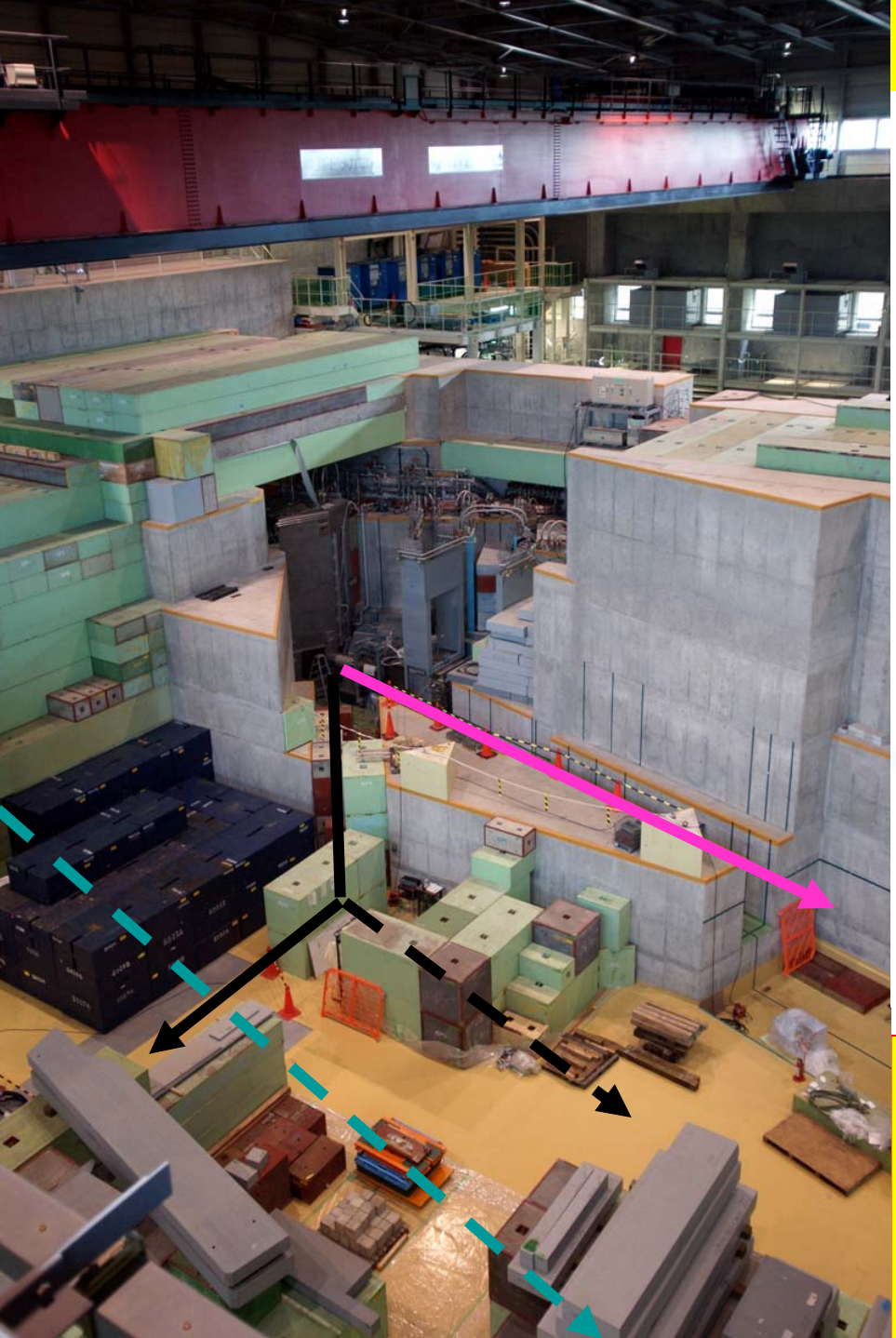


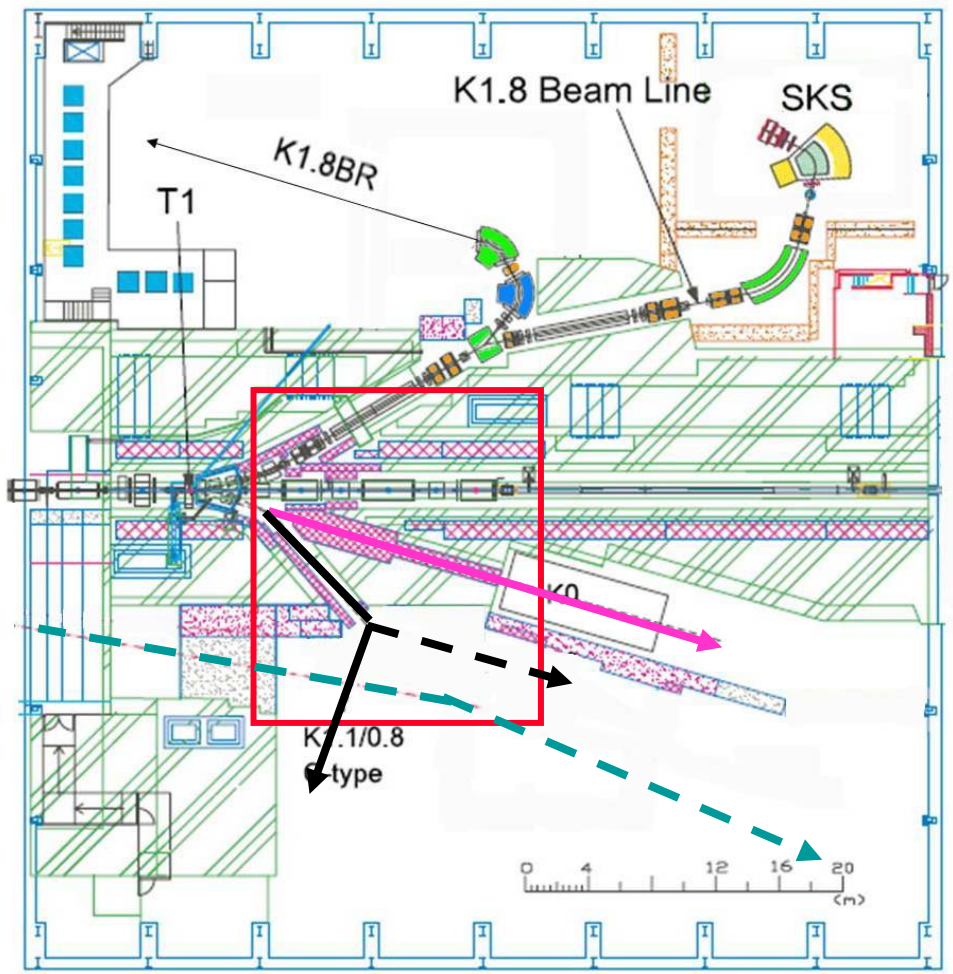
K1.8 Exp. Area

Sept.2009

- Installation of QQDQQ beam analyzer system has been completed!
- Cooling down by Liq. He started!

