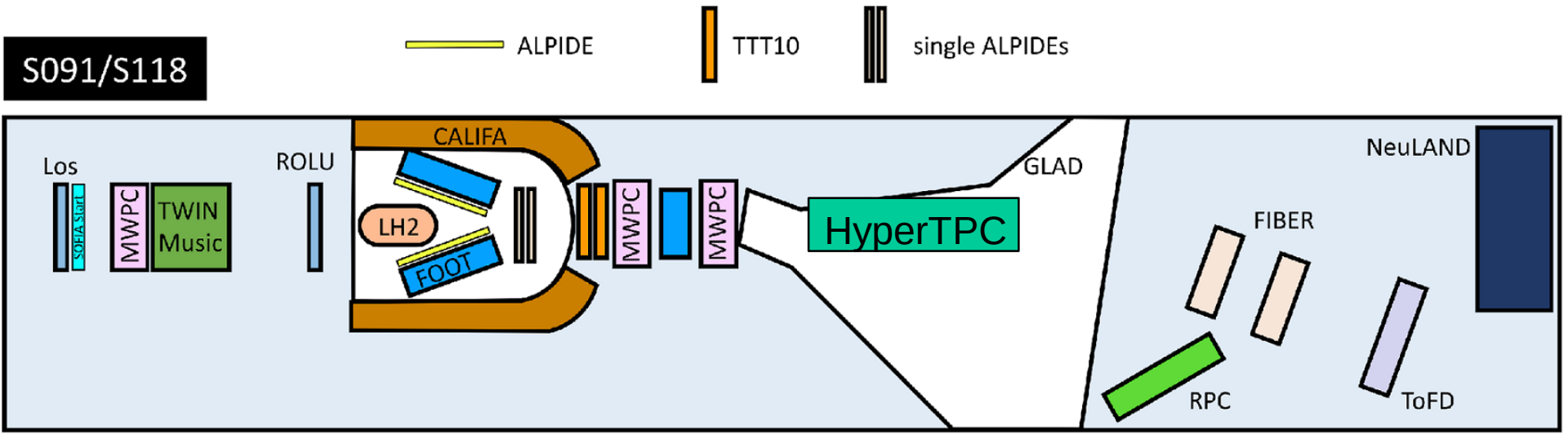
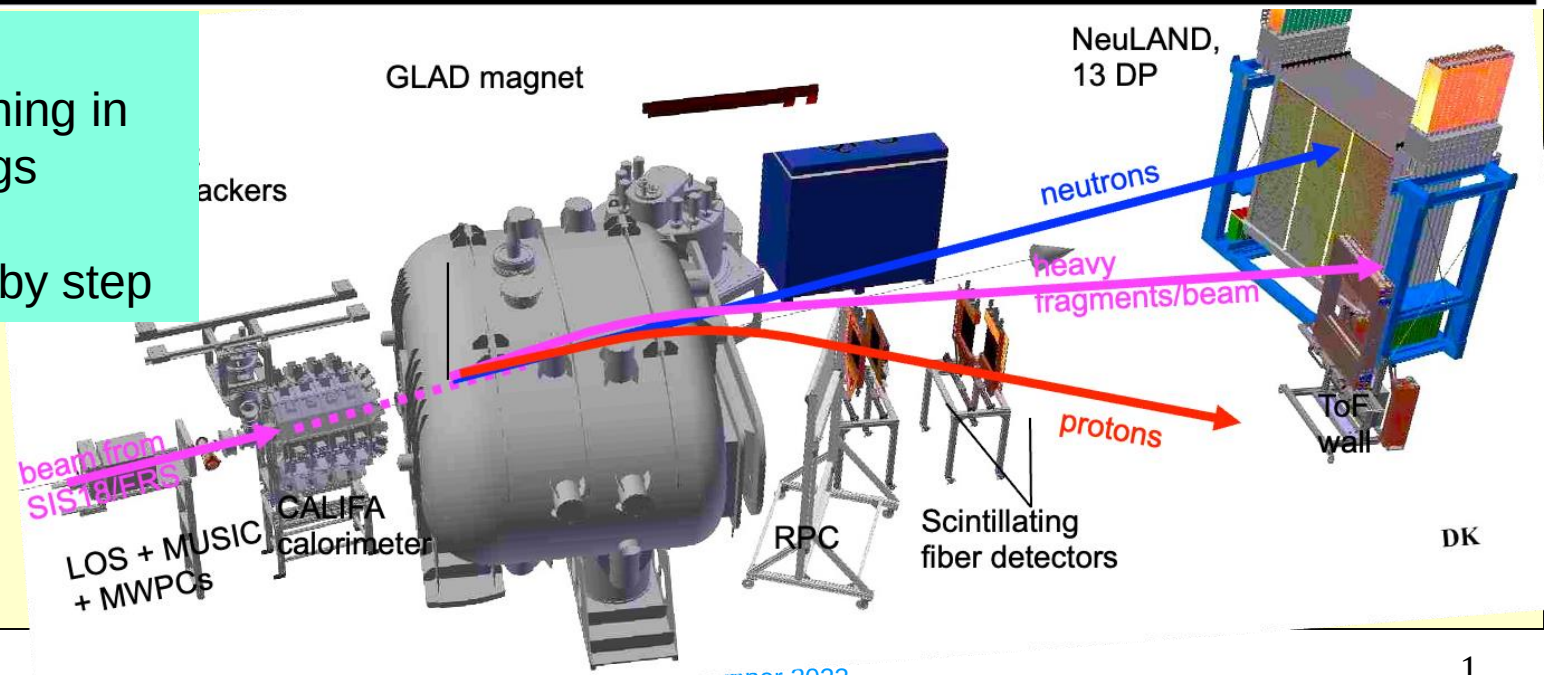
A Common Setup for 3 Experiments

