Spectroscopy STAP

DetG Update

KEVIN FISSUM

2023-04-25

DetG Update

1. Changes within the DetG
2. Common efforts
   - RMMs
   - Racks
   - BMs
3. By Tranche
   - 1 – BIFROST
   - 2 – CSPEC
   - 3 – TREX, MIRACLES, VESPA
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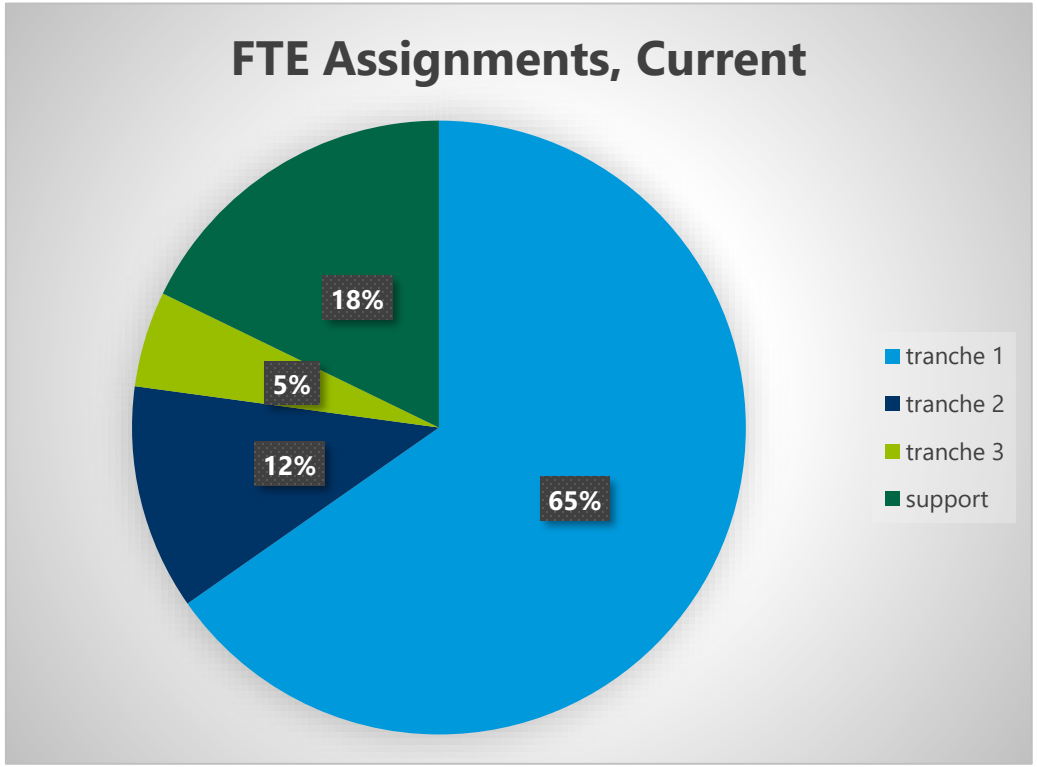
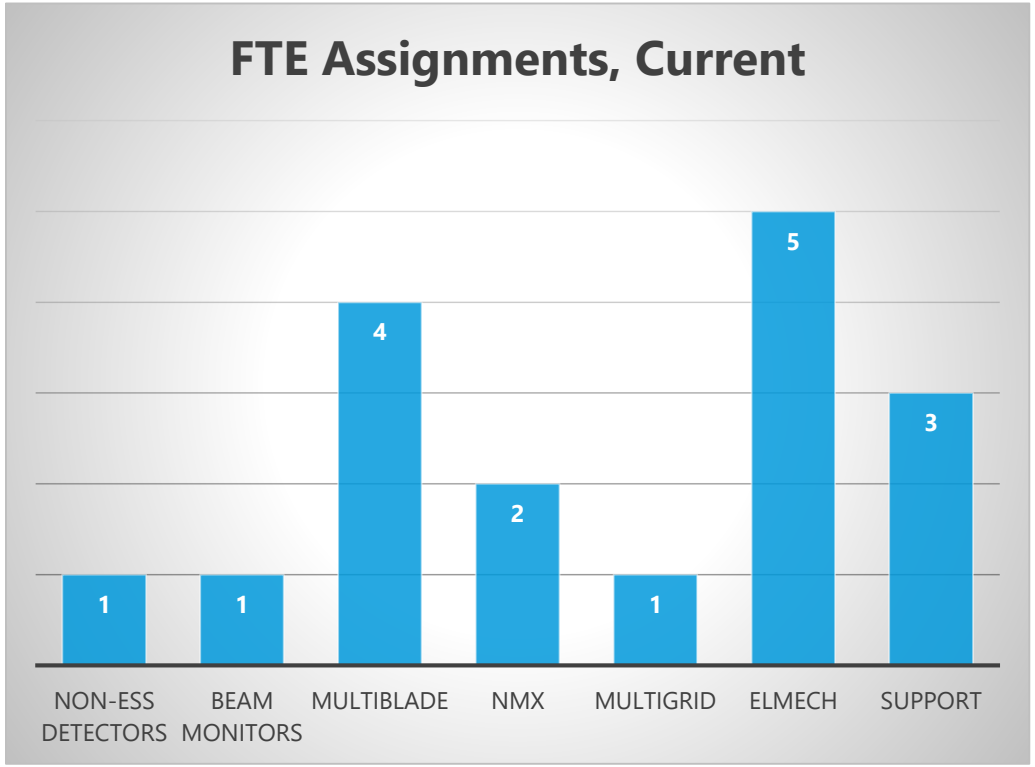
2023-04-25





Changes within the DetG

Jack Segal, Technical Section Lead, 2023-06-01

- 30+ years ground-up experience with detector systems
- international profile built upon establishing Halls A and C at Jefferson Lab from a “green-swamp” site
- extensive detector-related technical skills: technician, technical coordinator, senior technical coordinator, engineering support manager
- skillset includes systematic diagnostics, reverse engineering, and demonstrated productivity under broadly stated objectives