Right-hand side



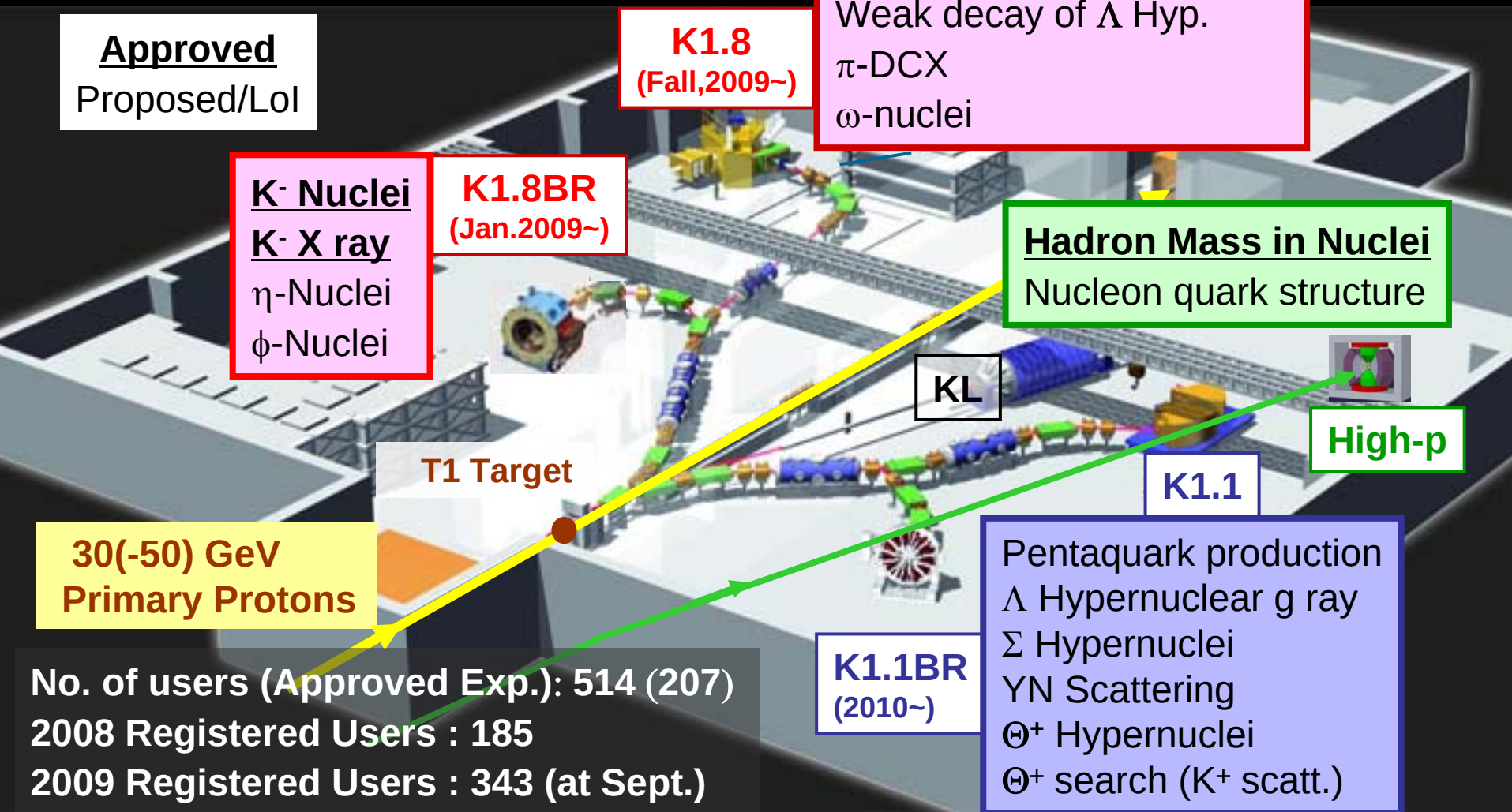


KL Beam Line for $K_L \to \pi^0 \nu\bar{\nu}$,

Low mom. K1.1 Beam line,

High-p Beam line

Nuclea & Hadron Experiments proposed at Hadron Hall

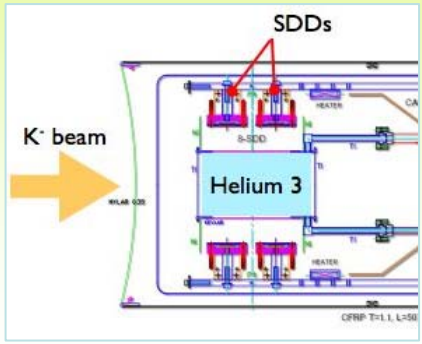


No. of users (Approved Exp.): 514 (207)
2008 Registered Users : 185
2009 Registered Users : 343 (at Sept.)

Research Facilities for Hadron Hall Experiments (or LoIs)

Experiments at the existing beam lines

CDC(Deeply bound Kaonic Atom)



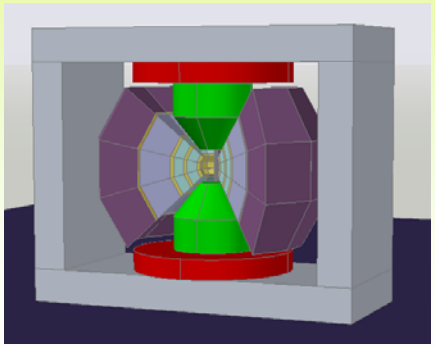
Liquid Target/SSD
E 1 5 (Kaonic X-ray)

SKS

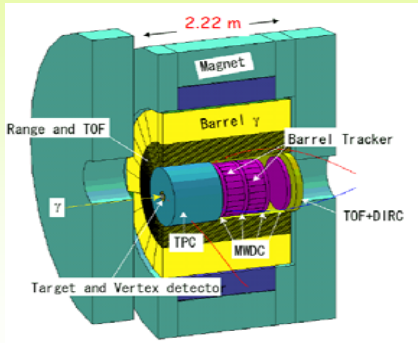
Hyperball-J

Ge detector Complex

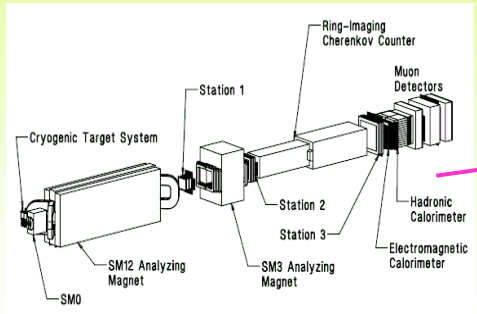
Experiments requiring new beam lines



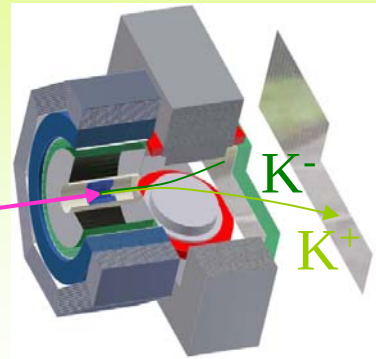
E 1 6 (Origin of hadron mass)
SCINDEN Spectrometer
Primary beam line



L O I (Search for multi-quark states)
MQ spectrometer
Low momentum Kaon beam



P 2 4 (hunting the orbital motion of quarks in the proton)
Dimuon Spectrometer
Polarized proton beam (primary)