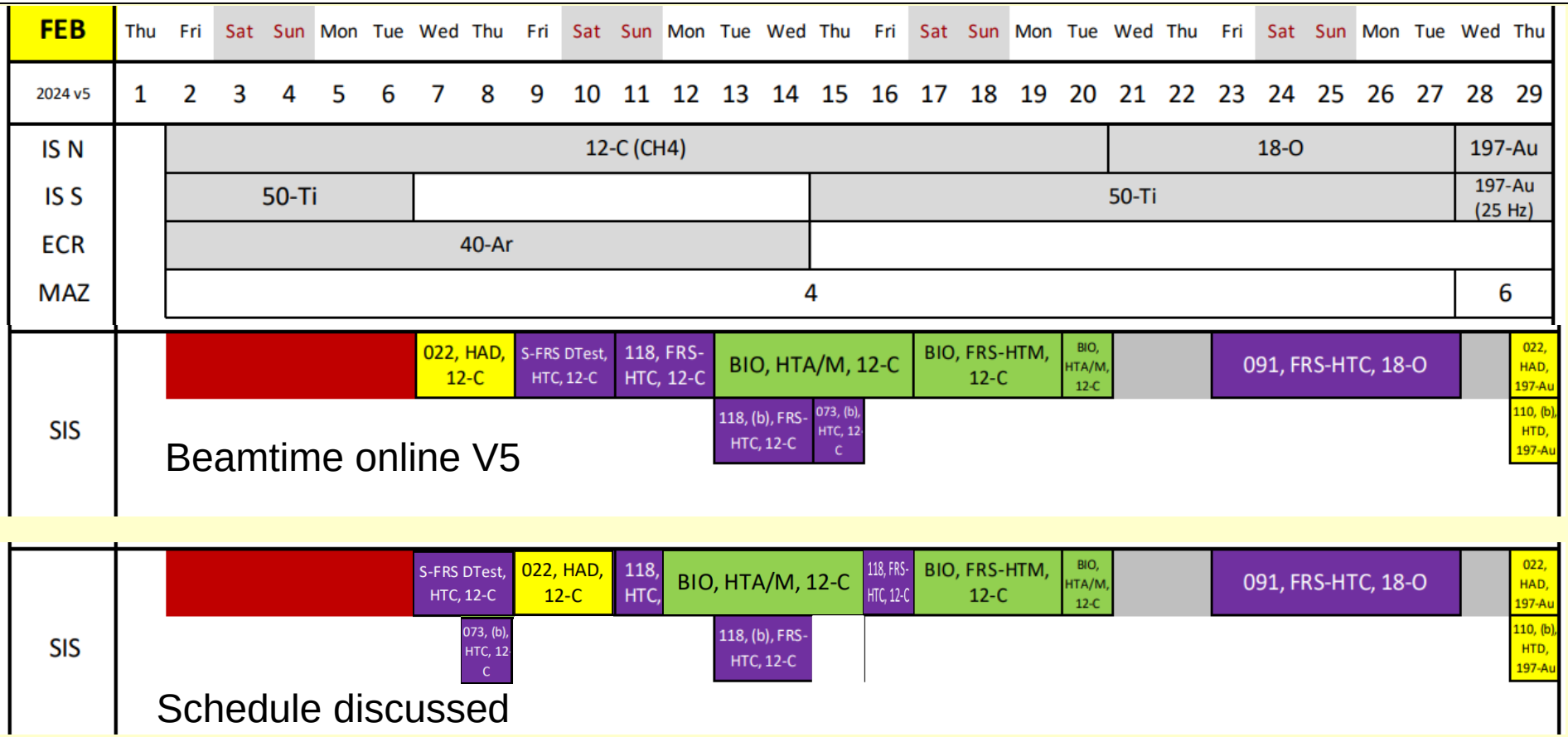
S091/S118



Strategy:
Start with everything in and remove things hurting the next experiment step by step



Schedule



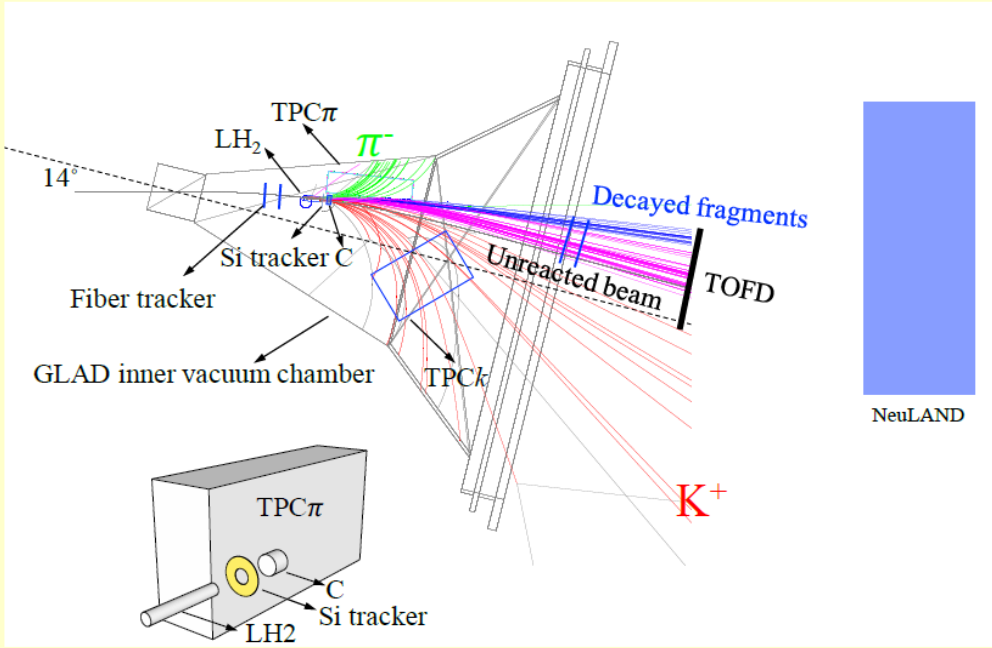
Final approval with Daniel and “Bio” still ongoing (Haik)

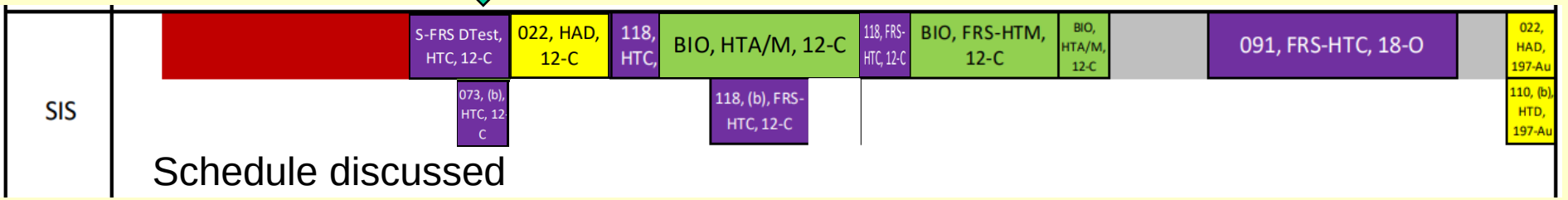
S073

Beam optimized for Cave-C already before
Main goal:
Test HyperTPC with ^{12}C 1.9 AGeV

Risk: GLAD high field (^{3}He)
Discussion: 14° vs. 18°
Can we have ^{12}C for TOFD Meander.
2nd Energy for TOFD Calib. Chiara part.

