Implementation of WASA at FRS

Plans for Beam Time 2019+

Take R. Saito

GSI Helmholtz Center for Heavy Ion Research, Germany
and
Helmholtz Institute Mainz, Germany

Workshop on WASA at GSI/FAIR,
November 27th – 28th, 2017, GSI, Germany

Background of the idea

- **Kenta Itahashi considerd WASA for FRS**
- **September 2016:**
  - Three proposals for baryon resonances, eta'-nuclei and hypernuclei started to consider WASA at FRS
  - Discussions with the WASA collaboration started
- **July 2017:**
  - Meeting with the part of the WASA and Super-FRS Experiment Collaborations in Juelich
- **August 2017:**
  - Green light by the WASA collaboration to move the WASA central detector from COSY to GSI
- **September 2017:**
  - GSI G-PAC, approval of the two proposals
- **November 2017:**
  - Approval by the GSI/FAIR Joint Scientific council

UPPSALA
UNIVERSITET

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Docent

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August 25, 2017

To whom it may concern

Transfer of the WASA Central Detector to GSI

On the Collaboration Board Meeting on August 25, 2017, the WASA-at-COSY collaboration has decided to agree on a transfer of the WASA Central Detector (excluding the pellet target) to GSI to be used in experiments by the planned "WASA-at-FRS" collaboration for an initial period up to the end of 2022.
The recipient is responsible for reassembly, operation and maintenance of the equipment. The formal transfer should be documented in a memorandum of understanding between the owners of the equipment and the host laboratory GSI.

Uppsala, August 25, 2017

Dr. Magnus Wolke

Spokesperson of the WASA-at-COSY Collaboration

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Summary: FRS + WASA

S447: **Hypernuclei**

- Puzzles on nnΛ and $^{3}_{\Lambda}$H lifetime

S457: **η'-nuclei**

- Semi-exclusive measurement

Novel Technique towards Super-FRS at FAIR

S463: **Baryon resonances in asymmetric nuclear matter**

- To separate projectile and target resonances with π^- measurements

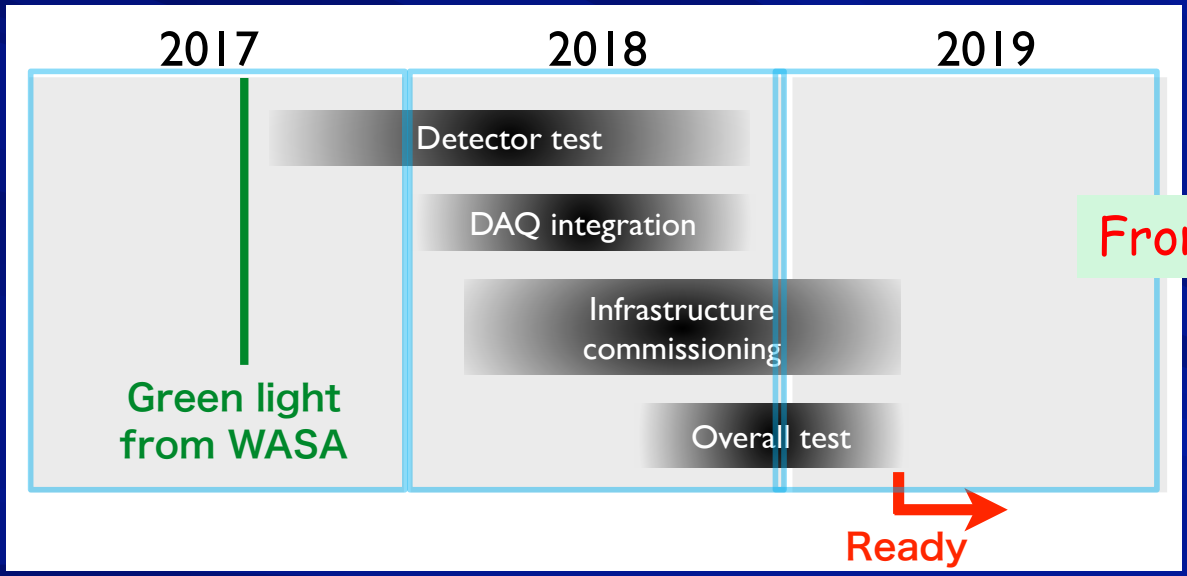
	Beam	Main shifts	Commissioning shifts (50%)
S447	^{6}Li at 2 *A* GeV, 1.7 X 10^{7} /s	33	18
S457	Proton 2.5 GeV, 2.5 X 10^{8} /s	18	18
S463	^{136}Xe and ^{124}Xe at 0.4, 0.8 and 1.2 *A* GeV, 10^{8} /s	14	18

Common if as a campaign in 2019

Two approved proposals

Table 5: Summary of the approved proposals.

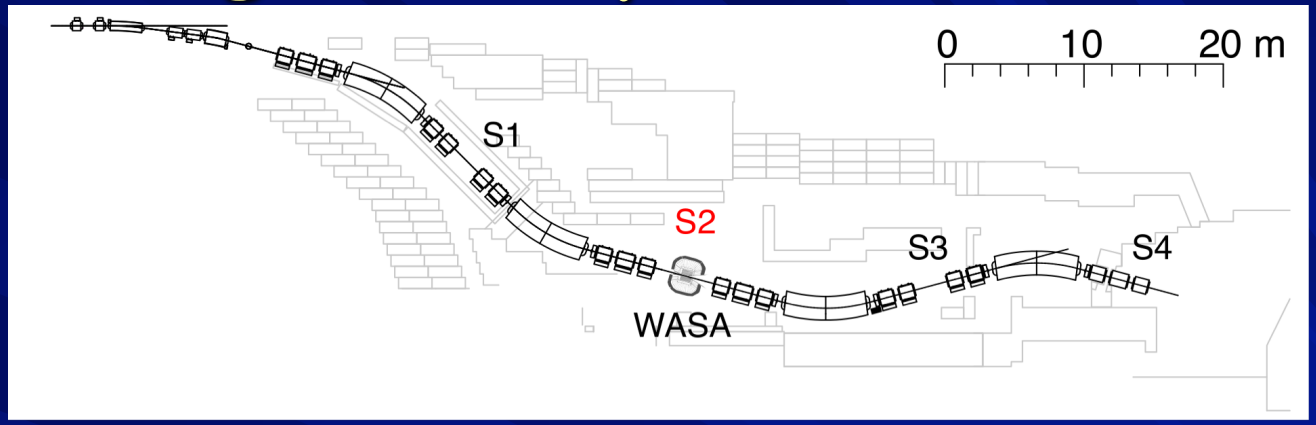
Proposal	Grade	Asked (physics)	Asked (commissioning)	Approved (physics)	Approved (commissioning)	Year
S447, hypernuclei	A	33	18	27	18	2019
S457, η'-nucleus	A-	18	18	18	18	2019

