SNOGLOBE - LSM Run Plan

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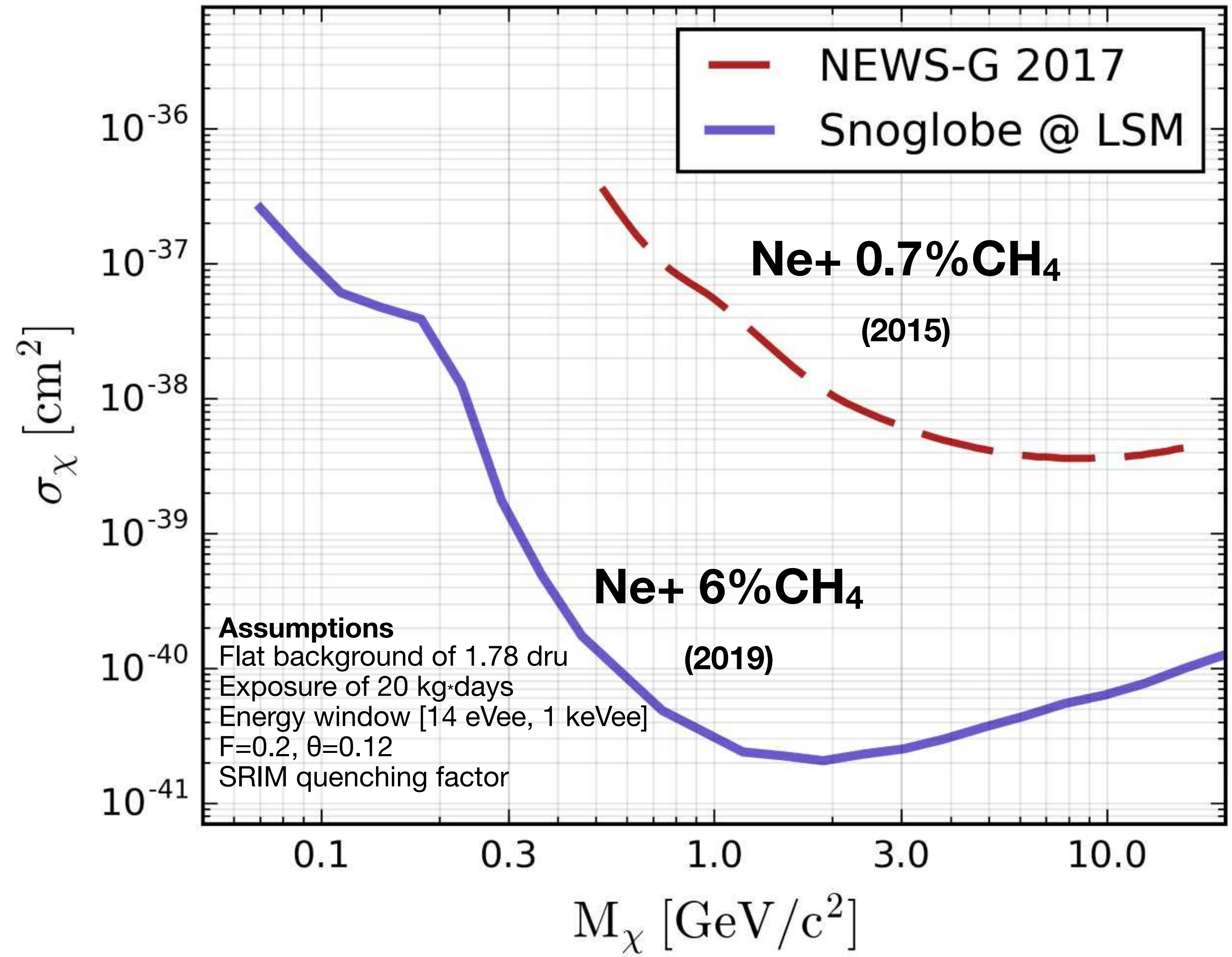
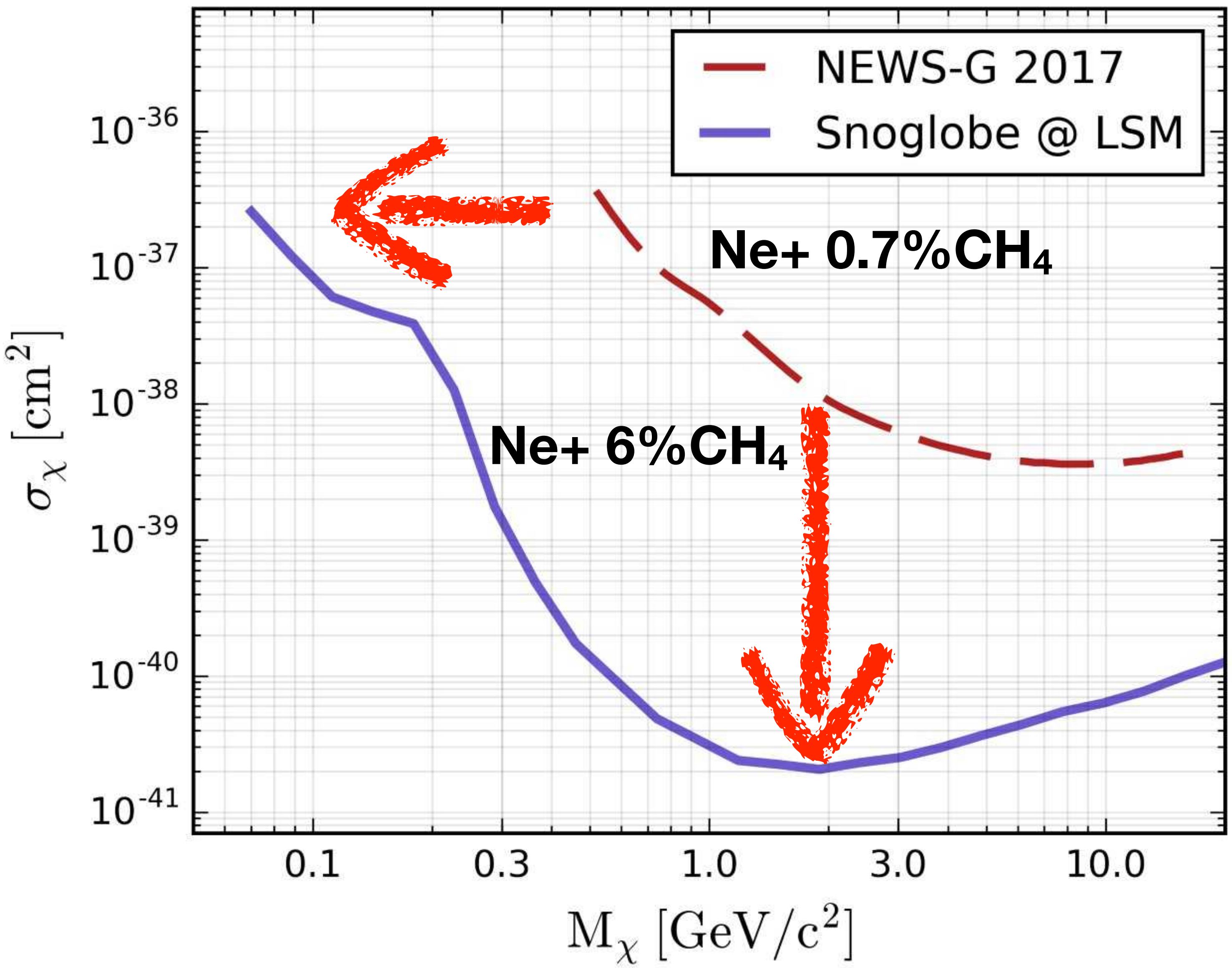


Our goal at LSM

Increase sensitivity with SNOGLOBE



Assumptions

Flat background of 1.78 dru

Exposure of 20 kg*days

Energy window [14 eVee, 1 keVee]