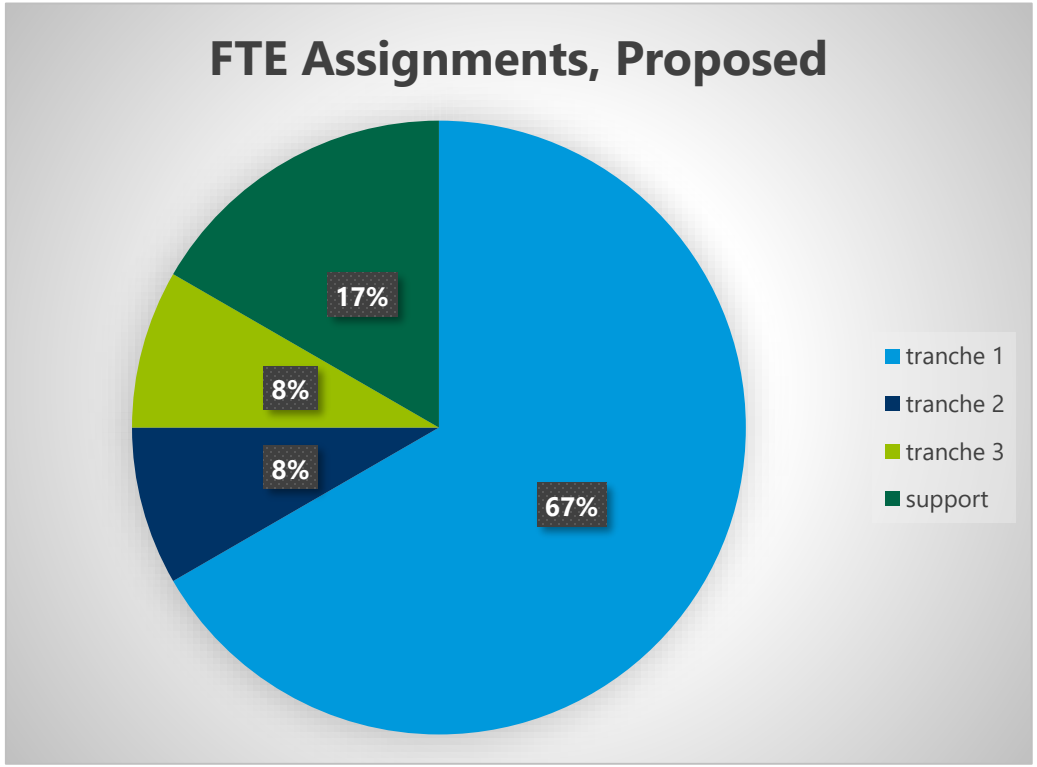
Changes within the DetG

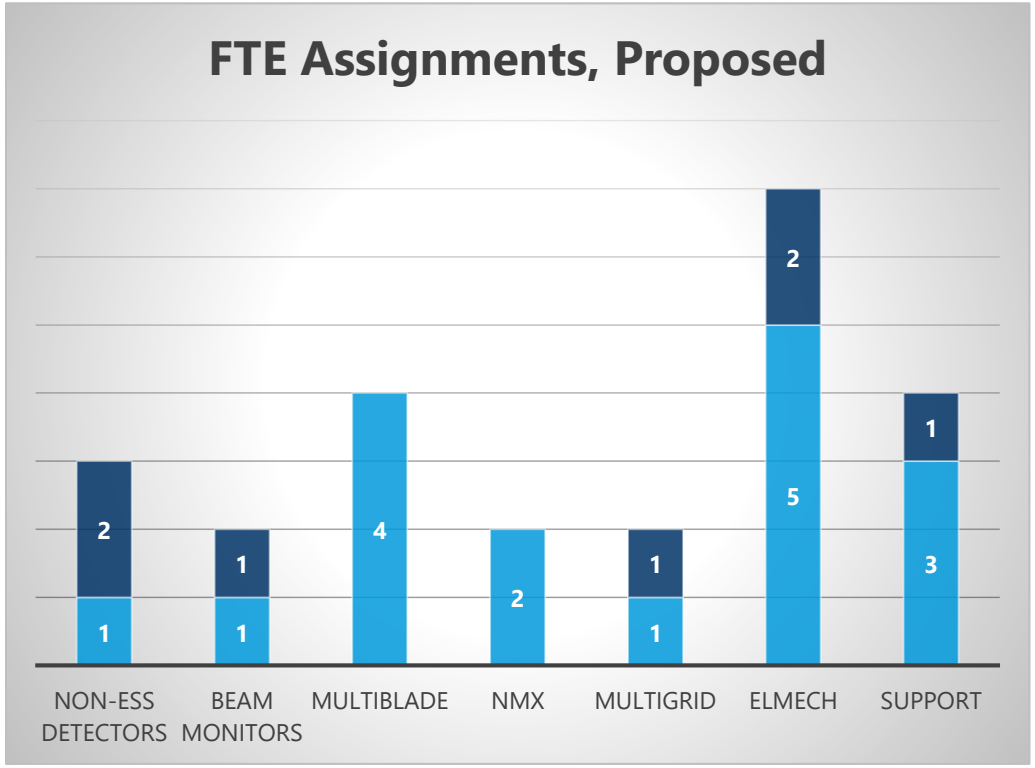
By 2023-04-30

- Thomas Kittelmann to DMSC, Patrik Strindin end of contract, Ramsey Al Jebali on 6-month leave-of-absence
- Istvan Csakí (eplanning) back with us at 100%
- 4 entry level scientists (adverts live):
  - beam monitors ESD-29782
  - boron-10 based detectors ESD-29828 (envisioned TREX support)
  - installation and commissioning ESD-29829
  - signal processing ESD-29830
- 1 Detector Laboratory Workshop Technician ESD-26226 (live)
- 1 Mechanical Technician (approved)
- 3 summer students (likely approved this week)
- dimensioning for He-3 underway (envisioned CSPEC support)

Status DetG

Soon





Labs

Reorganizing…

- Coatings Lab Linköping: moving to site B02 (midsummer), will require access to LU NanoLab to ensure quality of coatings in the future. Losing 200 m^2.
- E04: borrowed by Motion Control, future of room uncertain. Losing 50 m^2.
- Utgård: we will lose this space at the end of 2025, and we will likely need 2024 to plan a transition somewhere. Losing 800 m^2.
- request for annexes: for 12 X 12 m^2 on the Long Instrument Hall and 8 X 8 m^2 annex on the Short Instrument Hall (D04?), both radiation hardened. Potentially adding 200 m^2. Essential for CSPEC.
- Source-Testing Facility: budget approved by CCB and contract underway, access to neutron sources at LU guaranteed – huge step forward. Gaining 400 m^2.
- net loss of workspace: 400 m^2. Net loss of time to relocate? Where to relocate?

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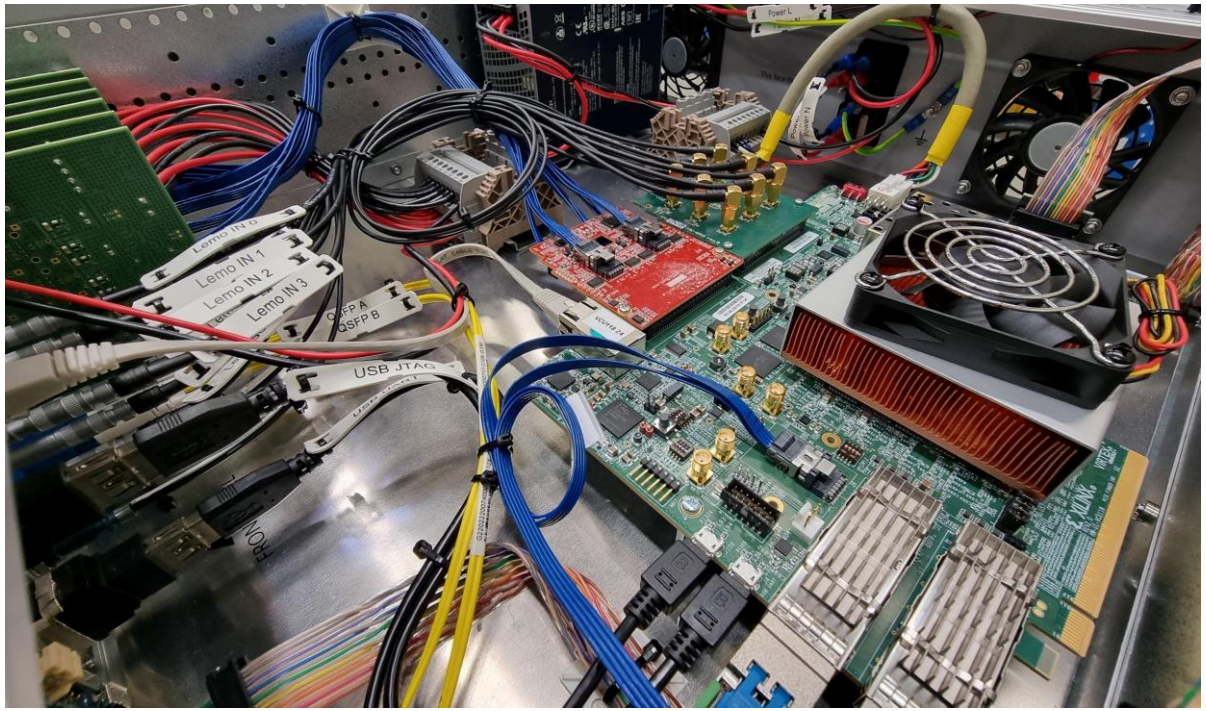
RMM

CDR (and CE) completed



European Spallation Source ERIC
Box 176
221 00 Lund, Sweden
ess.eu
info@ess.eu

CE
0640

Product:	Detector Readout Master Module
Type:	Detector Data Acquisition System Backend
Serial number:	DRMM22-01-01
Manufact. Year:	2022

Documentation…

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Racks

Gaining momentum…

courtesy ePlan designer Istvan Csaki

MASTER RACK 1 42U 2000H x 800W x 1200D (mm)	
U	Description
1	Network Copper/Fibre Hub
1	
1	
1	fiber patch panel rings
1	MASTER Module
1	
1	
1	
1	Free
1	Free
1	Free
1	Free
1	Free
1	Free
1	Free
1	Free
1	Free
1	Free
1	Free
1	Monitor /keyboard
1	PC (moved as VM)
1	
1	Free
2	Rack/Detector Monitoring
1	Free
8	Wiener MPOD (LV and HV)
1	Free
1	Free
6	UPS

Assister RACK 1 42U 2000H x 800W x 1200D (mm)	
U	Description
1	Fibre Hub
1	Free
1	KC705
1	KC705
1	Free
1	KC705
1	KC705
1	Free
1	KC705
1	KC705
1	Free
1	KC705
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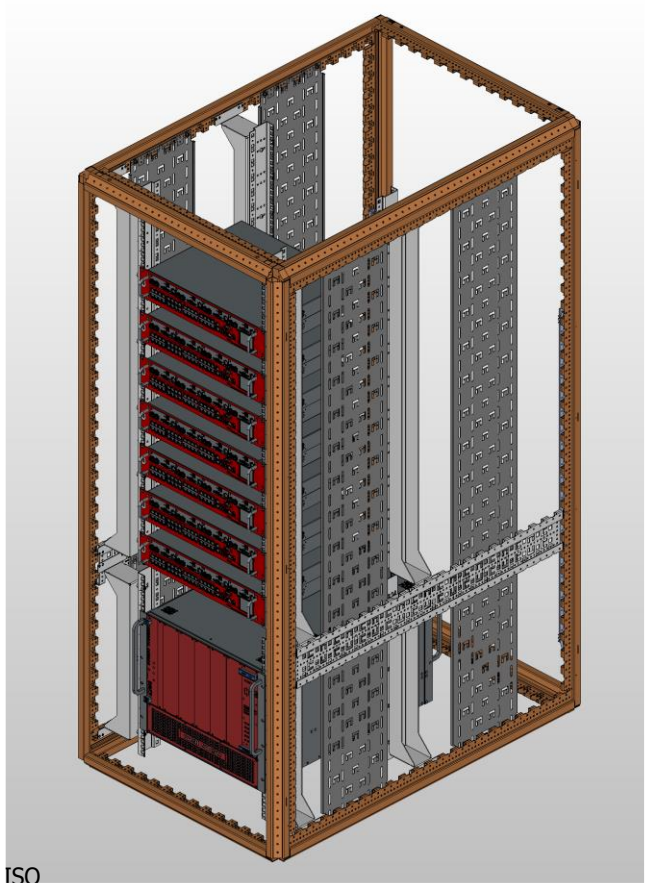
NMX Detector rack layout



Detector rack in CATIA

Utgård 2023-03-06 (LOKI)

Racks

Gaining momentum…

- Focus is on the 5 LOKI detector racks, BIFROST is next
  - Documentation necessary to allow the eplanning by the CEP team is underway
  - Testing the assembly and cabling of LOKI slave rack 1 ongoing in Utgård.

