SksPlus用 Honeycomb Drift Chamber の開発

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特定領域研究会@加賀温泉　2008/10/30

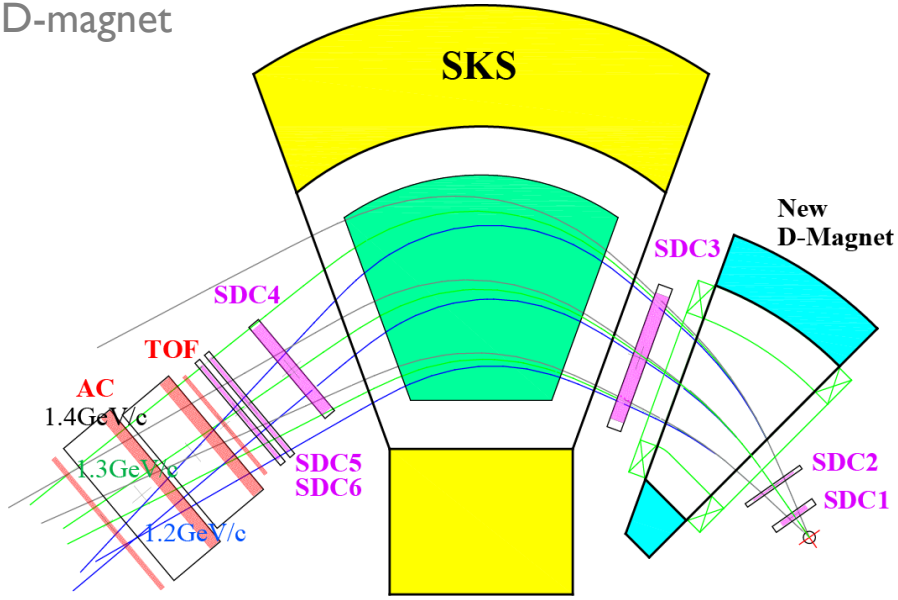
Introduction

- J-PARC E05 experiment
  - Spectroscopic Study of Ξ-hypernucleus, $^{12}_{\Xi}$Be, via the ^{12}C(K^-, K^+) Reaction
  - Observe Ξ-hypernuclear state for the first time
  - Ξ-N interaction <- binding energy
  - ΞN->ΛΛ coupling force <- width
- Experimental method
  - Missing mass spectroscopy using (K^-, K^+) reaction
    - elementary process : $K^-p \rightarrow K^+\Xi^-$
  - High-intensity K^- beam at K1.8 beamline : 1.4M/spill(0.7s)
  - High-resolution spectroscopy -> SksPlus

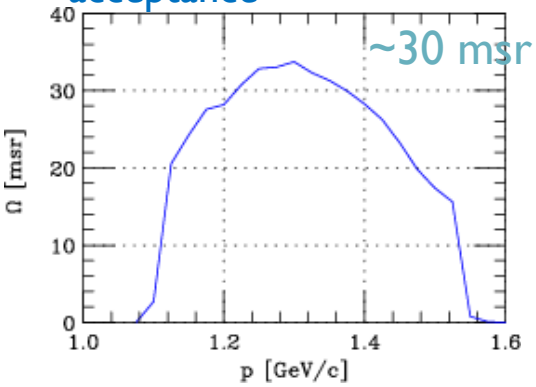
SksPlus

review

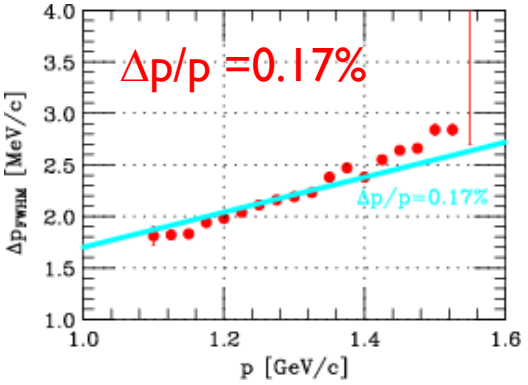
consists of existing SKS and New D-magnet



acceptance



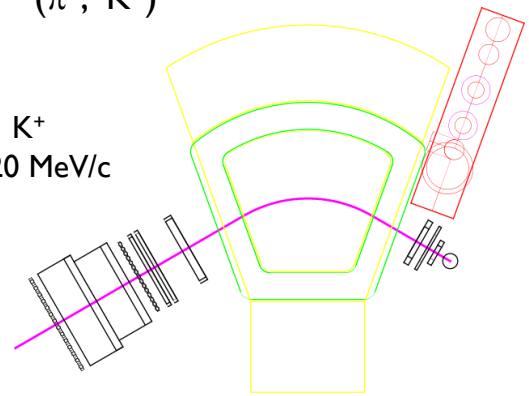
momentum resolution



- The Highest Momentum Resolution at (K^-, K^+) Reaction Spectroscopy
- SKS is disassembled and transported from KEK to J-PARC