F=0.2, θ=0.12

SRIM quenching factor

Requirements

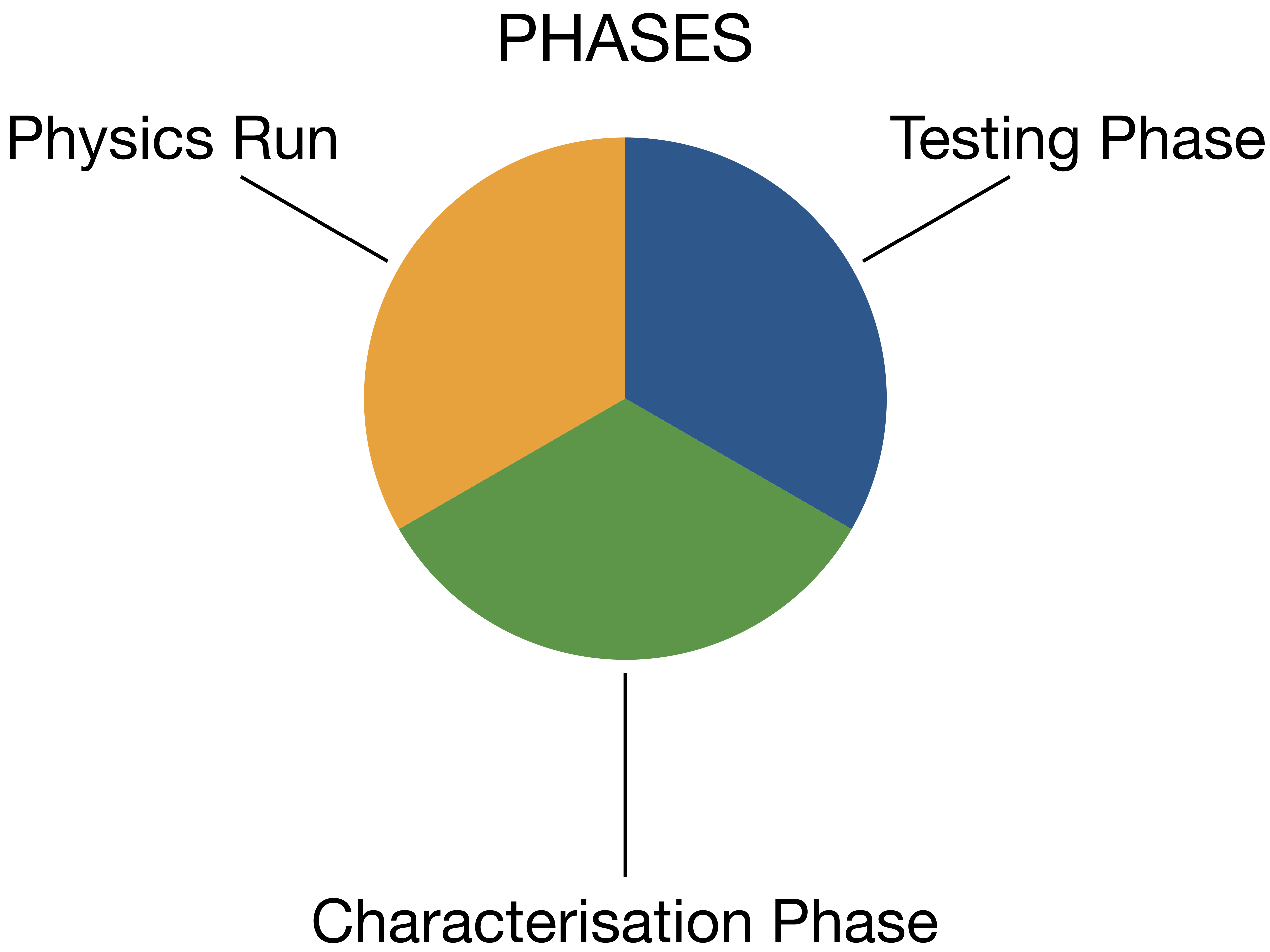
A. Increase exposure
   a. Tightness
   b. Mass
   c. Stability

B. Lower background
   a. Radio-purity
   b. Rn-less environment

C. Lower threshold
   a. High gain
   b. Rich in low A targets
   c. Discrimination of lower energy events

Detector Debugging

Snoglobe - LSM



Structure of the Testing Phase

Sensor choice

Single anode sensor

- Familiarity
- Simple response
- Lowest noise
- Better resolution

Multi-anode sensor

- Increased electric field
- Crucial for calibrations using the laser
- Minimises the effect of contaminants

Ar/CH_4 (98/2) 250 mbar

Single Anode Sensor

8 keV Cu fluorescence

Background: Alpha, Beta

Noise

Noise Optimisation

Resolution

Tightness

Multi Anode Sensor

8 keV Cu fluorescence

Background: Alpha, Beta

Noise

Resolution

Ne/CH_4 (94/6) 500 mbar

Multi Anode Sensor

8 keV Cu fluorescence

8 keV high gain 2 keV/ADU

Resolution

Noise

Fiducialisation Capabilities

Laser diagnostics

Ne/CH_4 (94/6) 1000 mbar

Multi Anode Sensor

8 keV Cu fluorescence

8 keV high gain 2 keV/ADU

Resolution

Fiducialisation Capabilities

Stability (Laser, ^{37}Ar)

What we will learn from the Testing Phase

- 8 keV fluorescence detection
  - Rate - difference between sensors
  - Resolution - difference between sensors
  - Noise levels - effect of ACHINOS to noise

- Stability
  - Running time
  - High gain operation
  - Spark rate

- Background
  - Alpha rate
  - Beta rate
  - Difference between sensors

Operational laser

The most important is that now we have a working detector

Characterisation Phase

A simple procedure after the testing phase

Important aspects of this phase

- First use of the Getter + Rn trap filtering
- Use of ^{37}Ar source required
- Laser operation is crucial
- The shielding is on during the whole duration

Ne/CH4 (94/6) 1000 mbar (Filtered)

Multi Anode Sensor

8 keV Cu fluorescence

8 keV high gain 2 keV/ADU

Resolution

Alpha rate

Low power laser
<G>, θ, drift time, diffusion

Introduction of Ar37

2.82 keV
^{37}Ar K-line

270 eV
^{37}Ar L-line

Low power laser
F, W(270 eV)

Low power laser, ^{22}Na
Rate study vs Gain

What we will learn after the Characterisation Phase

- **X-ray detection**
  - 8 keV
  - 2.82 keV
  - 270 eV

- **Filtering**
  - Effect of Getter
  - Resolution Improvement
  - Attachment improvement
  - Rn trap efficiency

- **Detector parameters**
  - Resolution
  - Threshold

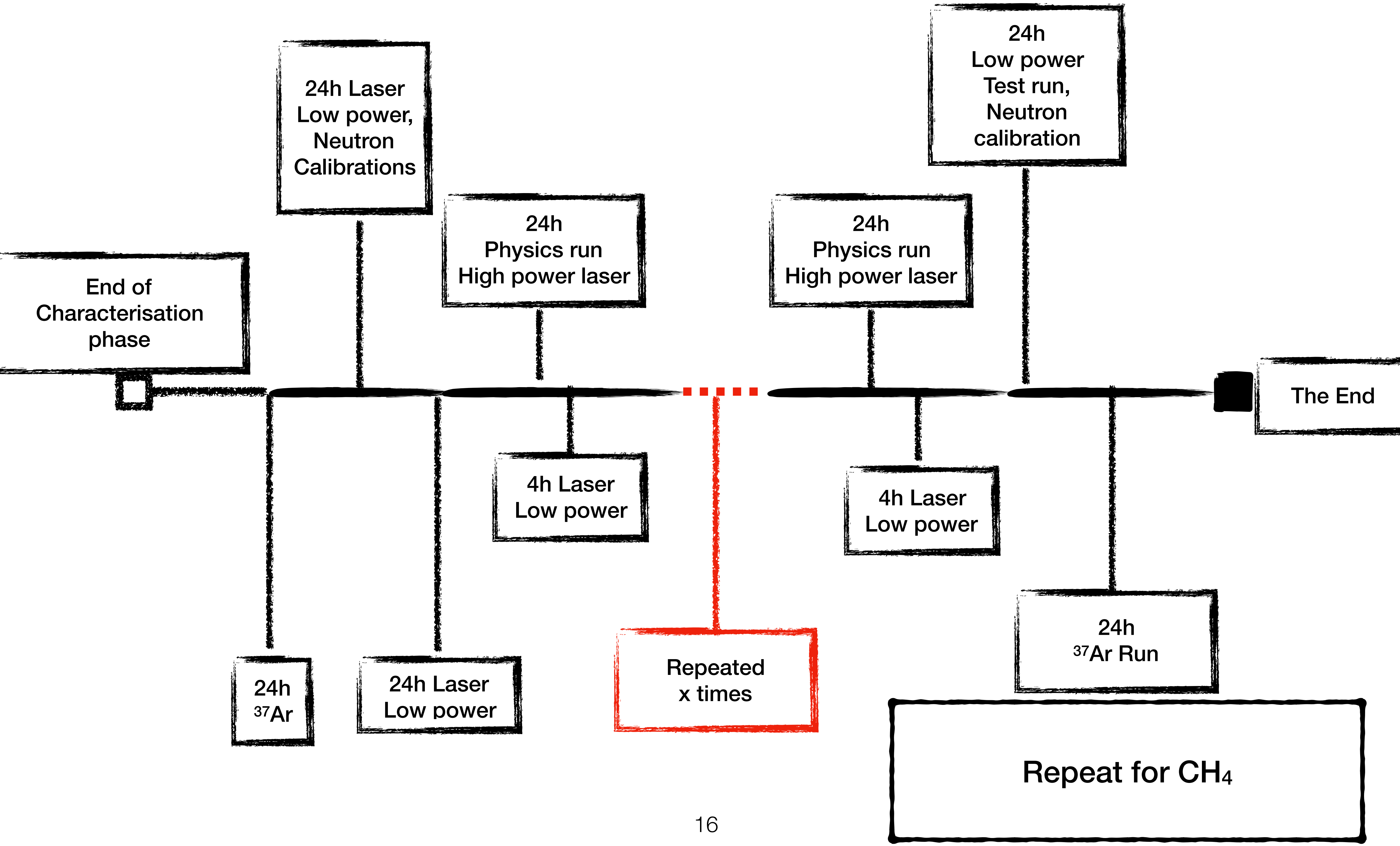
- **Gas parameters**
  - Gain
  - Polya distribution
  - Drift and Diffusion coefficients