EUROPEAN SPALLATION SOURCE

Document Type	Requirement Specification
Document Number	ESS-4969251
Date	Apr 13, 2023
Revision	1 (1)
State	Preliminary
Confidentiality Level	Internal
Page	1 (21)

ELECTRICAL REQUIREMENT SPECIFICATIONS FOR THE LOKI DETECTOR RACKS

	Name	Role/Title
Owner	Irina Stefanescu	Detector Scientist, Detector Group
Author	Irina Stefanescu	Detector Scientist, Detector Group
Reviewer	Kevin Fissum Clara Lopez Istvan Csaki	Group Leader, Detector Group LOKI integration engineer Electrical and I&C Engineering Group
Approver	Stuart Birch	Senior Engineer, NSS Technical Groups

EUROPEAN SPALLATION SOURCE

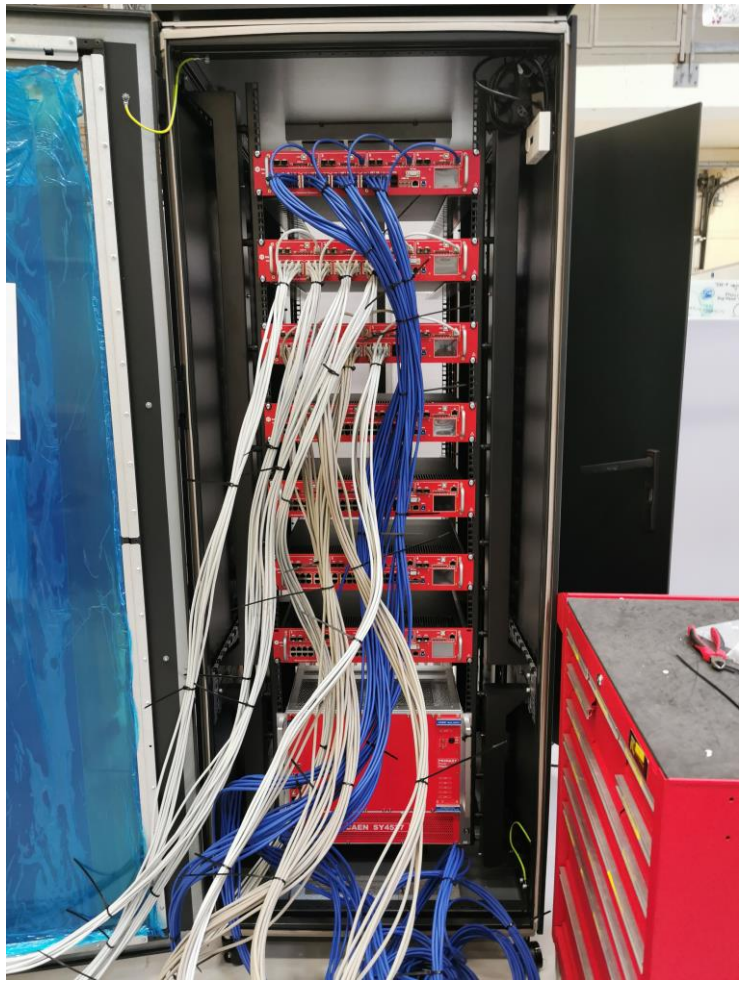
Document Type	Requirement Specification
Document Number	ESS-4970501
Date	Apr 21, 2023
Revision	1 (1)
State	Preliminary
Confidentiality Level	Internal
Page	1 (5)

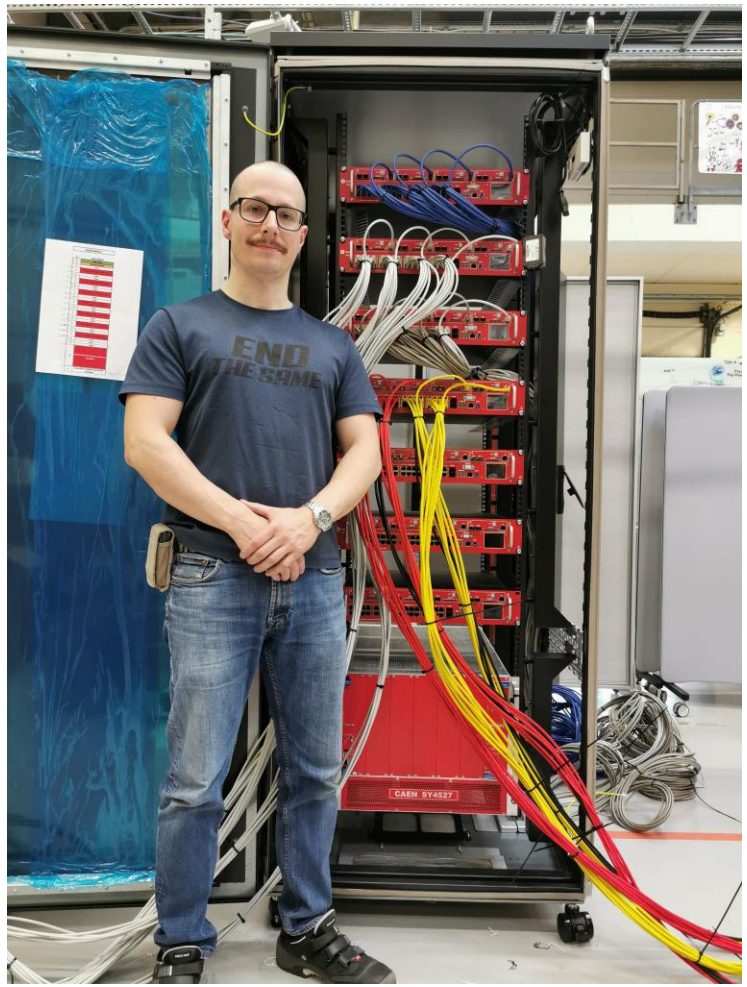
ELECTRICAL REQUIREMENTS FOR THE BIFROST DETECTOR RACKS

	Name	Role/Title
Owner	Irina Stefanescu	Detector Scientist, Detector Group
Author	Irina Stefanescu	Detector Scientist, Detector Group
Reviewer	Kevin Fissum Rasmus Toft-Petersen Liam Whitelegg Istvan Csaki	Group Leader, Detector Group BIFROST Instrument scientist, ESS BIFROST lead engineer, ESS Electrical and I&C Engineering Group
Approver	Stuart Birch	Senior Engineer, NSS Technical Groups

Racks

LOKI slave





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Beam Monitors

Status

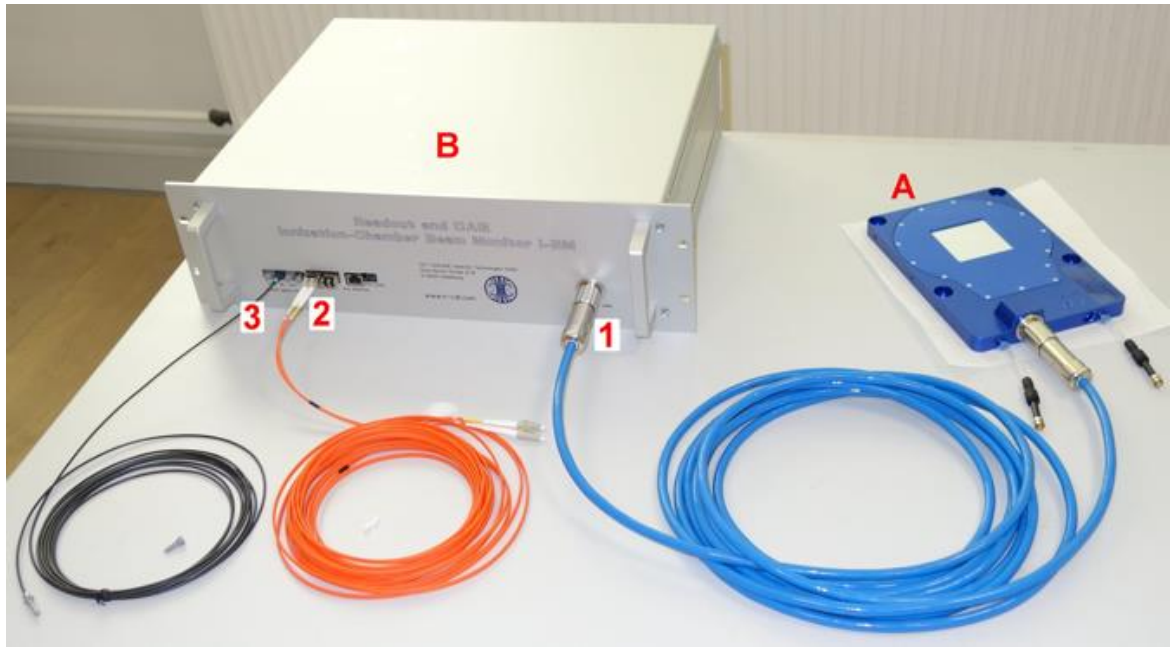
- Dialog with instrument scientists established
- Thorough review of BM requirements performed
- A long list of special BM requirements determined
  - Radiation hardness
  - Large dynamic range
  - Time resolution
  - 0D, 1D, 2D position resolution
  - In-vacuum operation
  - Very low attenuation
- Plan set: identify a bare minimum of very well-established technologies that satisfy the needs of as many monitoring points as possible
- then move on to (special) and (special, special) cases