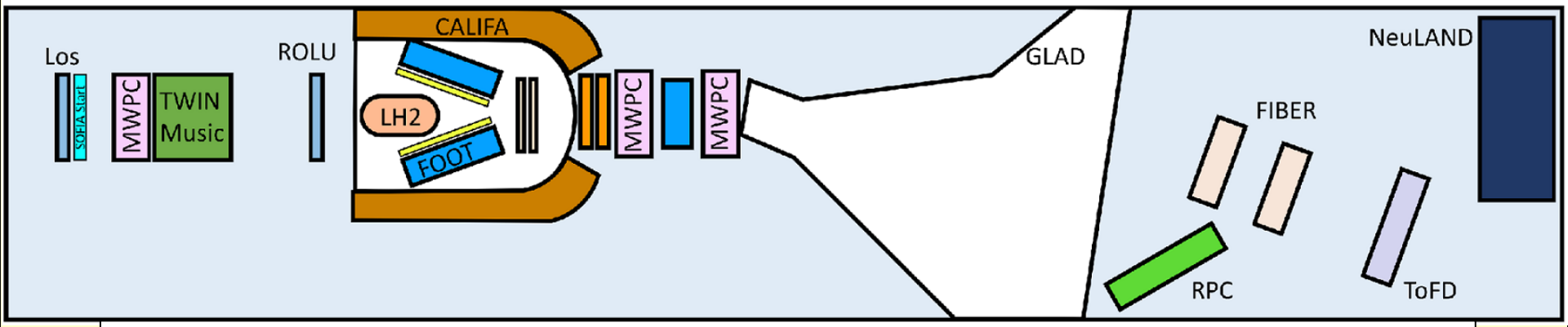
Additional Pb Target (1 hour) for Neuland time calibration





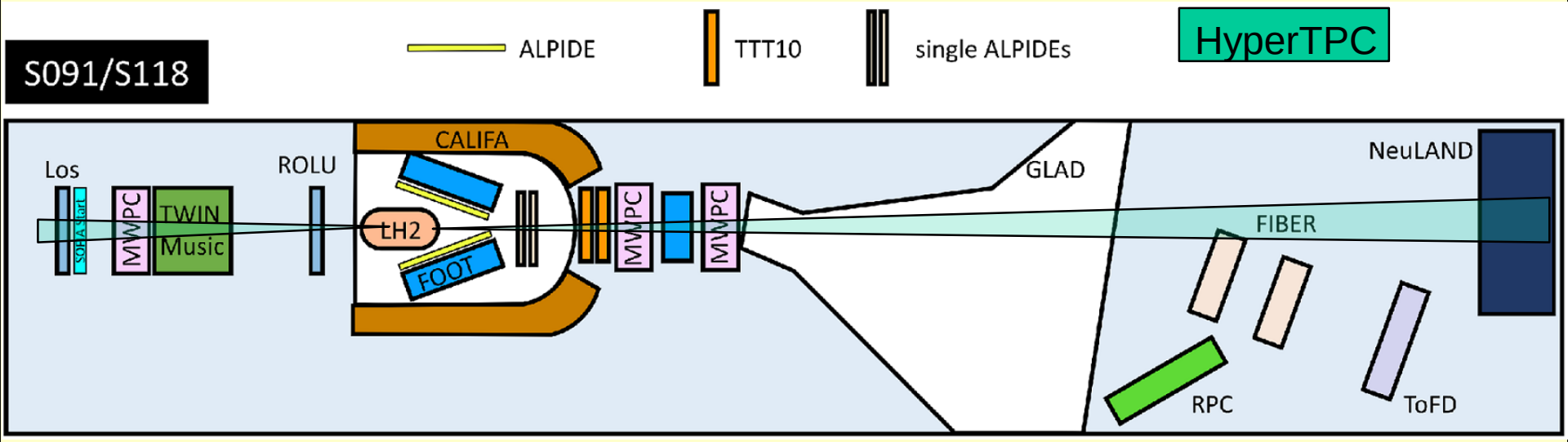
3H(p,2p) steps and Goals

S091/S118



- Get the 3H beam (400AMeV) straight into the cave (use Neuland as a tracker. Beam tuning + energy loss calibration of the Neuland bars.
  (S2, Sofia-Start, LOS, Neuland)
- Switch on GLAD and sweep 3H over TOFD. (rough adjustment of the 3H to get the fraction of 3H in the beam)
- CALIFA (2, 2p) condition, check statistics and BG conditions
  (S2, Sofia-Start, LOS, Neuland + CALIFA)
  Minimum setting, 2 Neutron response of Neuland
- Get full kinematics, Reconstruct momentum in the 2p system
  (ALPIDE, FOOT, we do not have incoming or outgoing tracks)
  Get absolute efficiency of Neuland
- In addition monitor deuterons in RPC.
  Again look at the beam cocktail, look to (p, pn)

Tuning with Tritons



- We start with 0-Field --- Glad was down for removing HyperTPC anyhow
- **Neuland is our tracking and PID** (Trigger: Sofia Start 5E3 1/s)
  Goals: a) Beam tuning, b) Neuland TOF Calibration, C) See if MWPCs work
- Range of 400 AMeV ^{3}H is 250cm we have the perfect target and detector….
- Particle separation with LOS (tune HV), TOF with Sofia-Start, LOS in addition
- Sweep once over TOFD and fibers when scaling the GLAD.
  Should be enough to provide a NEULAND veto later in Software.
- Do we need a downscaling of the trigger?

FRS Config S118, S091 (Do we need S8?)

Primary	Fragment	Prim. target	Slits-x (S1/S2)	S2 degrader	S8 slit
^{12}C	^{1}H	16g/cm^2 Be	Open (+/- 1%)	~1g/cm^2 Al Wedge	5mm
^{12}C	^{2}H	16g/cm^2 Be	S2 < +/- 5mm	~1g/cm^2 Al Wedge	< 5mm
^{12}C	^{3}H	16g/cm^2 Be	S2 < +/- 5mm	~1g/cm^2 Al Wedge	< 5mm
^{18}O	^{16}C	16g/cm^2 Be	Open (+/- 1%)	Minimum material	5mm
^{18}O	^{14}C	16g/cm^2 Be	Open (+/- 1%)	Minimum material	5mm
^{12}C	^{12}C	16g/cm^2 Be	S1 < +/- 1mm	Minimum material	5mm
^{12}C	^{10}C	16g/cm^2 Be	Open (+/- 1%)	Minimum material	5mm

Primary	Beam energy (Ptcl.-per-spill)	Fragment	Energy at Cave (MeV/u)	Rate at S2 (aft. slit)	Rate at Cave (1sec-spill)	Impurity (%)
^{12}C	600? (10^{10} pps)	^{1}H	523 +/- 1%	4e6/4e6	3.4e5	<0.01%
^{12}C	600? (10^{10} pps)	^{2}H	534 +/- 0.5%	5.7e6 / 7.3e6	1.6e6	<1% ^{4}He
^{12}C	600? (10^{10} pps)	^{3}H	537 +/- 0.5%	6.6e6 / 7.4e6	2.4e6	<0.01%

Discussion on Beams and Energies

2 energies due to beam time constraints.