Schedule

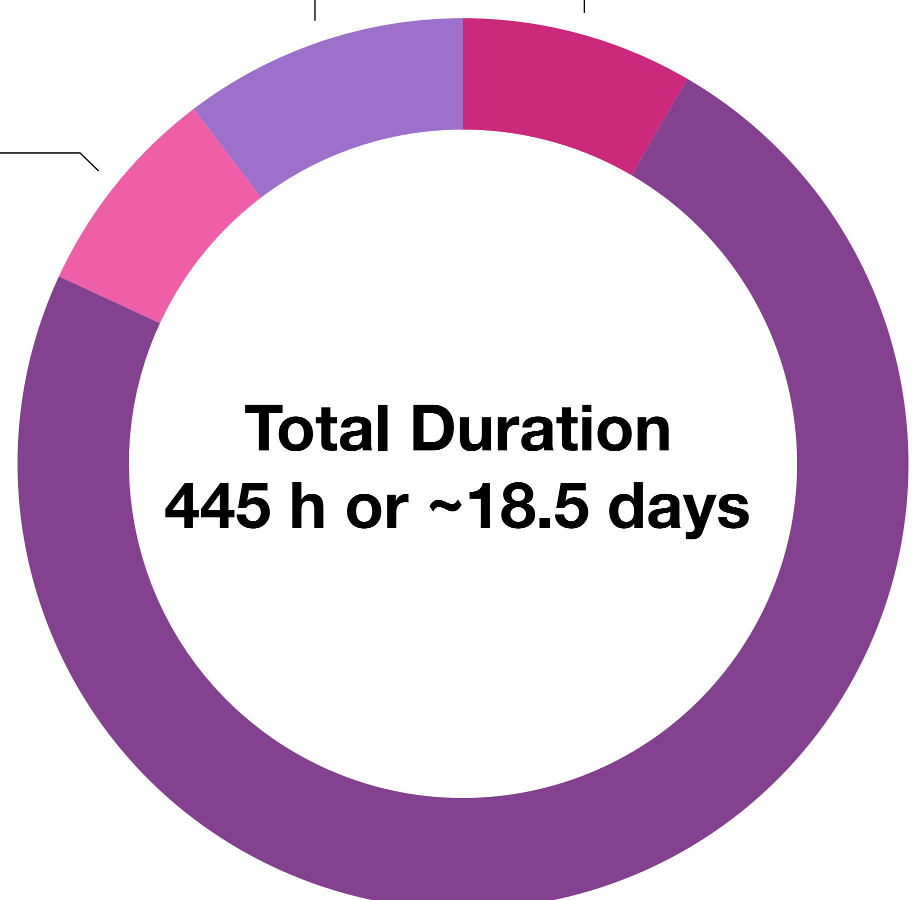
Test #	Phase	Commissioning #	Task	Gas Mixture	Pressure (mbar)	Purification	Tools	Starting Date	Goal
1	Single anode sensor tests	1	Locate 8 keV fluorescence	Ar:CH4 98:2	300	None	BG, Na22	29-05-2019	Confirm HV
2	Single anode sensor tests	1	Measure 8 keV resolution	Ar:CH4 98:2	300	None	BG, Na22		Resolution
3	Single anode sensor tests	1	Background measurements - Alpha	Ar:CH4 98:2	300	None	BG alpha		Measure alpha rate
4	Single anode sensor tests	1	Background measurements - beta	Ar:CH4 98:2	300	None	BG beta		Measure beta rate
5	Single anode sensor tests	1	Noise measurement	Ar:CH4 98:2	300	None	No source/Na22		Measure noise levels
6	Single anode sensor tests	1	Locate noise sources	Ar:CH4 98:2	300	None	No source/Na22		Optimise noise levels
7	Single anode sensor tests	1	Measure 8 keV resolution after noise optimisation	Ar:CH4 98:2	300	None	BG, Na22		Resolution
8	Single anode sensor tests	1	Stability - Gas conditions test	Ar:CH4 98:2	300	None	BG, Na22		Stable operation
ACHINOS and Laser Installation - Pumping									
9	ACHINOS	1	Locate 8 keV fluorescence	Ar:CH4 98:2	300	None	BG, Na22	10/06/2019	Confirm HV, check if we can see the 8 keV, compare rise time distributions
10	ACHINOS	1	Background measurements - Alpha	Ar:CH4 98:2	300	None	BG alpha		Measure alpha rate
11	ACHINOS	1	Background measurements - beta	Ar:CH4 98:2	300	None	BG beta		Measure beta rate
12	ACHINOS	1	Locate 8 keV fluorescence	Ne:CH4 96:4	500	None	BG, Na22	10/06/2019	Confirm HV, check if we can see the 8 keV
13	ACHINOS	1	High gain run (8 keV=>16000 ADU)	Ne:CH4 96:4	500	None	BG, Na22		Spark rate measurement
14	ACHINOS	1	Fiducialisation capabilities run	Ne:CH4 96:4	500	None	Na22		Discrimination efficiency for volume and surface events
15	ACHINOS	1	Laser run	Ne:CH4 96:4	500	None	Na22	16/06/2019	Confirm proper laser operation
Quick Pumping - Going to 1 bar									
16	ACHINOS	1	Locate 8 keV fluorescence	Ne:CH4 96:4	1000	None	BG, Na22		Confirm HV
17	ACHINOS	1	High gain run (8 keV=>16000 ADU)	Ne:CH4 96:4	1000	None	BG, Na22		Spark rate measurement
18	ACHINOS	1	Fiducialisation capabilities run	Ne:CH4 96:4	1000	None	BG, Na22		Discrimination efficiency for volume and surface events

https://docs.google.com/spreadsheets/d/1YzhKx71ltVN8iOoMw_fG3_50ixLeaOR1pGou1kXE_go/edit#gid=1922433515

Physics run Procedure



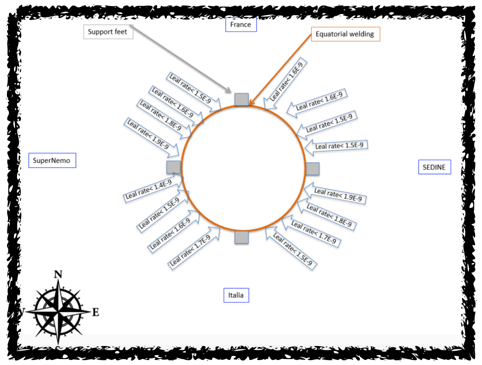
Physics run time budget



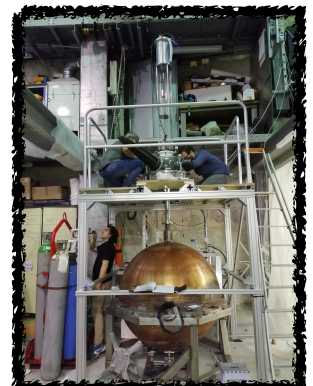
Assumptions
1000 mbar Ne/CH_4
1.26 kg target mass
15.88 days run