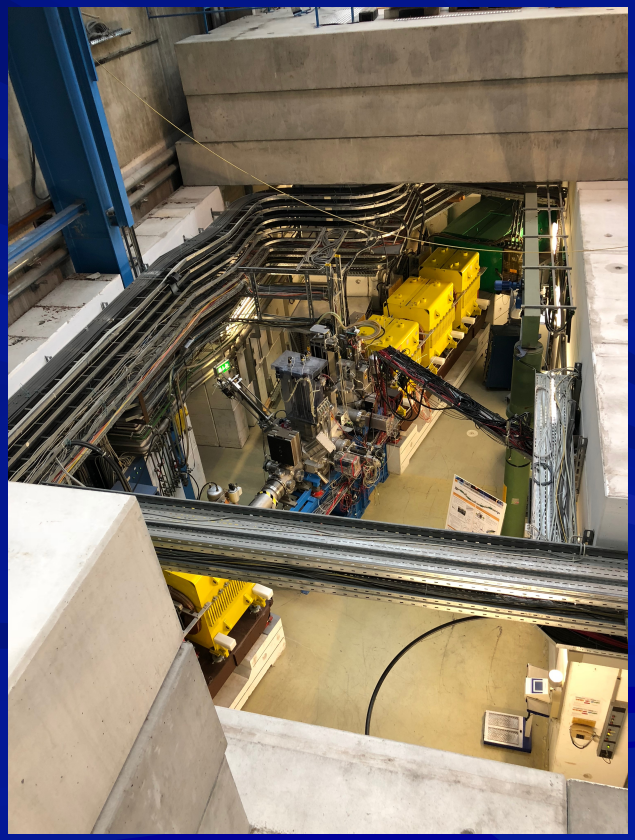


From August 2019

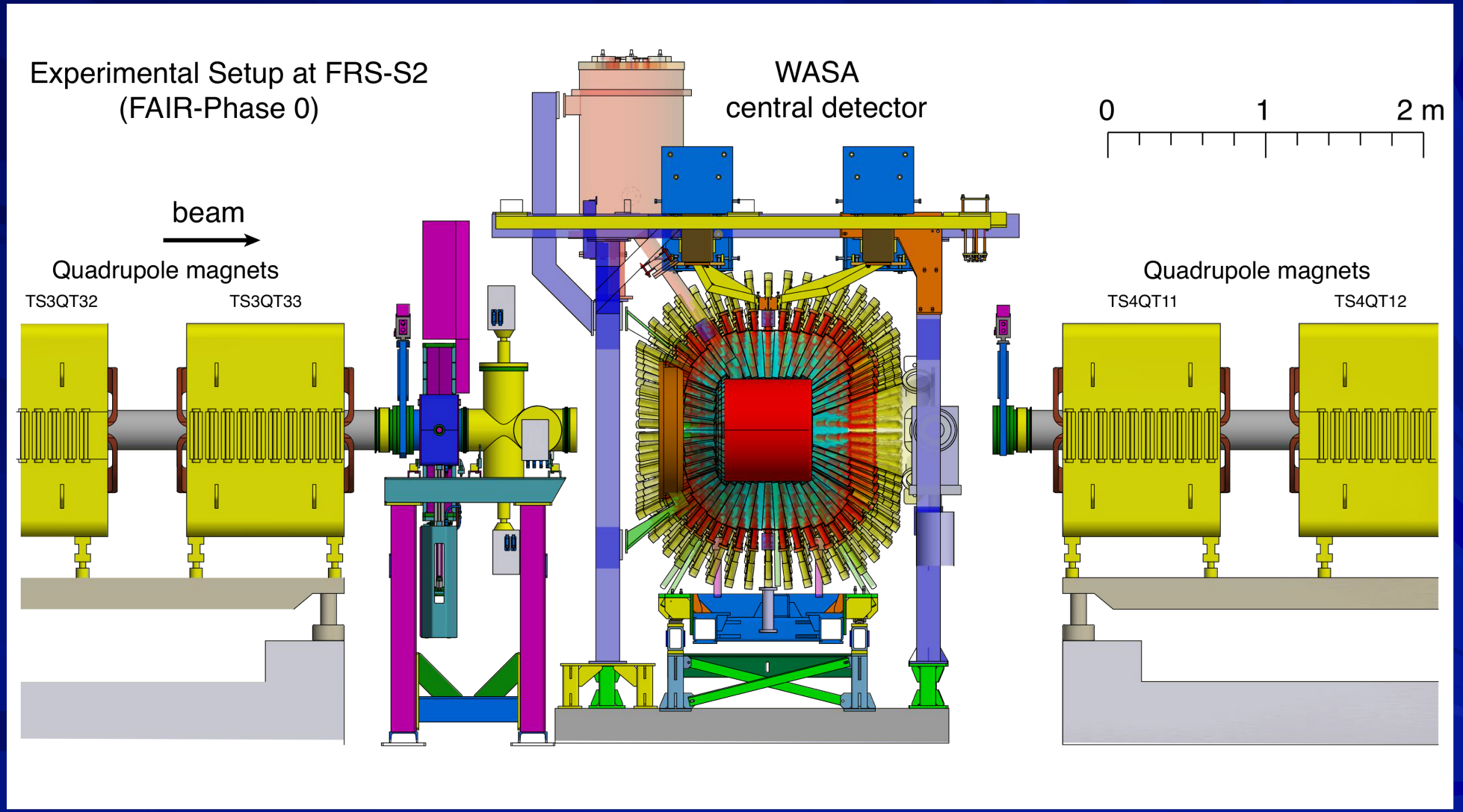
- 18 shifts for commissioning
- Break for a few weeks
- Physics shifts