Low energy
- Limit by straggling > 300 AMeV
- CALIFA + Foot clean ID < 400 AMeV
- Neuland thickness (> 350 AMeV)

High energy:
- CALIFA + Foot any ID < 800 AMeV
- GLAD 18 deg < 1200 AMeV

Should we use a special experiment
570 AMeV (S509) 400 AMeV (Typ R3B)

Do we have a chance to get the same program with deuterons?

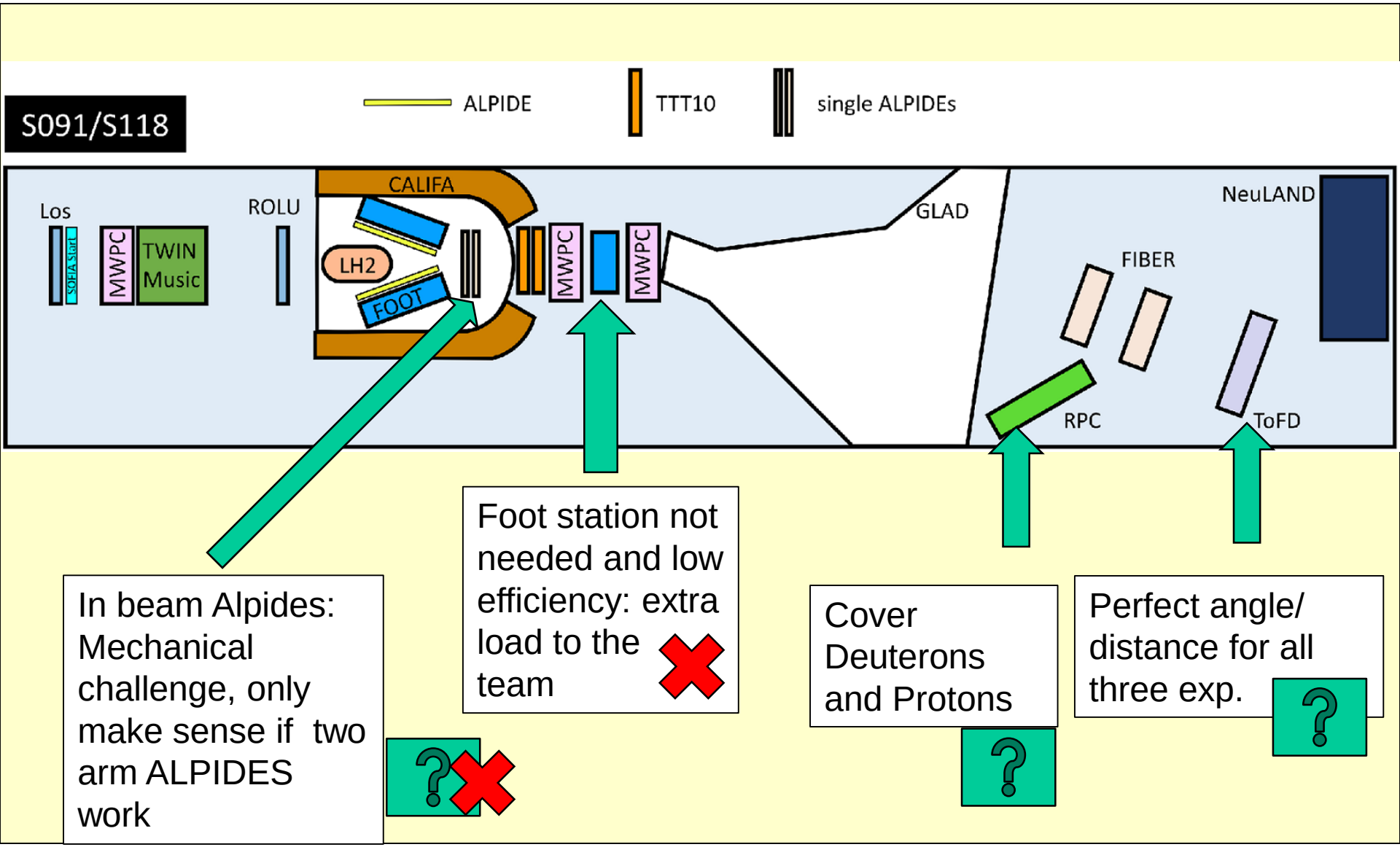
So far:

400 AMeV (Typ R3B))
σ_p/p = 1.418e-4
(Target)

σ_p/p = 2.8 e-4
(for all matter)

800 AMeV (Safe operation)

Optimizations to be done



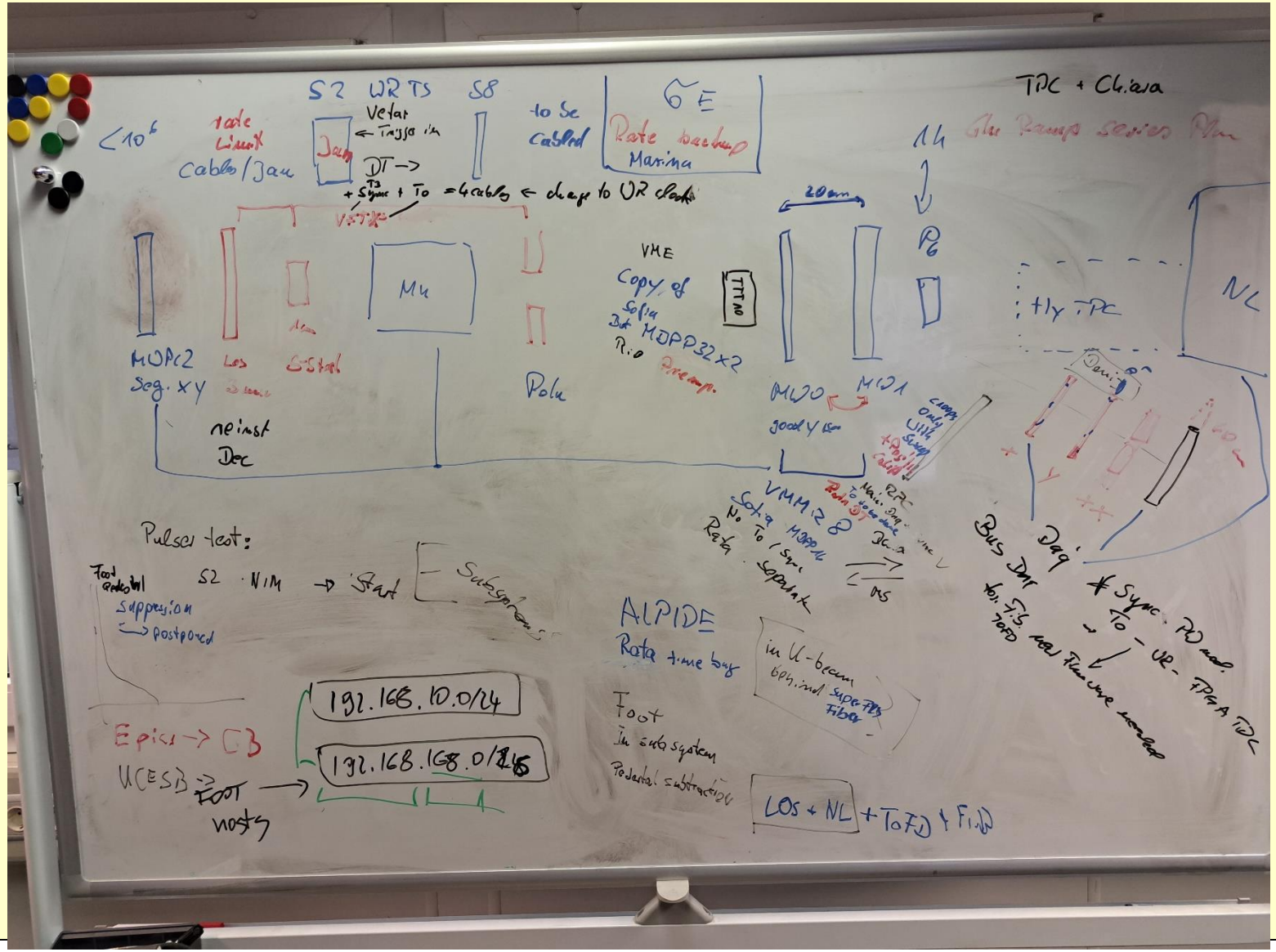
In beam Alpides: Mechanical challenge, only make sense if two arm ALPIDES work

