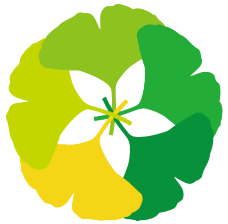
Tohoku-Kyoto Meeting
JLab hypernuclear experiment

Kyoto University
Toshiyuki Gogami

July 28, 2021

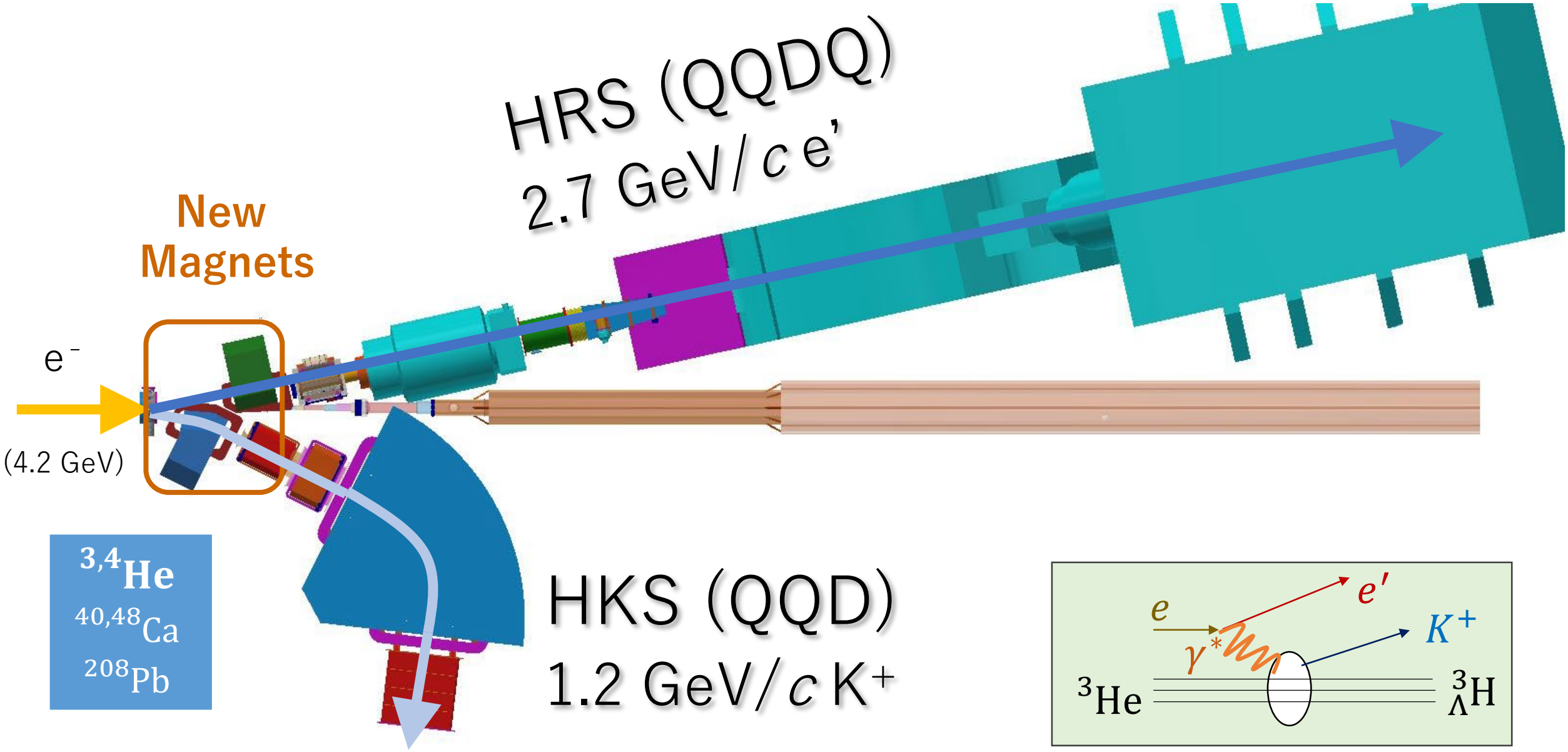


京都大学　理学研究科・理学部
GRADUATE SCHOOL OF FACULTY OF SCIENCE
KYOTO UNIVERSITY

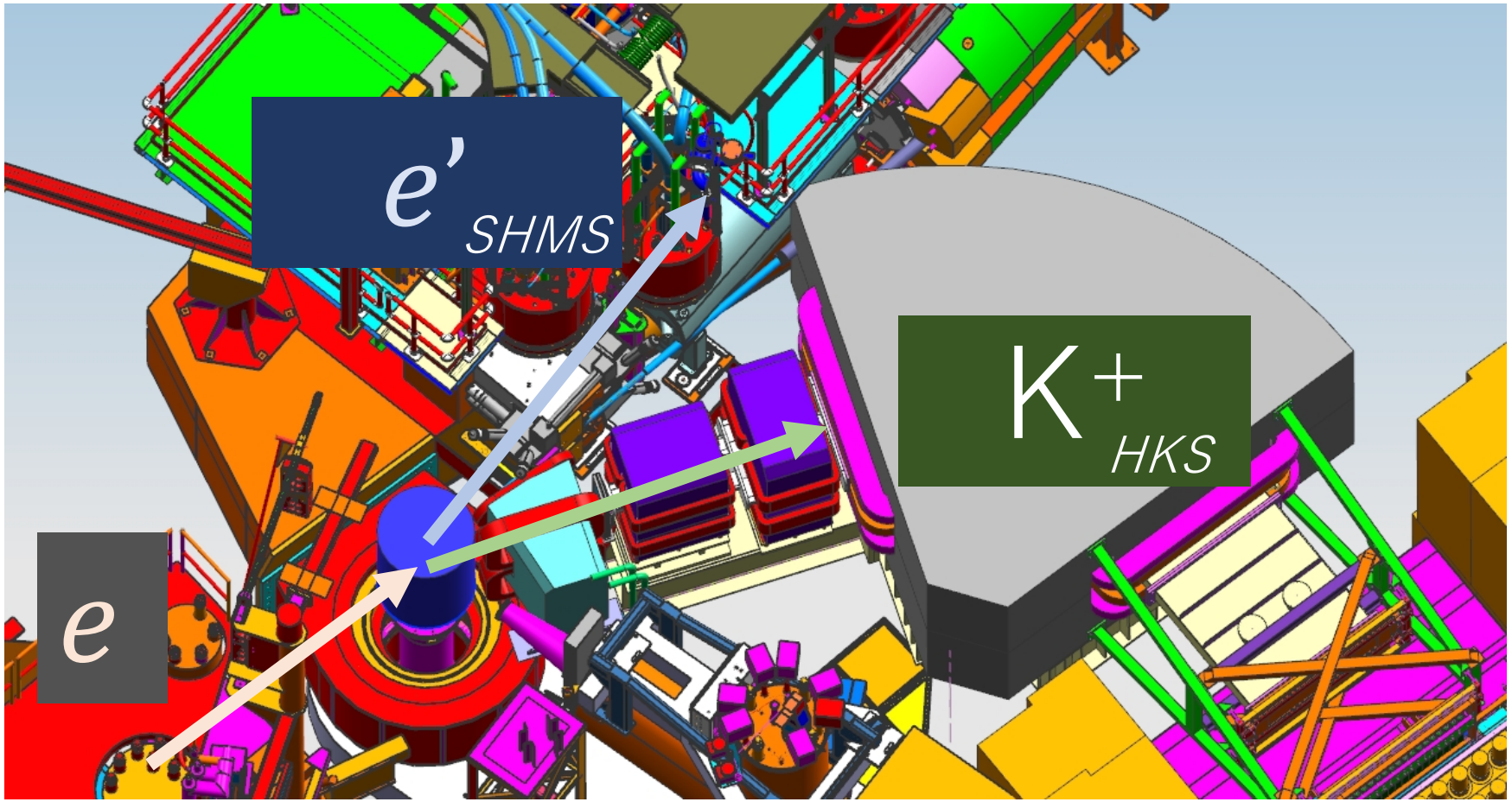
Done (7/1～)