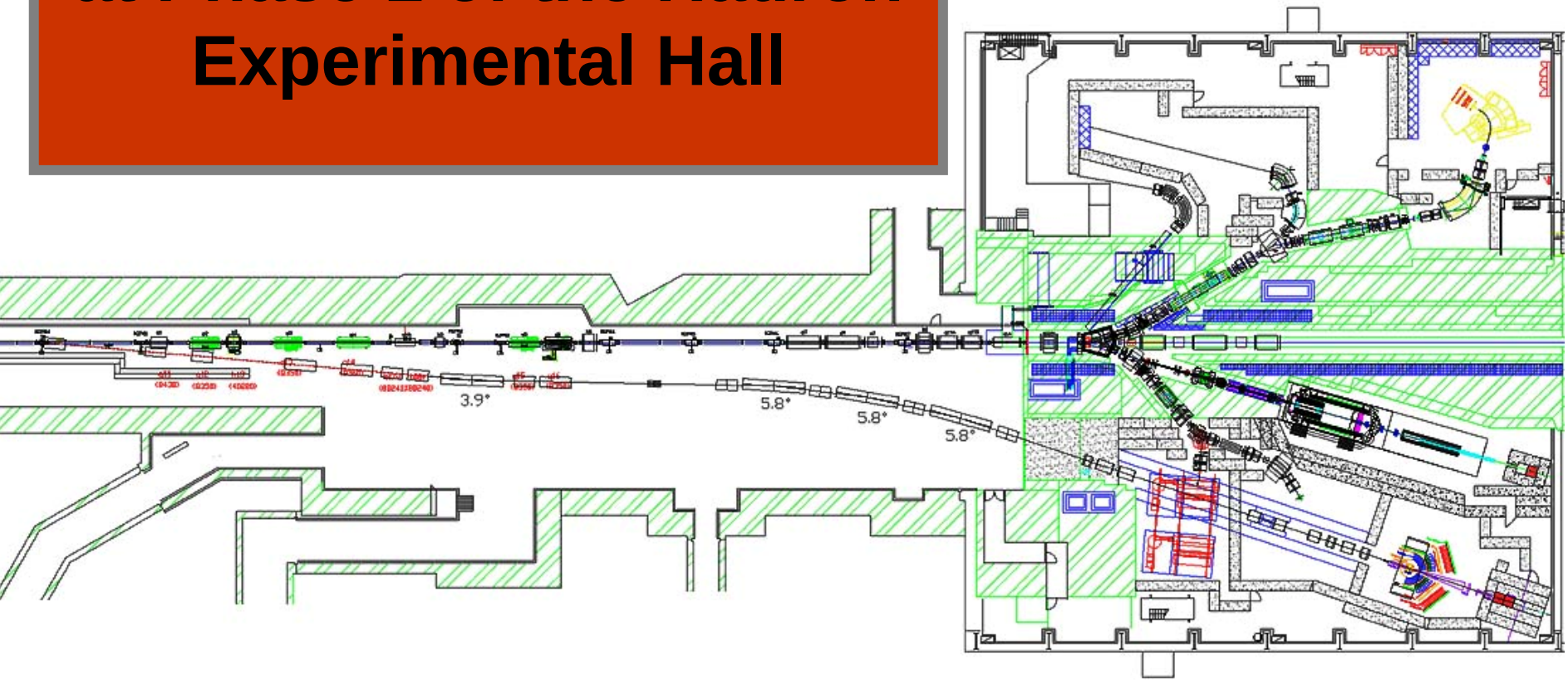


P 2 9 , LoI (Search for Φmeson bound state)

$\overline{p} + p \rightarrow K^+ + K^+ + K^- + K^-$

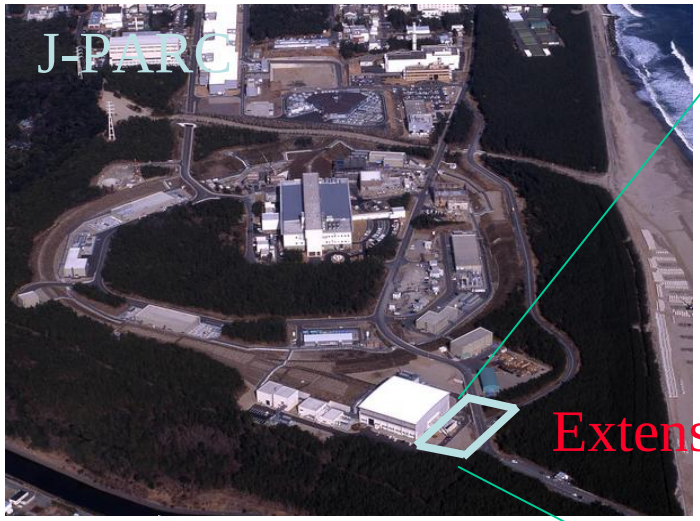