SKS -> SksPlus

SKS
(π^+, K^+)

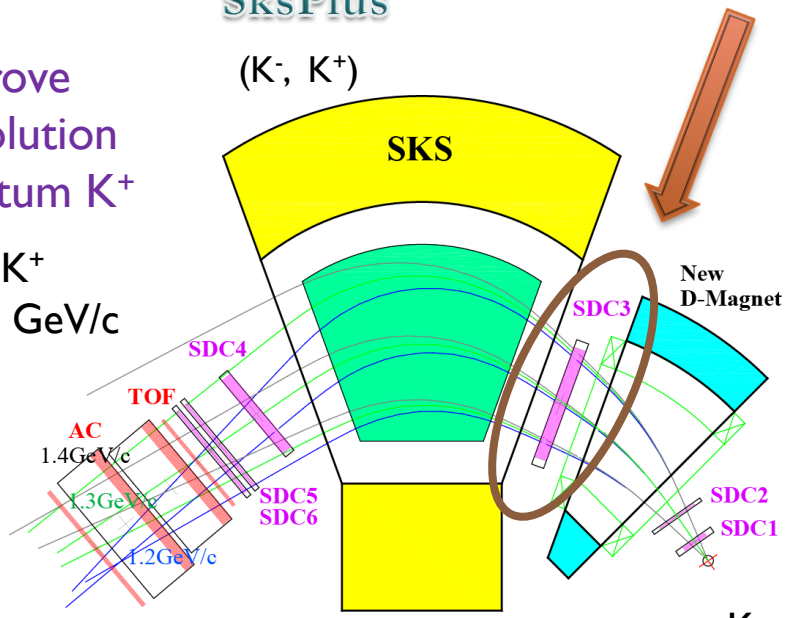


In order to improve momentum resolution for high-momentum K^+

K^+
~1.3 GeV/c

SksPlus
(K^-, K^+)

New SDC3

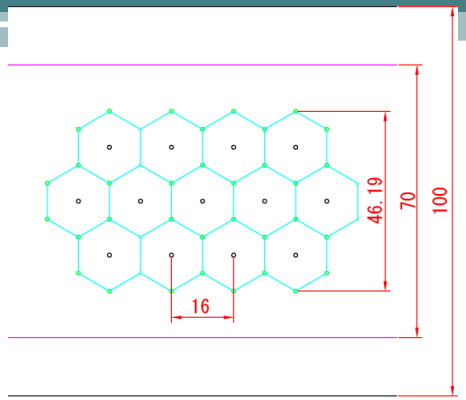


K^-
1.8 GeV/c

SDC3 for SksPlus

- Role of SDC3 in SksPlus
  - 新たにD-magnet を追加したことによる磁気光学系の変化
  - tune up magnetic optics
  - correct some correlation by SDC3 data
- disadvantage
  - multiple-scattering -> worsen momentum resolution

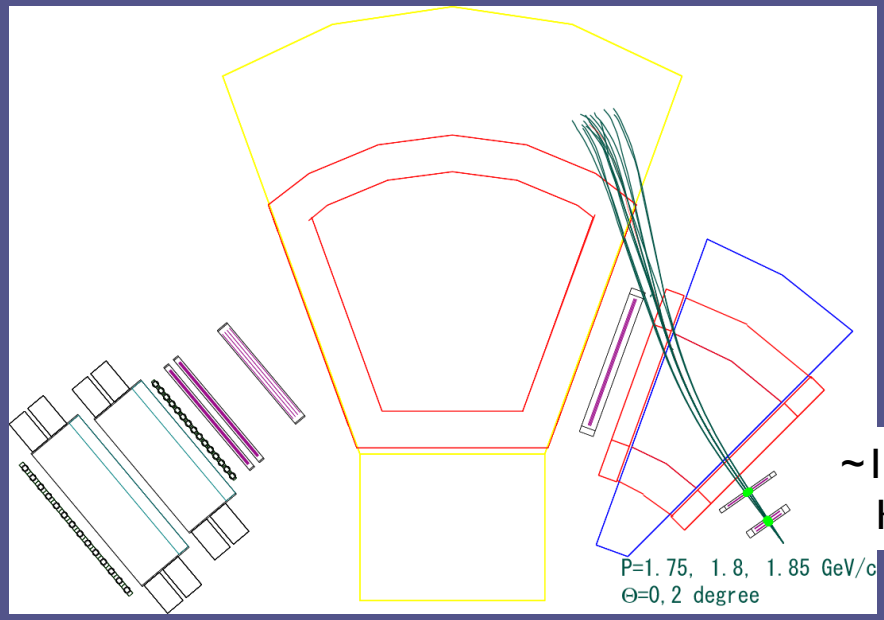
Design for SDC3



- Requested effective area : 1100 x 300
- Double charge exchange reaction (K^-, K^+) => not so high rate
  - drift length = 8 mm
- Cell structure
  - Honeycomb Cell Structure
    <= isotropic electric field , feed-through (easy maintenance)
  - 3 Layers of X
- Gas (<= low radiation length & stable drift region)
  - Ar : C_2H_6 = 50 : 50
- Applied H.V.
- Shield wires <= 前後のLayerでの
  電場の乱れを補正