- Hall C futures task force meeting (Jul 1)
  - https://hallcweb.jlab.org/wiki/index.php/Hall_C_Futures
- Japan-US meeting
  - 7/9, 7/23(, 8/6)
- Core member meetings
  - nnL analysis: 7/13, 7/27
  - Strategy: 7/27(, 8/5)
- JLab Hall A/C Collaboration Meeting (Jul 8—9)
  - https://indico.jlab.org/event/451/
  - A = 3, 4 hypernuclei → 5:00 a.m. on July 10 JST
- JLab PAC 49 (Jul 19—23)
  - https://www.jlab.org/physics/PAC
  - E12-19-002 → Approval with a rate of A

Experimental Setup at JLab Hall A



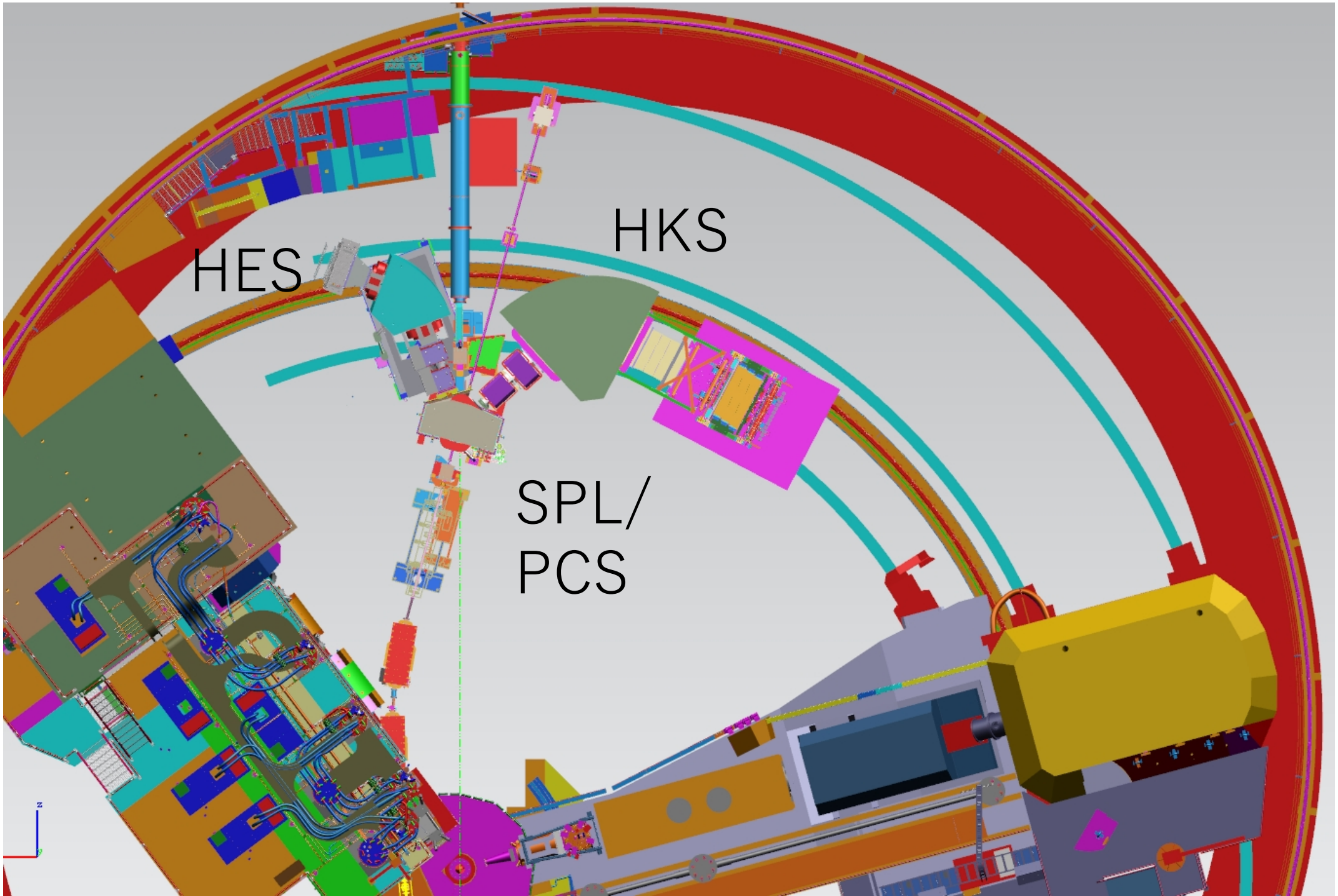
Possibility in Hall C



Evaluations are in progress

- SHMS + HKS
- Vertical HES + vertical HKS
- …

Thank you for the drawings + discussions → Bert, Paul, Steve


HES
HKS
SPL/
PCS

Questions

- Can HES (HKS) be vertical in terms of structural stability ?
  → Communication with JLab staff

- Can we achieve the goal physics in Hall C?
  - Simulation study (SIMC, Geant4)

  →Resolution, yield, S/N

Yield per day (Hall C) @ 20 μA

