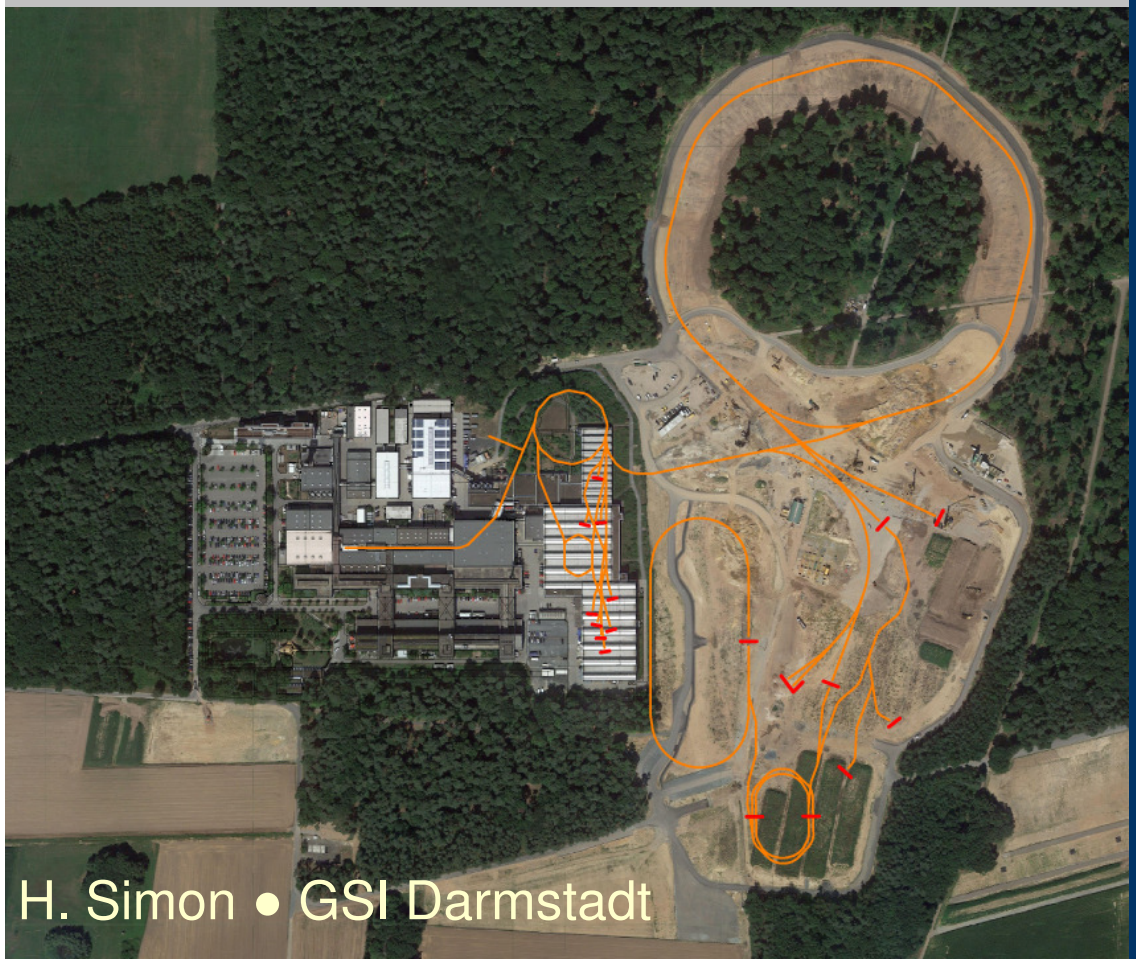
R³B Overview
-Status of systems in view of the experimental program at GSI and FAIR

NUSTAR week 2017

Jozef Stefan Institute
Ljubljana, Slovenia
20170925-29



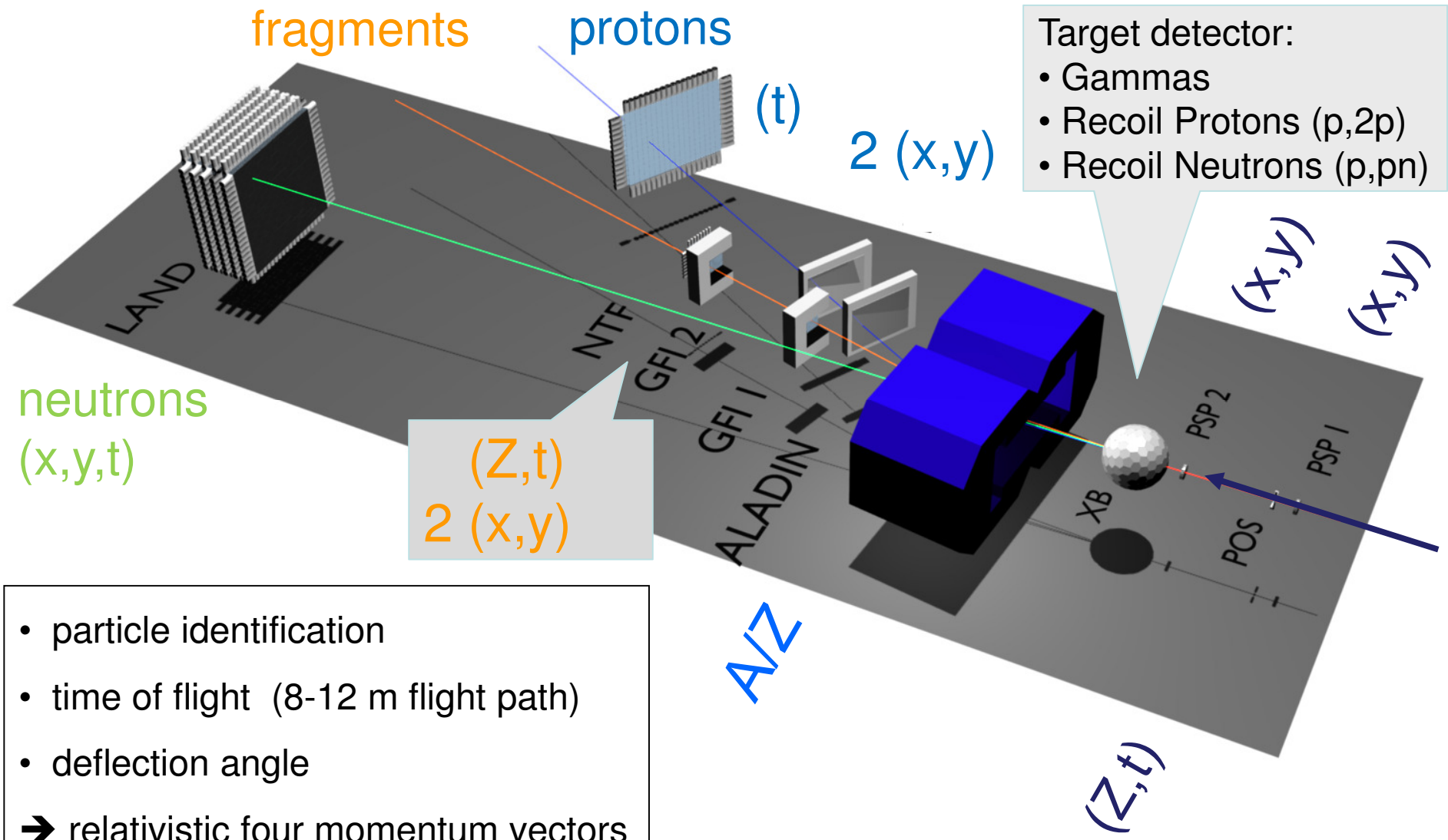
H. Simon • GSI Darmstadt

NUSTAR – The project 1.2

	Super-FRS	RIB production, separation, and identification
PSP	**Experiment**	**Description**
1.2.2	**HISPEC/ DESPEC**	In-beam γ-spectroscopy at low and intermediate energy, n-decay, high-resolution γ-, β-, α-, p-, spectroscopy
1.2.3	**MATS**	In-trap mass measurements and decay studies
1.2.4	**LaSpec**	Laser spectroscopy
1.2.5	**R^3B**	Kinematical complete reactions with relativistic radioactive beams
1.2.6	**ILIMA**	Large-scale scans of mass and lifetimes of nuclei in ground and isomeric states
1.2.10	**Super-FRS**	High-resolution spectrometer experiments
1.2.11	**SHE**	Synthesis and study of super-heavy elements
1.2.8	**ELISe(*)**	Elastic, inelastic, and quasi-free e^--A scattering
1.2.9	**EXL(*)**	Light-ion scattering reactions in inverse kinematics

(*) NESR required – alternative/intermediate “operation” within MSV under discussion.
SHE: Conceptual Design Report (CDR) in preparation.

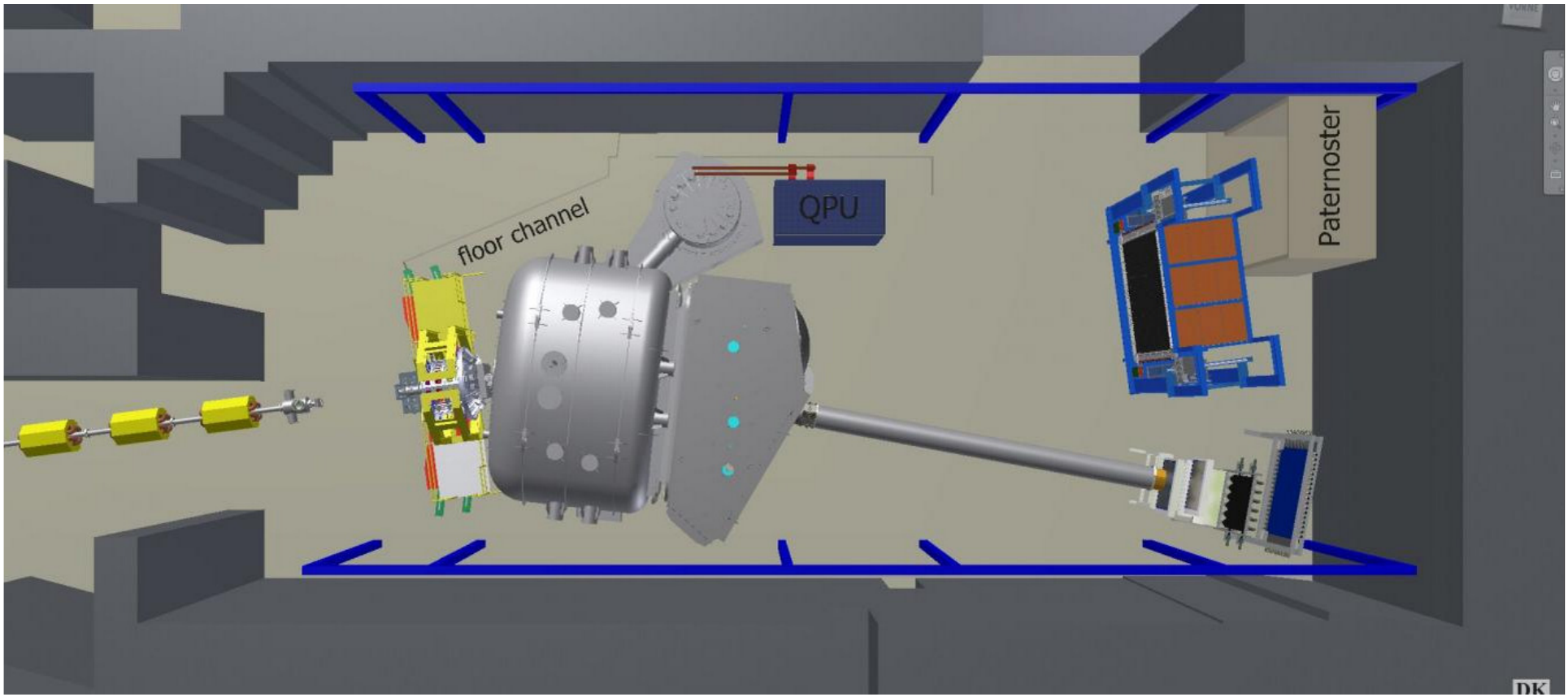
R³B/LAND Setup evolves to R³B/NeuLAND Setup + GLAD (kinematically complete)