Garfield Simulation

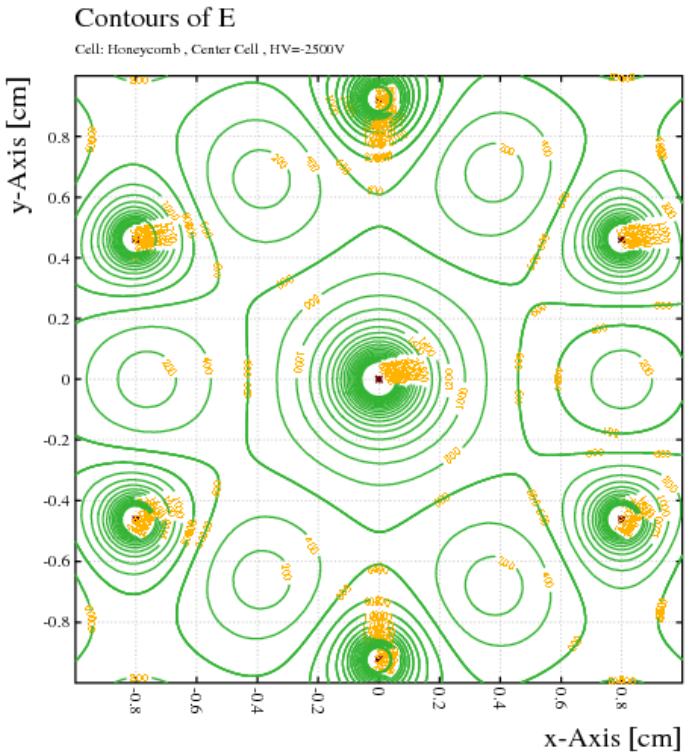
K^- Beam through



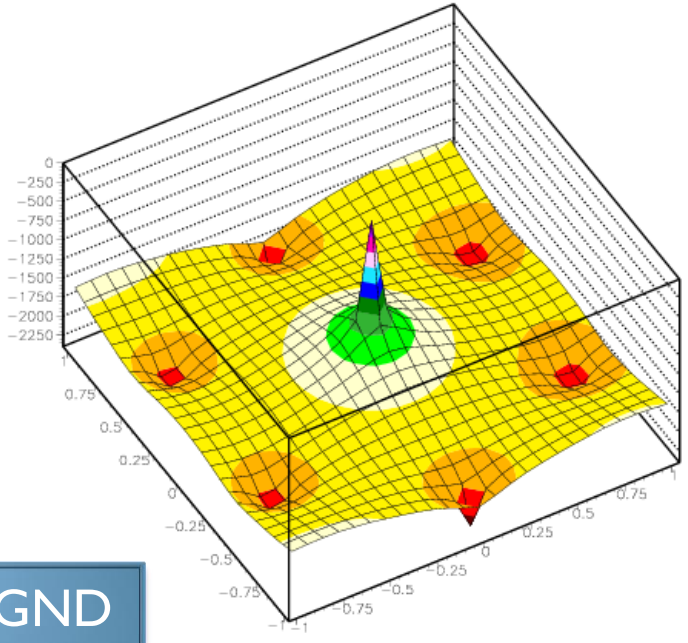
~1.8 GeV/c
K^- Beam

@ Center Cell

Electric Field : *E*



Potential : *V*



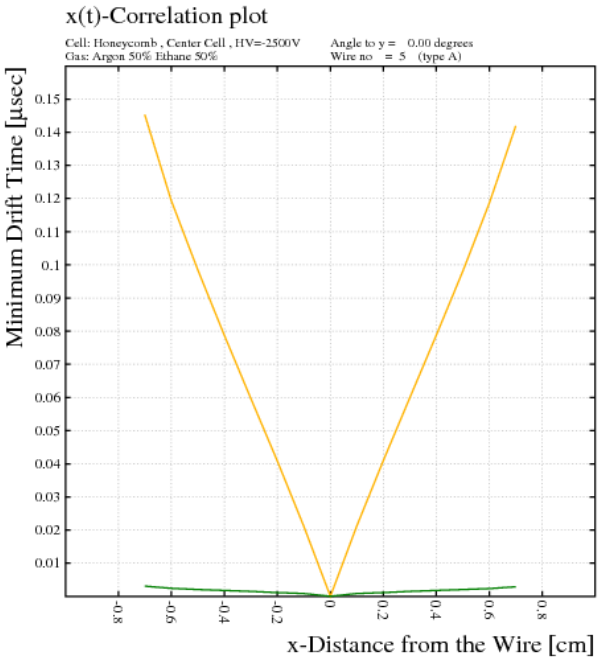
V_{anode} = GND
V_{field} = -2.5 kV

Ar : C_2H_6 = 50 : 50

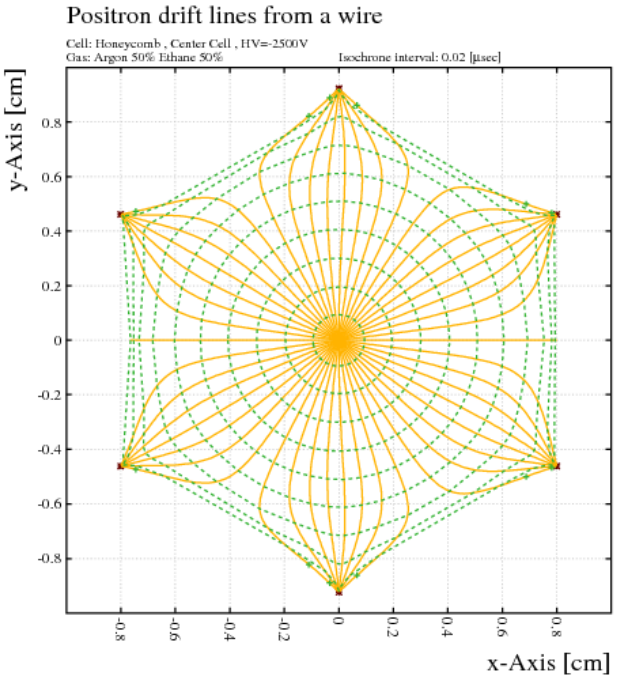