Areal density of target = 100 mg/cm^2

Configuration	ΔE_Λ (# of events needed for $\Delta B_\Lambda^{\mathrm{stat.}} = 20$ keV)	$^{3}\mathrm{He} \rightarrow {}^{3}_{\Lambda}\mathrm{H}$ 5 nb/sr	$^{12}\mathrm{C} \rightarrow {}^{12}_{\Lambda}\mathrm{B}$ 100 nb/sr	$^{40}\mathrm{Ca} \rightarrow {}^{40}_{\Lambda}\mathrm{K}$ 10 nb/sr	$^{208}\mathrm{Pb} \rightarrow {}^{208}_{\Lambda}\mathrm{Tl}$ 10 nb/sr
SPL+(HES+HKS)	**0.5 (113)**	109 (1 day)	547	16 (7 days)	3.2 (35 days)
PCS+(HES+HKS)		40 (3 days)	203	6.1 (19 days)	1.2 (94 days)
SHMS+(PCS+HKS)	**1.0 (451)**	37 (12 days)	186	5.6 (81 days)	1.1 (410 days)

In case of $\Delta B_\Lambda^{\mathrm{stat.}} = 50$ keV:
0.5 MeV FWHM → 18 counts
1.0 MeV FWHM → 72 counts

Not only yield and resolution, but also S/N needs to be studied
← S/N would be reasonable if the HKS-vacuum extension is modified

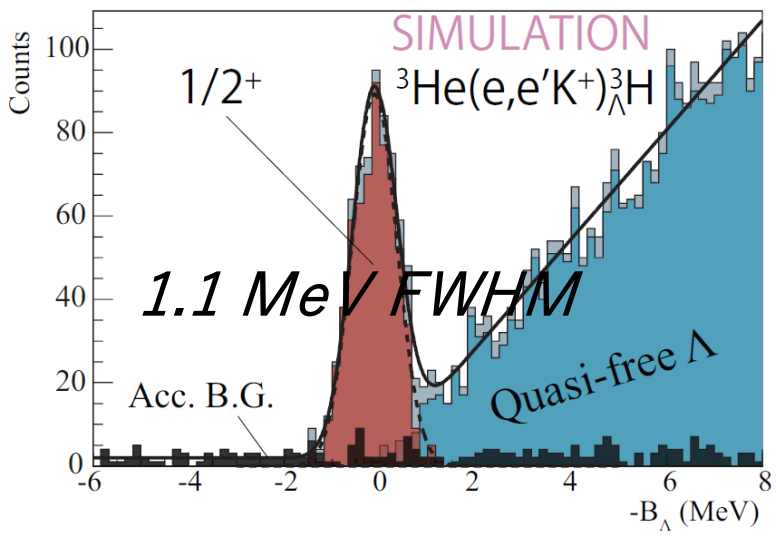
S/N について

HES-HKS で行って、HKSに e+e- がないとしHall A と同等のハドロンレート。
HES 計数率 = 2.5 MHz @8uA, 52Cr からスケールして (HES-HKS@20uA) →