Fragment separator and S2

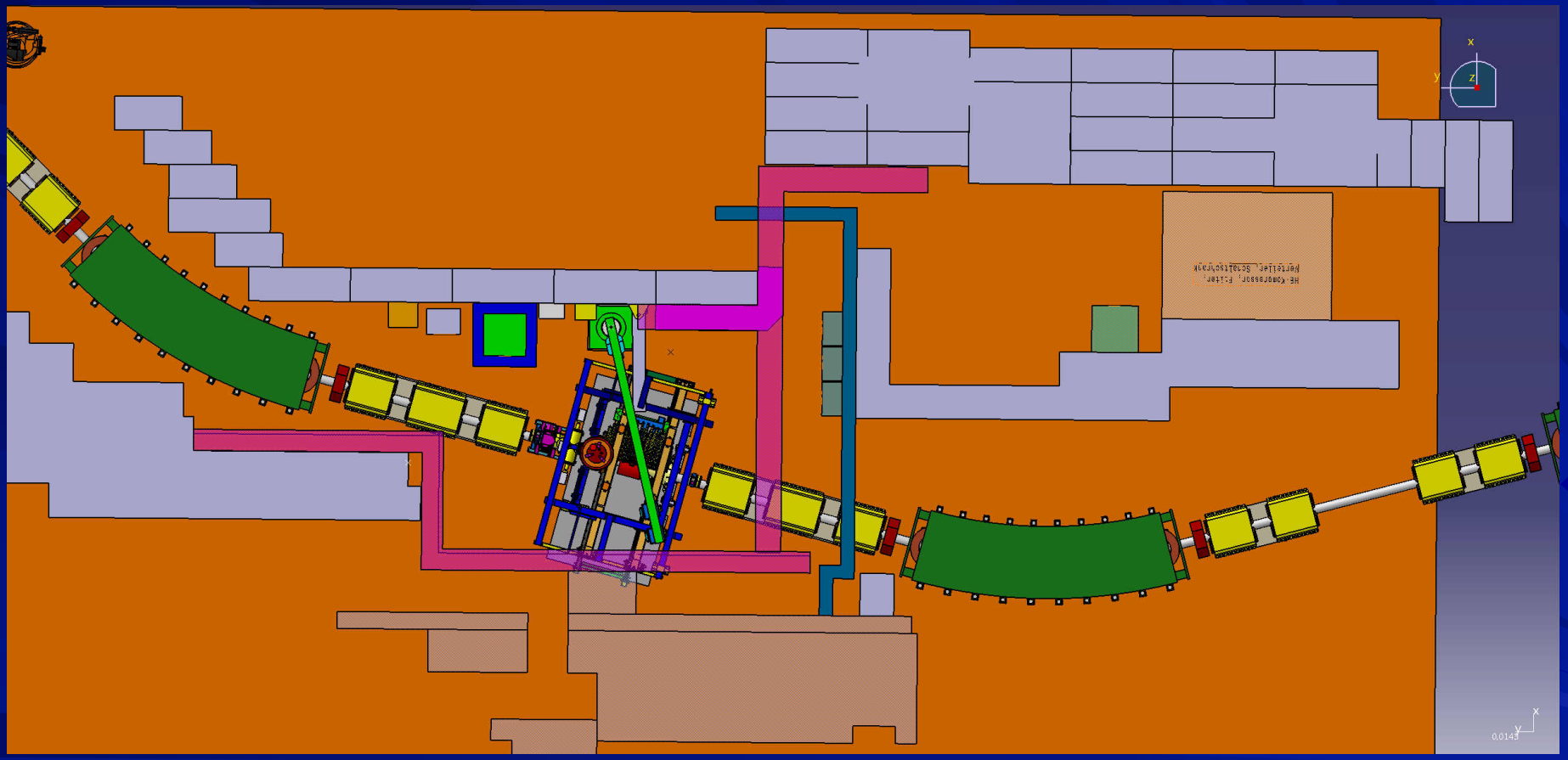




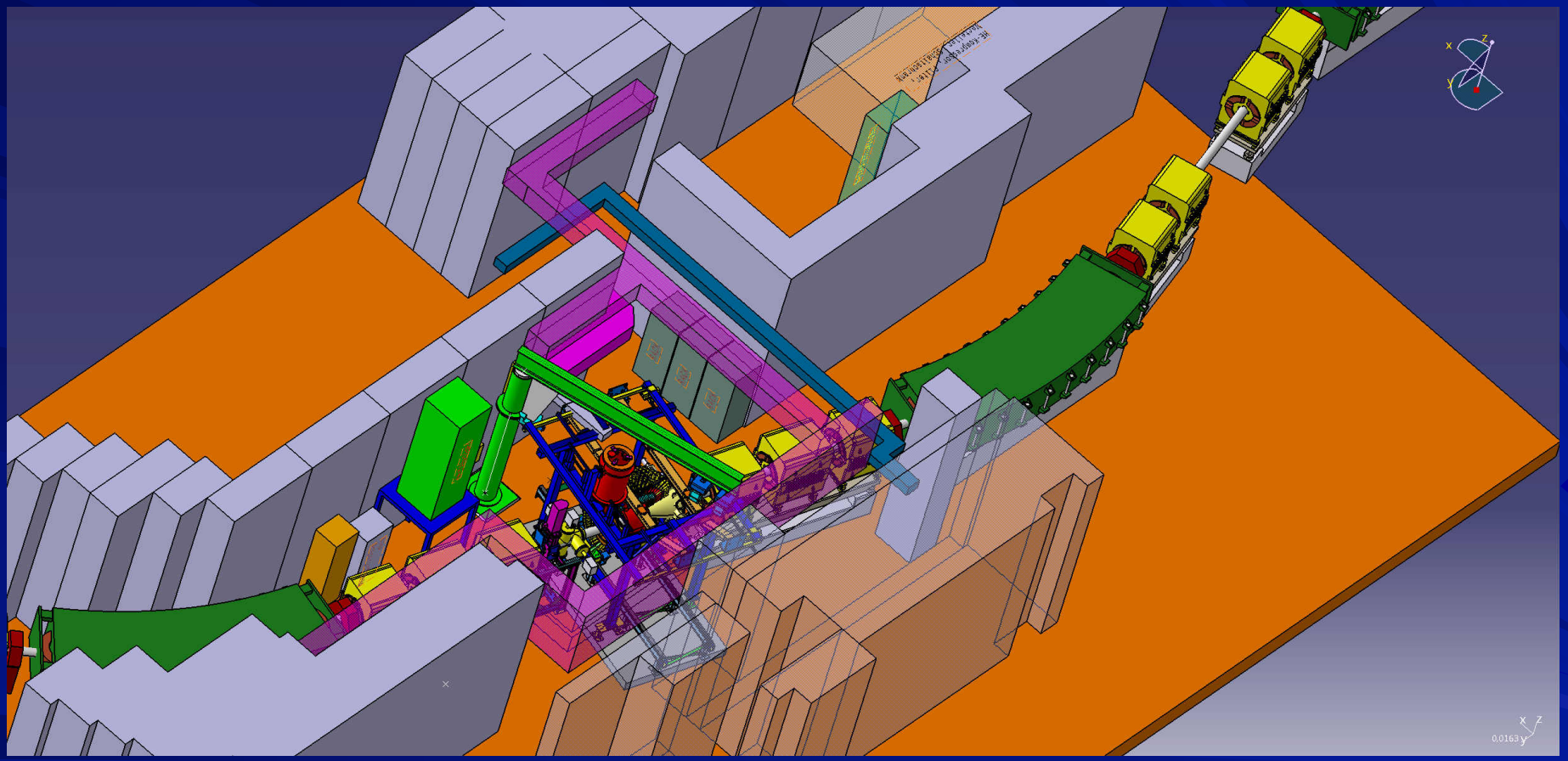
WASA at S2

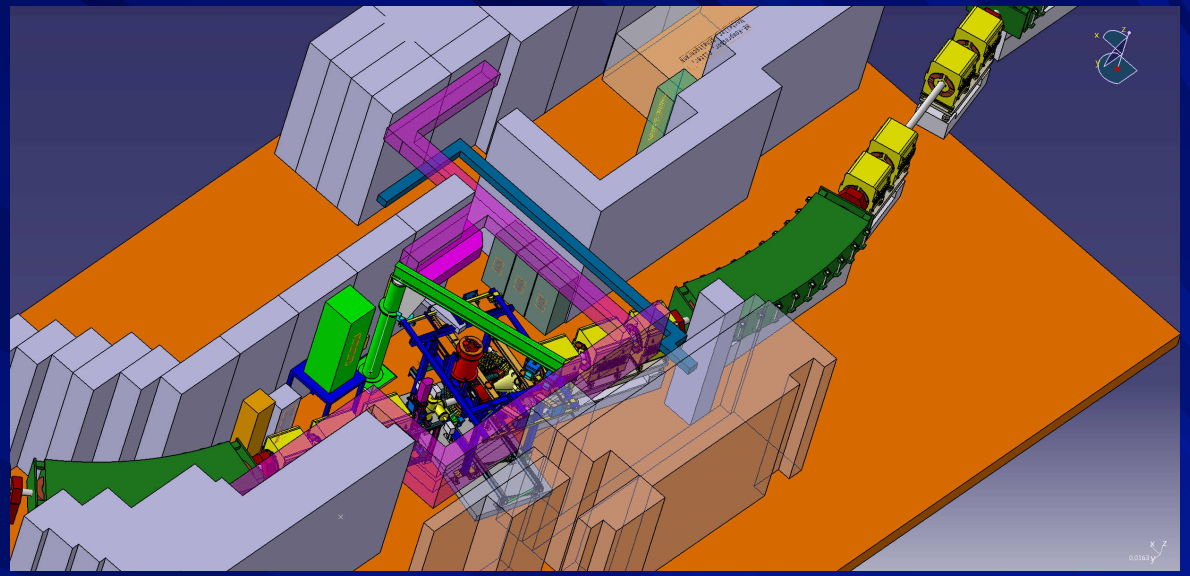

Experimental Setup at FRS-S2
(FAIR-Phase 0)
WASA
central detector
0
1
2 m
beam
Quadrupole magnets
TS3QT32
TS3QT33
Quadrupole magnets
TS4QT11
TS4QT12