isotropic & stable drift region

@ Center Cell

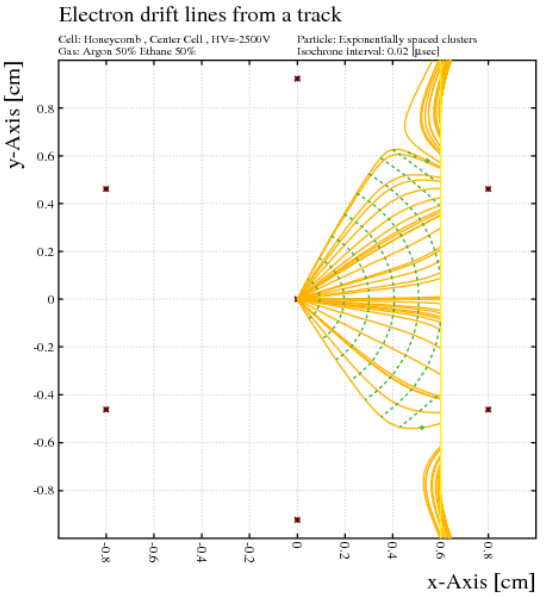
x-t plot



Drift lines & Contour lines



Electron drift lines from a track

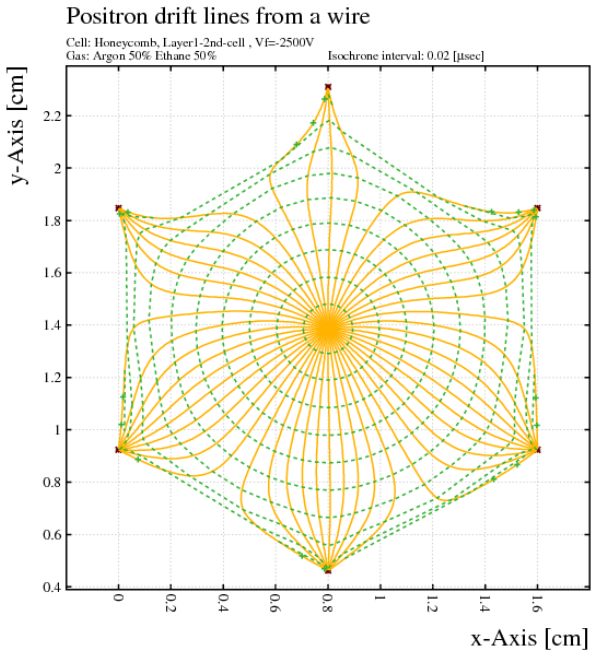


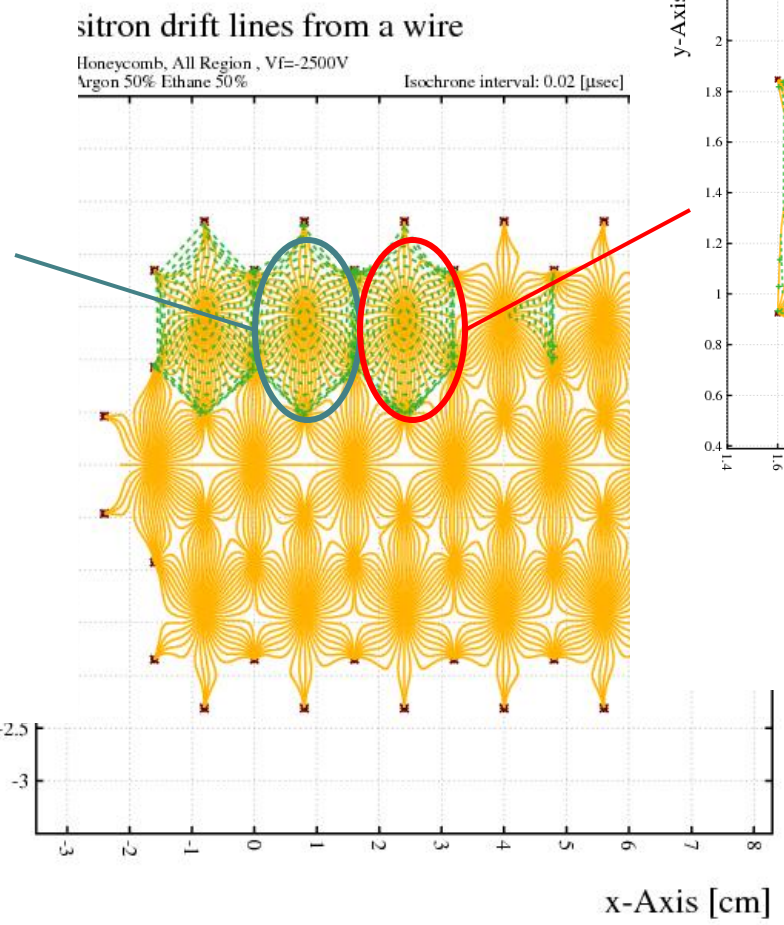
symmetric & almost linear

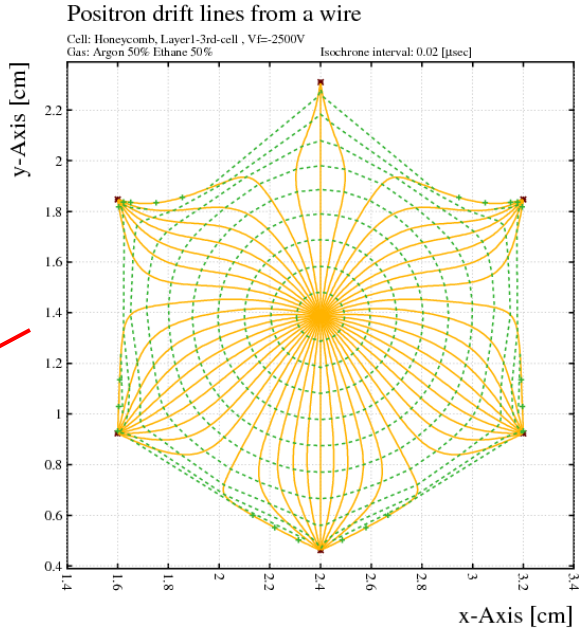
V_{anode} = GND