Beam Monitors

Candidates (subset), in bunker

CDT Ionization Beam Monitor

- Compensation ionization chamber for gamma-ray discrimination
- Long purpose-made cable to connect monitor and amplifier outside of high radiation fields, avoid crossing grounding zones
- Large dynamic range, current-mode operation
- Low material budget for low beam attenuation
- Developed by ESS/CDT as an in-bunker monitor solution, ESS DAQ compatible

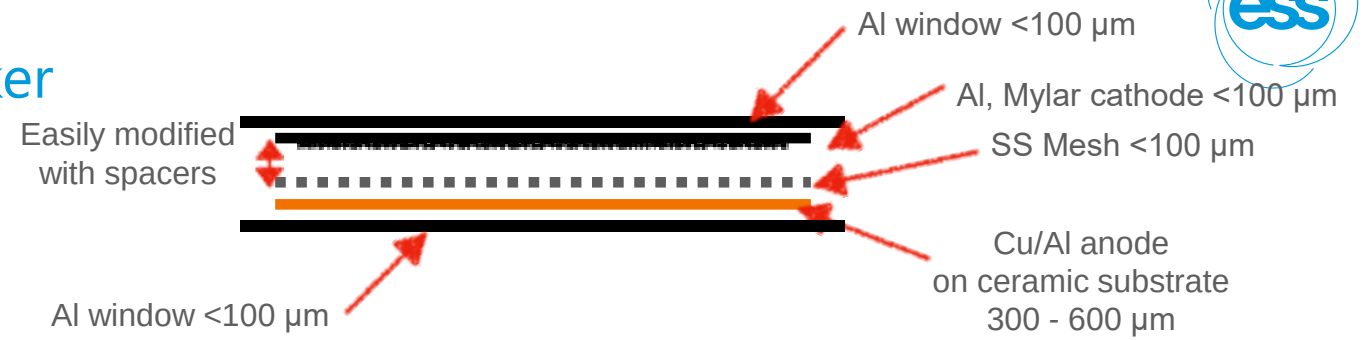


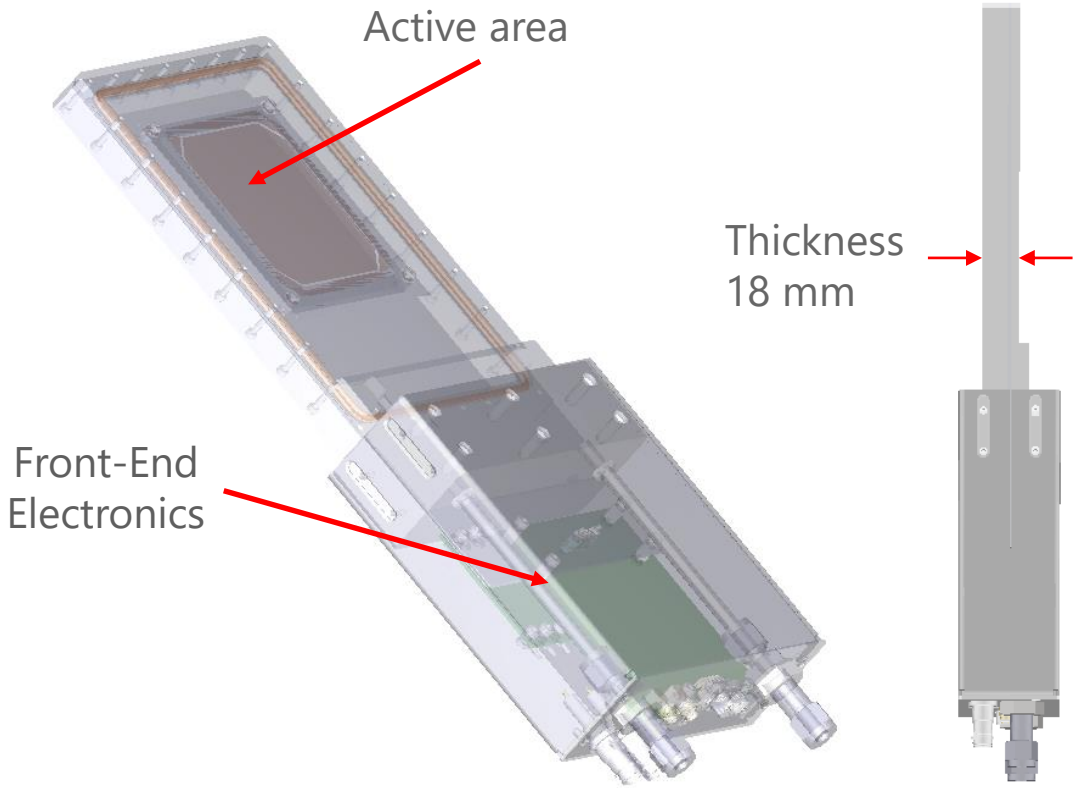
Beam Monitors

Candidates (subset), out-of-bunker

Micromegas

- developed at CEA Saclay, technology in use at ESS, nBLM
- adaptable from single event to 10^9 n·cm^{-2}s^{-1} via current mode
- 0D, 1D, 2D capable with reasonable rate capabilities and position resolutions
- form factor modifications, window changes, and gas variations will enable use at more unforgiving monitoring points





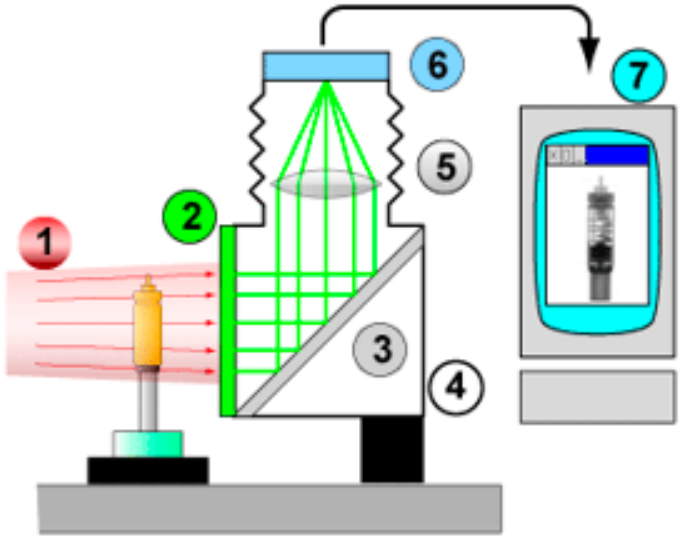
L. Segui et al., 2023 JINST 18 P01013 DOI 10.1088/1748-0221/18/01/P01013

Beam Monitors

Candidates (subset), downstream of sample

Cameras for transmission monitoring

- Off-the-shelf solution based on established, cost-effective technology
- Covers the needs of most instruments
- Pool being created by DetG to provide the service
  - 2 cameras in present inventory
  - More to be purchased
  - Ongoing discussions with instrument scientists



1. Point source of neutrons
2. Neutron to light converter
3. First surface mirror (45 degree)
4. Light tight box
5. Standard camera lens
6. Peltier cooled CCD chip
7. Computer