Things that took place

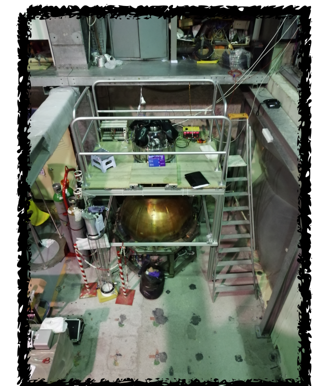
15-04-2019
Leak Test - Baking



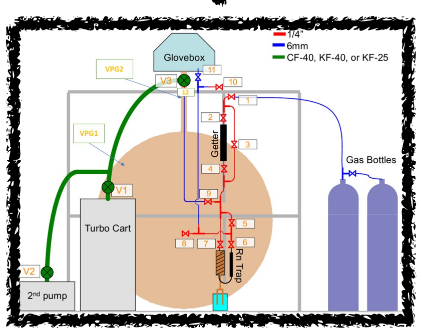
15-05-2019
Gas system- Glove Box installed



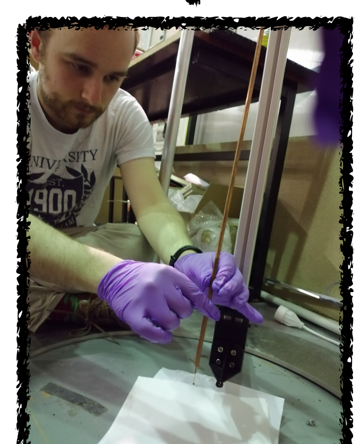
30-05-2019
Setup complete - Gas filled



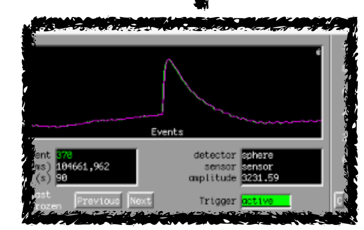
03-04-2019
Snoglobe at LSM



02-05-2019
Gas system - Glove Box Start of installation

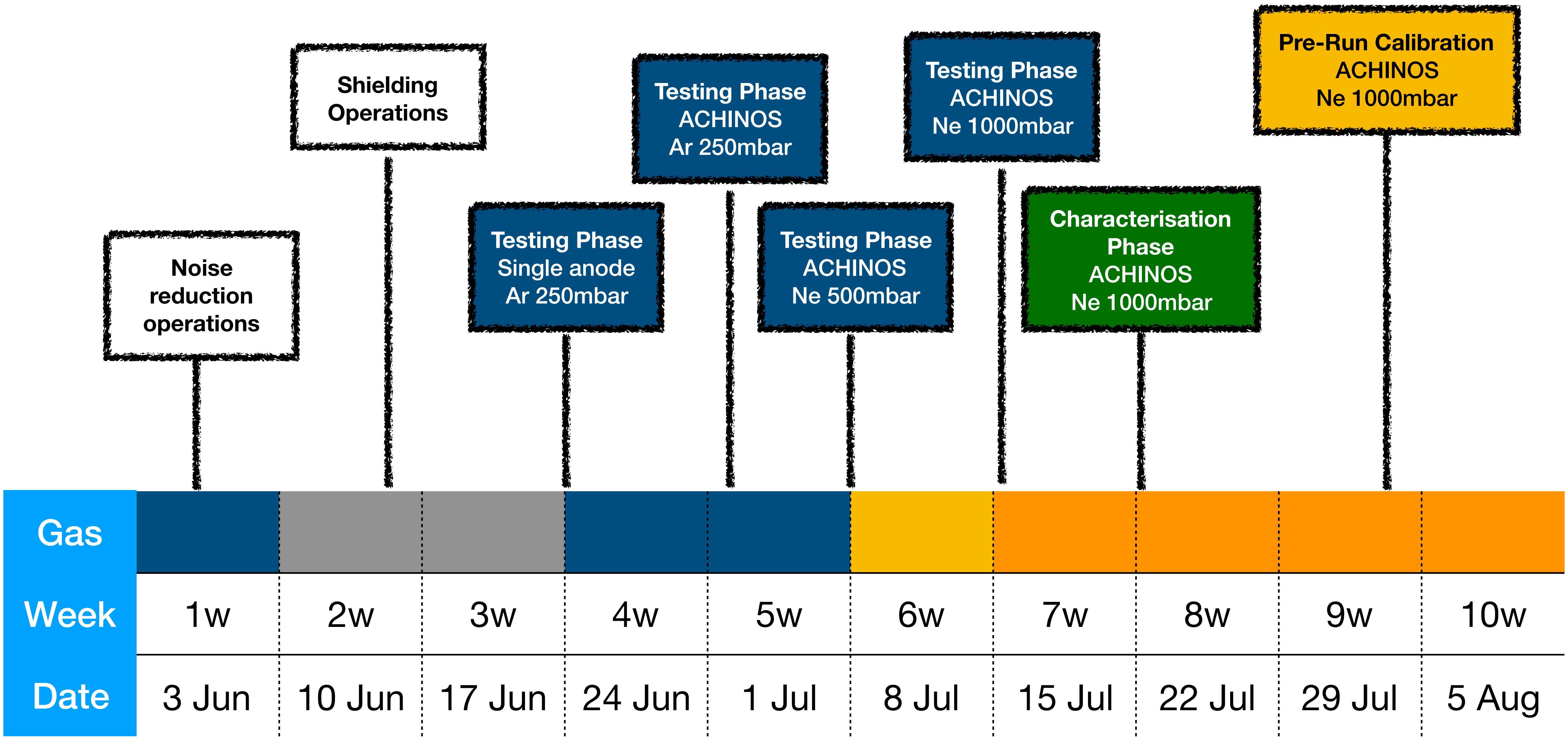


29-05-2019
Sensor Installation



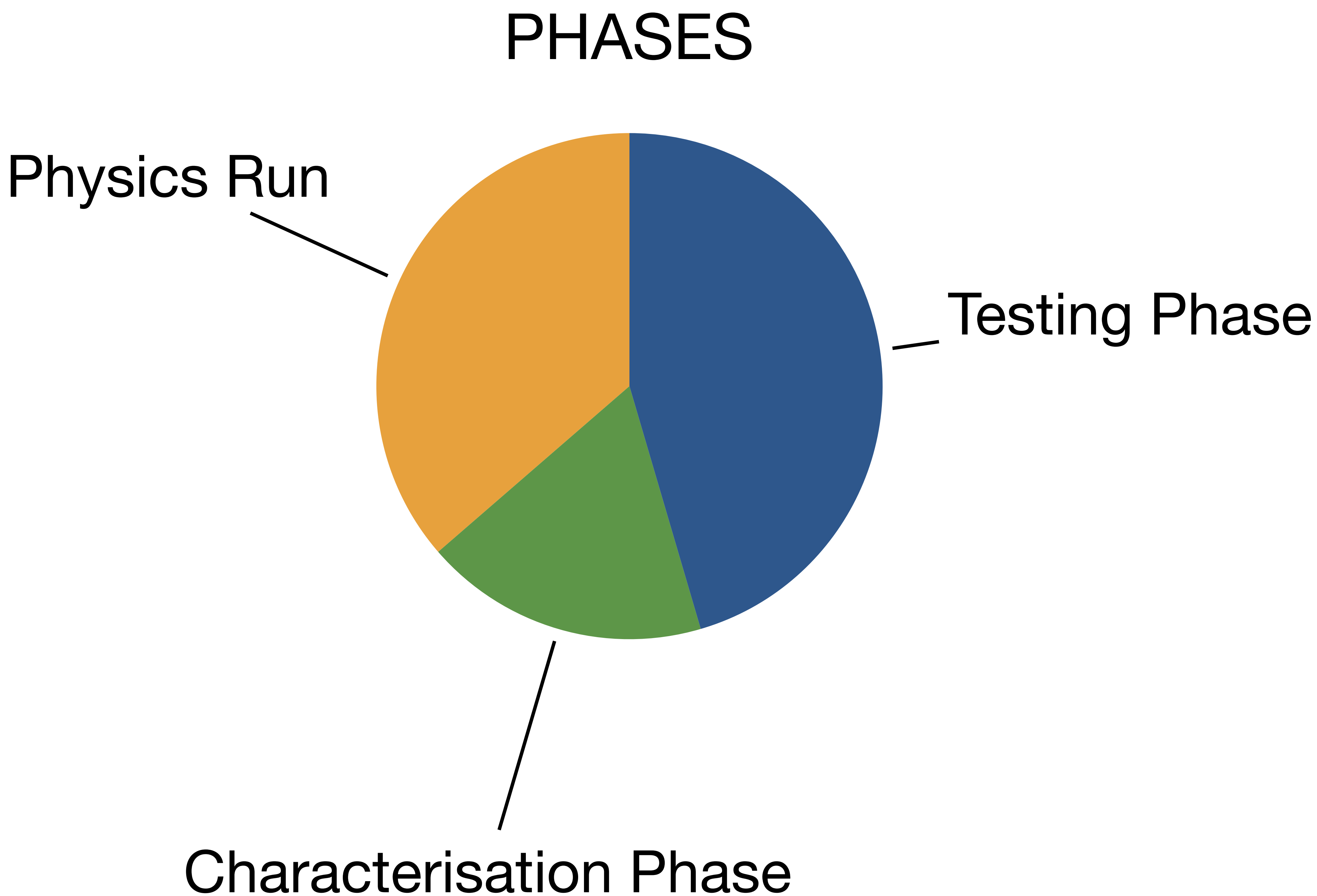
03-06-2019
First pulses

Next steps



Noise reduction operations
Shielding Operations