- particle identification
- time of flight (8-12 m flight path)
- deflection angle

➔ relativistic four momentum vectors

New intermediate R³B setup @ Cave-C



Schedule and first experiments

2014	Installation of 20% detectors NeuLAND and CALIFA Commissioning run in Q3/2014
2015/16	Construction and installation of detector components
2017/18	Commissioning of R3B setup (Cave C)
2018-202x	Physics runs at GSI (Cave C) (phase 0)
202x-202x+1	Move to High-Energy Branch building
202x+1 →	Commissioning and first experiments at Super-FRS

Experiments will make use of uniqueness of R^{3}B:

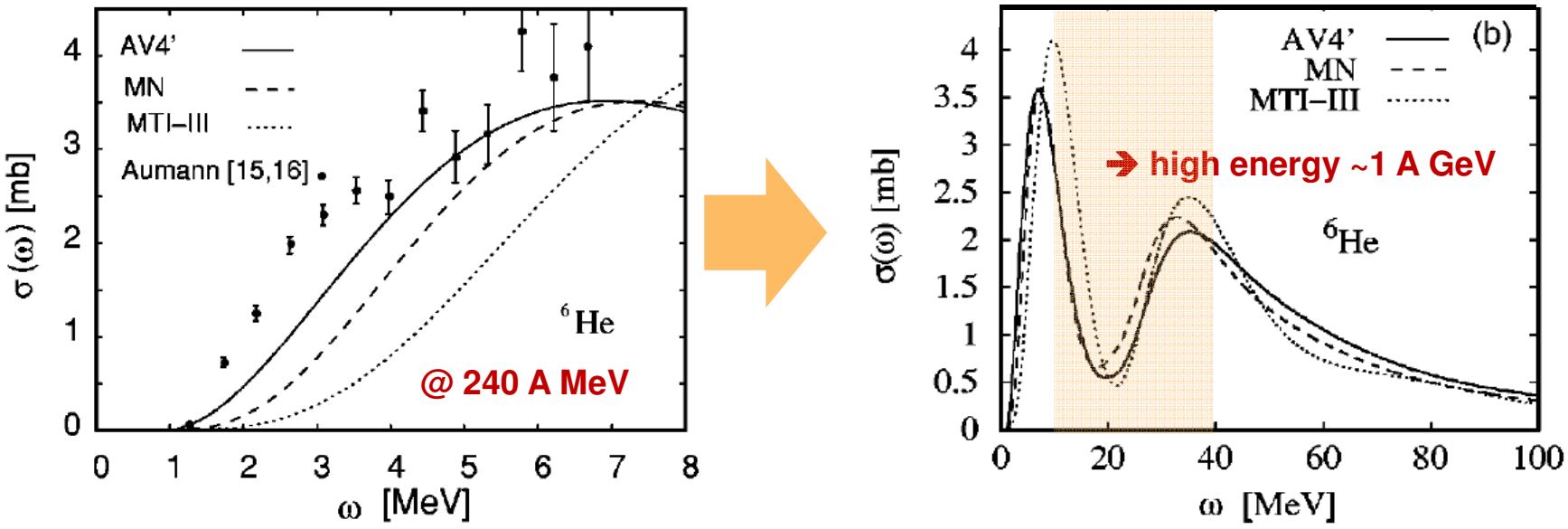
- Reactions at high beam energies up to 1 GeV/nucleon
- Tracking and identification capability even for the heaviest ions
- Multi-neutron tracking capability, high-efficiency calorimeter

→ **Experiments possible for the first time:**

- 4 neutron decays beyond the drip-line and for heavier n-rich isotopes
- Kinematically complete measurements of quasi-free nucleon knockout reactions
- Electric dipole and quadrupole response of Sn nuclei beyond N=82,
  and of neutron-rich Pb isotopes (polarizability, symmetry energy)
- fission barriers from (p,2p) reactions (→ r-process)

Dipole strength Distributions in neutron-rich nuclei (e.g. simple case ^{6}He)

- Excitation of core vs. neutron skins / halos
  → density / asymmetry



- Heavy systems in reach (no charge states)

S. Bacca et al.
PRL **89** (2002) 052502
PRC **69** (2004) 057001

Experiments proposed in phase-0

First round approval:

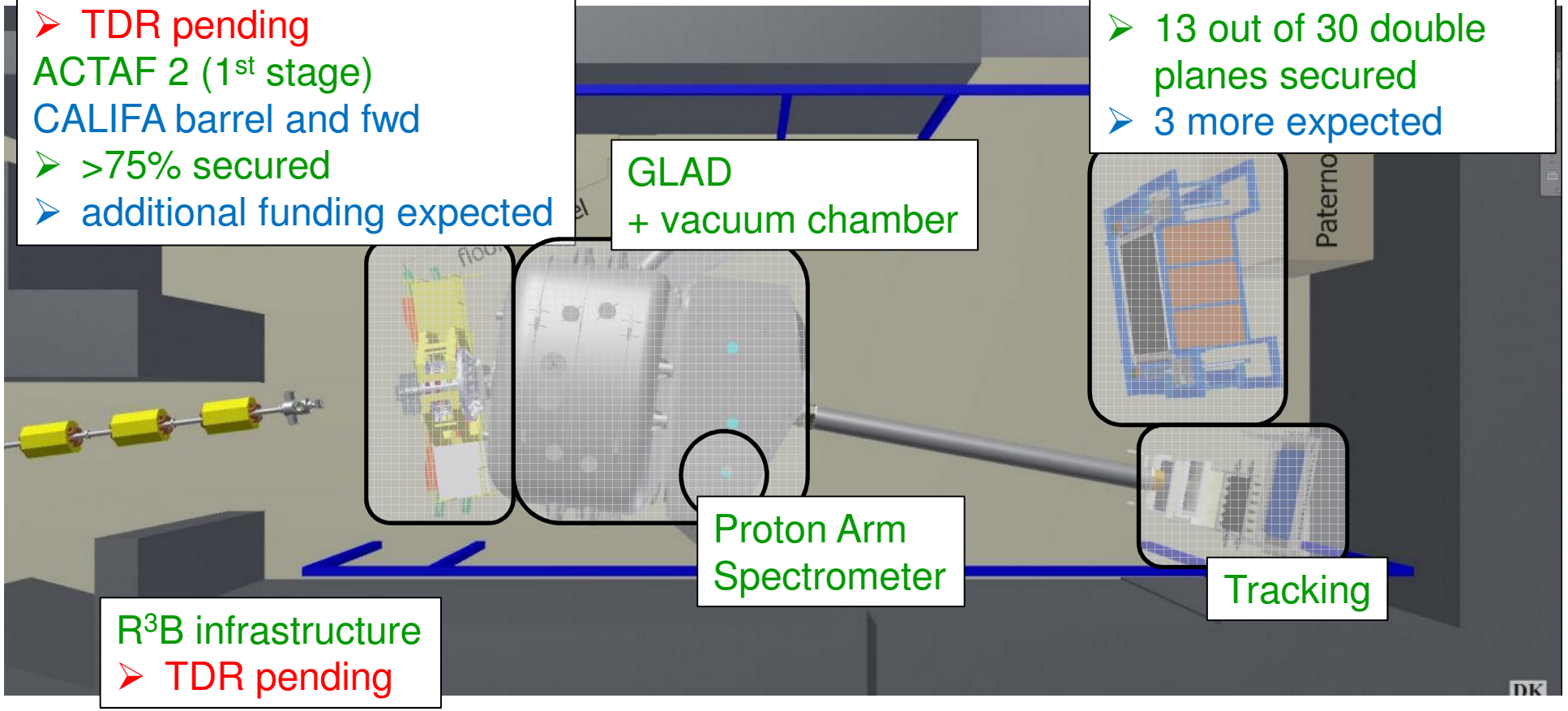
Prop. ID	Spokesperson	Local Contact Person	Proposal Title
NUSTAR: R3B + FRS + DESPEC			
S444	Gernhäuser, Roman	Simon, Haik	R3B - 2018 COMMISSIONING (CALIFA, L3T, GLAD, NeuLAND & Tracking)
S465	Aumann, Thomas	Simon, Haik	Dipole response of the drip-line nuclei ^{6}He and ^{22,24}O
S473	Aumann, Thomas	Simon, Haik	Constraining energy-density functionals and the density-dependence of the symmetry energy by measurements of accurate cross sections with large acceptance at R3B
S464, **LoI**	Russotto, Paolo	Simon, Haik	Determination of Symmetry Energy at Supra-Normal Densities: a feasibility study
S454	Heil, Michael	Simon, Haik	Studying the astrophysical reaction rate of ^{12}C(alpha,gamma)^{16}O via Coulomb dissociation of ^{16}O into ^{4}He and ^{12}C
S478	Khanzadeev, Alexey	Egelhof, Peter	Study of the nuclear spatial structure of neutron-rich B isotopes by proton elastic scattering in inverse kinematics
S441	Tengblad, Olof	Simon, Haik	Study of the 13Be structure from the 14B(p,2p)13Be -> 12Be + n + gamma (+ 2p) reaction
S442	Sorlin, Olivier	Simon, Haik	Study of multi-neutron configurations in atomic nuclei towards the drip line
S466	Kröll, Thorsten	Simon, Haik	Evolution of nuclear structure east of ^{208}Pb studied by (p,2p) reactions
S467	Paschalis, Stefanos	Simon, Haik	Single-particle structure of neutron-rich Ca isotopes: shell evolution along Z=20
S455	Taieb, Julien	Simon, Haik	Fission investigated with relativistic-radioactive beams and the advanced SOFIA@R3B setup

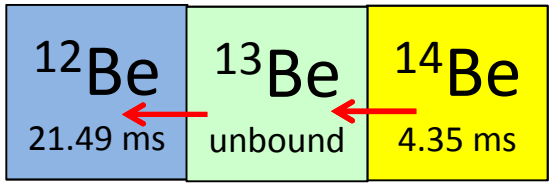
Components get installed

R³B (Status Phase 0)

Tracking
Si tracker
- TDR pending

ACTAF 2 (1st stage)
CALIFA barrel and fwd
- >75% secured
- additional funding expected

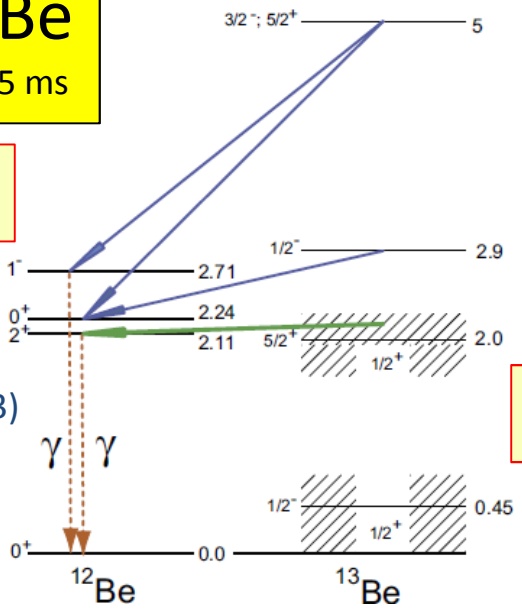


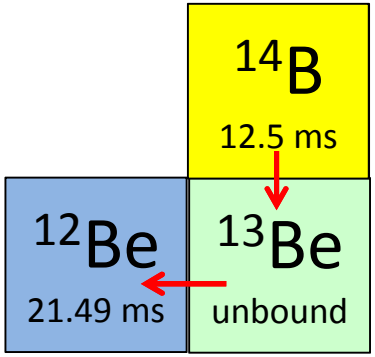


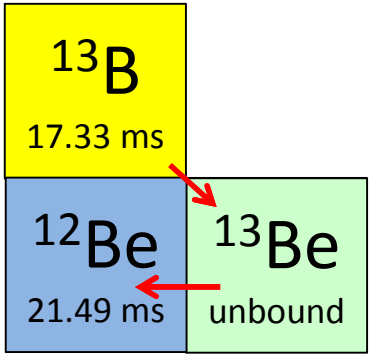
H(14Be,12Be+n)

GSI 304 MeV/u
Yu. Aksyutina *et al.*,
Phys.Rev. C 87,064316 (2013)