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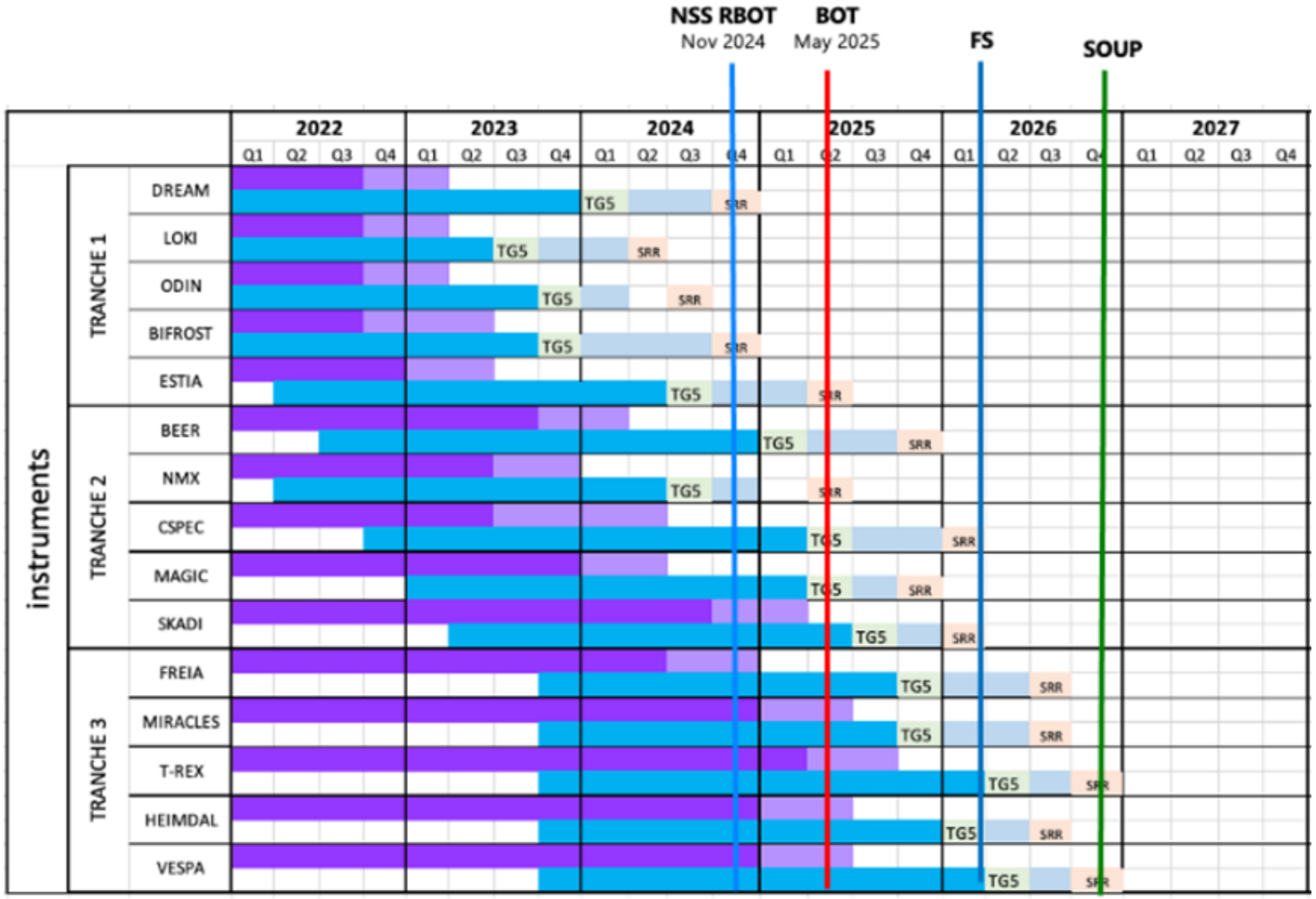
NSS RBOT
Nov 2024
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FS
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2023
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2025
2026
2027
Q1 Q2 Q3 Q4
instruments
TRANCHE 1
TRANCHE 2
TRANCHE 3
DREAM
LOKI
ODIN
BIFROST
ESTIA
BEER
NMX
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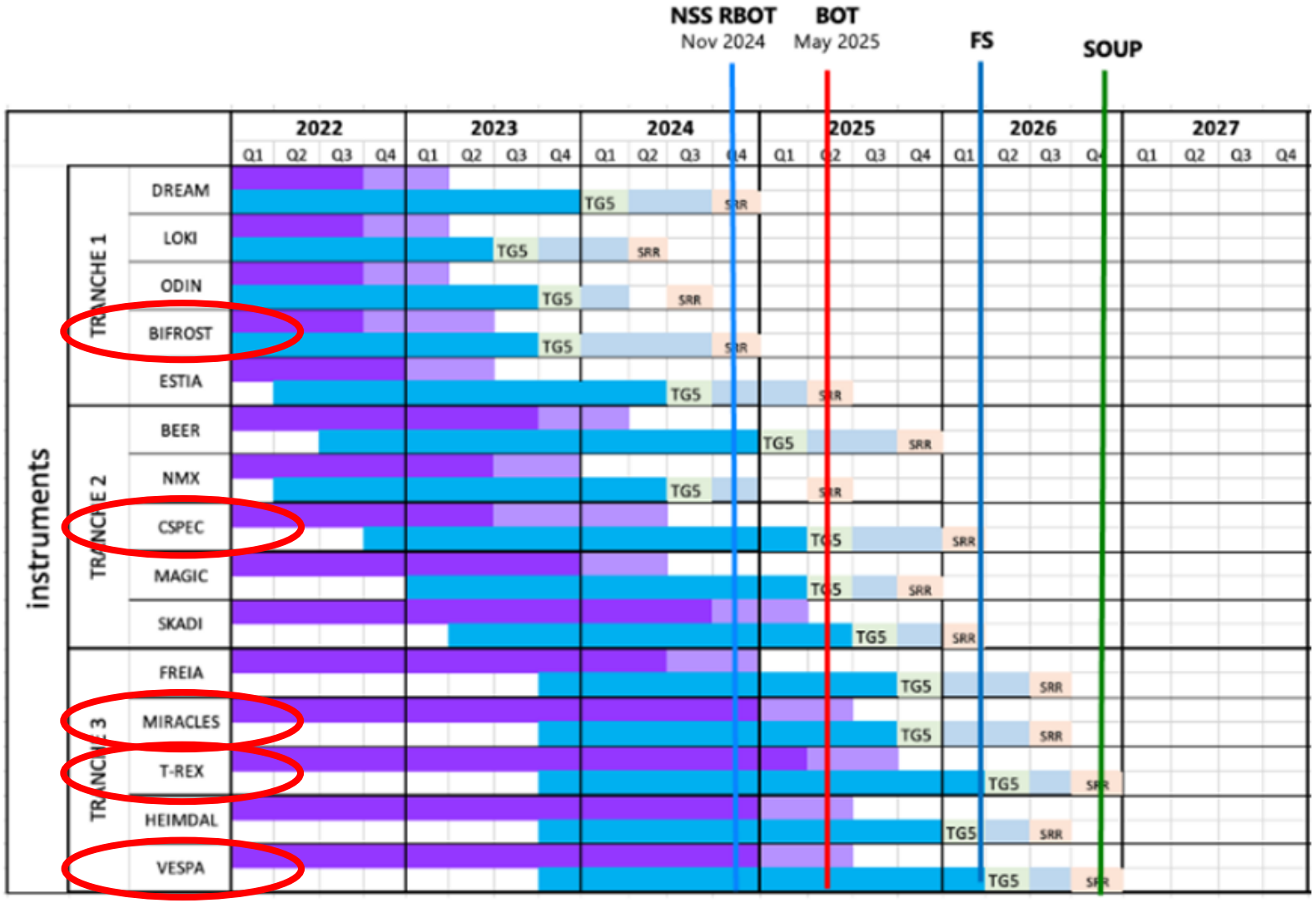
MAGIC
SKADI
FREIA
MIRACLES
T-REX
HEIMDAL
VESPA
TG5
SRR

Tranches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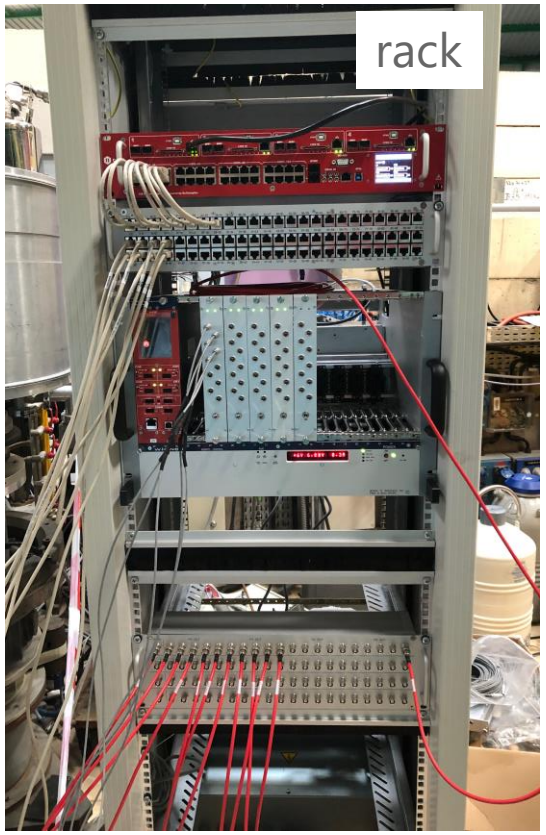
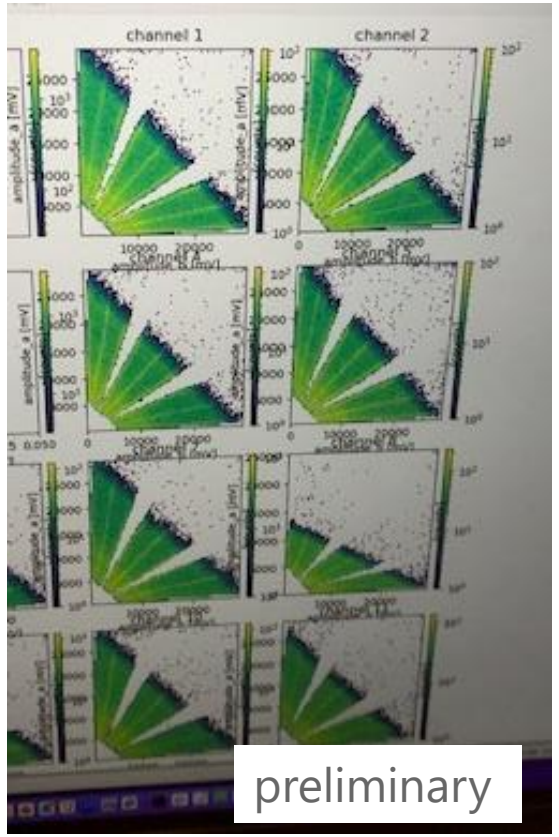
1 - BIFROST

v16 2023, white spectra

- Unintegrated BIFROST detector test with a 37 GBq Am/Be source at CEA Saclay.