WASA at S2



WASA at S2





Tour: today
at 16:00 – 17:00

Transportation of WASA CD to GSI

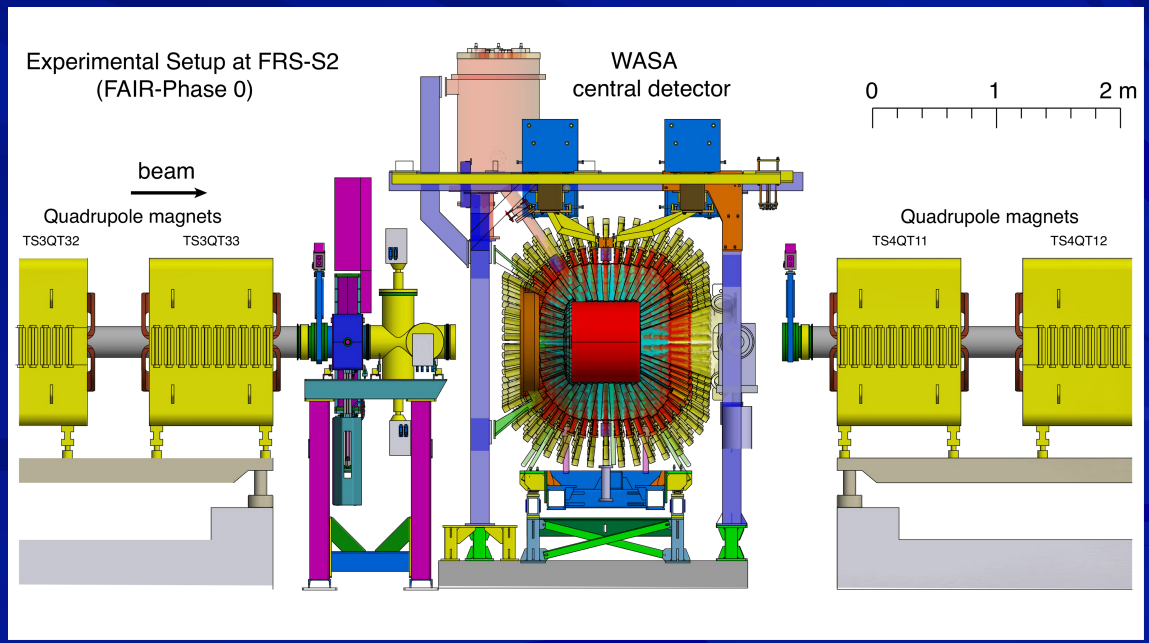
- In the first quarter of 2018

- Super conducting magnet and associated cryogenic
- Slow control system

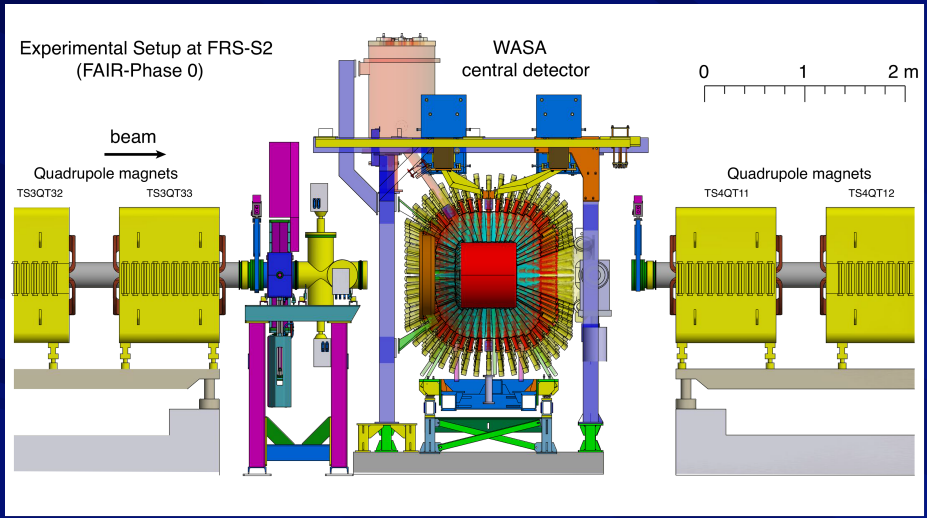
- MDC
- Plastic barrel and end-caps
- CsI