Testing Phase Single anode Ar 250mbar
Testing Phase ACHINOS Ar 250mbar
Testing Phase ACHINOS Ne 500mbar
Testing Phase ACHINOS Ne 1000mbar
Characterisation Phase ACHINOS Ne 1000mbar
Pre-Run Calibration ACHINOS Ne 1000mbar
Gas
Week
Date
1w
2w
3w
4w
5w
6w
7w
8w
9w
10w
3 Jun
10 Jun
17 Jun
24 Jun
1 Jul
8 Jul
15 Jul
22 Jul
29 Jul
5 Aug

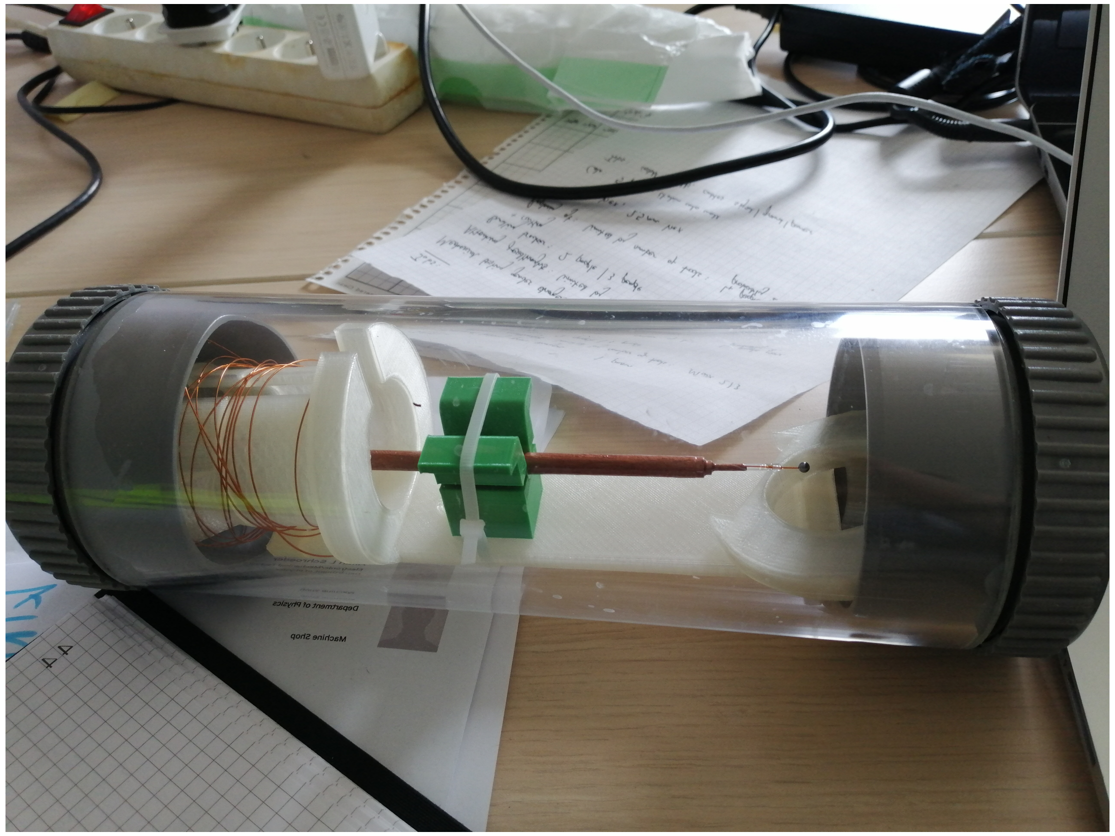
Snoglobe - LSM



Data taking

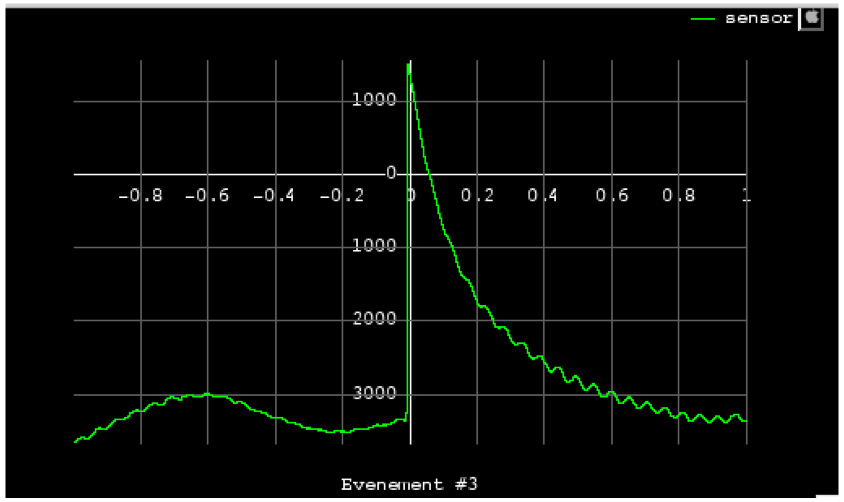
Start date 30-05-2019

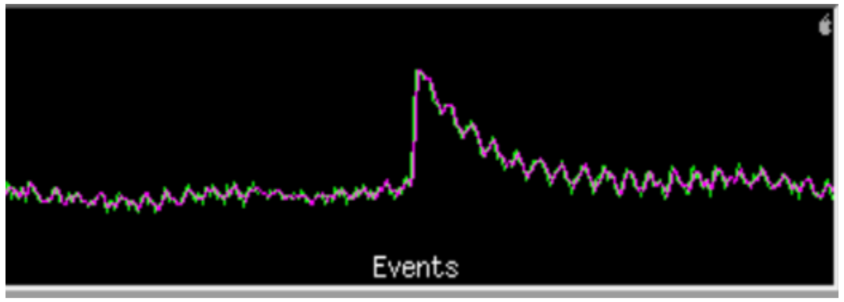
Conditions
Gas Mixture: Ar/CH_4 (98/2)
Pressure: 256 mbar
Single anode
Sensor anode ⌀: 3 mm
No Filtering method used