RIKEN 69 MeV/u
Y.Kondo *et al.*,
Phys.Lett. B 690, 245 (2010)





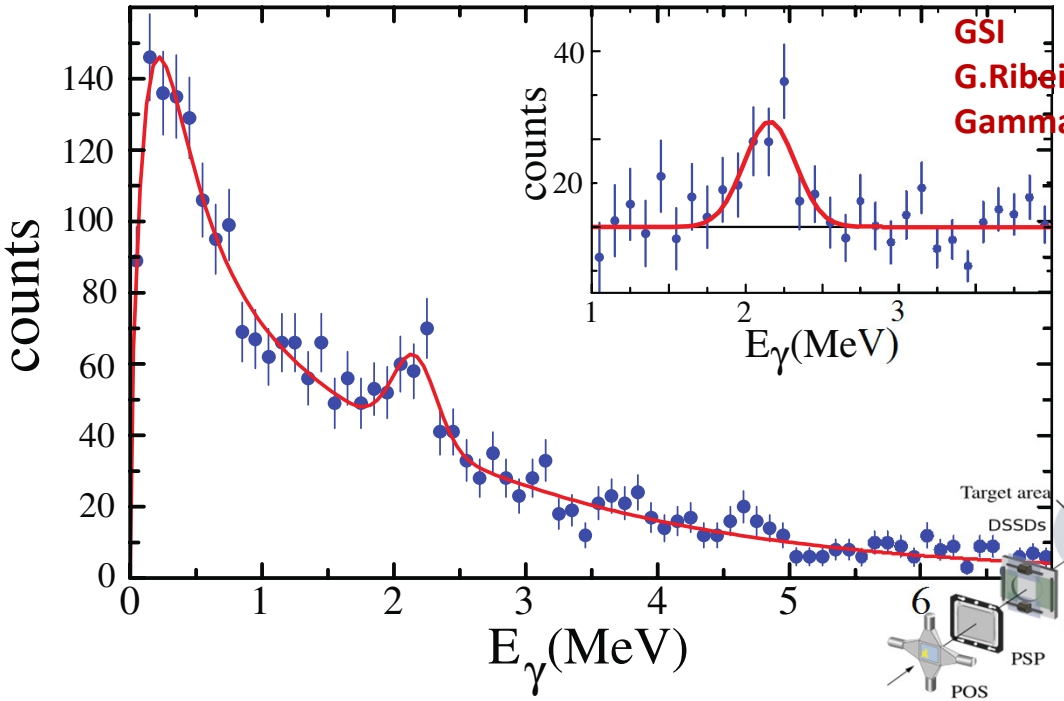


H(14B,12Be+n)

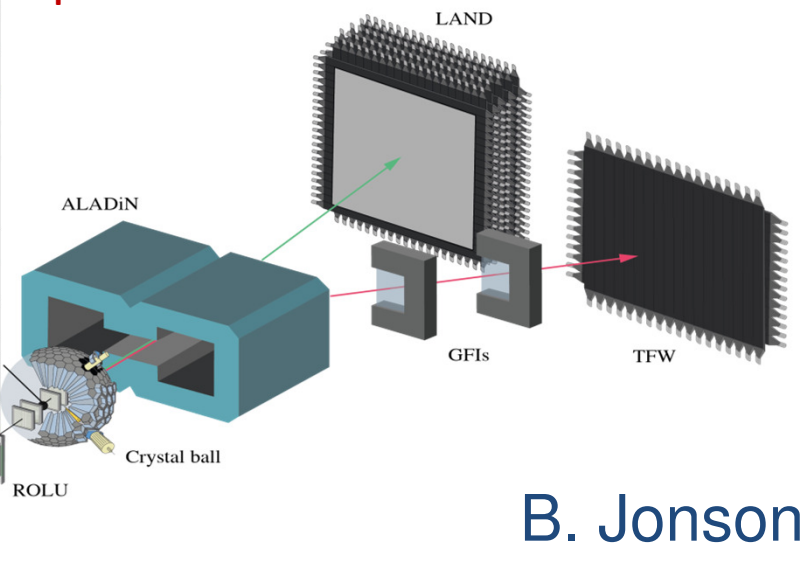
GANIL 35 MeV/u
G. Randisi *et al.*,
Phys.Rev. C 89, 034320 (2014)

Be(13B,12Be+n)

MSU 71 MeV/u
B.R. Marks et al.,
Phys.Rev. C 92, 054320 (2015)



GSI 400 MeV/u
G.Ribeiro, PhD thesis 2015
Gamma spectrum !



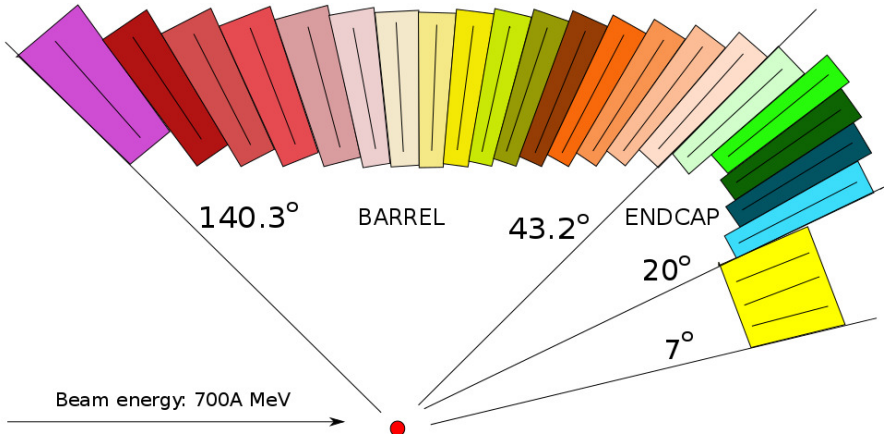
B. Jonson

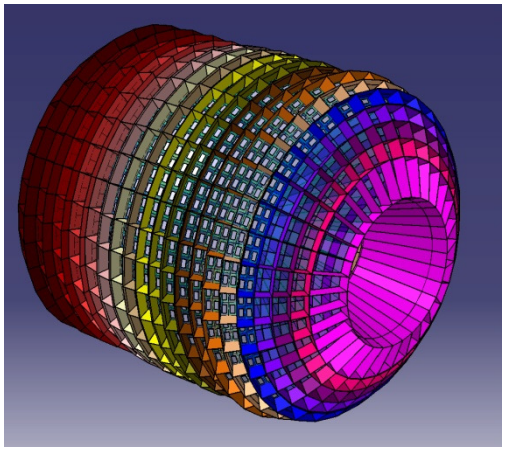
CALIFA : Calorimeter in-flight detection for γ-rays and LCP

D. Cortina

Design dominated by the kinematics of particles emitted by relativistic sources
Detector split in two sections : BARREL and ENDCAP

TDR's approved 2013 and 2015





Intrinsic photopeak efficiency	40% (up to Eγ=15 MeV PF)
Gamma sum energy resolution $D(E_g sum)/<(E_g sum)>$	< 10% for 5 γ rays of 3 MeV
Calorimeter for high energy LCP	Up to 320 MeV in lab system
Gamma energy resolution	~5-6% (FWHM at Eg=1 MeV)
LCP resolution	~2%
Proton-g ray separation	For 1 to 30 MeV

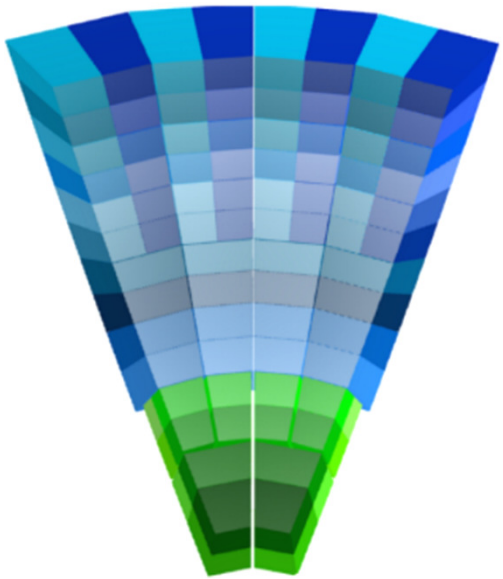
Physics imposes the scientific requirements
- Huge dynamic range
  100 keV γ-rays – 700 A MeV charged particles
- high efficiency, good resolution
- high granularity → Doppler correction
- particle identification

USC-IEM UVigo | GSI-TUM EMMI-TUD | Chalmers Lund | CFNUL | JINR NRC

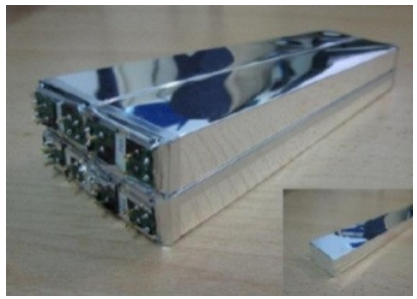
CALIFA : Calorimeter in-flight detection for γ-rays and LCP

CsI(Tl)+LAAPD

2464 units
Polar angle 20-140^0



- CsI (Tl) range between 15-22 cm long
- Packed in groups of four (VM2000 and Carbon fiber)
- APD collecting area 10x20 mm^2

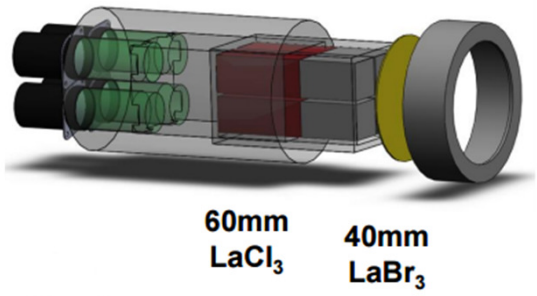


- Good ΔE/E ~6% @ 1 MeV for g and 2 % for p up to 320 MeV
- PID and E determination based on two different intrinsic times of CsI up to 700 MeV ΔE/E ~ 5%
- Background rejection

LaBr/LaCl+PM

96 units
Polar angle 7-20^0

- LaBr 6 cm and LaCl 8 cm long
- Packed in groups (Al cane)
- PM 1.5 ¨ diameter



- Very good ΔE/E ~ 3% @ 662 keV for γ
- E determination based on two different time decay of LaBr/LaCl ΔE/E ~ 5%
- Good timing
- Background rejection