Happy Spectrometer
Anti-proton beam

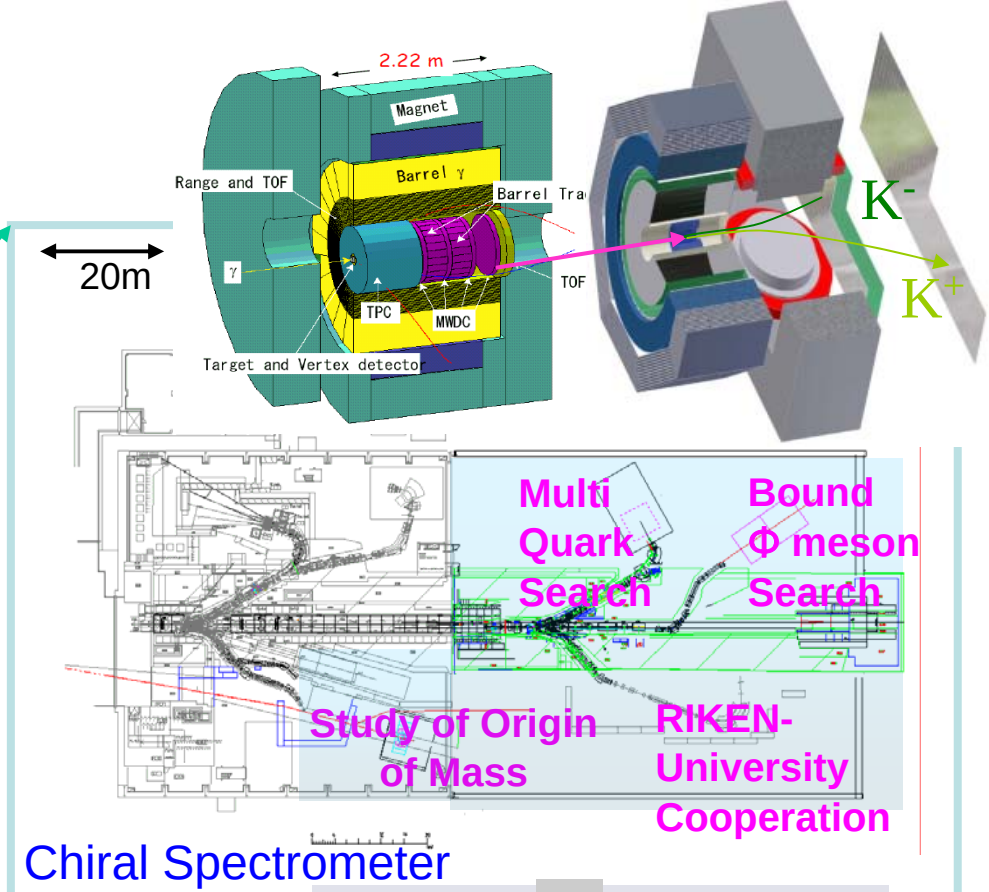
Beam Line Construction at Phase 1 of the Hadron Experimental Hall