- Associated electronics

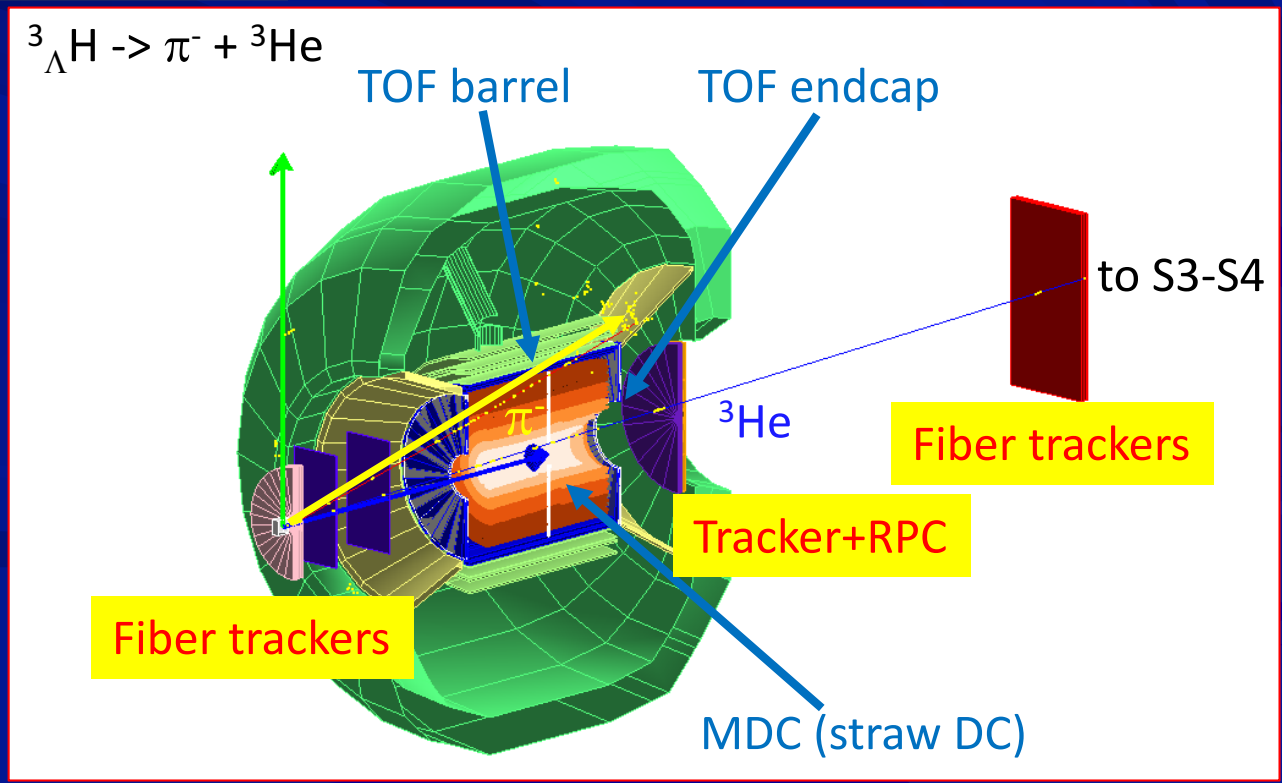
- Drying plant for CsI



Setup for hypernuclei



1.8 T if possible



Superconducting magnet and cryogenics

- First, installed on the roof of S2

Superconducting magnet and cryogenics

- First, installed on the roof of S2
- Test of the magnet system asap
  - 1.8 T operation possible or not
  - Important for the hypernuclear proposal
  - Revision of Monte Carlo simulations
- We need more manpower

Laboratory spaces at GSI

- For detector tests
  - MDC
  - Plastics
  - Fiber detectors

MDC test

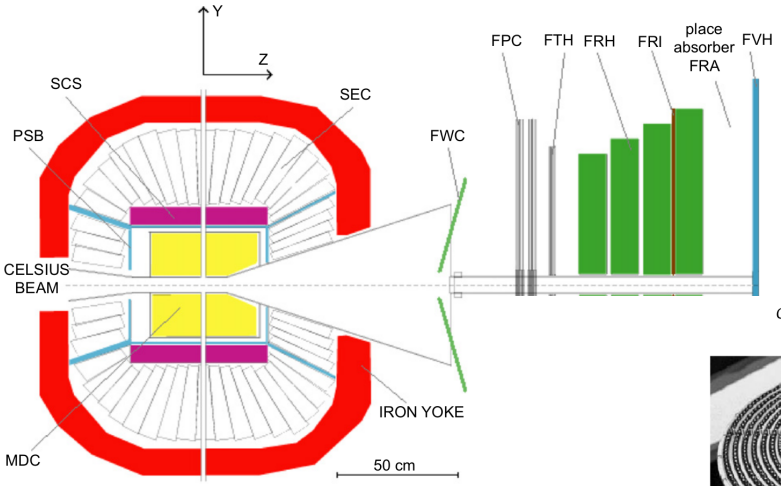


Fig. 2. Cross-section of the WASA detector. The central detector built around the interaction point i
detector are visible on the right-hand side. The individual components are described in the text.

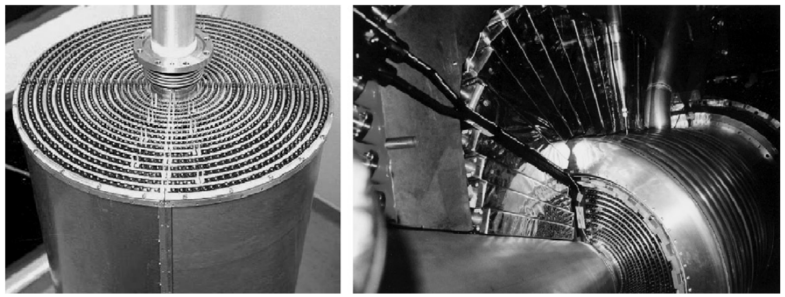


Fig. 10. (Left) The fully assembled MDC inside the Al–Be cylinder. (Right) The MDC surrounded by PSB elements and the SCS cryostat.