Triplets of triplets of 10 bar He-3 tubes

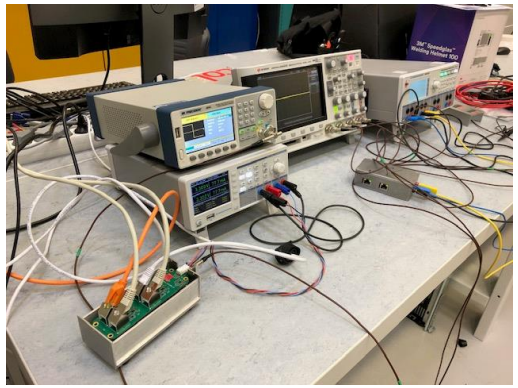


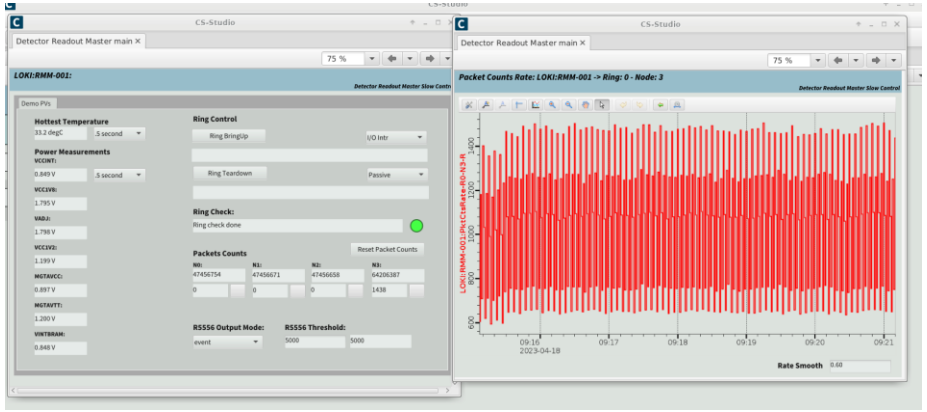


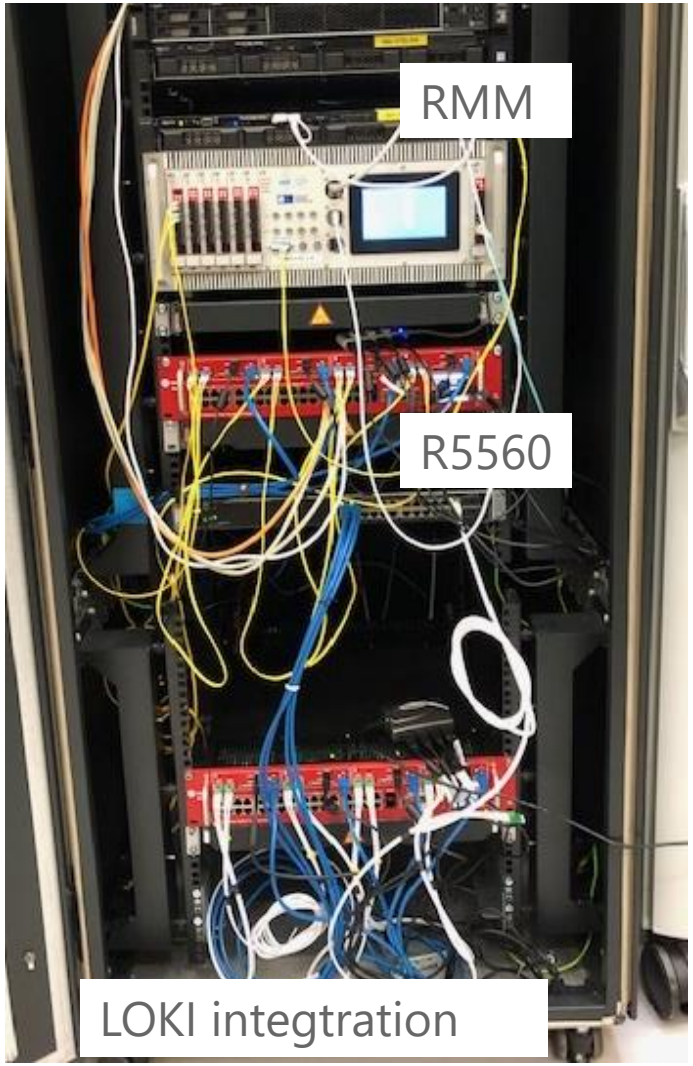
1 – BIFROST related

Integration

- ECDC/DMSC initiated reachout to teams considering the CAEN R5560 digitizer
  - LOKI, BIFROST, MIRACLES, possibly CSPEC and VESPA
- Goal: a common firmware-development framework to facilitate installation, operation and maintenance
- A triplet-triplet BIFROST module with preamps will soon be sent to Utgård/STF for integration testing (similar to LOKI)







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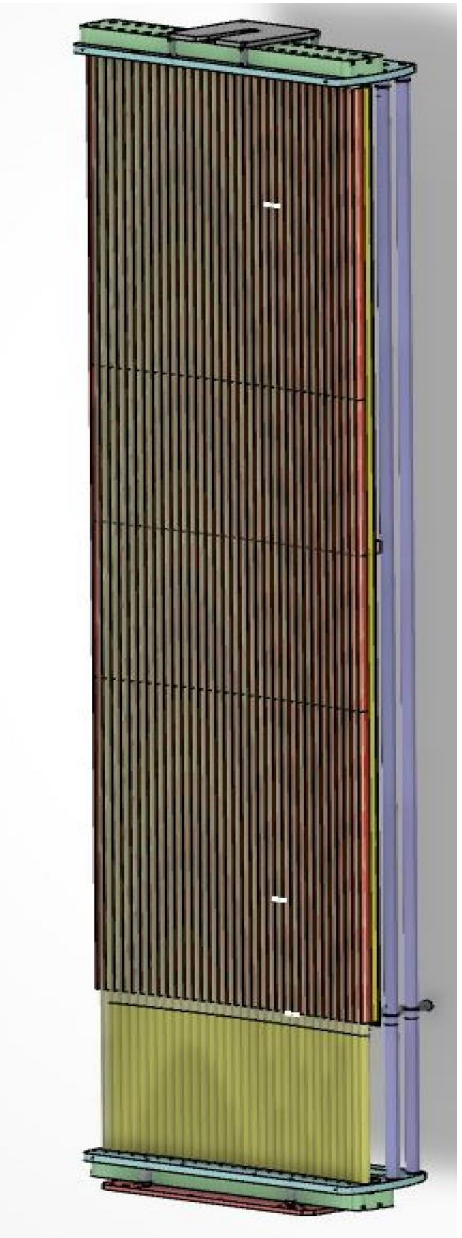
2 - CSPEC

He-3 solution

- Proposed ILL MultiTube solution is stabilizing
  - Favorable construction window from ILL side
  - ”No” risk associated with the modules
  - Trickledown into BMs
- IN5ish device to be provided
  - Includes the preamps
  - Add the standard CAEN 5560 digitizer system
- Scrutiny of the proposed costing has commenced
  - To be referenced against the existing CSPEC plan
  - He-3 is a driver, how many modules?
  - resulting CR should be a one-time event
- Approaches:
  - Plan A (all in), Plan B (absolute minimum)
  - Significant non-existing unplanned onsite support infrastructure (12 X 12 m^2 annex) required