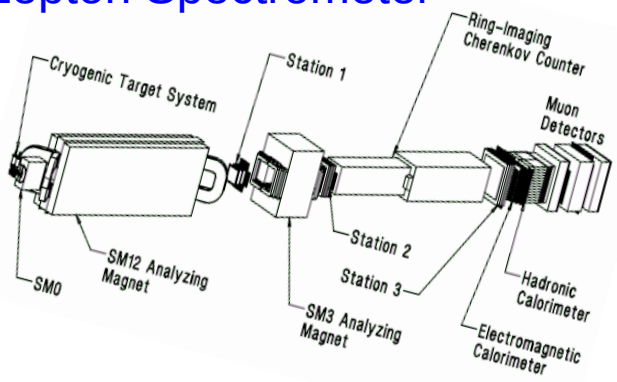
- K1.8 and KL will be ready by autumn 2009.
- K1.1BR Beam Line will be available by the middle JFY2010.
- Budget Request of the High Momentum Beam Line started in JFY2009.

Tentative Plan for Hadron Hall Phase-II

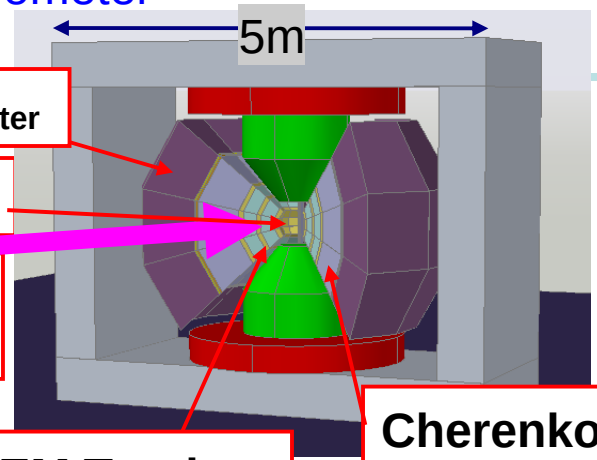




Di-Lepton Spectrometer



Nucleon quark structure

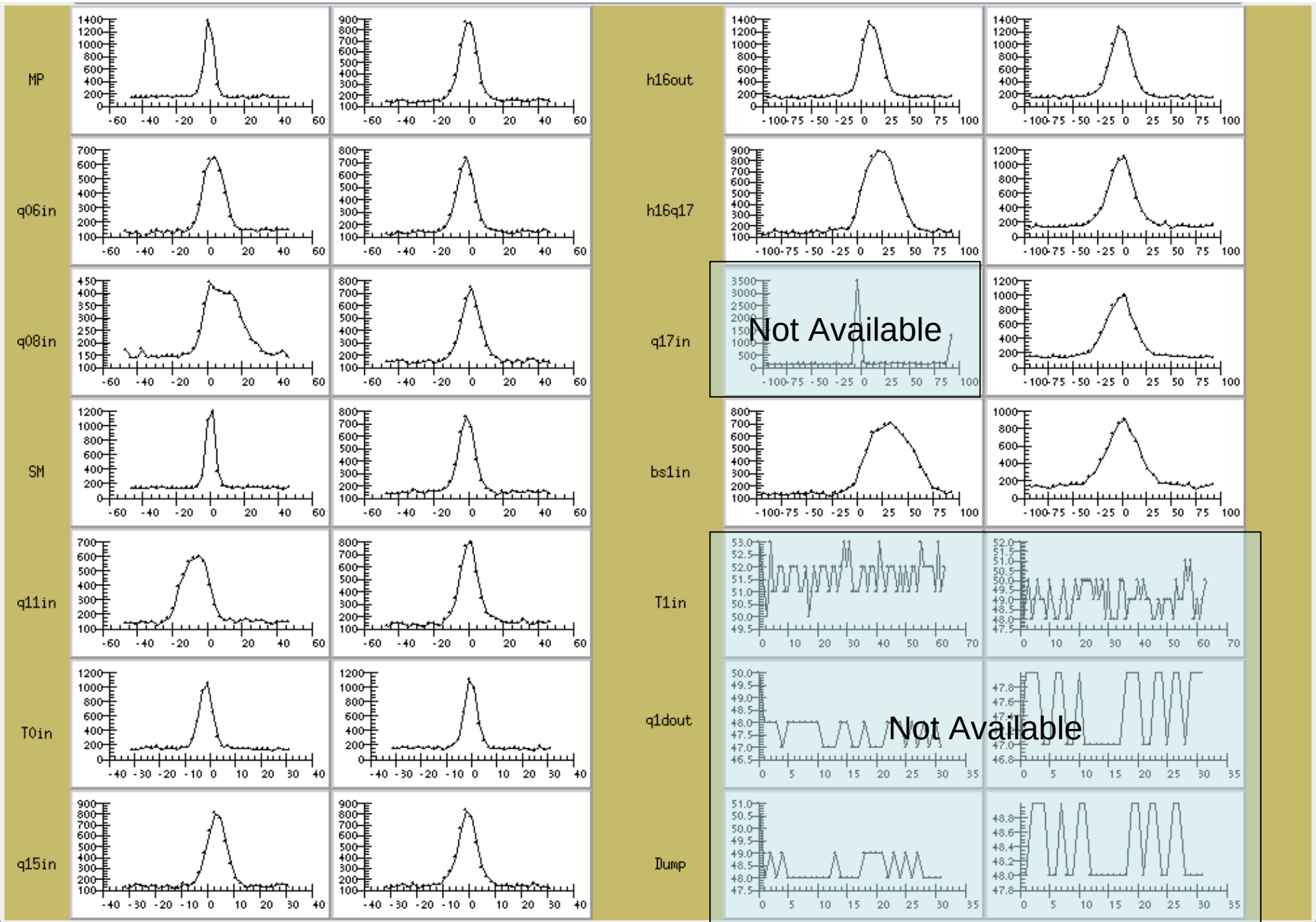


Summary and/or Present Status

- Hadron Experimental Hall has been completed.
- The first beam was successfully introduced to the Hall on January 27th.
- T1 Target was IN on February 10th and beam commissioning of K1.8BR started.
- Kaons were successfully identified!
- Experiments started!
- More Beam lines are under construction and budget requesting!