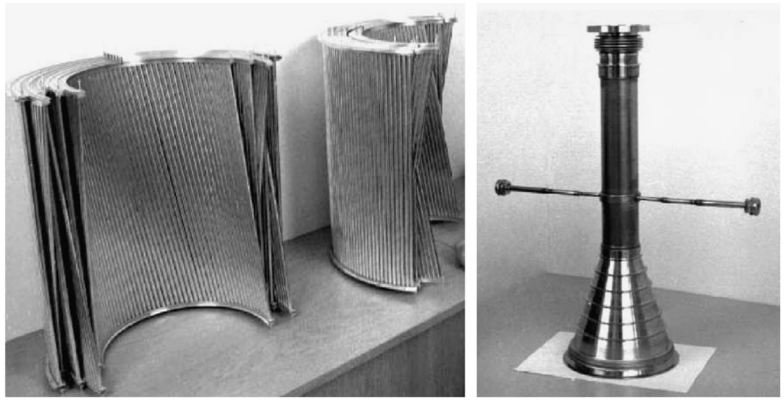


Fig. 11. (Left) Drift tubes secured in the end-plates. Note the *stereo* layers interleaved with parallel layers. (Right) Be beam pipe with pellet pipe crossing and forward cone.

MDC test

- Testing in the lab with cosmic-rays
- Identify dead channels

- Implement dead channels in MC simulation
- Revision of the simulations with the realisitic configurations

- One postdoc + one PhD student

Upgrading the plastic detectors

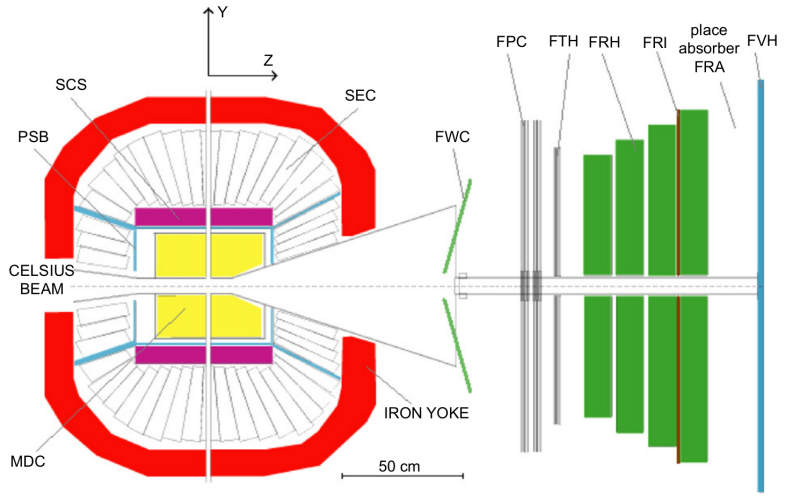


Fig. 2. Cross-se… detector are vis…

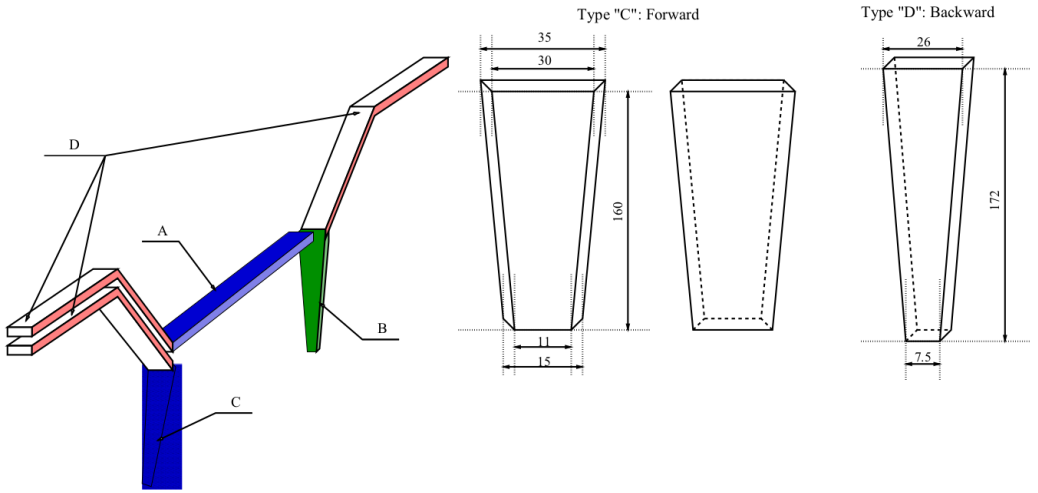
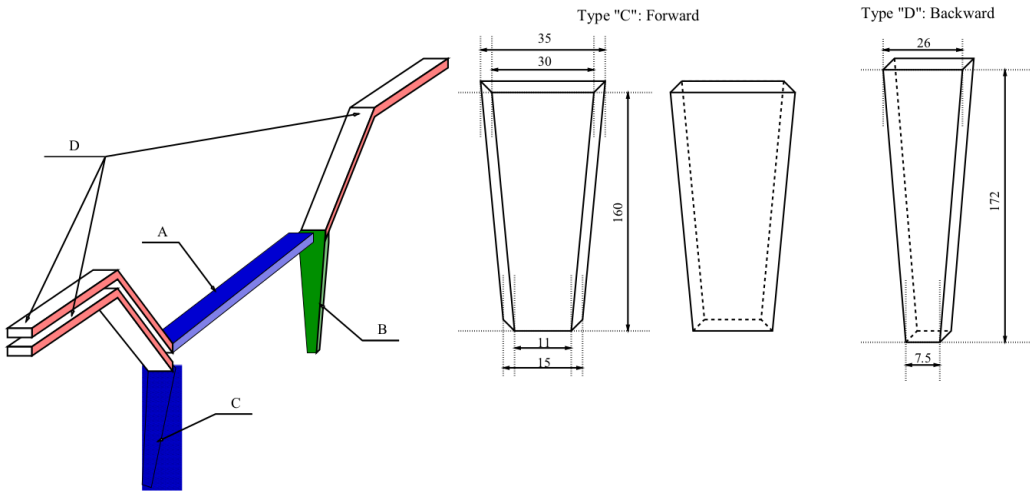


Fig. 15. (Left) Layout of one section of the PSB detector. A denotes the rectangular counters of the barrel wall and B and C are trapezoidal elements in the forward and in the backward caps respectively. D are bent light guides. (Middle) Two shapes of the trapezoidal forward elements with dimensions marked in mm. (Right) Shape and dimensions in mm of the trapezoidal backward element.