Foot station not needed and low efficiency: extra load to the team

Cover Deuterons and Protons

Perfect angle/ distance for all three exp.

And there is DAQ



Preparation Schedule

November

SA	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr
04.11	05.11	06.11	07.11	08.11	09.11	10.11	11.11	12.11	13.11	14.11	15.11	16.11	17.11
		R3B	week	R3B	week			DAQ	Test	Setup	Install	Hydra	laser

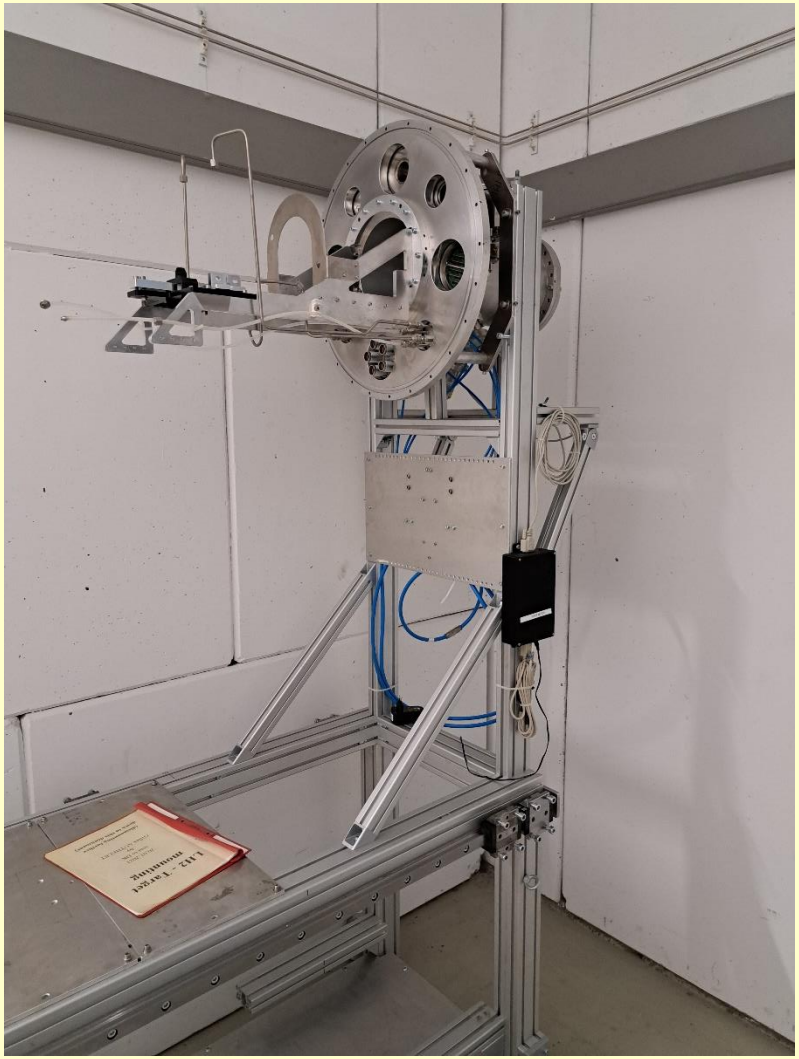
SA	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr
18.11	19.11	20.11	21.11	22.11	23.11	24.11	25.11	26.11	27.11	28.11	29.11	30.11	01.12
test		GLAD	on	GLAD	Hydra	laser	test	CALIF A ME	CALIF A ME	beam line	install	beam line	

December

SA	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr
02.12	03.12	04.12	05.12	06.12	07.12	08.12	09.12	10.12	11.12	12.12	13.12	14.12	15.12
	U.beam			U.beam	remove	beam line	target	area	foot	alpide	mwpc	music	TTT10

SA	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr
16.12	17.12	18.12	19.12	20.12	21.12	22.12	23.12	24.12	25.12	26.12	27.12	28.12	29.12
	U.beam	HTD	HTD				Chris	tmas	break	Chris	tmas	break	