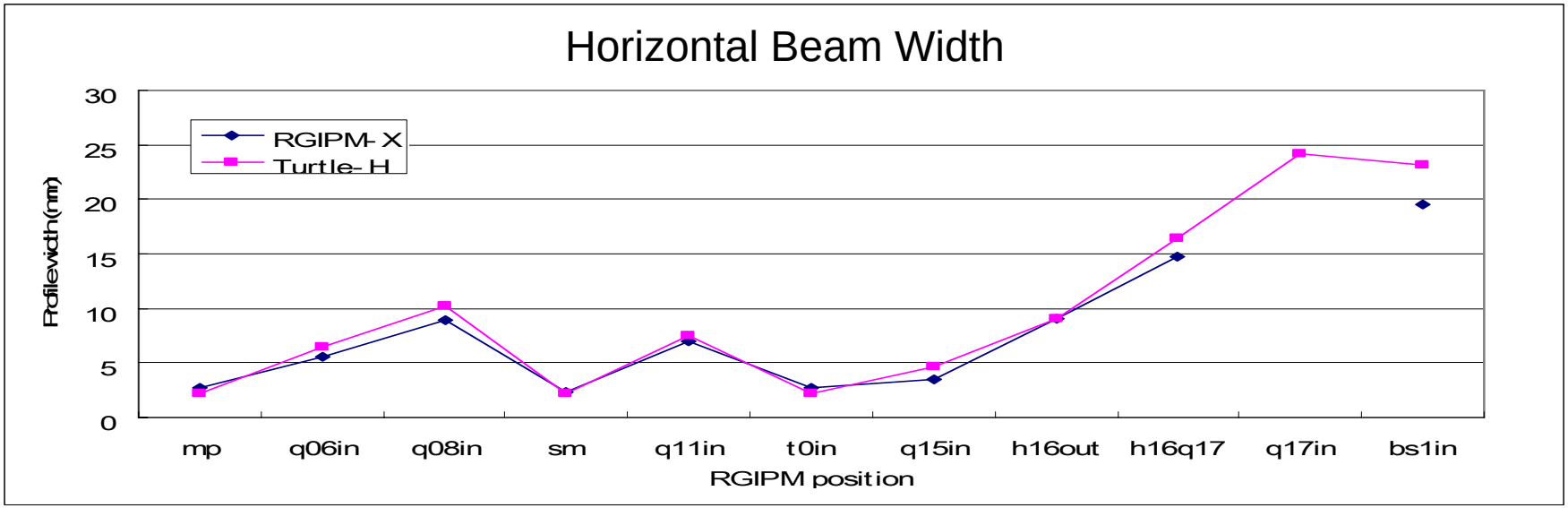
Back up

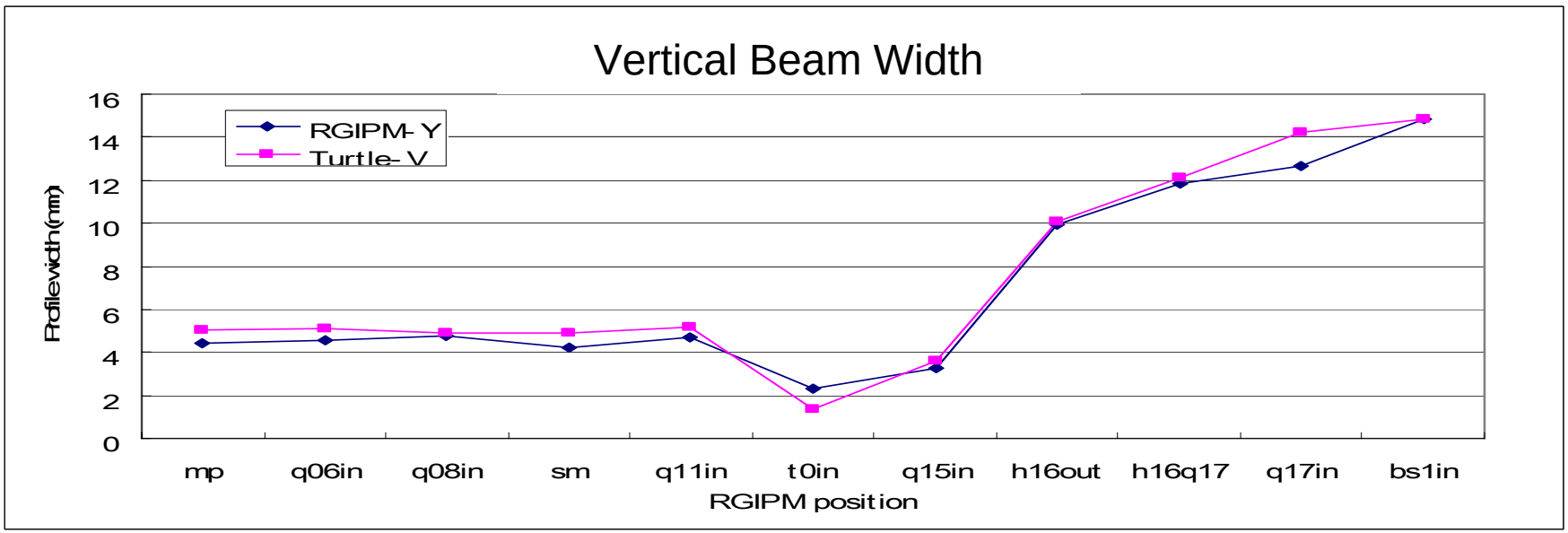
Typical Beam Profiles measured with RGIPM



Beam Profile Widths measured with RGIPM (Run 22, Shot 422)

Decay Turtle emittance
ε_H=4.4πmm*mrad