Upgrading the plastic detectors

- **Plastic barrel**
  - Readout with both sides
  - With SiPMs
  - Very mandatory for the hypernuclear experiment
    - Position information
    - Better time resolution (100 ps)
- **One postdoc + one student**

SiPMs: 10-20 k Euro
Electronics: 22 k Euro



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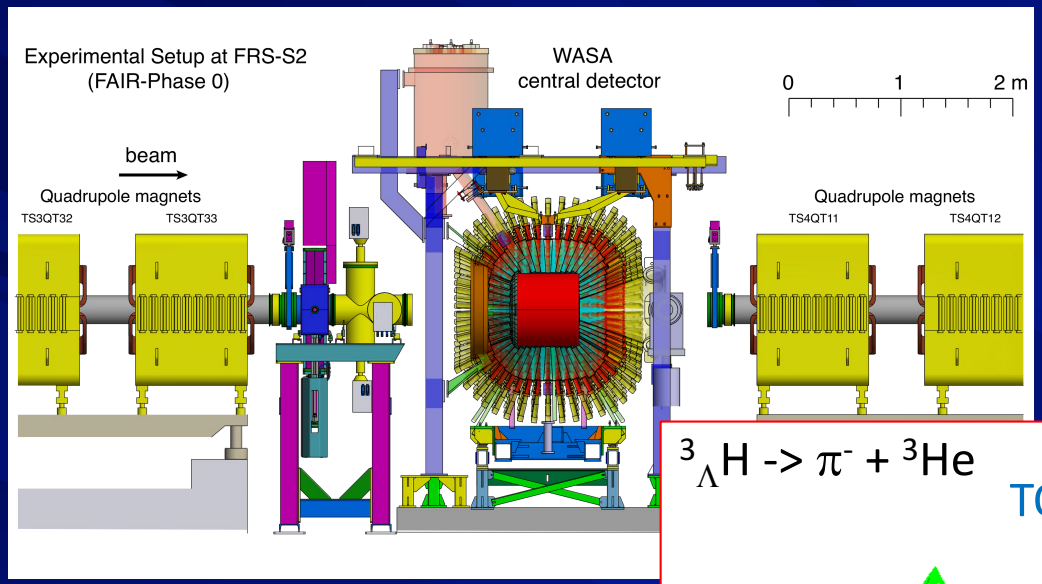
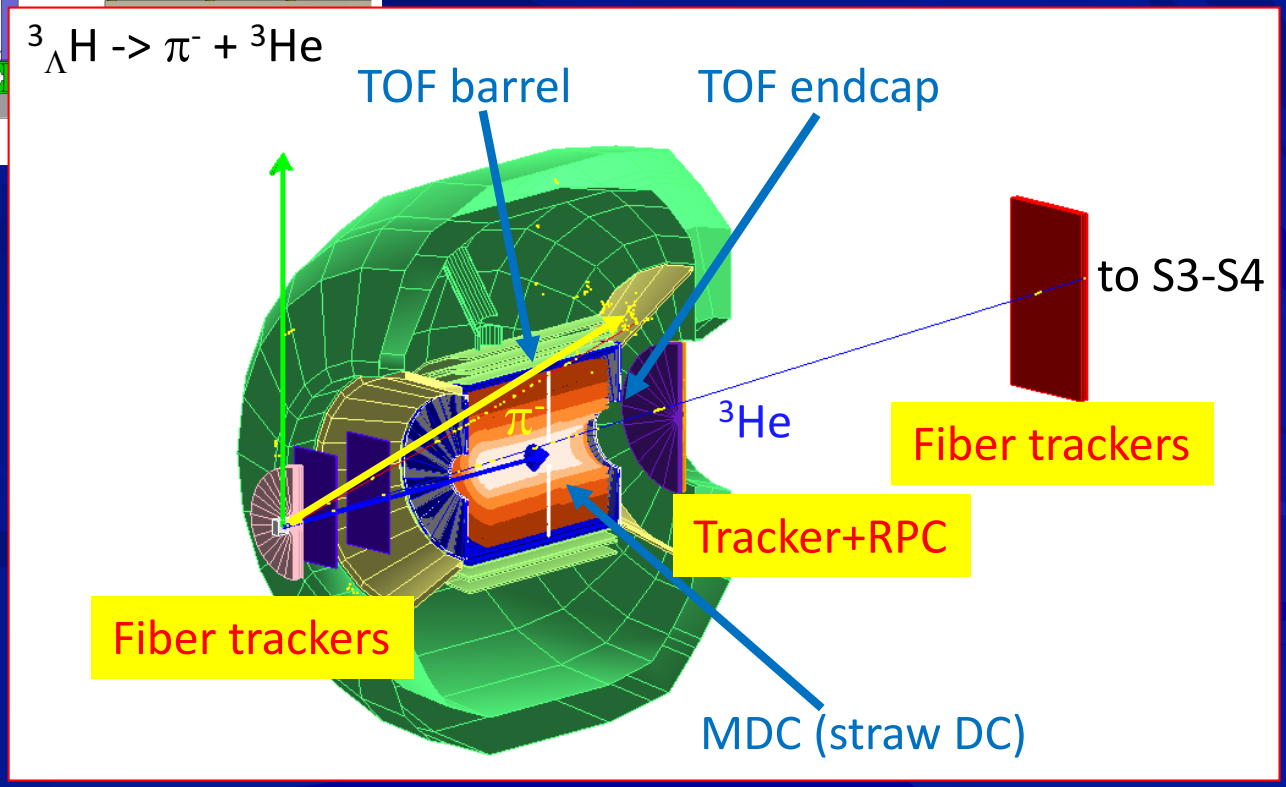
A little modification