- 2.2 (^{3}He) MHz
- 3.6 (^{40}Ca) MHz
- 55.7 (^{208}Pb) MHz

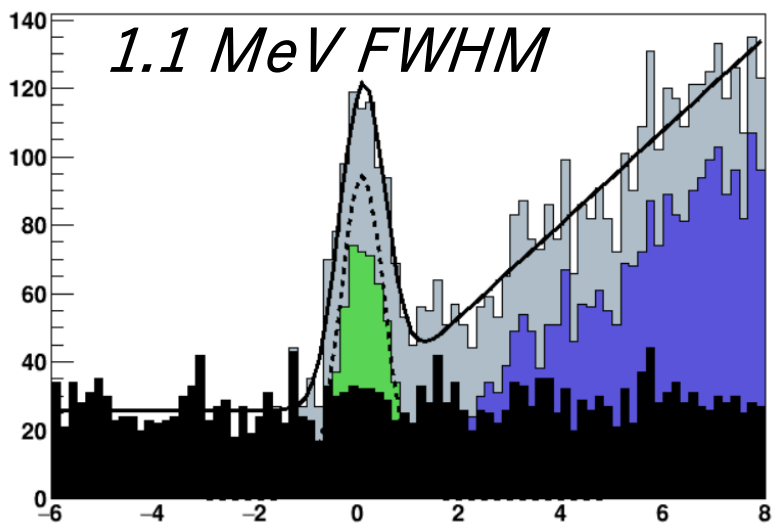
50 uA

HRS-HKS @Hall A

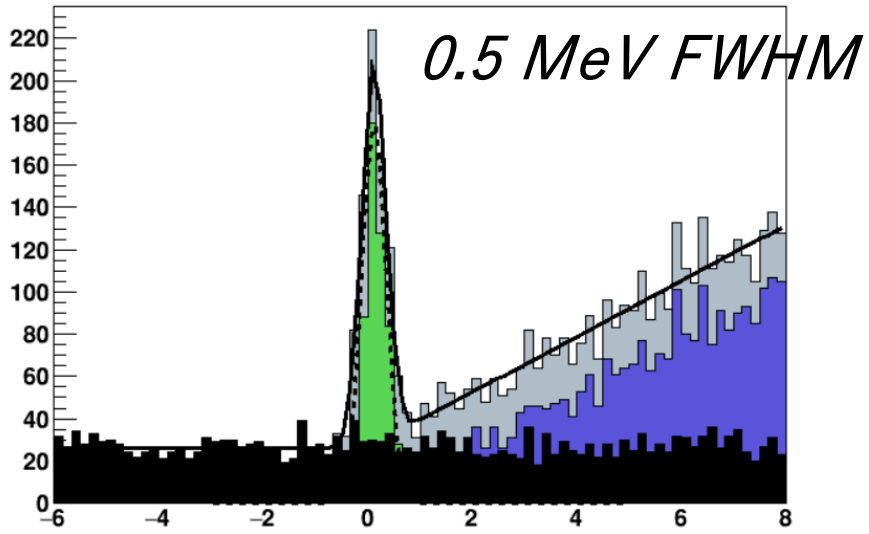


Stat. err. = 20 keV

S/N: HES-HKS @Hall C, 20 uA