ε_V=2.5πmm*mrad





Experimental Method

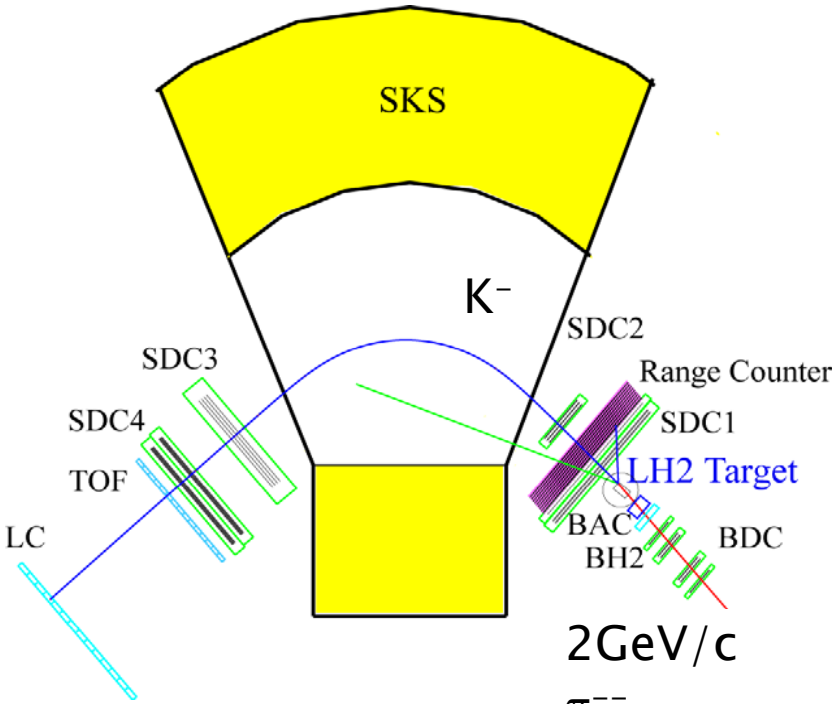
K1.8 beam line + SKS

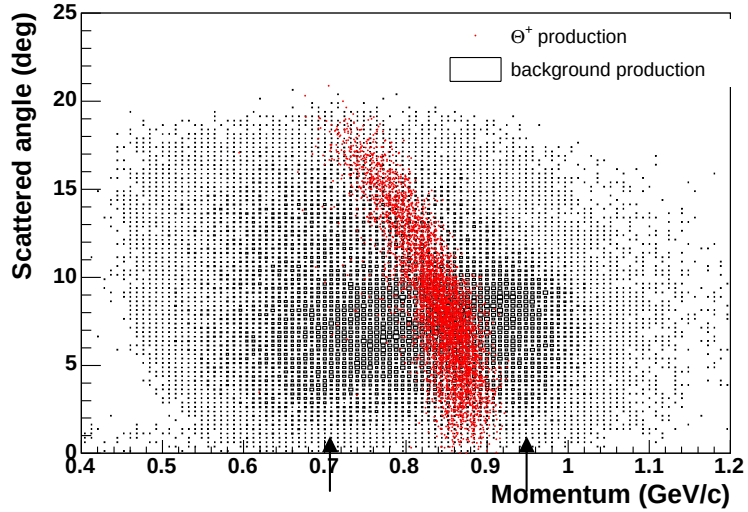
2GeV/c $\pi^- + p \rightarrow K^- + \Theta^+$
target : liquid H_2, reuse E559'