- For the hypernuclear proposal

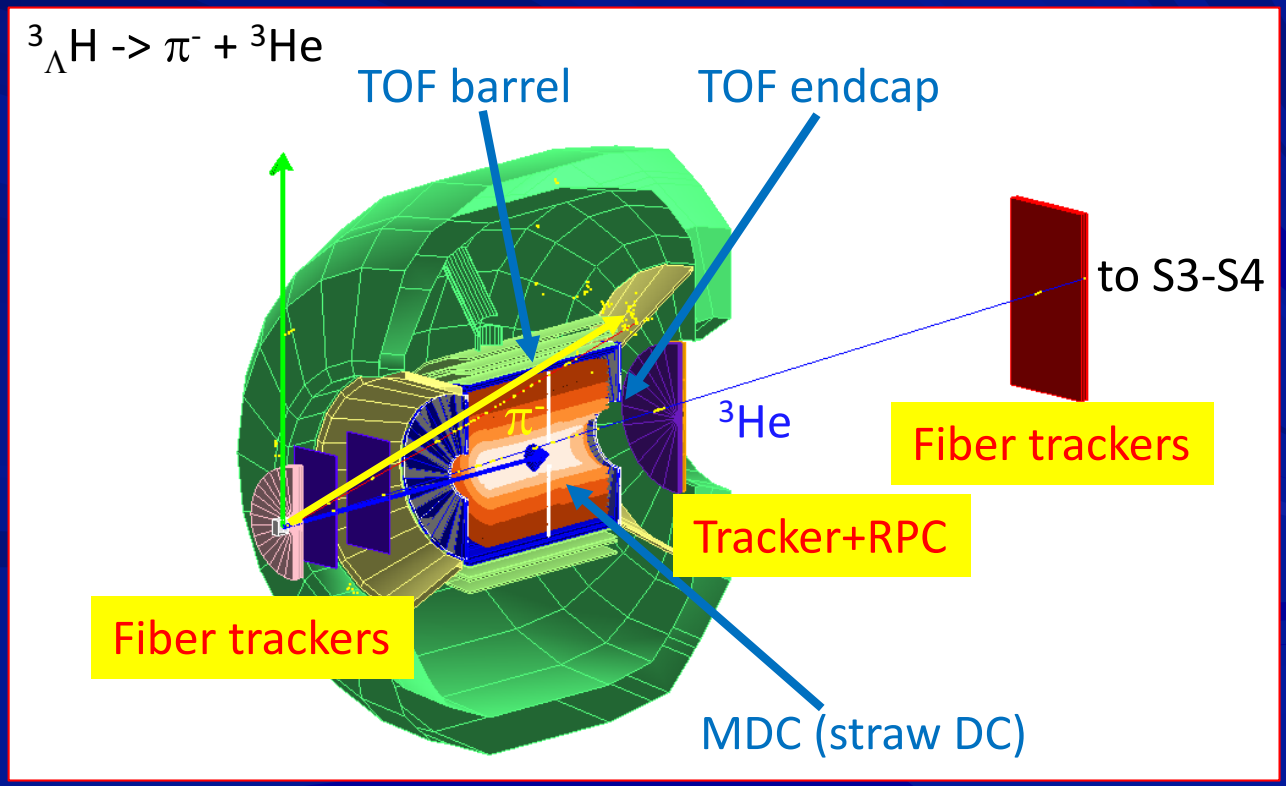




Fiber detectors for hypernuclei

- Fibers from Catania?
- HypHI fibers?
- Readout by SiPMs
- New readout electronics

- One postdoc + two PhD students



Online/Offline software development

- Based on the WASA and HypHI analyses package
- Coupling to the FRS analyses program

- Analyze simulated and real data
- Fast online/nearline analyses

- Improvement of the Monte Carlo simulations

- A few postdocs and a few PhD students

Electronics

- WASA CD
- Fiber for hypernuclei
- FRS detectors
- With MBS

- The WASA electronics system coipled to the MBS system
  - Not trivial
- New GSI readout electronics for WASA with MBS

Table 6: Summary of the possibilities with newly developed electronics at GSI.

Detector	Readout channels	Required Readout	Electronics	Number of cards	Cost (Euro)
MDC	1738	TDC	PADI+ClkTDC	15	36 k
Plastic	196	TDC + charge	PADI+TAMEX (11ps)	15	22 k
Fiber	3000	TDC+charge	PADI+ClkTDC	25	66 k
Total					124 k

- Budget necessary
- Production from 2017 (after the allocation of budgets)

Funding

- **Local budget at GSI**
  - 2016: ~ 44 k Euro
  - 2017: Asking more than 100 k Euro
    - Transportation cost
    - Holding structures
    - For laboratories
    - Manpower

- **Very strong statement by the GSI/FAIR Joint Scientific Council**
  - "Excellent project with no cost" can be supported

Funding applications

Table 7: Summary of the on-going funding applications.

Funding name	Country	Applicants	Total Budget (Euro)	man power	duration size (years)	Results expected
ERC Advanced grant	EU	T.R. Saito	2.5 M	7	5	April 2018
JSPS Kiban B	Japan	K. Itahashi	150 k		5	Spring 2018
1000 talents program	China	T.R. Saito	0.7 M + much more	a few	5	Soon
JSPS Tokutei Ryoiki	Japan	T.R. Saito		2	5	Summer 2018

- Additional application will be made by T.R. Saito
- Most of them are from the mid of 2018
- Short of manpower

Two approved proposals

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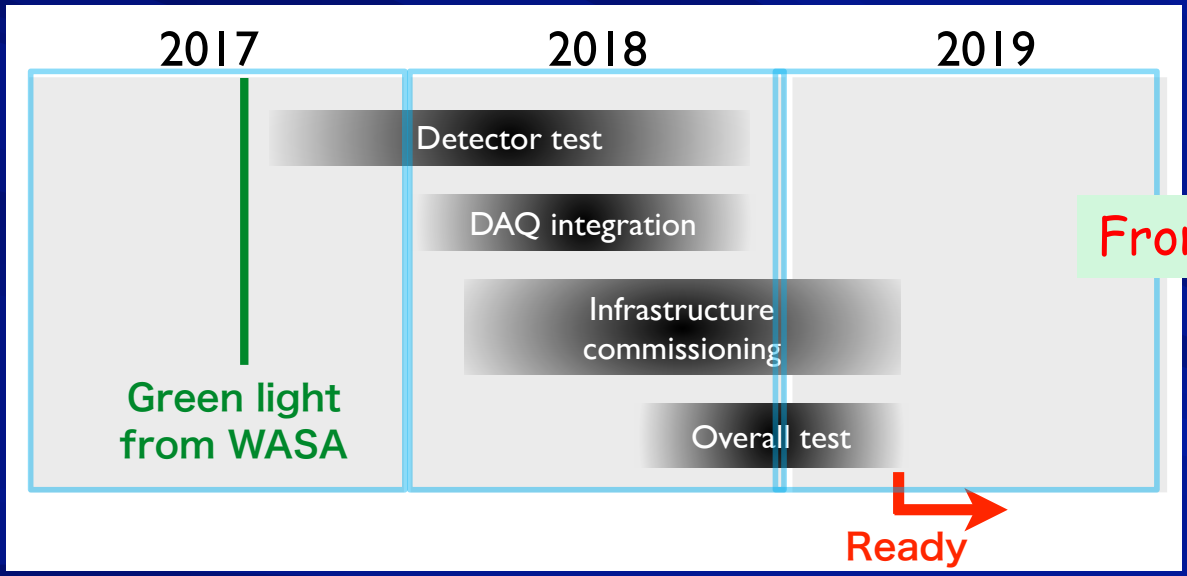

- **We will make ourselves ready in 2019**
- In 2019, only hypernuclear experiment, most probably
- 2020???

The Wide Angle Shower Apparatus (WASA) at GSI and FAIR

"WASA-at-GSI/FAIR"

Author list and affilliations, to be filled.

Current authors are Karlheinz Behr, Jose Benlliure, Kenta Itahashi, Take R. Saito, Susan Schadmand,

Christoph Scheidenberger,

Version, November 26th, 2017

Abstract

To be filled.

Contents

Meeting for technical issues:

Nov. 28th (tomorrow), 15:30
(after all sessions)