CALIFA : CEPA4 Prototypes

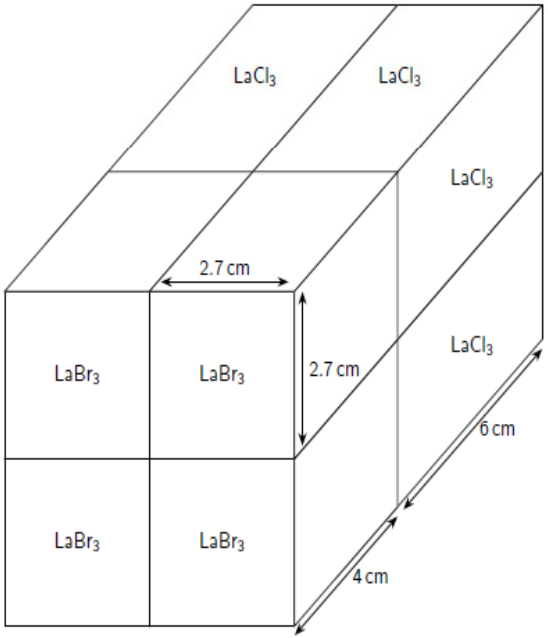
CHALMERS

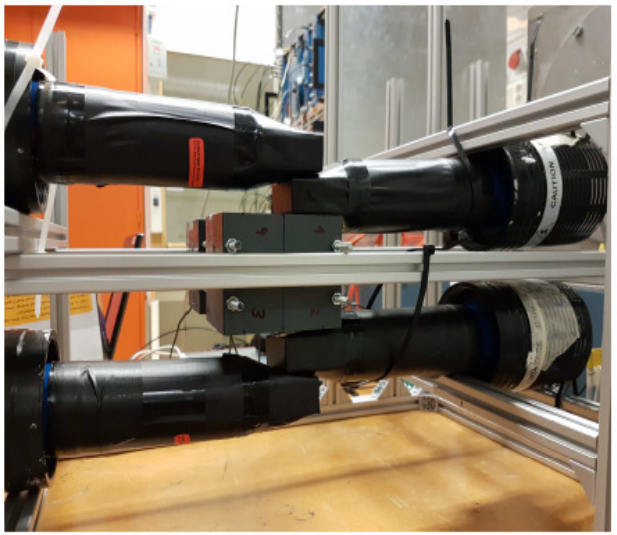
CEPA4 Prototype Characterization

Measurements performed using

- **Cosmic Muons**
- **γ sources**: ^{60}Co, ^{137}Cs, ^{22}Na

CEPA 4





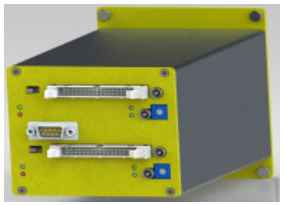
Energy Resolution for $LaBr_3$

γ source	Energy (MeV)	Resolution (best)
^{60}Co	1.173	3.76%
	1.332	3.66%

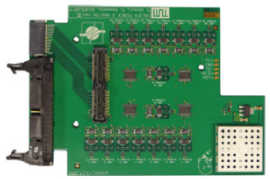
P. D. Fernández, G. Bruni

CALIFA : Calorimeter in-flight detection for γ-rays and LCP

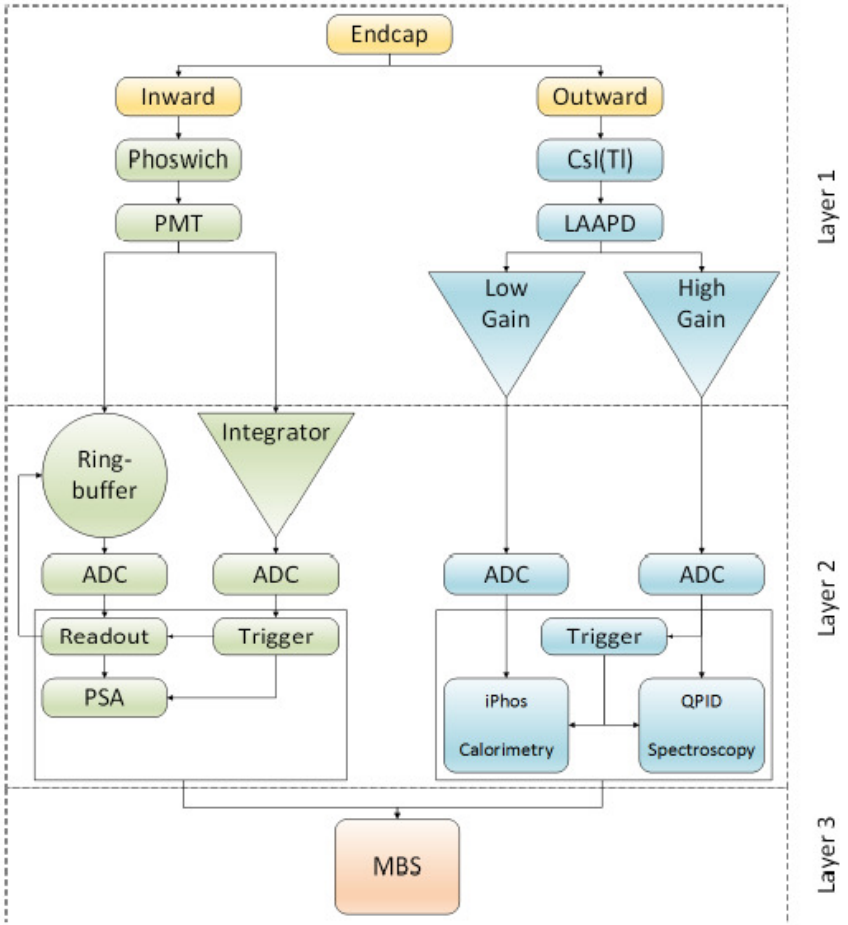
✓**Preamplification for the CsI(Tl)** : mounted directly at the detector level (optimized for low noise and low power consumption and simple mechanical access)



✓**Digitizers** modules located on the movable support of the detector. They perform full signal processing and provide buffer memory for an asynchronous data collection.

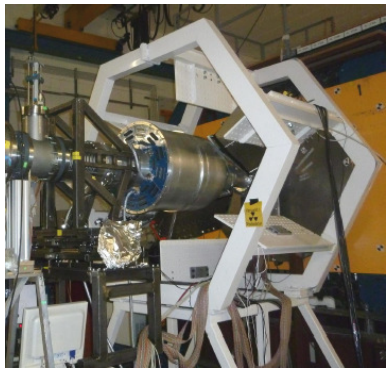
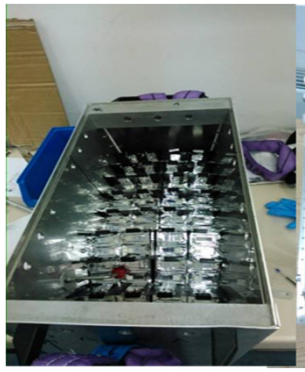


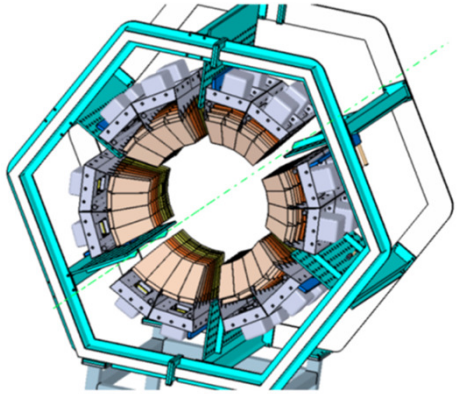
✓**DAQ** based on MBS and GOSIP protocol.



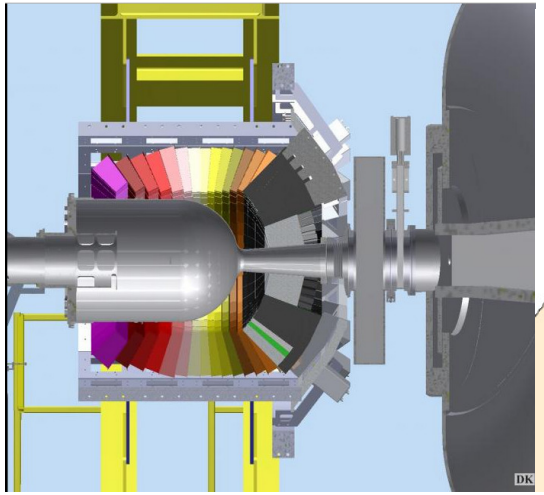
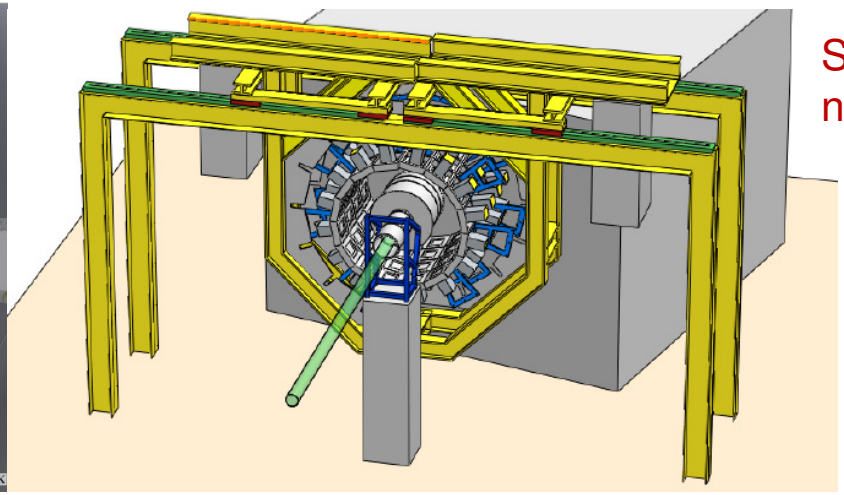
CALIFA : Calorimeter in-flight detection for γ-rays and LCP

The construction of 12 petals (~ 768 Barell detection channels) is foreseen to be completed within 2017

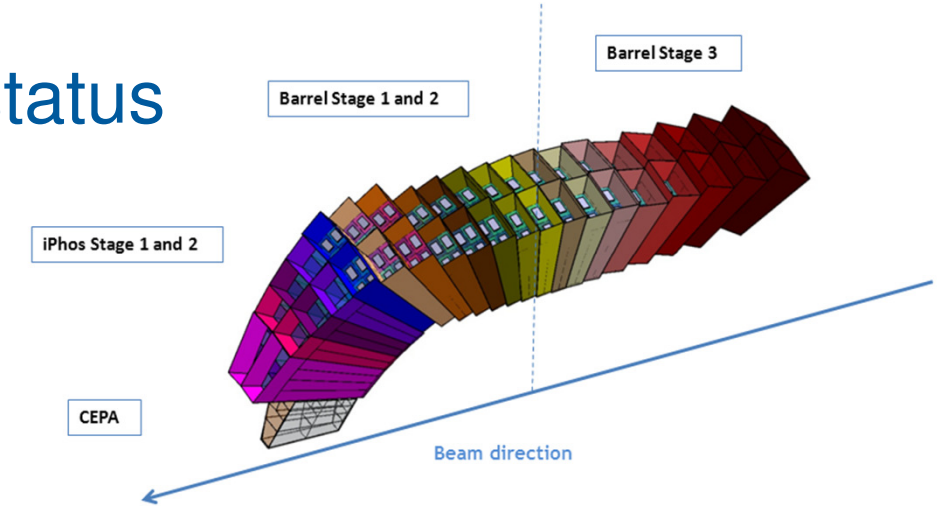


Full detector:

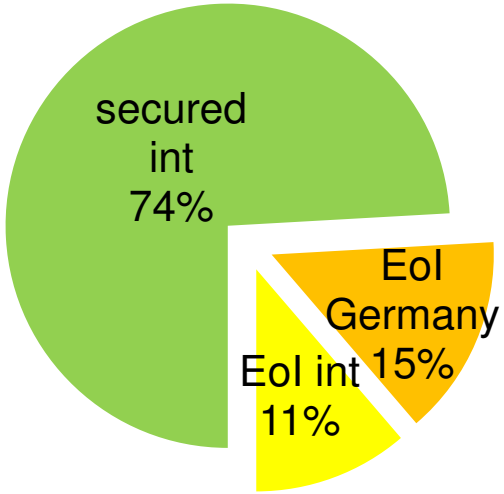



Support structure not yet funded

R³B – CALIFA funding status



CALIFA fwd endcap

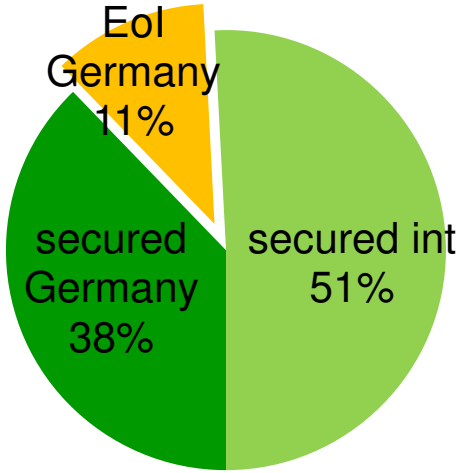


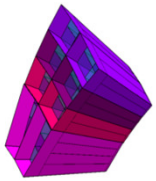
additional funding from Germany expected (BMBF-VF)

246 kEUR

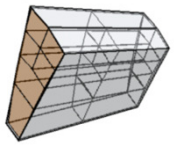
CALIFA barrel stage 1+2

214 kEUR

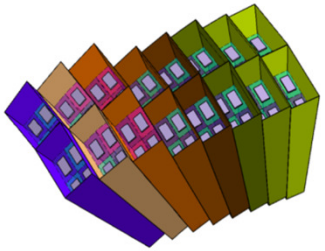




Forward endcap
iPhos (Germany, Russia, Spain)



Forward endcap
CEPA (Sweden)