K^- : scattered angle ≤ 40°
momentum < 0.9 GeV/c

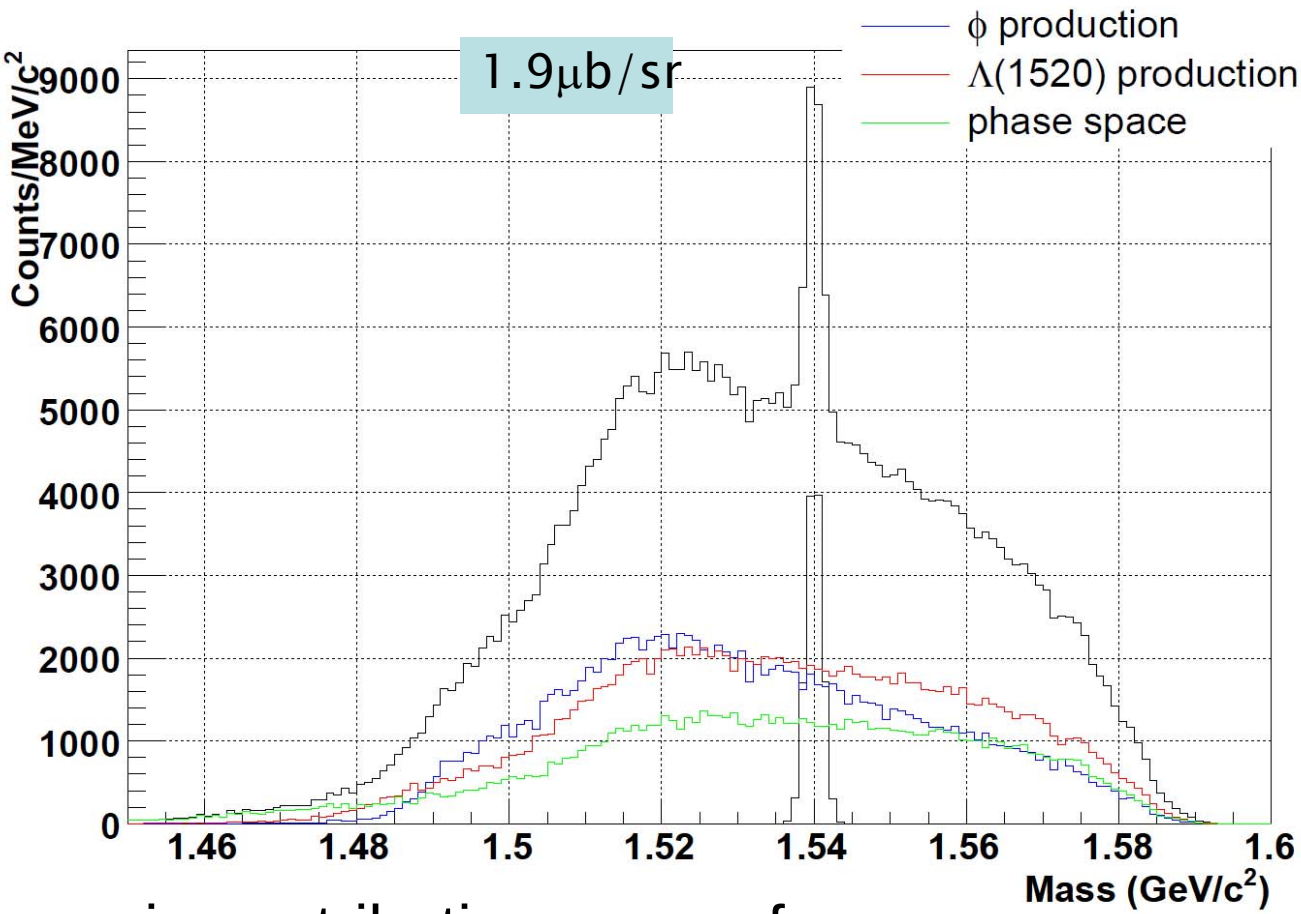
SKS : momentum coverage : 0.7–0.95GeV/c
angle coverage ≤ 20°
$p_{scattered}$ up to ~ 1.1 GeV/c
dp/p ~ 0.2% @ 1GeV/c
(~5 times better than KURAMA)

ideal for Θ^+ detection





EXPECTEd Missing mass SPECTRUM



significance :
62σ assuming
$\Gamma < 2\text{MeV}$
$\sigma = 1.9\mu b$

main contributions come from;

ϕ :	$\phi n \rightarrow K^+K^-n$	30.0±8.0 nb
Λ :	$\Lambda(1520)K^0 \rightarrow K^-$	20.8±5.0 nb
phase	K^0pK^+N	26 μb

Expected Yield & Sensitivity

- yield
  - beam pions :160 hours beam time → 4.8 X 10^{11} π for each p_π
  - SKS acceptance : 0.1 sr
  - analysis efficiency : 50%
  - K decay : 50% ← TOF 4.7m
  - 1.9μb/sr @ p_π=1.92GeV/c ← E522

    → 1.2 X 10^4 events
- background
  - 0.8 μb/sr/MeV @ 1.530MeV for proton target ← E522
  - momentum flat

    → 5.0 X 10^3 co V

statistics	sensitivity
62σ $\Gamma <$ 2 MeV	75nb/sr $\Gamma <$ 2 MeV

cf. 340nb/sr Γ=1MeV (Born approx.)

→ Γ<0.22MeV