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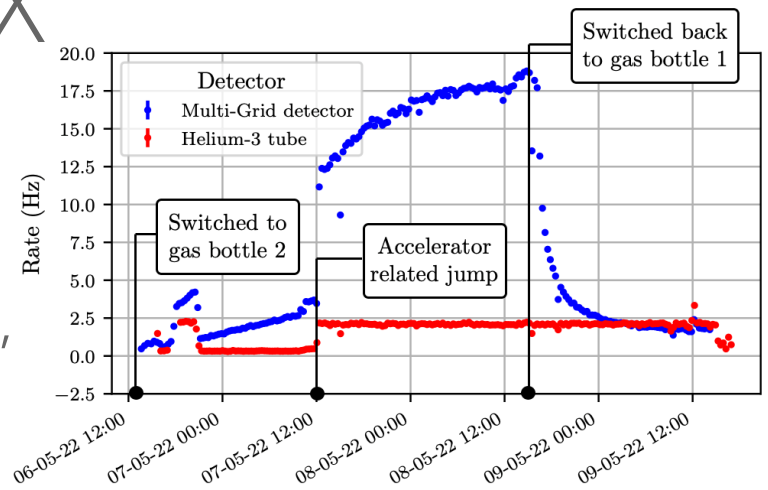
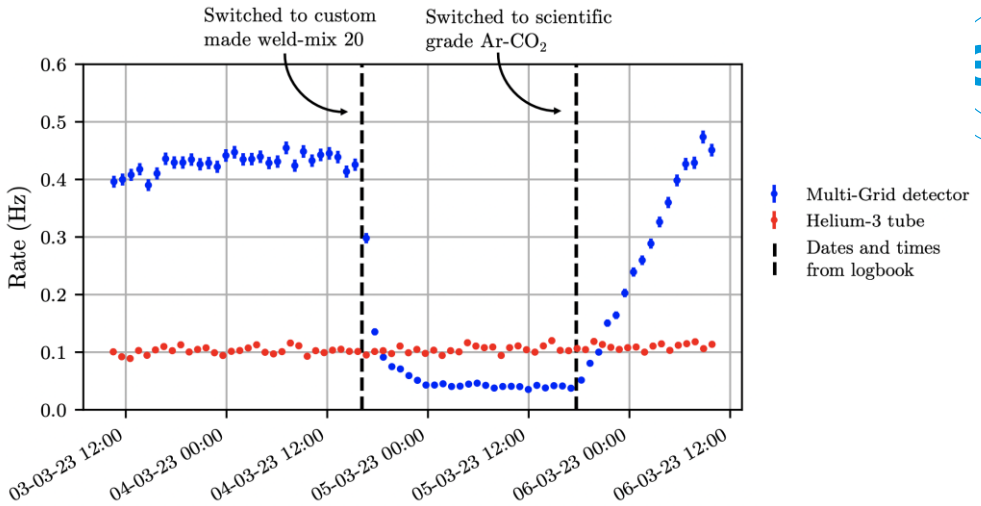
3 - TREX