Stat. err. < 30 keV



Stat. err. < 20 keV

Hall C possibility

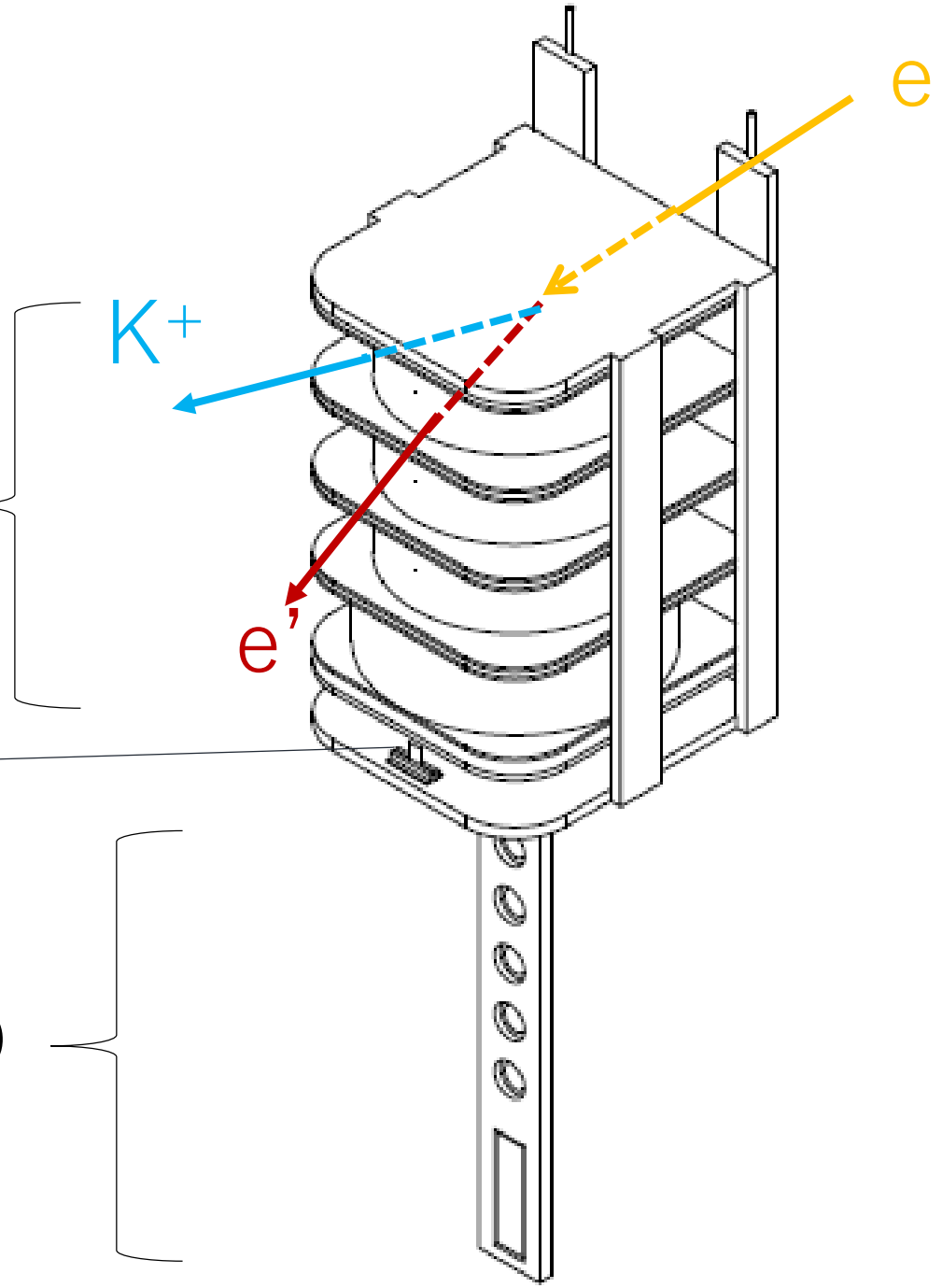
- Feasibility (崩れないか、置けるか)
- Data quality (分解能、収量、S/N → 誤差 vs. 物理)
- Cost (リーズナブルか。誰が払うか)

Target cells (tuna can)