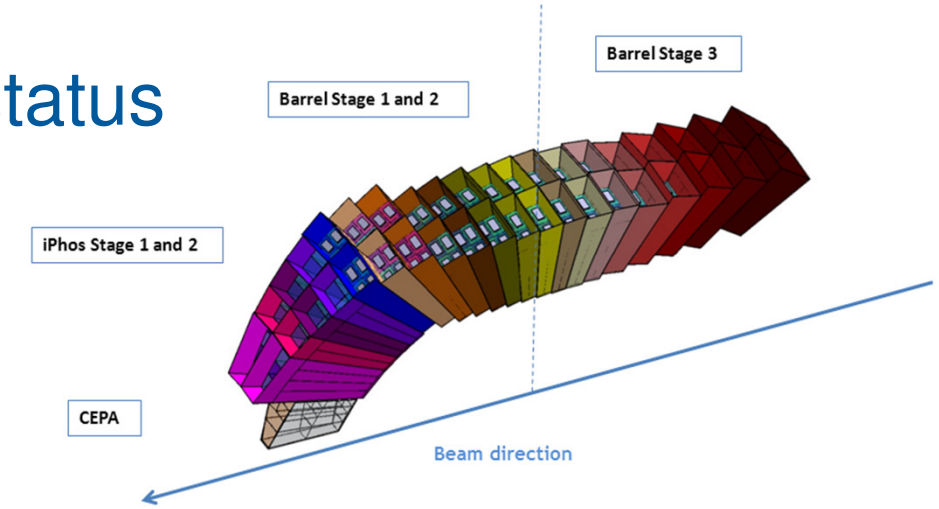
Barrel stage 1+2
(Germany, Spain, Sweden)