V_{field} = -2.5 kV

Ar : C_2H_6 = 50 : 50

w/o shield wires



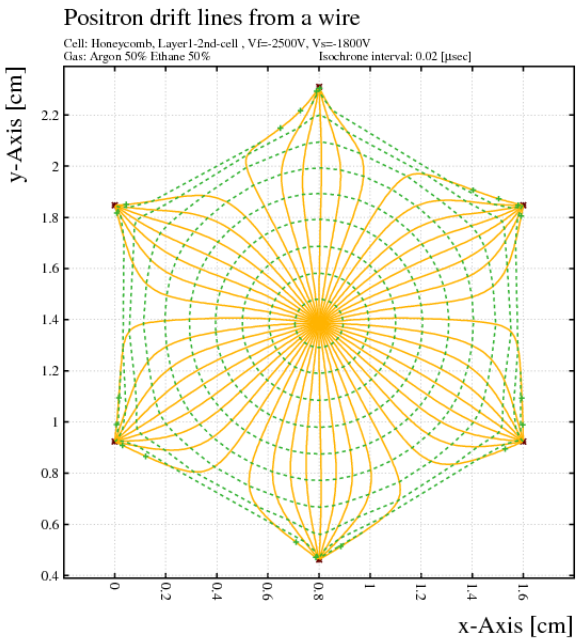


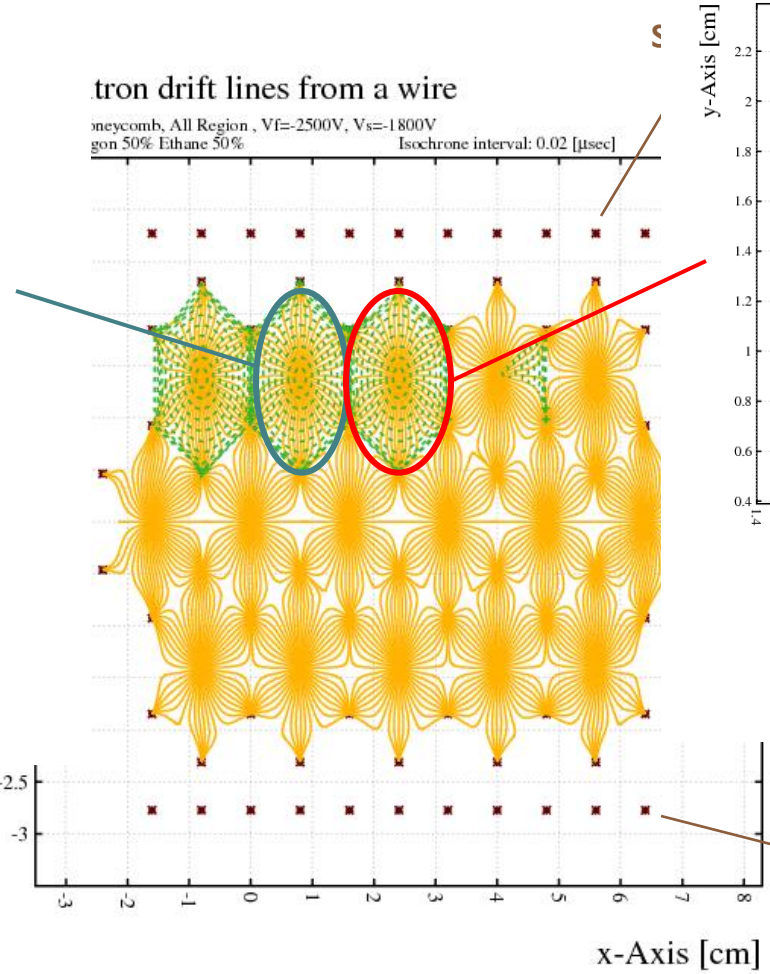


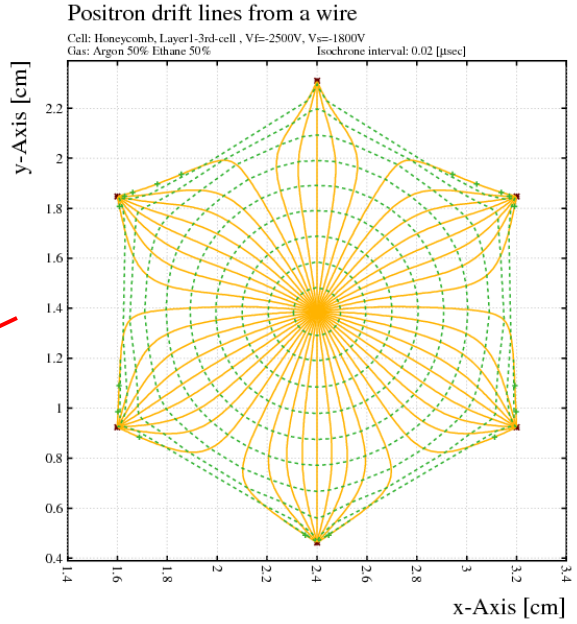
前後のLayerでの電場の非等方性が見られる

V_{anode} = GND
V_{field} = -2.5 kV

w/ shield wires







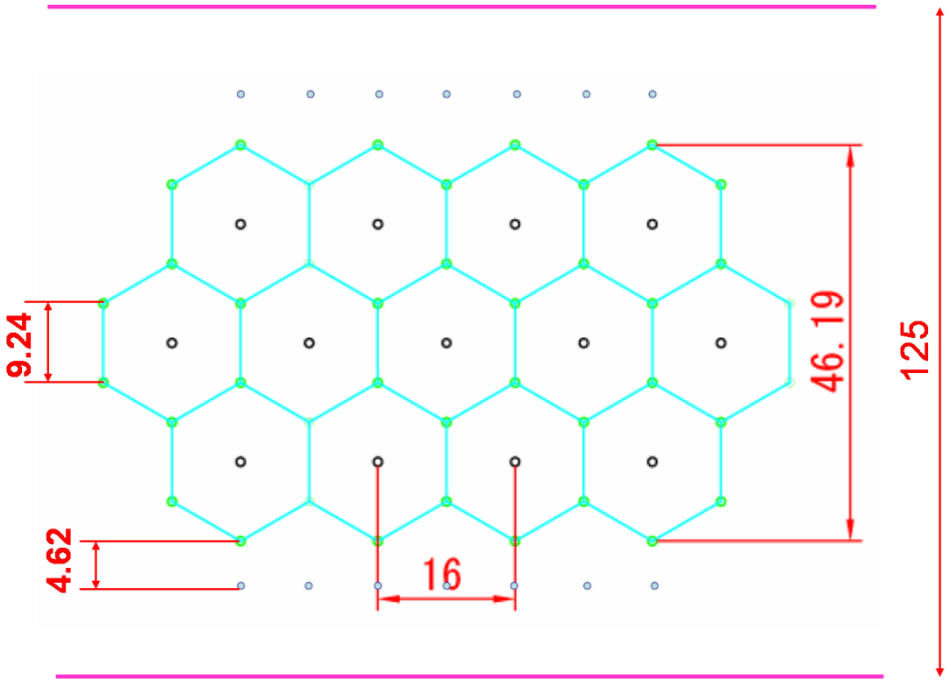
shield wire

電場の非等方性を改善！