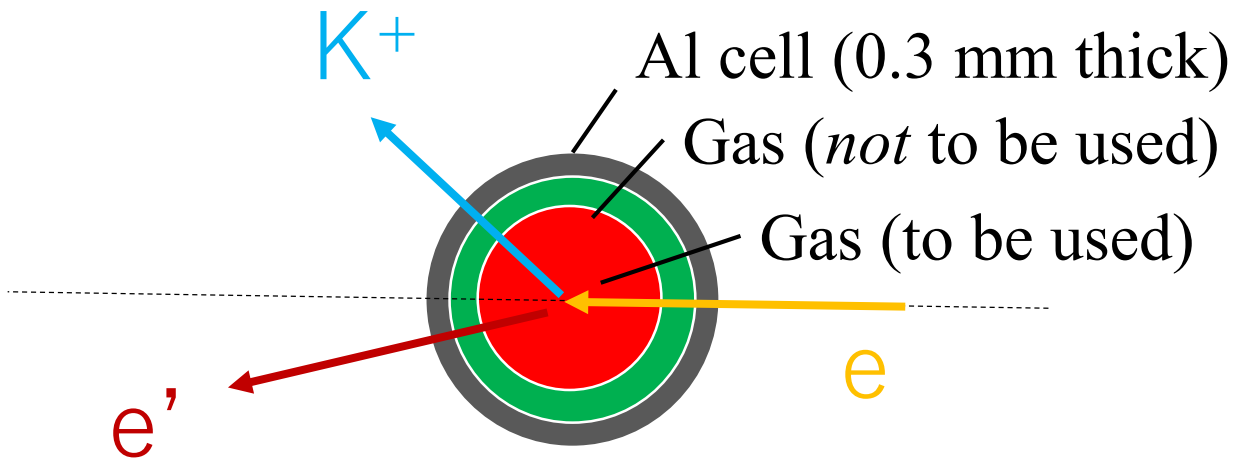
Gas targets (ϕ 200 mm, height = 50 mm)