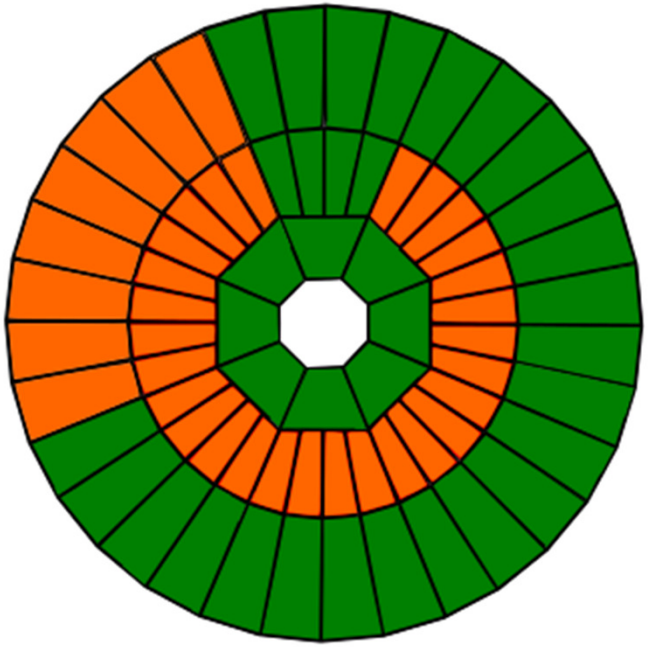
R^{3}B – CALIFA funding status

Funded

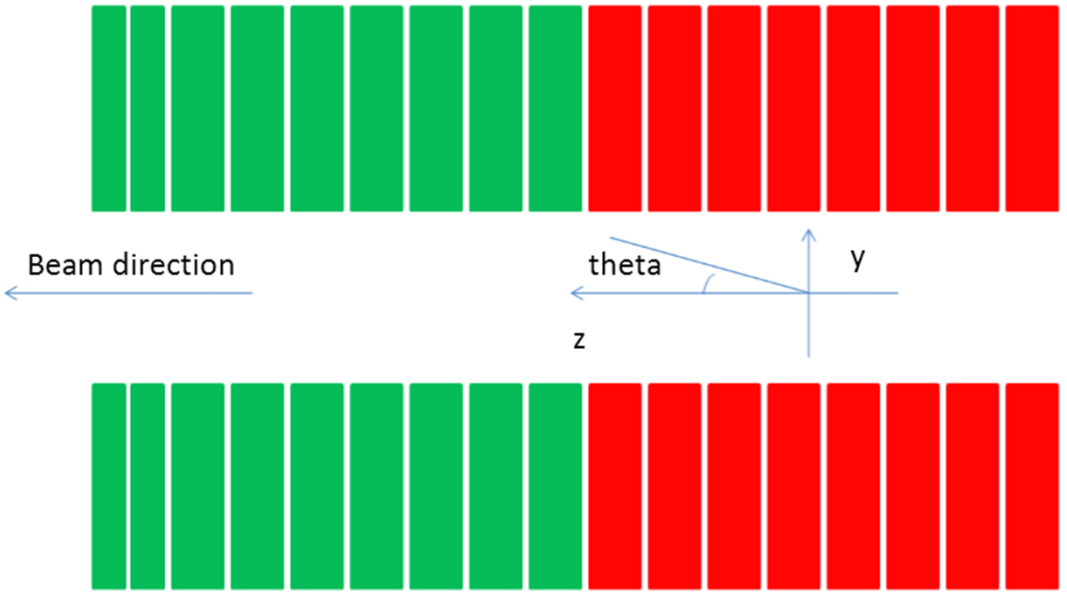
EoI

to be assigned



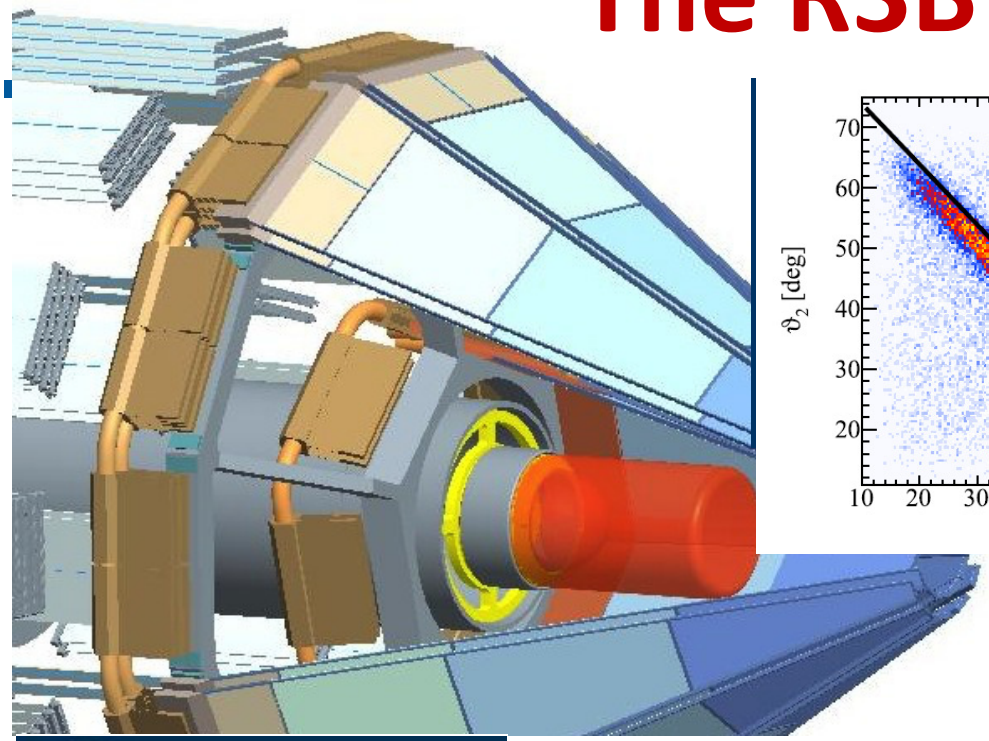


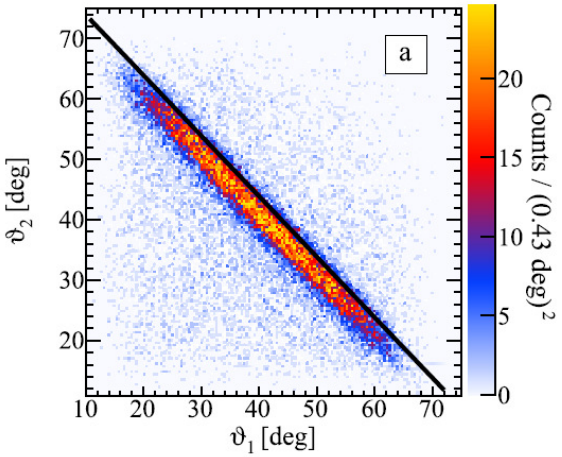
Endcap Front view

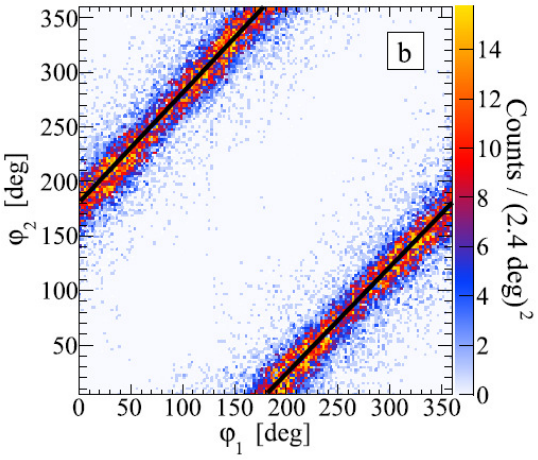


Barrel Azimuthal section

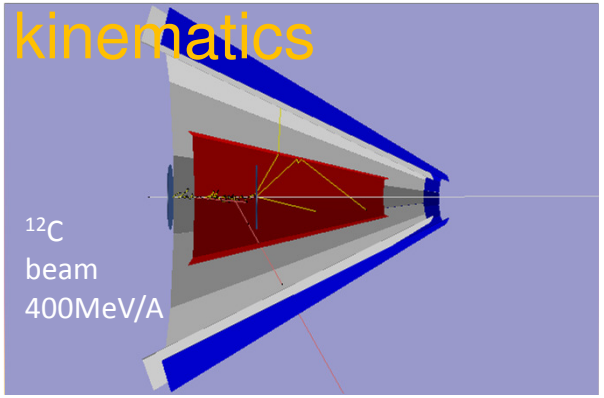
The R3B Si Tracker







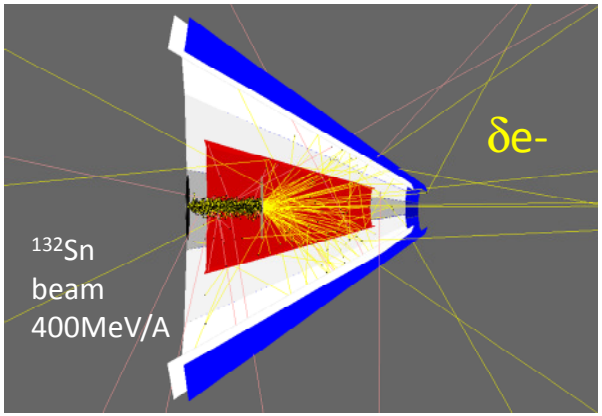
(p,2p) kinematics



Science & Technology Facilities Council

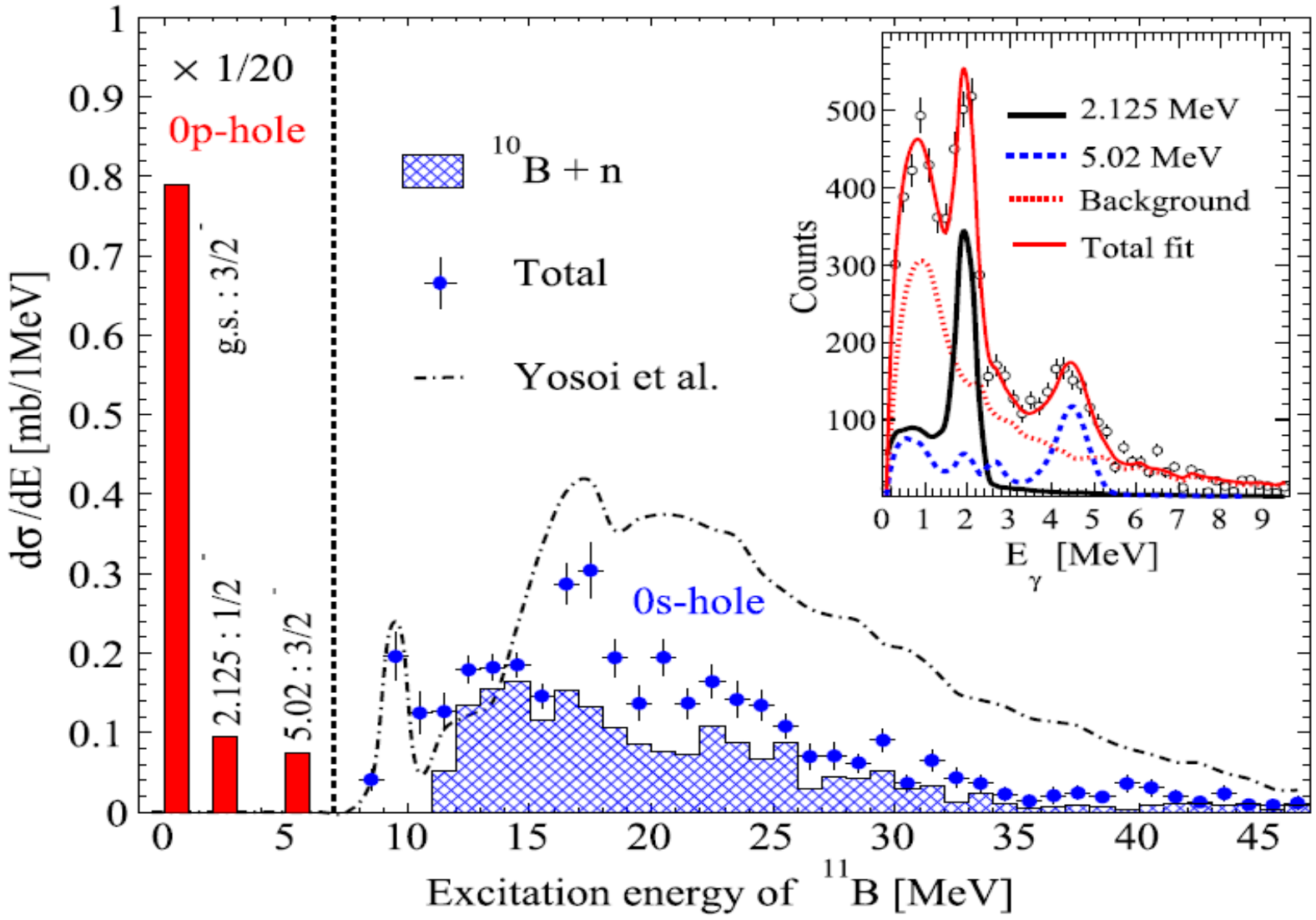
The R3B-UK Collaboration:

University of Birmingham
University of Edinburgh
University of Liverpool
University of Surrey
STFC Daresbury Laboratory
STFC Rutherford Appleton Laboratory



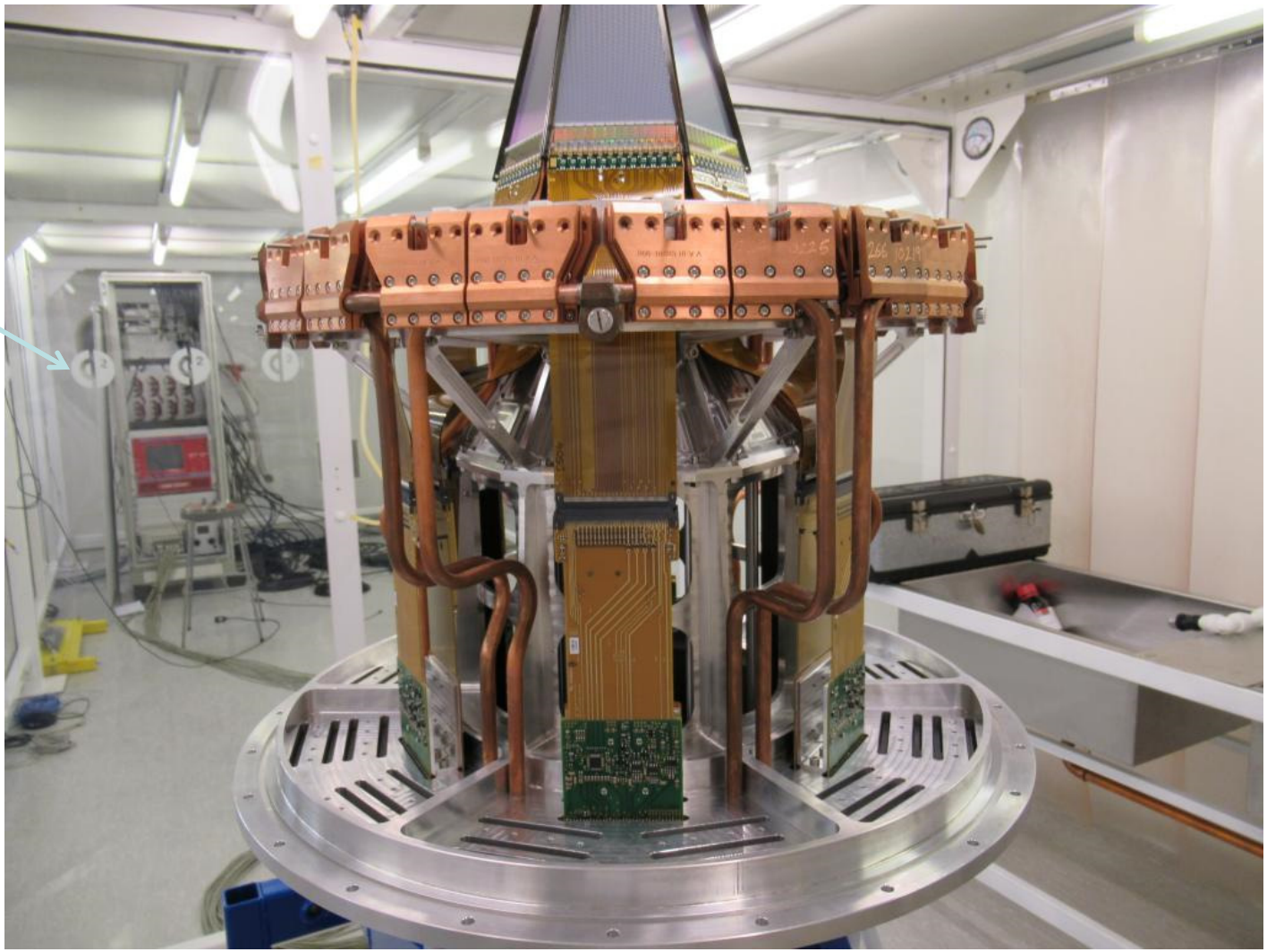
Challenging background contribution

$^{12}C(p,2p)^{11}B$


× 1/20
0p-hole
g.s. : 3/2⁻
2.125 : 1/2⁻
5.02 : 3/2⁻
10B + n
Total
Yosoi et al.
0s-hole
dσ/dE [mb/1MeV]
Excitation energy of 11B [MeV]
2.125 MeV
5.02 MeV
Background
Total fit
Counts
Eγ [MeV]

Si-tracker (UK, fully funded) in laboratory tests

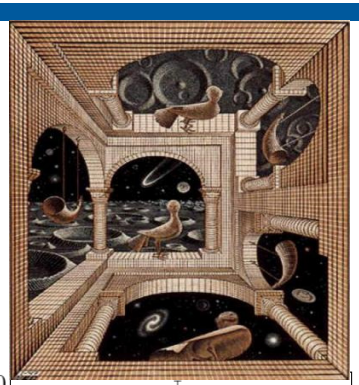
Electronics rack

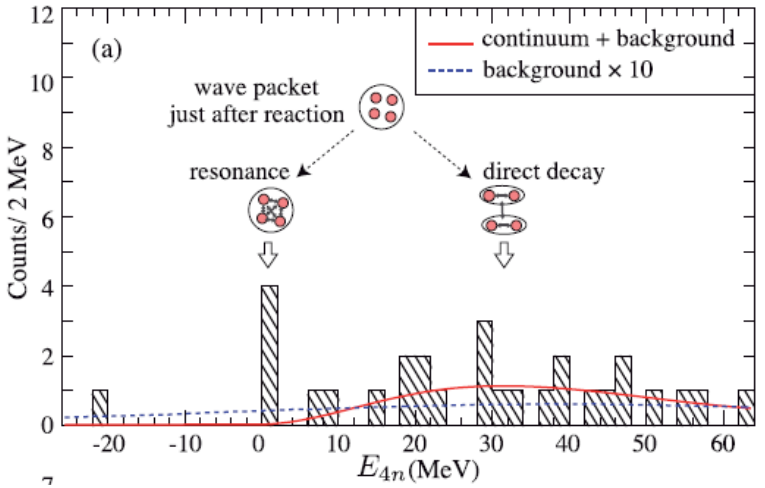


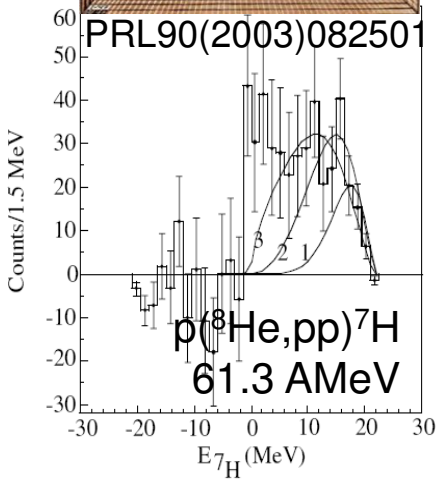
^{7}H ↓ and 4n →

PRL 116, 052501 (2016)
Selected for a Viewpoint in *Physics*
PHYSICAL REVIEW LETTE

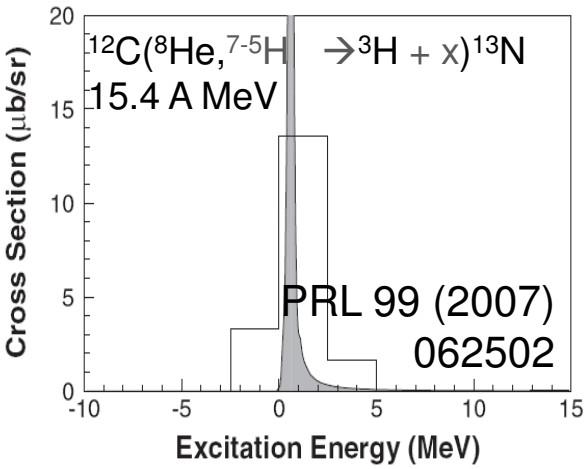
K. Kisamori et al.
^{4}He(^{8}He; ^{8}B)
@ 186 MeV/u