V_{anode} = GND
V_{field} = -2.5 kV
V_{shield} = -1.8 kV

Final Specification of Honeycomb DC

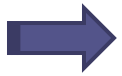
- effective area : 1120 x 340
- frame size : 1262^{W} x 570^{H} x 145^{T}
- Honeycomb cell
- drift length = 8 mm
- 3 layers of X
- Gas Ar : C_2H_6 = 50 : 50
- HV
  - V_{anode} = 0 V
  - V_{field} = -2.5 kV
  - V_{shield} = -1.8 kV
- Readout
  - 208 ch => ASD card -> TKO



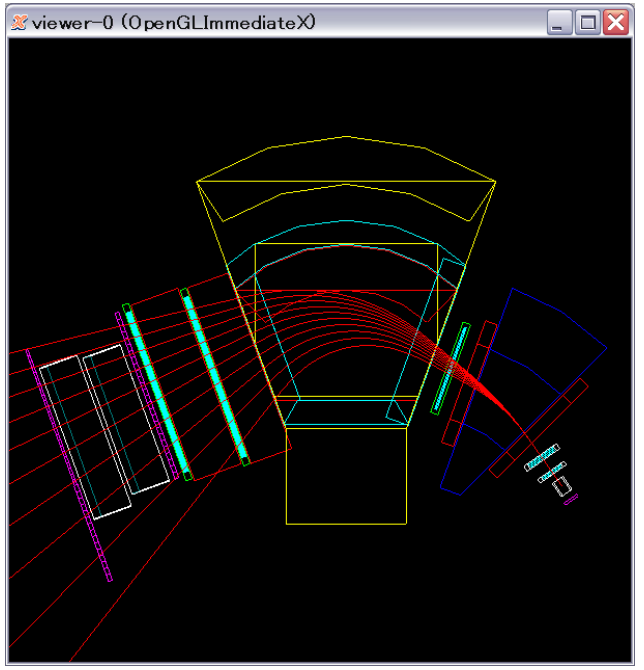
- anode wire 20μm (W-Re)
- field wire 75μm (Al)
- shield wire 75μm (Al)

Simulation
- momentum resolution check -

- SDC3を加えたことによる運動量分解能への影響をsimulationにより考察する必要がある
- multiple-scattering の影響
- 影響が大きい場合はガスをArからHeに変えるなどの工夫が必要