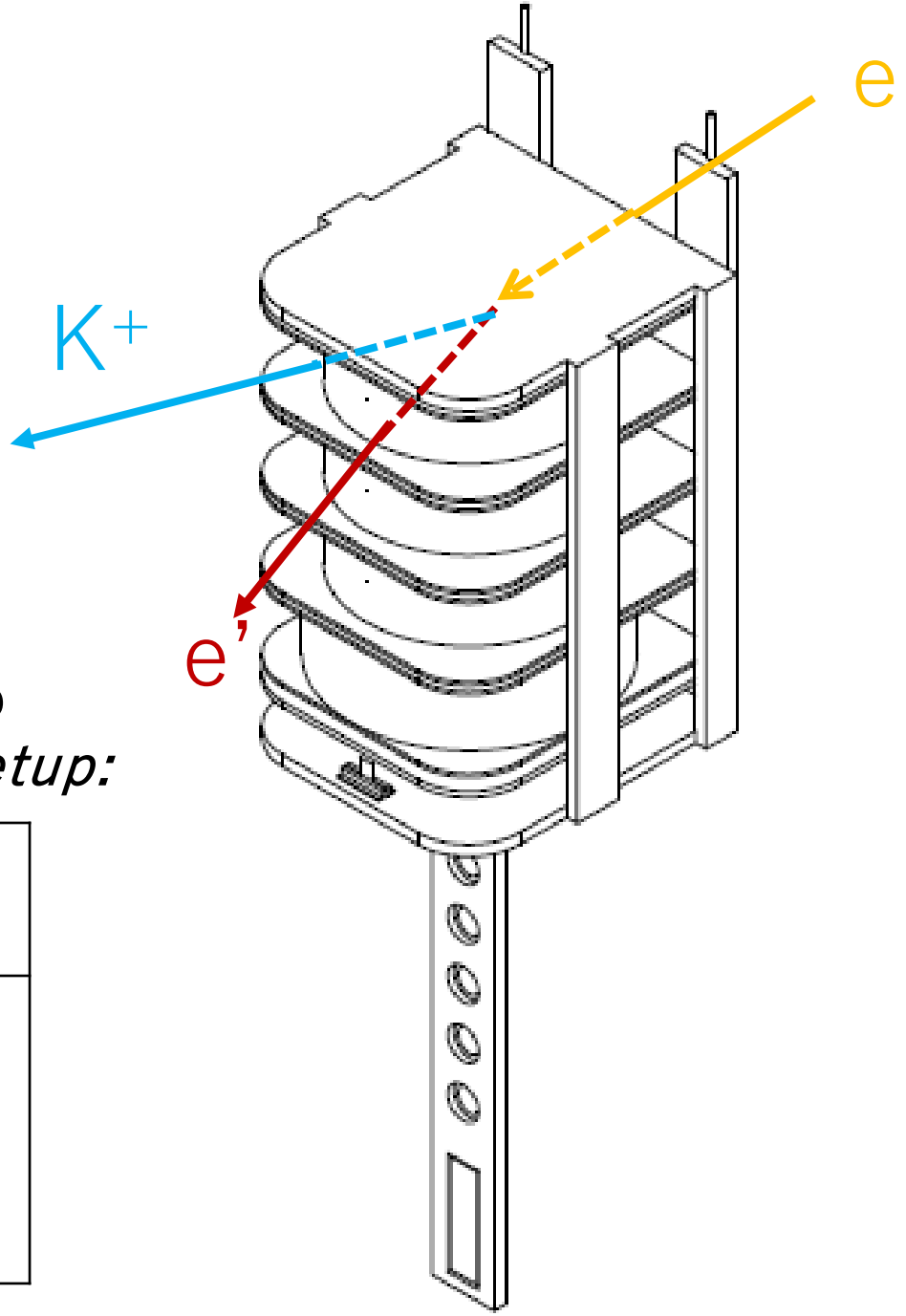
Multi carbon targets

Solid targets (E12-15-008, E12-20-013)



Target cells (tuna can)





Available densities calculated by the JLab Target Group
maintaining a compatibility with our experimental setup:

Target	Density [/(g/cm^3)]	Temperature [/K]	Pressure [/atm]
^{3}He	9.5	12	3
^{4}He	13.1		
$^1H_2$	2.8	30	

Target

TAC COMMENT 1:
The authors indicate that a new target system design was developed i n collaboration with the JLab Target Group to accommodate the restricted space at the target pivot and for compatibility with the E12-15-008 experiment. Some existing cryogenic gas handling systems can be utilized with modified operating parameters specifi c to this application. It is noted a new ladder and motion system (which can be similar to that used for PREX) will need to be built. It was not clear the cost or how much time is needed for these developments. While the authors note a similar effort to that of PREX/CREX is likely, it would be useful to illustrate further details of the setup (e. anticipated power load, conceptual drawings, etc.) and required labor.

- We gave up the high density targets (roughly 10 times larger density than that proposed this year was assumed last year) because of the space limitation.
- To compensate the density reduction, a larger cell is assumed in this proposal;

  50 mm → 200 mm for He gas targets (4 times thicker target).

  In addition, 2 times longer beamtime is requested for ^{4}He.
- Manpower and cost
  - Designer and scientist 6 months working at about 60% to complete the design of the target.
  - Fabrication of the target will take about 6 months and about $500K in material and fabrication labor.
  - The installation will be about 6 weeks and require 80% of the target group technical staff, 1 engineer and 2 scientists.
- Heat load $\leq$ 25 W (gas + cell)

9/8—11 WEPH、可能でしたら是非ご参加お願いします
（前回： http://physics.daliborskoupil.cz/onlineWS2020/ ）

PANIC とかぶっている…

Backup

散乱電子側の計数率の見積もり
制動放射のみ
クロムを使った過去のデータより

He: (190/134. * 0.01 + 162/134*0.304) * 2.5 * 20./7.3 = 2.2 MHz

Ca: (100/134. * 0.7) * 2.5 * 20./7.3 = 3.6 MHz

Pb: (100/134. * 10.9) * 2.5 * 20./7.3 = 55.7 MHz