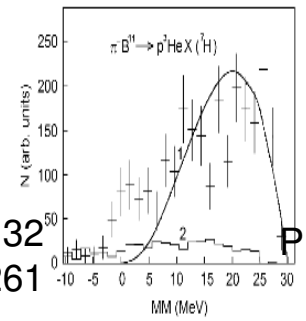




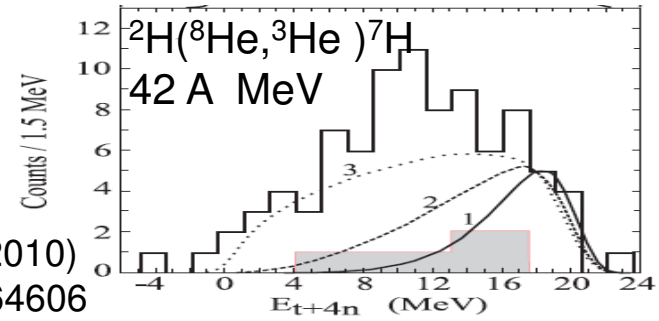


- Missing mass analysis



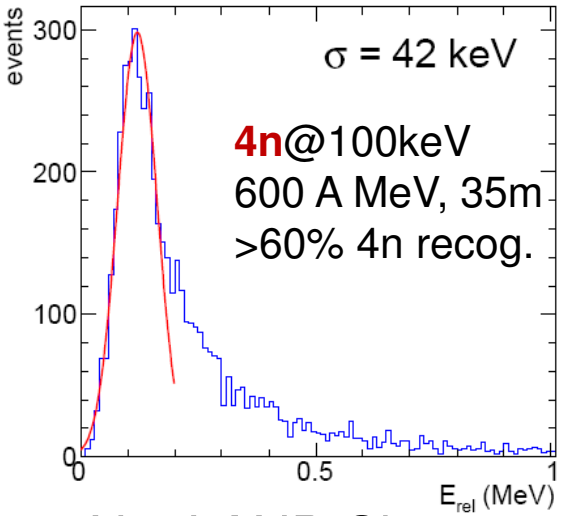


EPJA 32 (2007) 261



PRC81 (2010) 064606

- Improvement by exclusive measurements



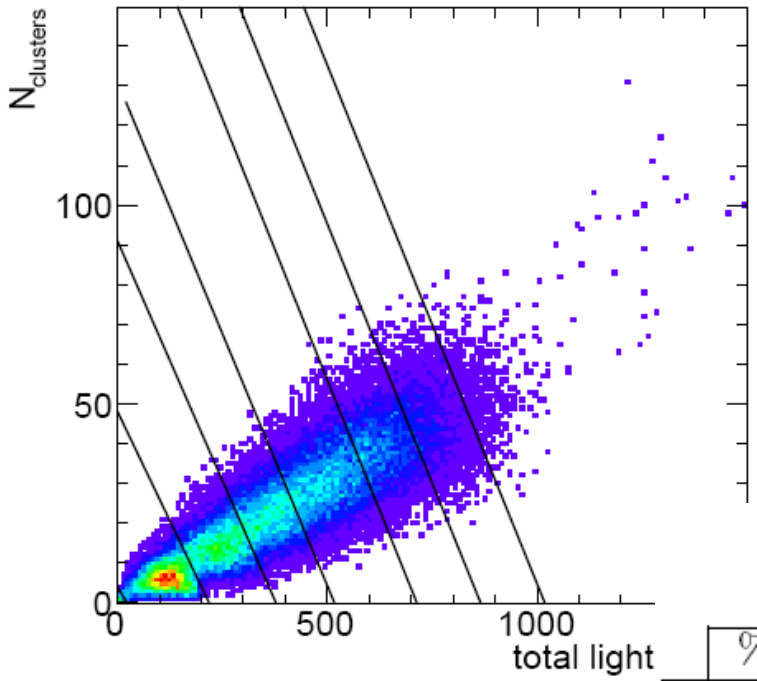
NeuLAND Simul.

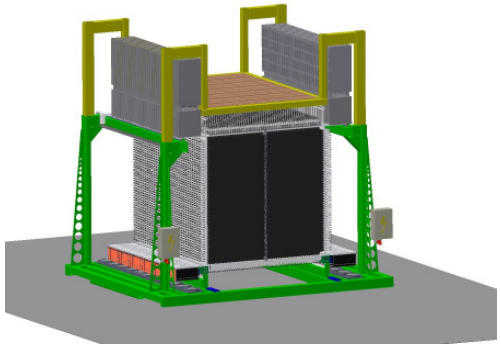
Novel Neutron Detector: NeuLAND

K. Boretzky

Fully active neutron detector based on scintillators

(calorimetry & tracking)





		1000 MeV generated				
	%	1n	2n	3n	4n	5n
detected	1n	**89**	12	1	0	0
	2n	7	**78**	23	3	0
	3n	0	8	**63**	26	5
	4n	0	0	12	**63**	40
	5n	0	0	0	7	**46**
	6n	0	0	0	0	8

Previously < 50%

Previously <5% !

➔ 4/5n decay channels in reach

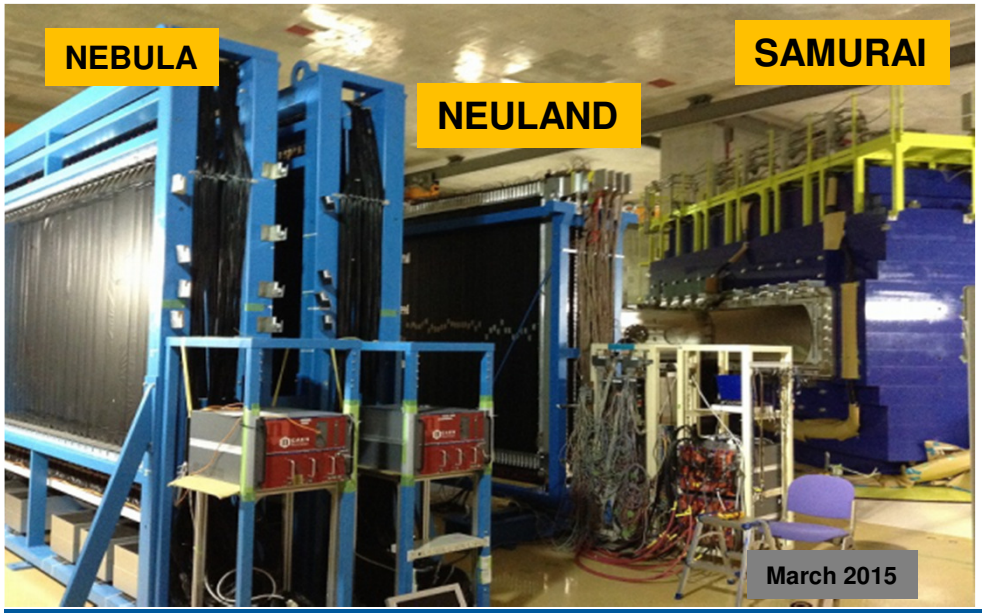
30 double planes
2 x 50 paddles each
5 x 5 x 250 cm³
RP408 / R8619ASSY

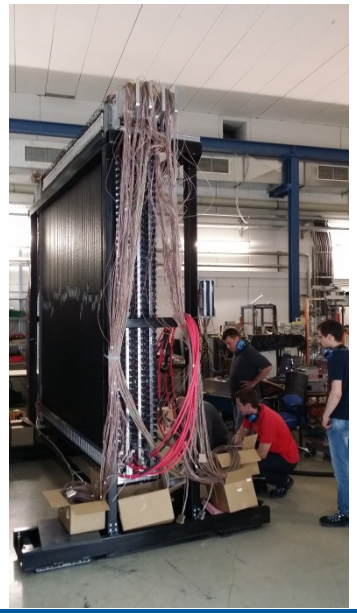
FPGA TDC readout

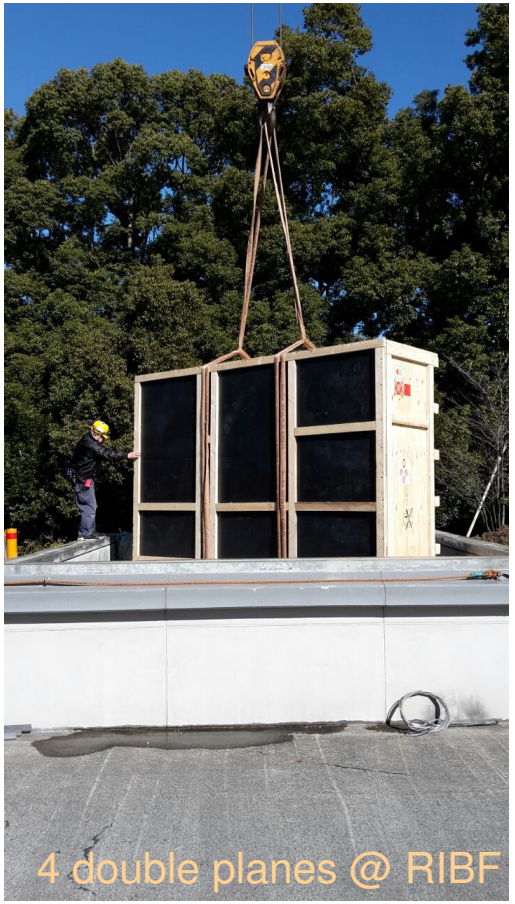
Experimental equipment on the way …

- NeuLAND demonstrator (40 cm depth with only 4 double planes and 800 readout channels) at RIKEN up to end of 2017, participation in various beam times

- at GSI continuation of production (4 more double planes ready), production scheme dominated by funding profile, 13 out of 30 d.p. in 2018







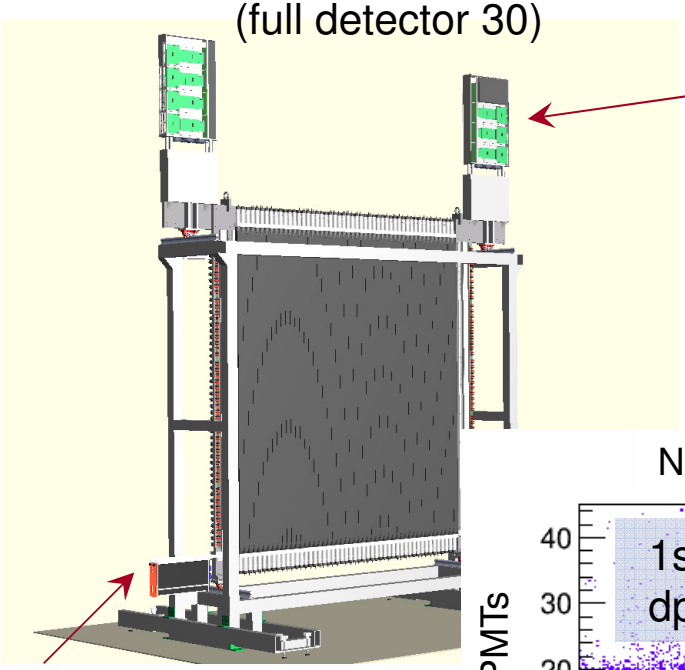
… e.g. to RIKEN

See talk of D. Rossi

Next Step: Novel neutron detector for R³B - NeuLAND demonstrator performance

6 Double planes in test (August and October 2014)

(full detector 30)