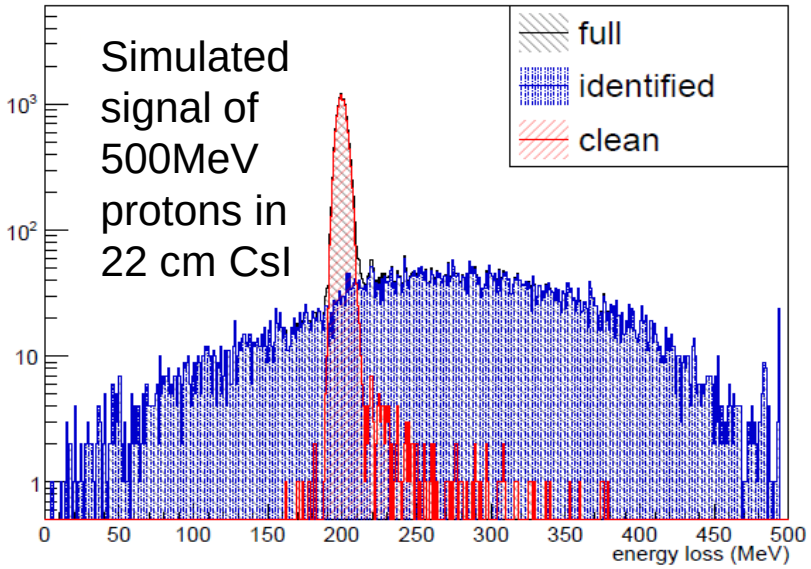
Some Hardware ToDo

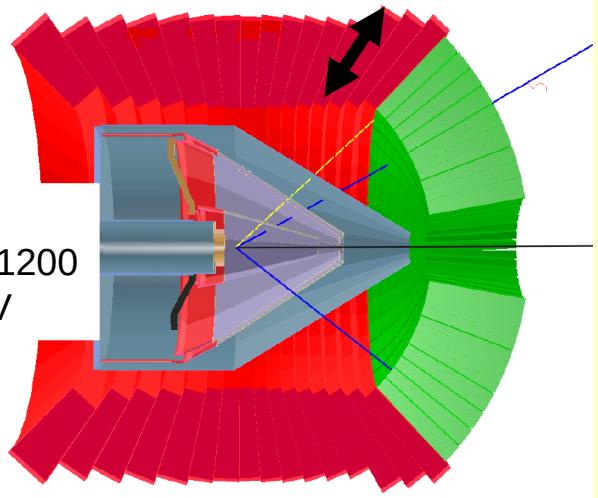


Task list for January

- Common Pulser distribution system.
- Trigger testing and time correlation plots.(sync, t0, trigger timing….)
- DAQ should always run!
- S2+S8 Cabling and DAQ tests. (Date to be defined.)
- One week for LH2 target installation. (When, open target chamber? Backup in case of fail.
- ALPIDE readout upgrade
- Fine tuning of CEPA-CsI (Should not hinder DAQ as all modules are already in.
- TEST UCESB unpackers
- TEST R3Broot on pulser data
- ……Your input…….