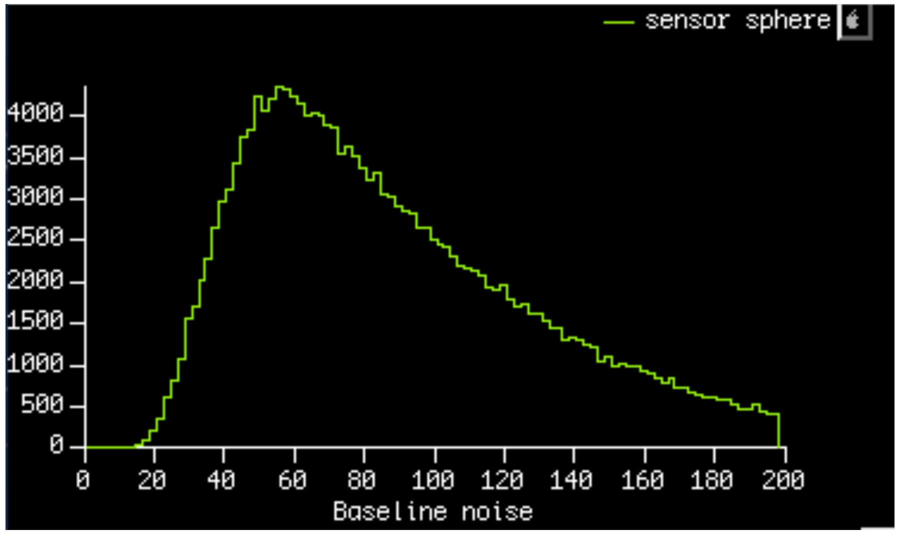
Noise and Spurius pulses

Spurius Pulses
Fast rise time
Random Amplitudes

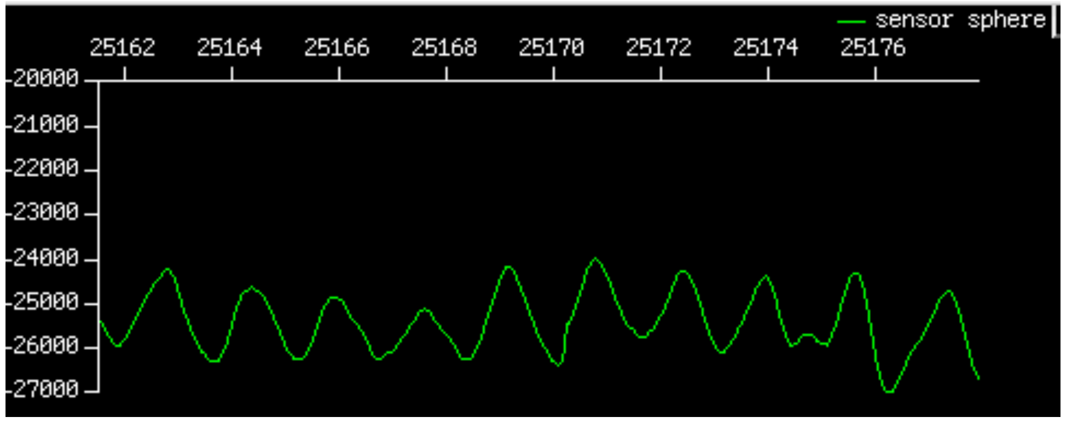




Noise Histogram (ADU)



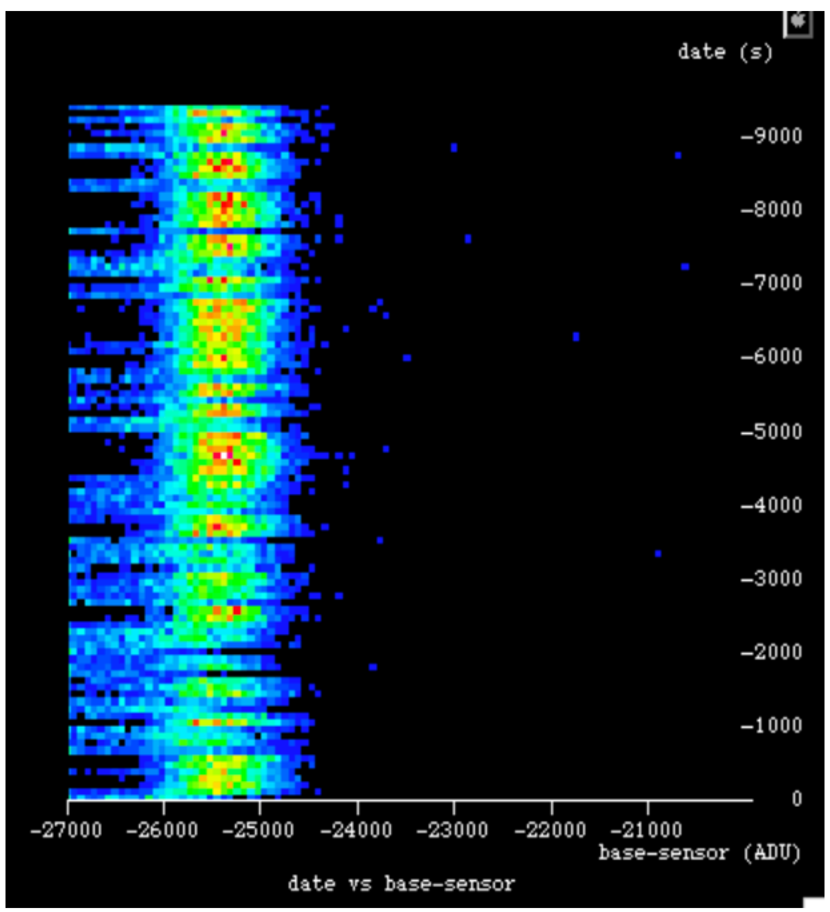
Baseline Oscillation

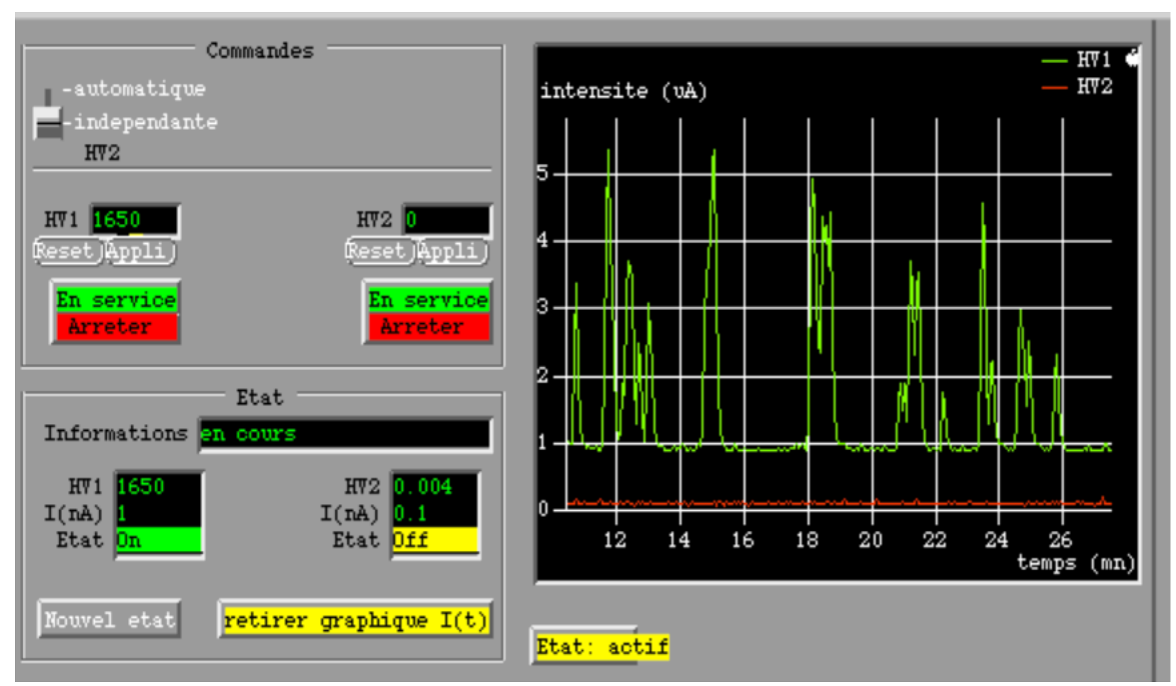


Sparking

Run: tf07s007
Type: No source inside
Cuts: rt(0.03, 10)ms, ampl(2000, 100k) ADU
Voltage: HV=1650 V , HV2= 0 V,
Info: T=10 k s, N=3.5 kevents, R=3.5 Hz