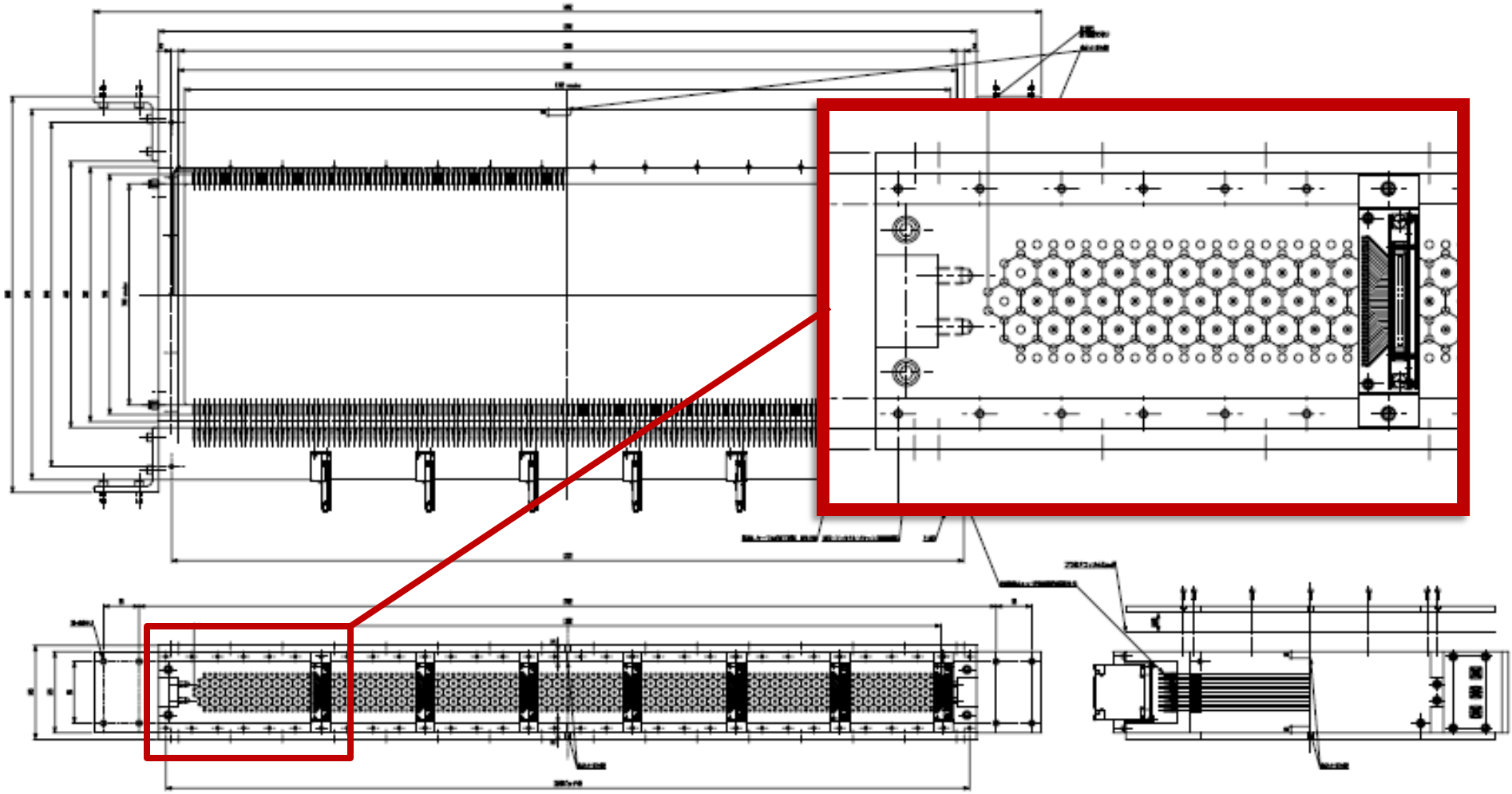
・今後Studyする予定



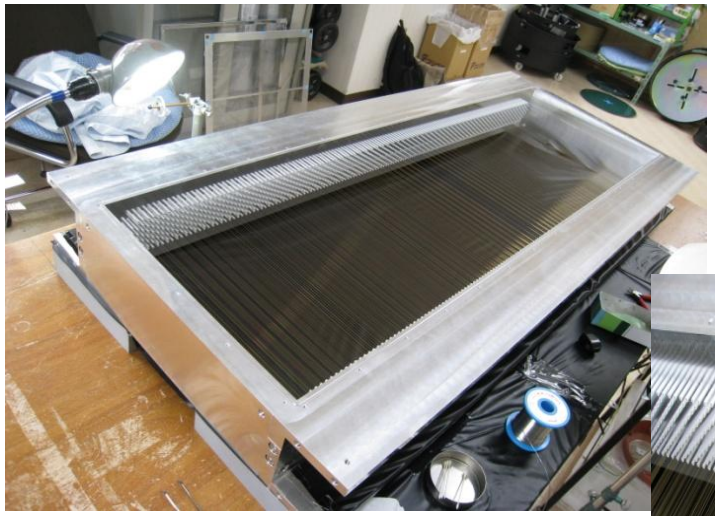
Geant4 Simulation

Construction Status (1)

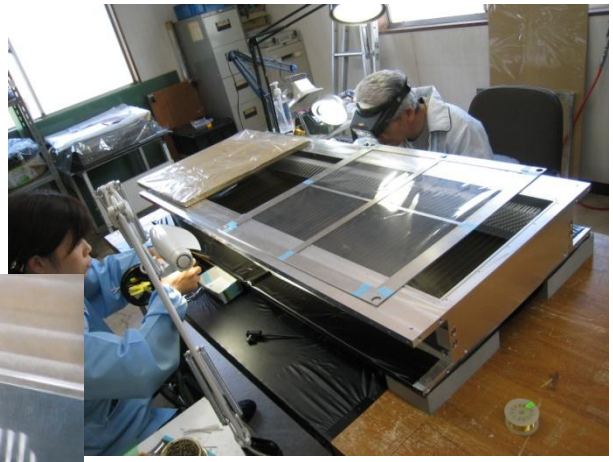
Drawing



Construction Status (2)



Frame 完成　2008 / 09



@林栄つくば営業所

1072 wires

ワイヤー張り終了 2008 / 10 / 27

Construction is almost finished !!

Summary & future plan

- Honeycomb Drift Chamber for SksPlus is now constructing
  - definition of the design
  - electric field calculation with Garfield
  - simulation for momentum resolution check -> to be studied
  - construction is nearing completion
- Start commissioning of chamber after completion
  - efficiency check
  - position resolution
  - …