Proton Energy Reconstruction in CALIFA



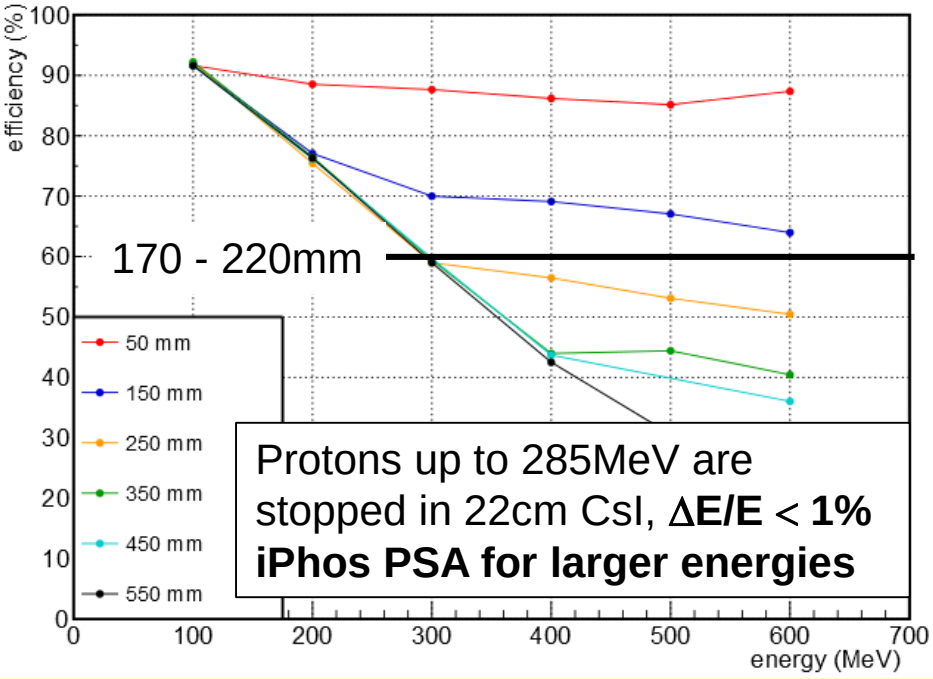


E_{beam} 300 -1200 AMeV

Pulse shape analysis (PSA) cleans up the reactions in the active material

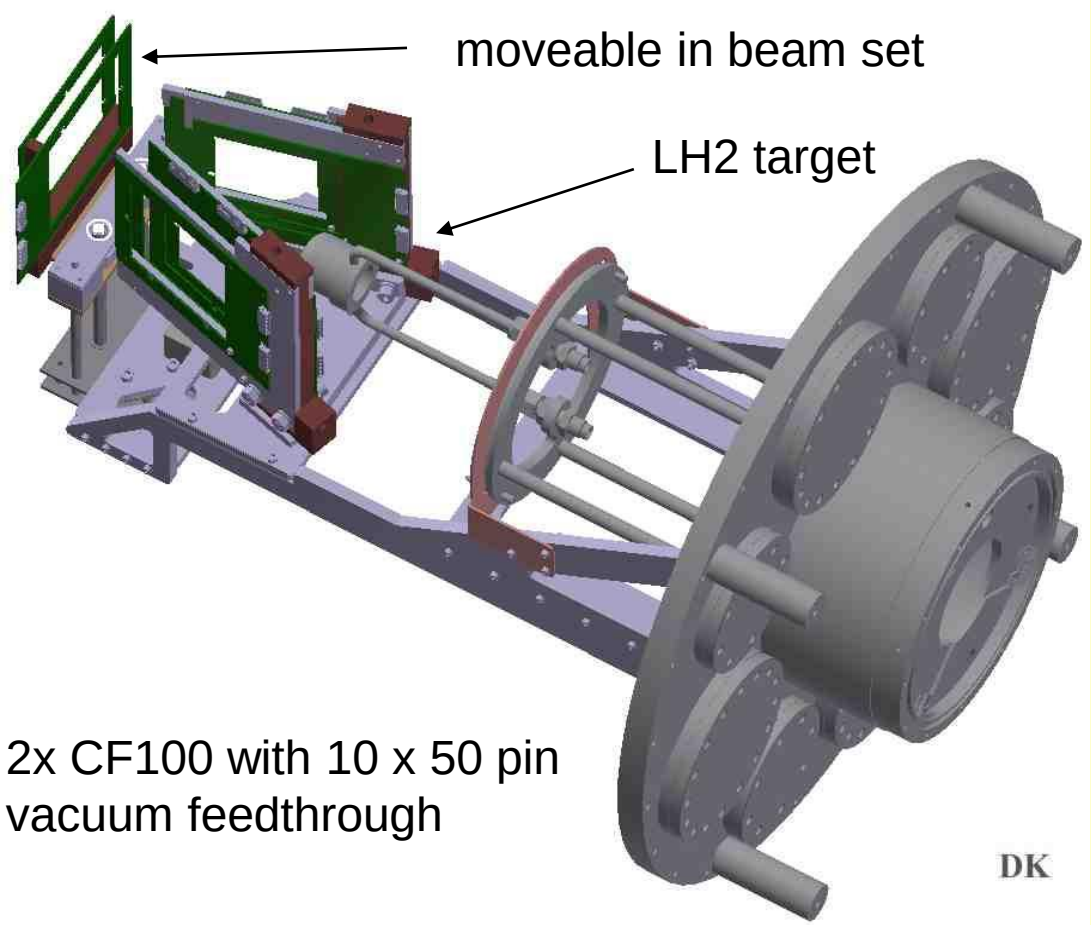
Iphos completed now 100%

- With (p,p) elastic: well defined correlation in energy and geometry.
- Correlation will shrink to a narrow line.
- determine the full energy efficiency



Protons up to 285MeV are stopped in 22cm CsI, **ΔE/E < 1%**
iPhos PSA for larger energies

Foot Setup in 2 Arm Geometry



10 planes of SSD for yxxy – tracking (7000 ch.)
150 μm silicon wafers,10 cm x 10 cm
Triggered system $\sigma E < 20$ keV

Tasks:

- energy dept. efficiency
- rate dept. efficiency
- cluster algorithm
- combinatorial background
- delta electrons from LH2 with heavy beams
- proton HI separation

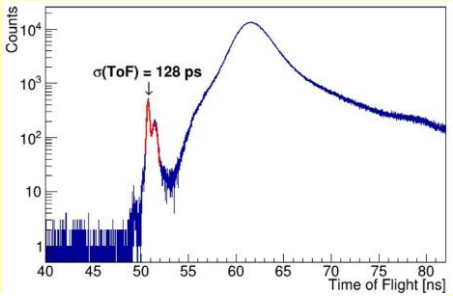
Tools:

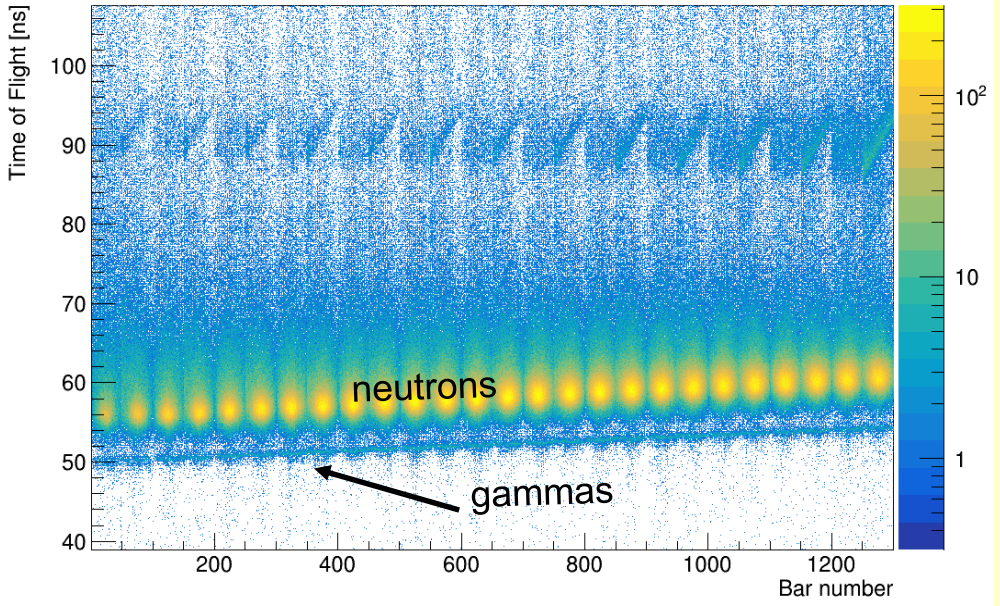
- (p,p) elastic scattering E(Θ) known from the 2nd proton
- In beam detectors at different rates and beam energies.
- Sn(p, 2p) for delta electrons
- 31Ar(p,2p) for 2 particle correlations.

NeuLAND: The High Resolution Neutron Time-of-Flight Spectrometer for R³B

NeuLAND@GSI /FAIR(2024):

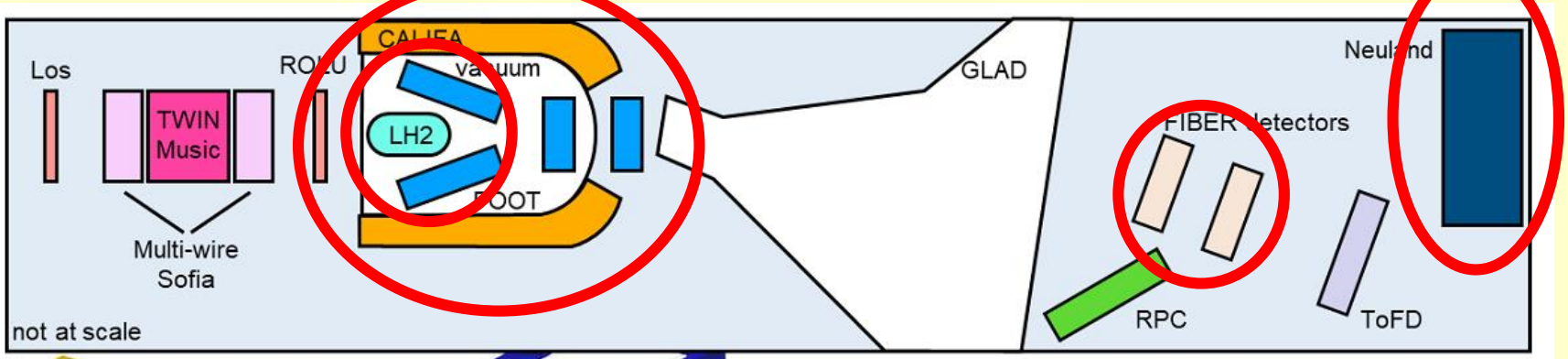
- → 13 dp's (43% of full detector) +(1-3 dp's)
- → ready for beam in 2024 at GSI
- → TOF calib with gammas
- → alignment with cosmics
- → σ_{tof} ~ 128ps
- → first hit ID
- → multi neutron response