Baseline vs Time

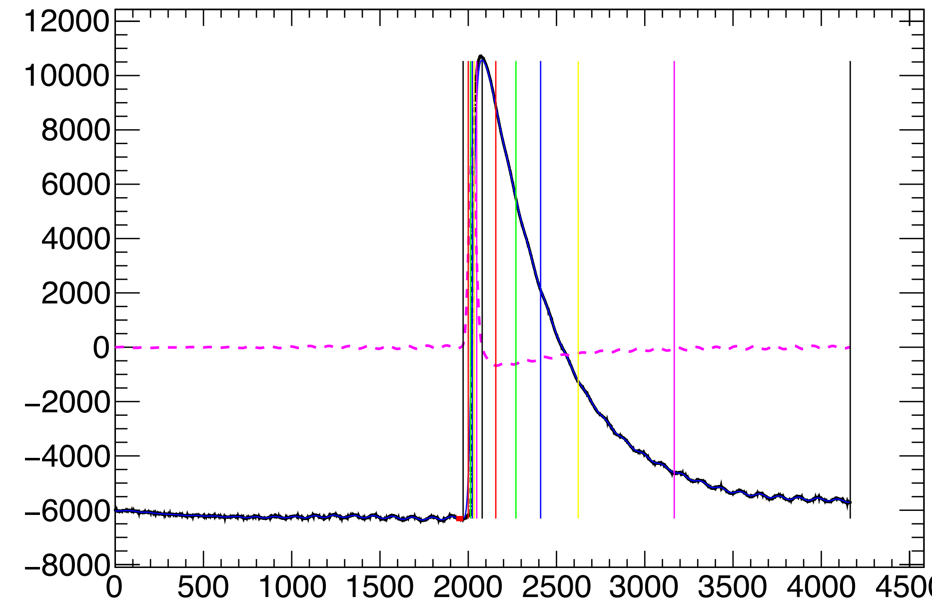




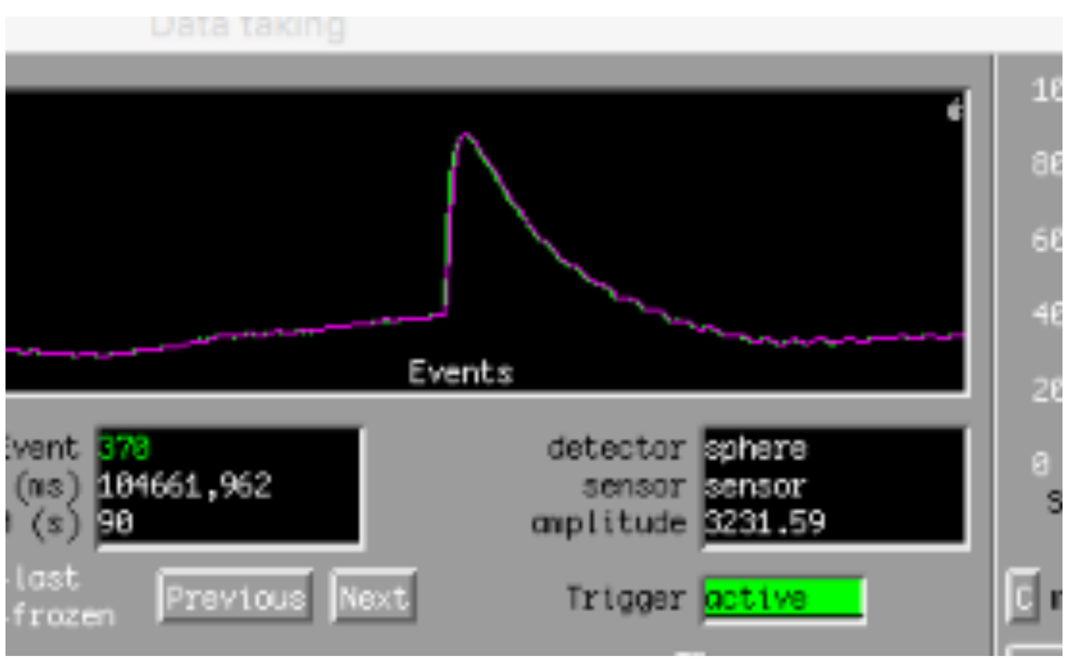
Power supply current

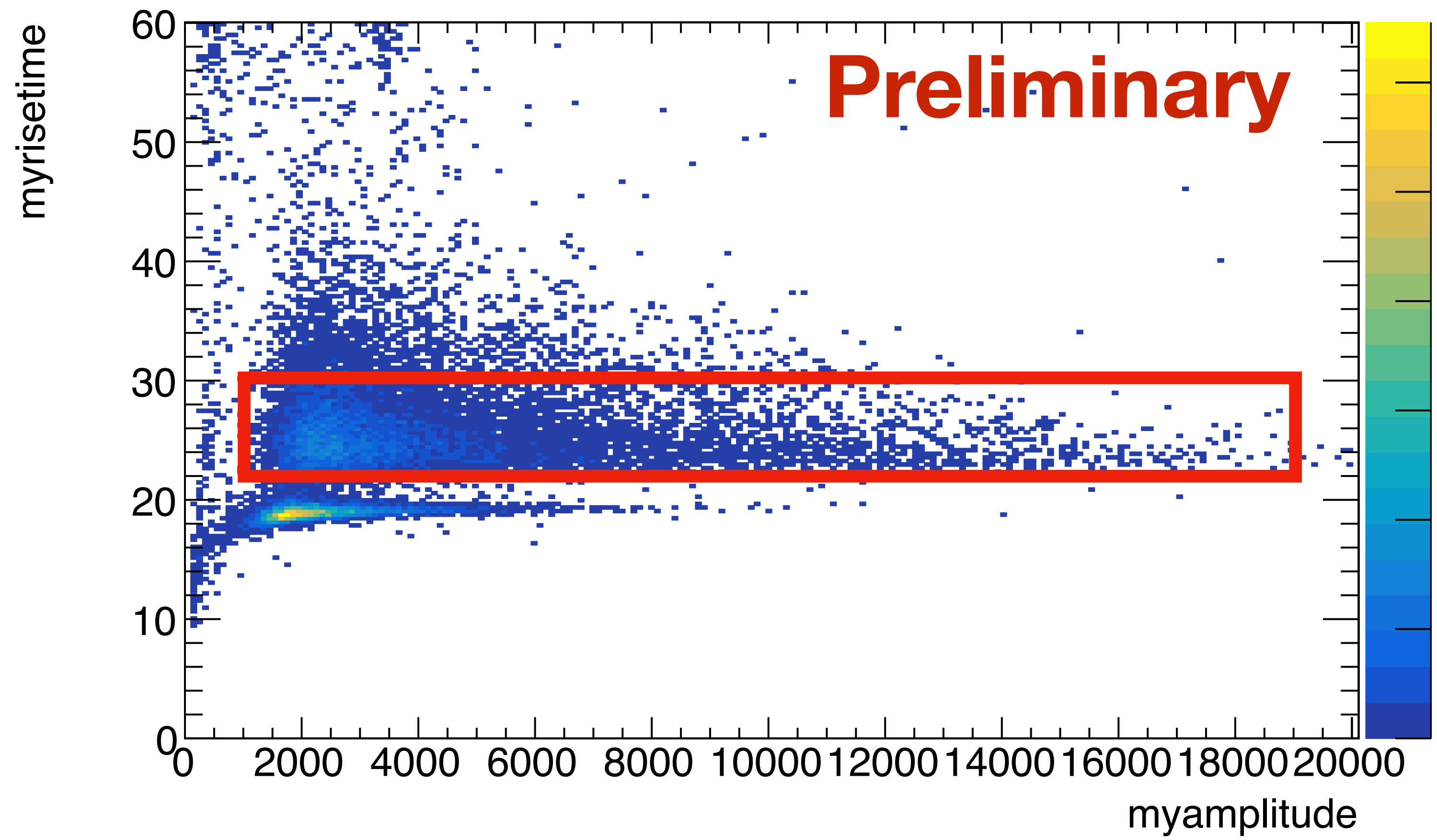
Possible physical events

Run: tf03s000
Type: No source
Cuts: rt(0.03, 10)ms, ampl(2000, 100k) ADU
Voltage: HV=1600 V , HV2= 0 V,
Info: T=4.2 ks, N=48.5 kevents, R=11.5 Hz