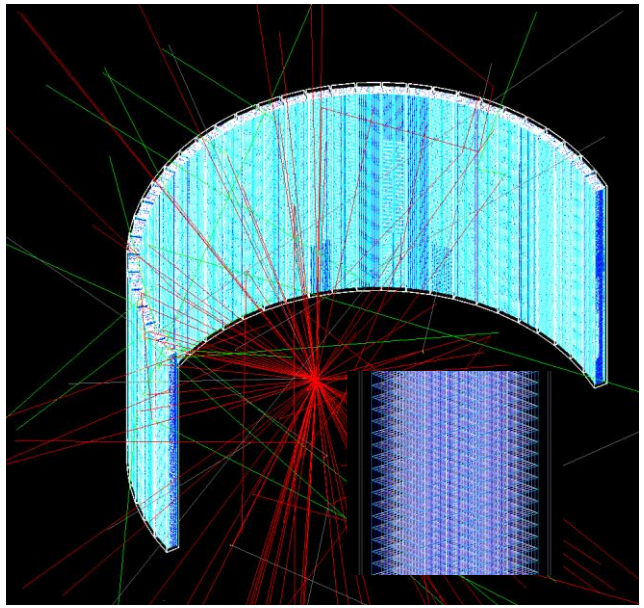
MultiGrid

- Sanity check, Weldmix20

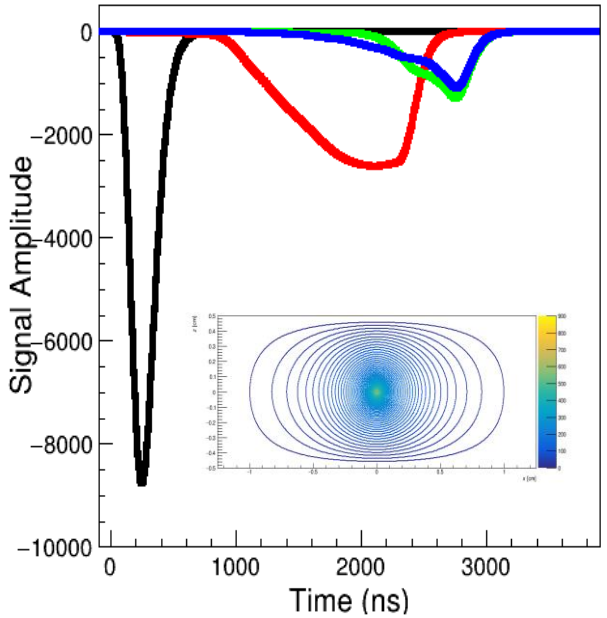




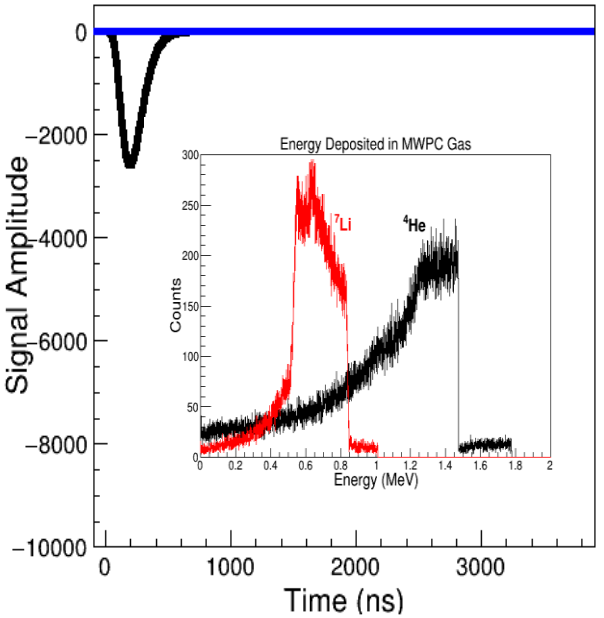
- Firebreak simulations



Ar-80%, CO_2-20%



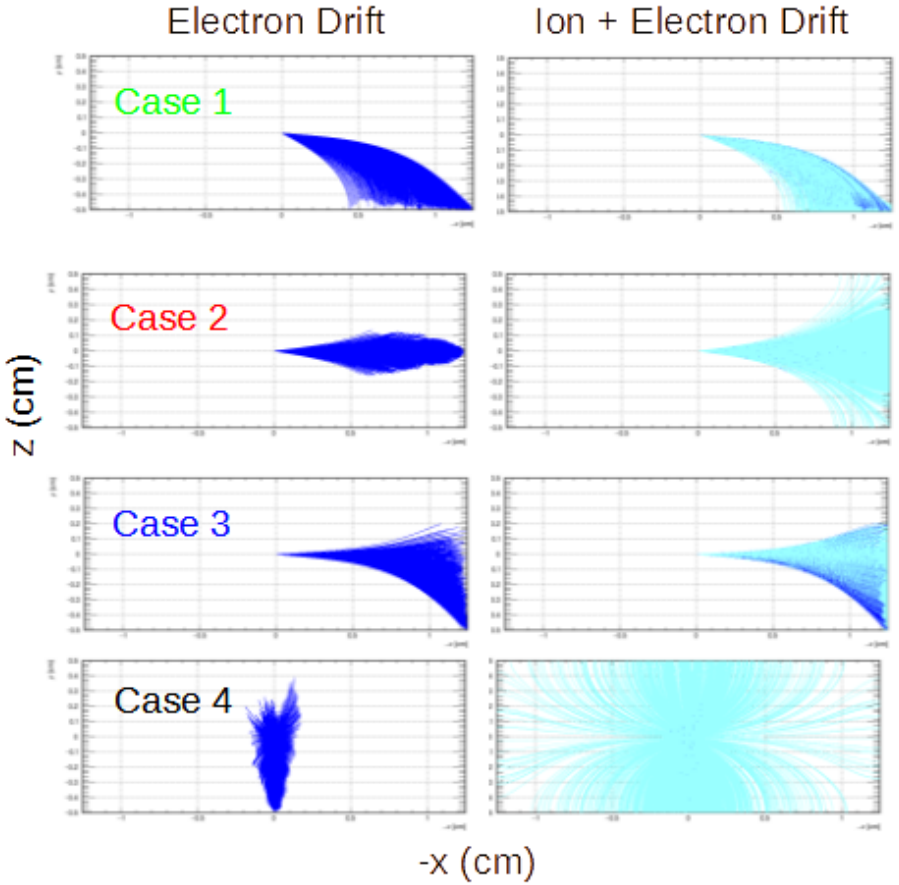
Ar-78%, CO_2-20%, O_2-2%

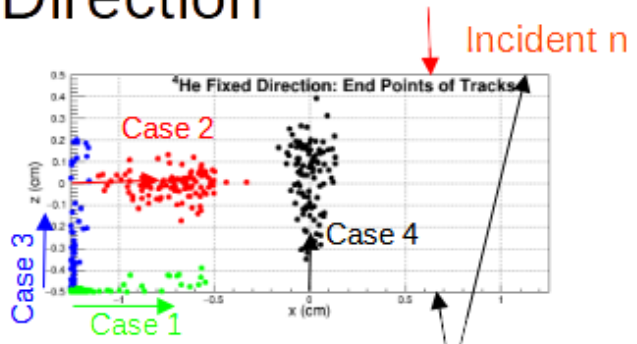


3 – TREX

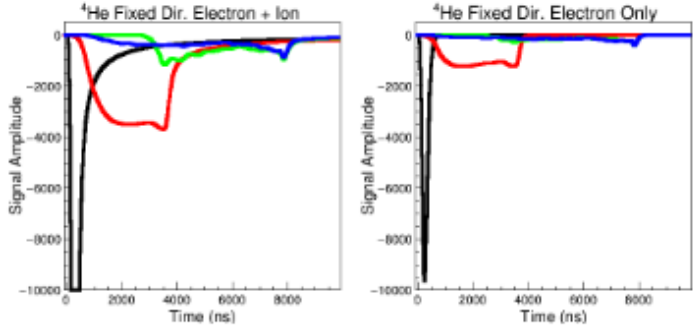
MultiGrid

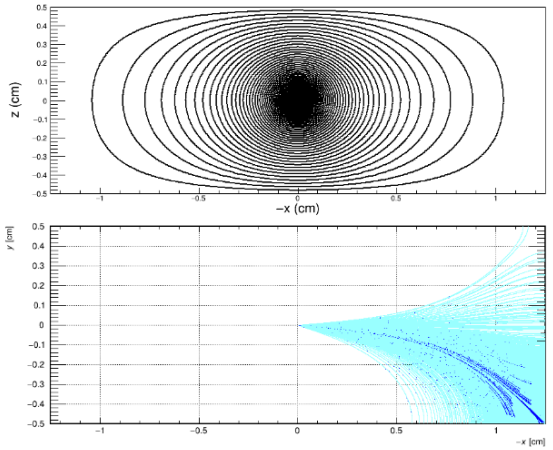
^{4}He Fixed Direction

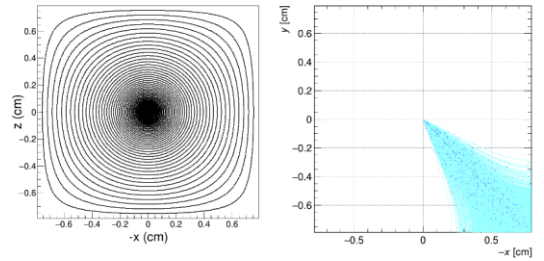


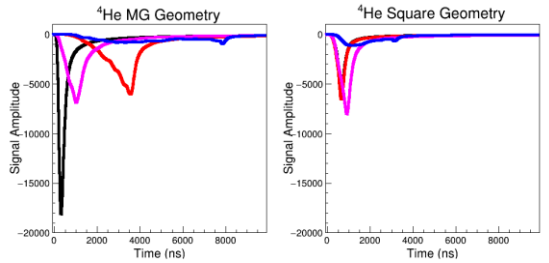


Most n interactions on x $^{10}B_4C$ surfaces









Transfer Function CR-RC n-stage shaping

$$f(t) = g\exp(n)\left[\frac{t}{n\tau}\right]^n \exp(-t/\tau)$$

Signal amplitudes: absolute scale under investigation, but relative sizes should be reasonable.

Start with $n = 4$, $g = 12.7$, $\tau = 40$ns

Not quite compatible with VMM3a front end, but fairly close

3 – TREX

MultiGrid

- Sanity checks indicate that ISIS behavior is understood
- currently no DetG scientist, will add 1 entry-level position (search underway) to keep the project alive
  - Technology currently "resides" with Glasgow
  - Apply to LENS for a PhD to continue collaboration with Glasgow
  - need liaison
- Collect interested parties: determine the way forward forthwith, workshop
  - What exists may be good enough, but we should touch base
  - Outsource any desired R&D to then recall it later after MultiBlade
  - Extensive unintegrated testing necessary
  - MultiBlade will fill in the integration gaps

3 - MIRACLES

Largely off-the-shelf

- Pairs of 15 cm He-3 tubes
- Readout with CAEN R5560 digitizers
- TG3 for detectors ongoing

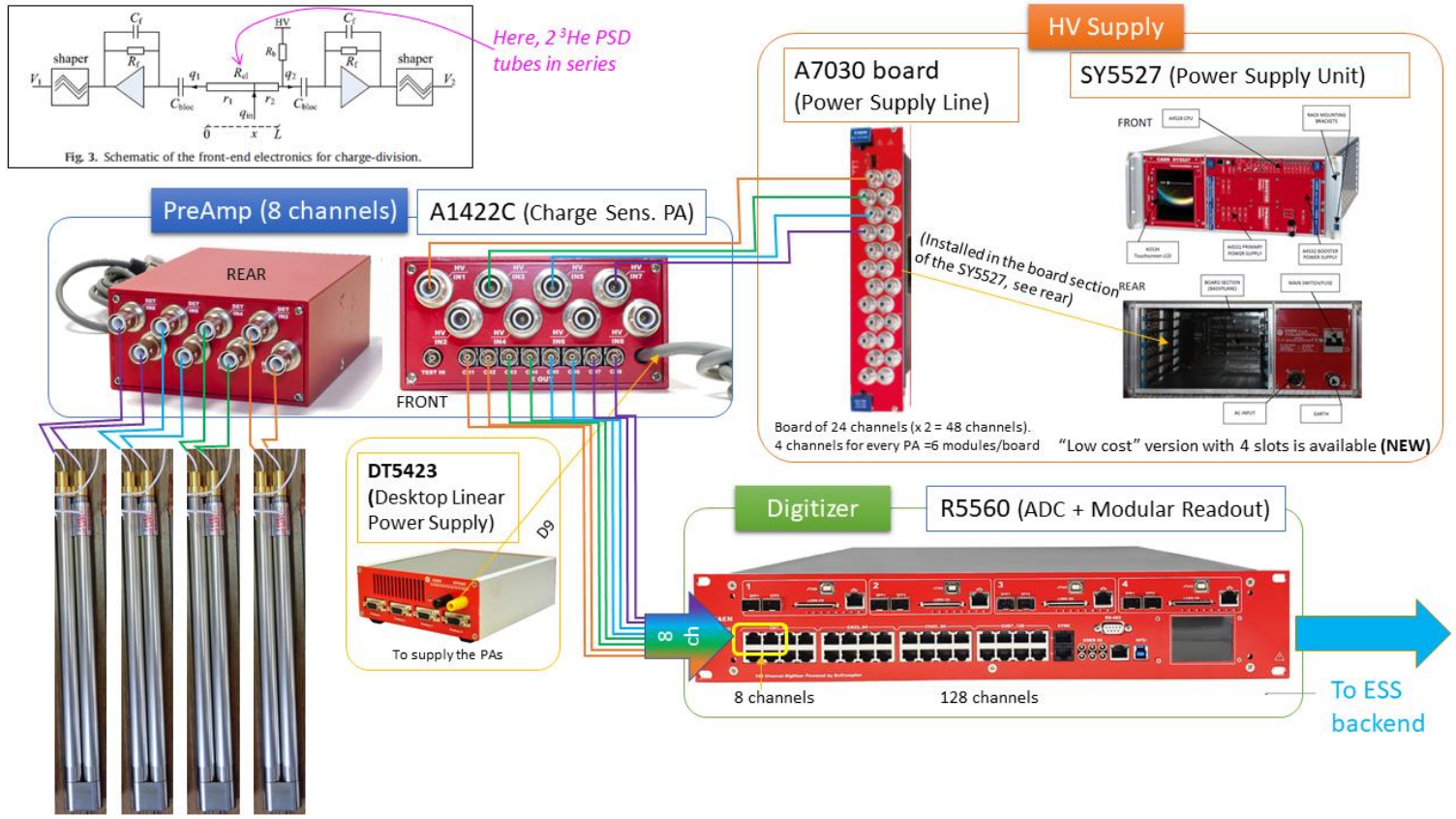


Image shamelessly stolen from TG3 documentation

3 - VESPA

Anticipate off-the-shelf

- Maybe short He-3 tubes?
- Maybe the CAEN R5560 digitizer?

DetG Update

1. Changes within the DetG
2. Common efforts
   - RMMs
   - Racks
   - BMs
3. By Tranche
   - 1 – BIFROST
   - 2 – CSPEC
   - 3 – TREX, MIRACLES, VESPA
4. Summary

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Summary

Spectroscopy Detectors

1 – BIFROST: non-ESS, no showstoppers envisioned

2 – CSPEC: need decision He-3 way forward very soon, not there yet

3 – TREX: need decision MultiGrid way forward, encourage discussion

3 – MIRACLES: non-ESS, no showstoppers envisioned

3 – VESPA: non-ESS, no showstoppers envisioned?

Spectroscopy has been affected by the MultiGrid detector project

- ILL MT solution for CSPEC is gaining traction
  - costing and CR work remain, priority
- MultiGrid is doing what it was designed to do
  - Firebreak simulations have provided considerable insight, encourage discussion
  - proper, exhaustive test suite needed before integration (MultiBlade)


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roup