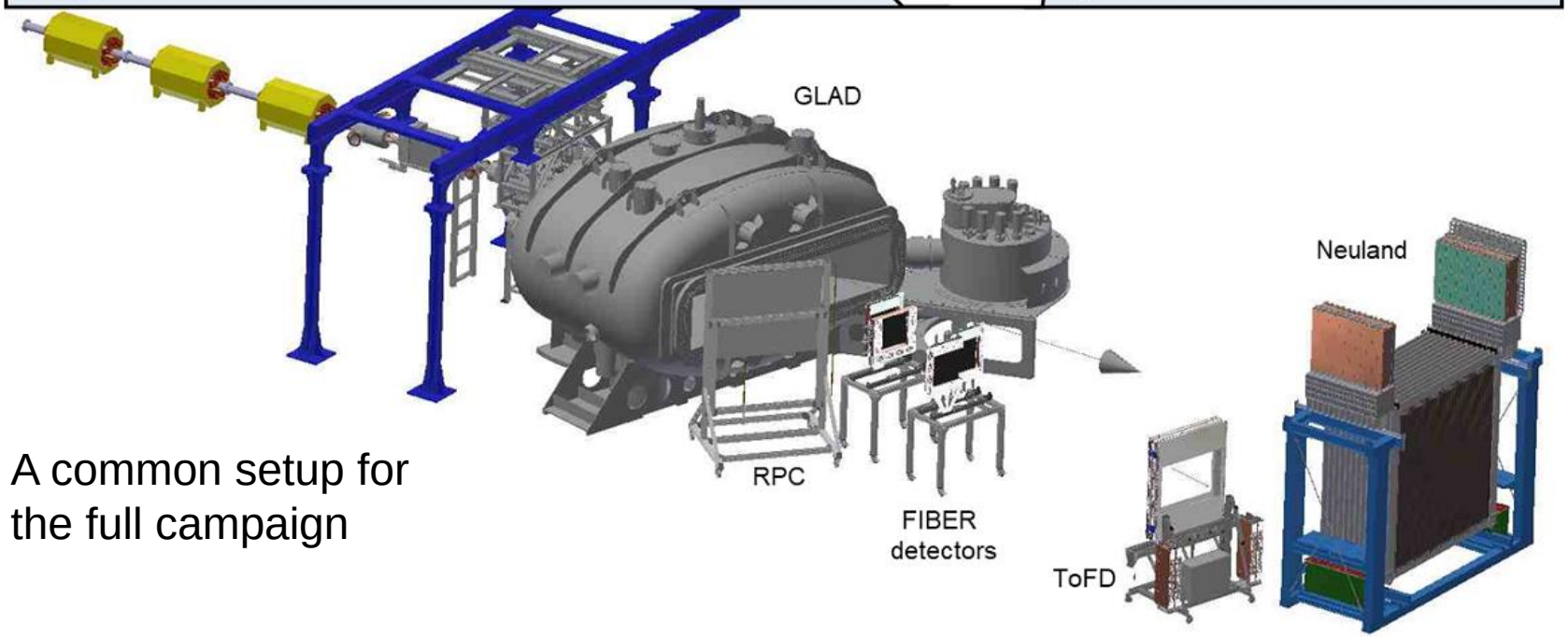




R³B- Comissioning 2023

Roman Gernhäuser, Olof Tengblad

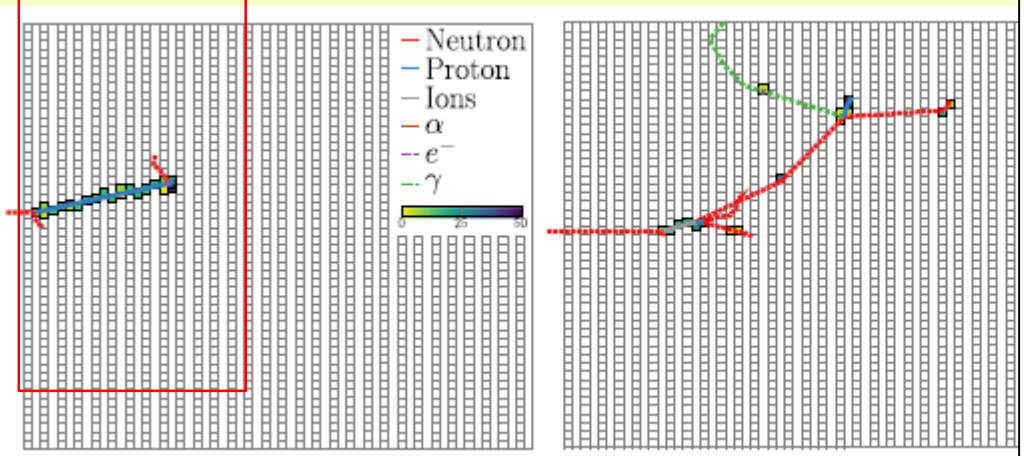




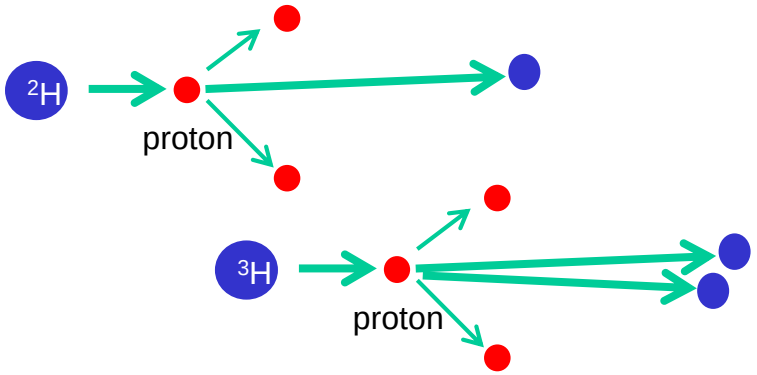
A common setup for the full campaign

NeuLAND: Multi Neutron Efficiency

Complex pattern even for 1 incoming neutron simulated here @ 600MeV (3D – (time,energy, position) pattern



Efficieny and Detector Response



- Missing momentum tracks the neutrons
- Three energies 250, 600, 1200 AMeV to compare the detailed response with simulations
- TOT and TOF systematics on correlated neutrons

200 MeV		Generated 1	2	3	4
detected	0	7	0	0	0
	1	**90**	28	5	1
	2	3	**58**	24	5
	3	0	13	**48**	22
	4	0	0	23	**72**

600 MeV		Generated 1	2	3	4
detected	0	5	0	0	0
	1	**89**	20	2	0
	2	6	**66**	23	4
	3	0	14	**56**	26
	4	0	0	19	**69**

1000 MeV		Generated 1	2	3	4
detected	0	4	0	0	0
	1	**88**	18	2	0
	2	7	**70**	24	5
	3	0	11	**62**	30
	4	0	1	13	**66**

K. Boretzky et al., NIM A 1014 (2021) 165701