First physical event observed

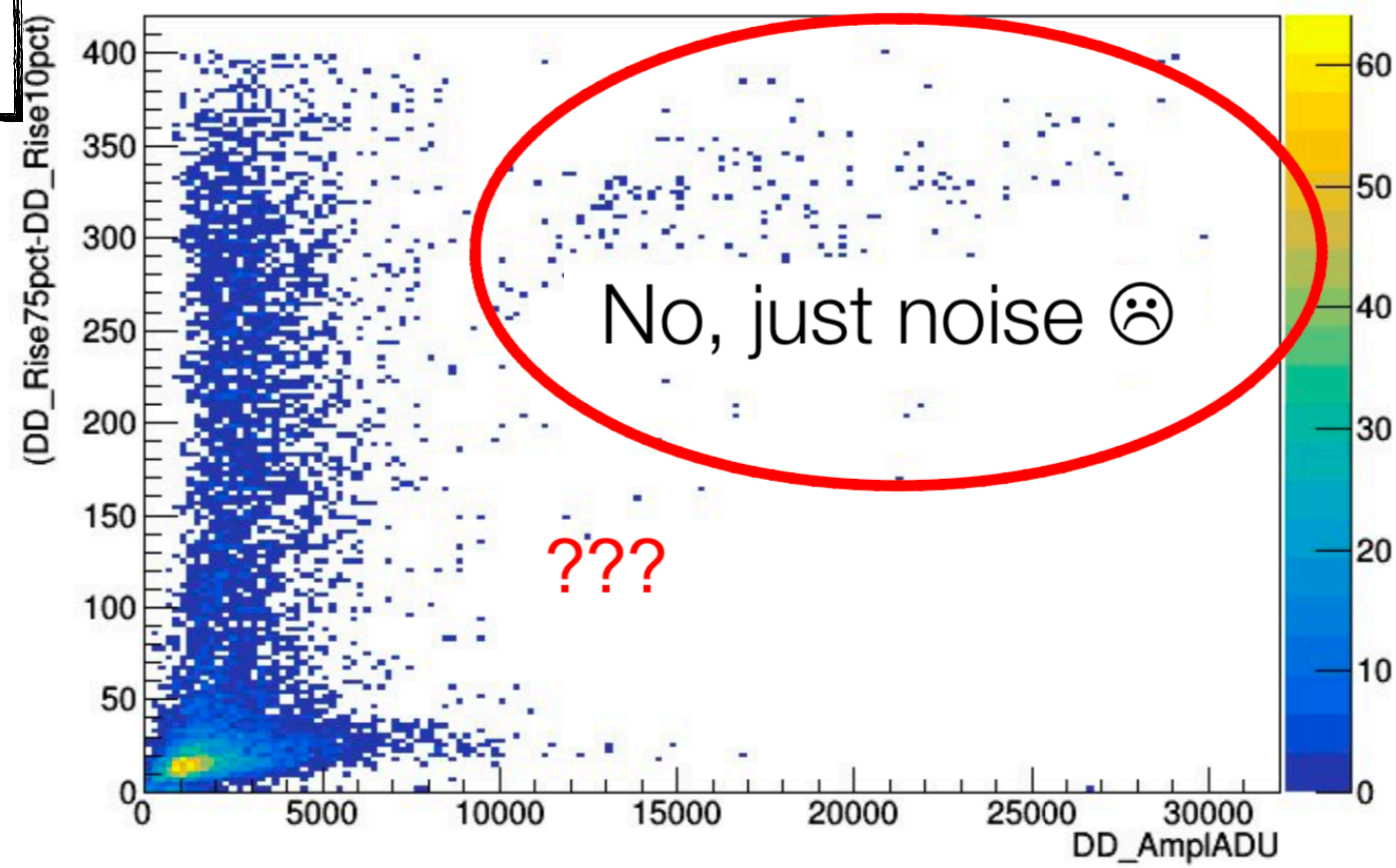




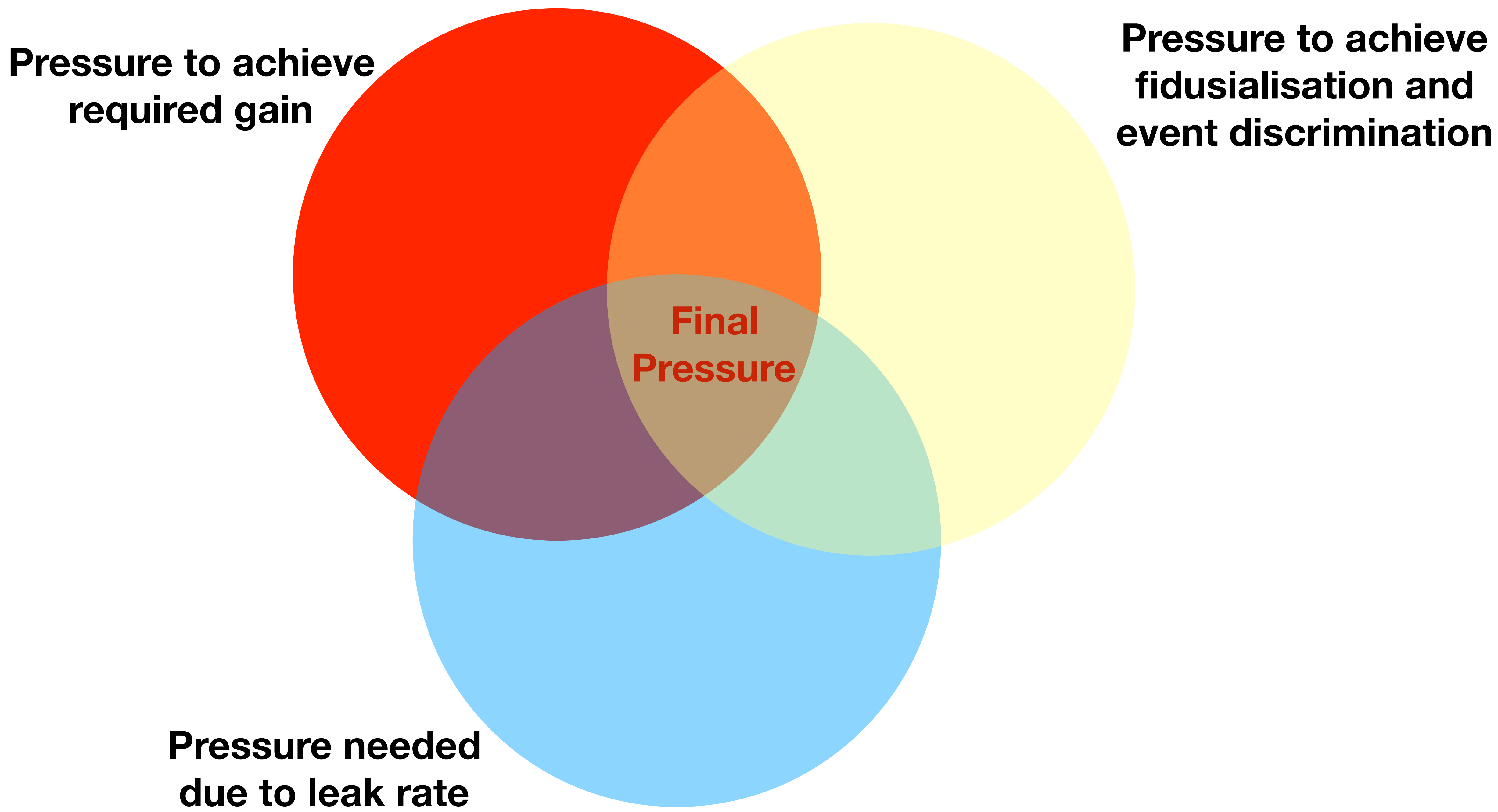
Runs Na^{22} source

Run: tf07s002
Type: Na22
Cuts: rt(0.03, 10)ms, ampl(1000, 100k) ADU
Voltage: HV=1600 V , HV2= 0 V,
Info: T=25 min, N=9.9 kevents, R=6.4 Hz

Preliminary



Change in plans



Subsidiary studies

- ACHINOS simulation (2-hemisphere)
- Drift/Diffusion simulations
- Modelling W-value vs Energy for penning mixtures
  - For electrons
  - For ions

Discussions from which we will benefit

- Dates - Scheduling
- Risk Management
- Noise reduction

Thank you for listening

6th NEWS-G collaboration meeting