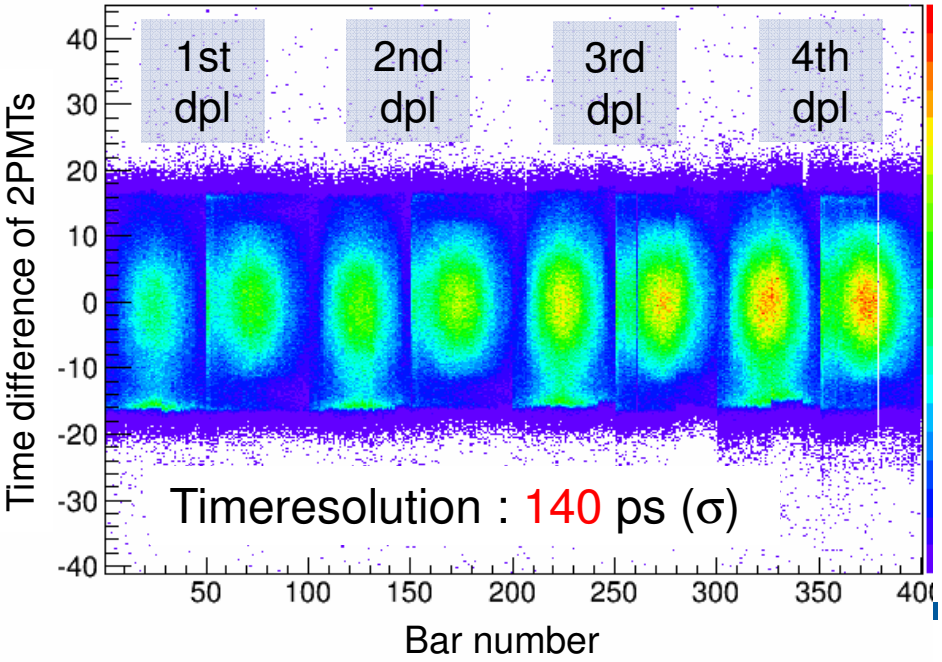
FPGA TDC based

Readout Electronics

HV system

PNPI: Site Acceptance Test week before X-Mas 2014

Neutron hit patterns in 4 double planes

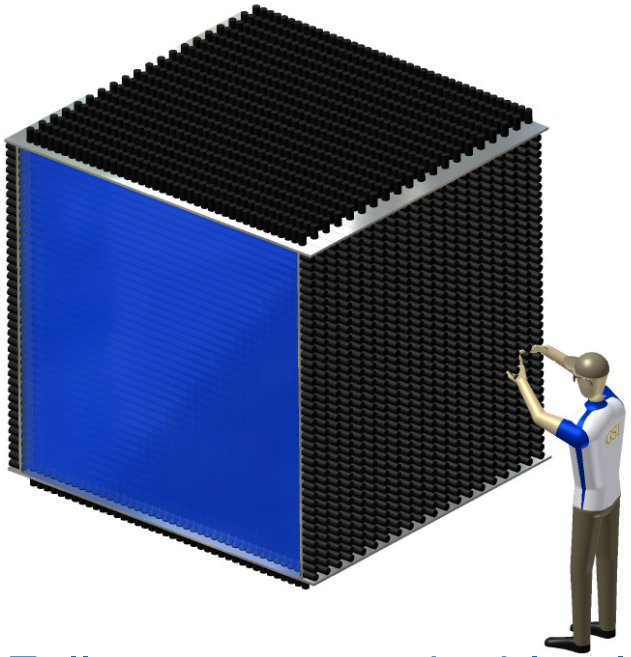


Improve multi neutron detection efficiency down to low energy

Preparations for 2018ff
- NeuLAND demonstrator back at GSI

20170921 Return from RIKEN via FRA to GSI

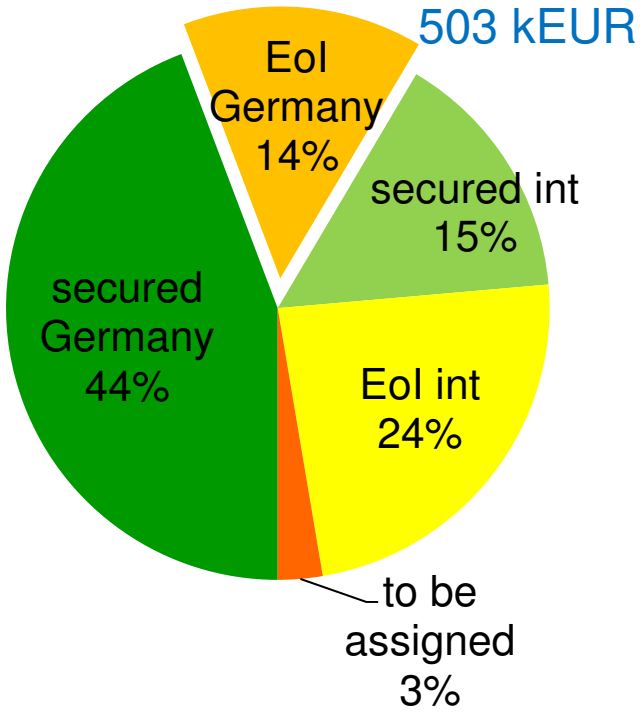
R³B – NeuLAND funding status



Full system = 30 double planes

- 2 x 50 paddles each
- 5 x 5 x 250 cm³
- RP408 / R8619ASSY
- FPGA TDC readout

NeuLAND stage 1+2

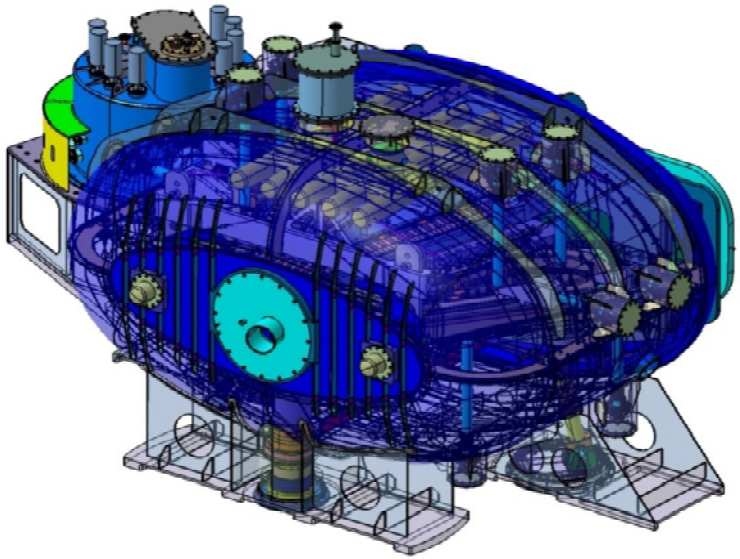


- **13 out of 22 double planes for NeuLAND stage 1+2 funded**
- 3 more double planes expected from German funding (BMBF-VF)

Large-acceptance superconducting dipole magnet GLAD ➔ System study for FAIR

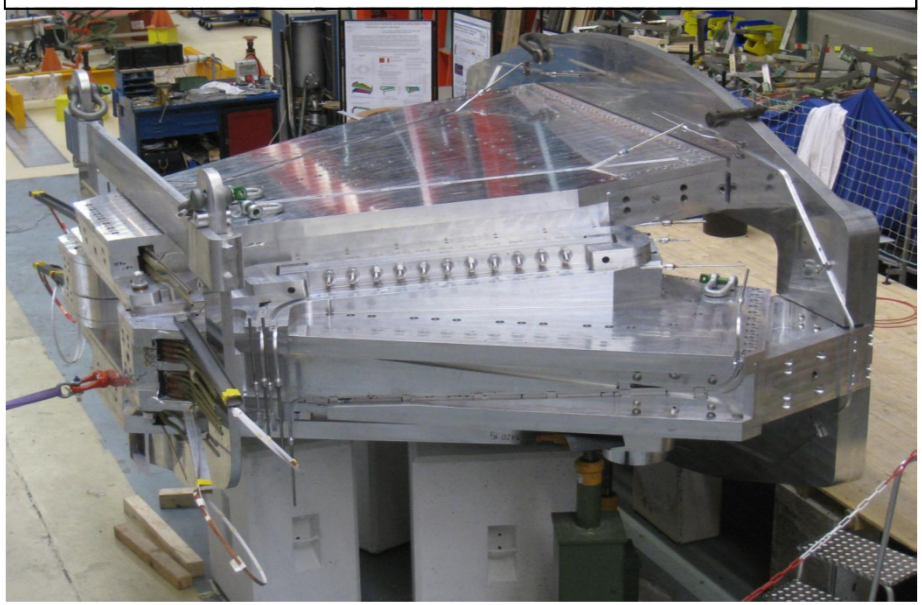
Magnet parameters:

- Large vertical gap ± 80 mrad
- High integrated field of 4.8 Tm
- Fringe field at the target position less than 20 mT
- Operational temperature 4.6 K
- The overall size of the conical cryostat: 3.5 m long, 3.8 m high and 7 m wide.

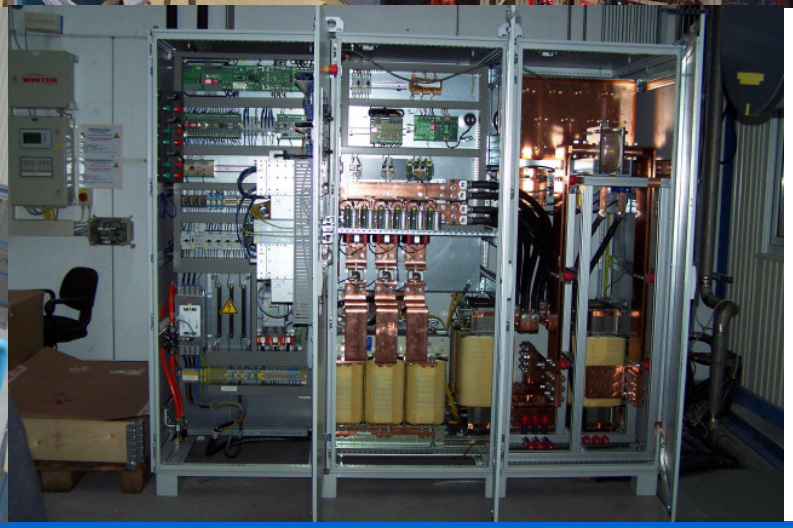


Challenging Magnet design:

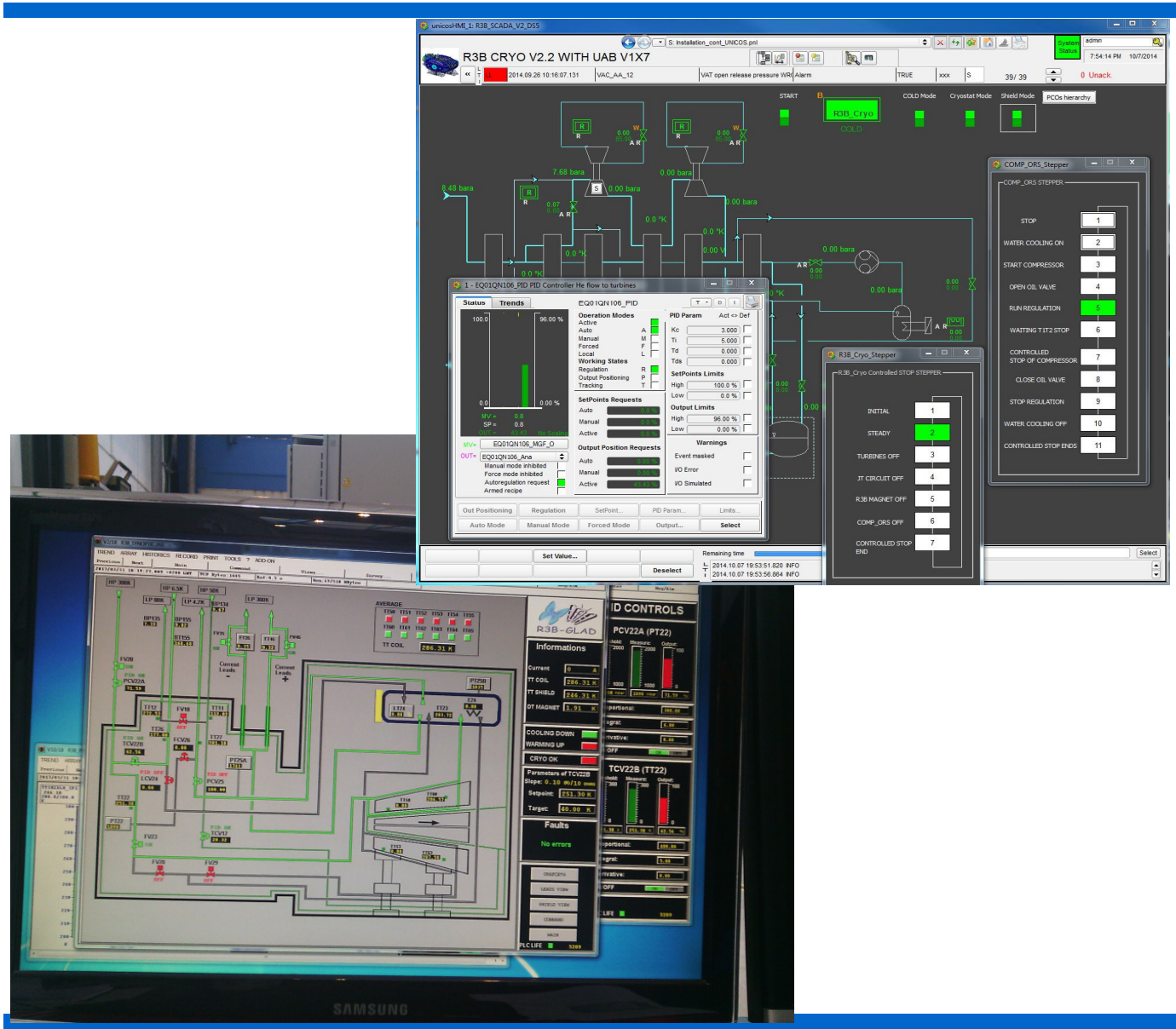
- Collaboration CEA Saclay/GSI
- Tilted coils, ironless design
- Correction Coils
- Lightweight design
- Indirect coil cooling
- Thermosyphon cryo distribution



All Infrastructure and magnet installed 2013-2016
Commissioning started



Status in brevity .....



Cooling down (since 06/2017)

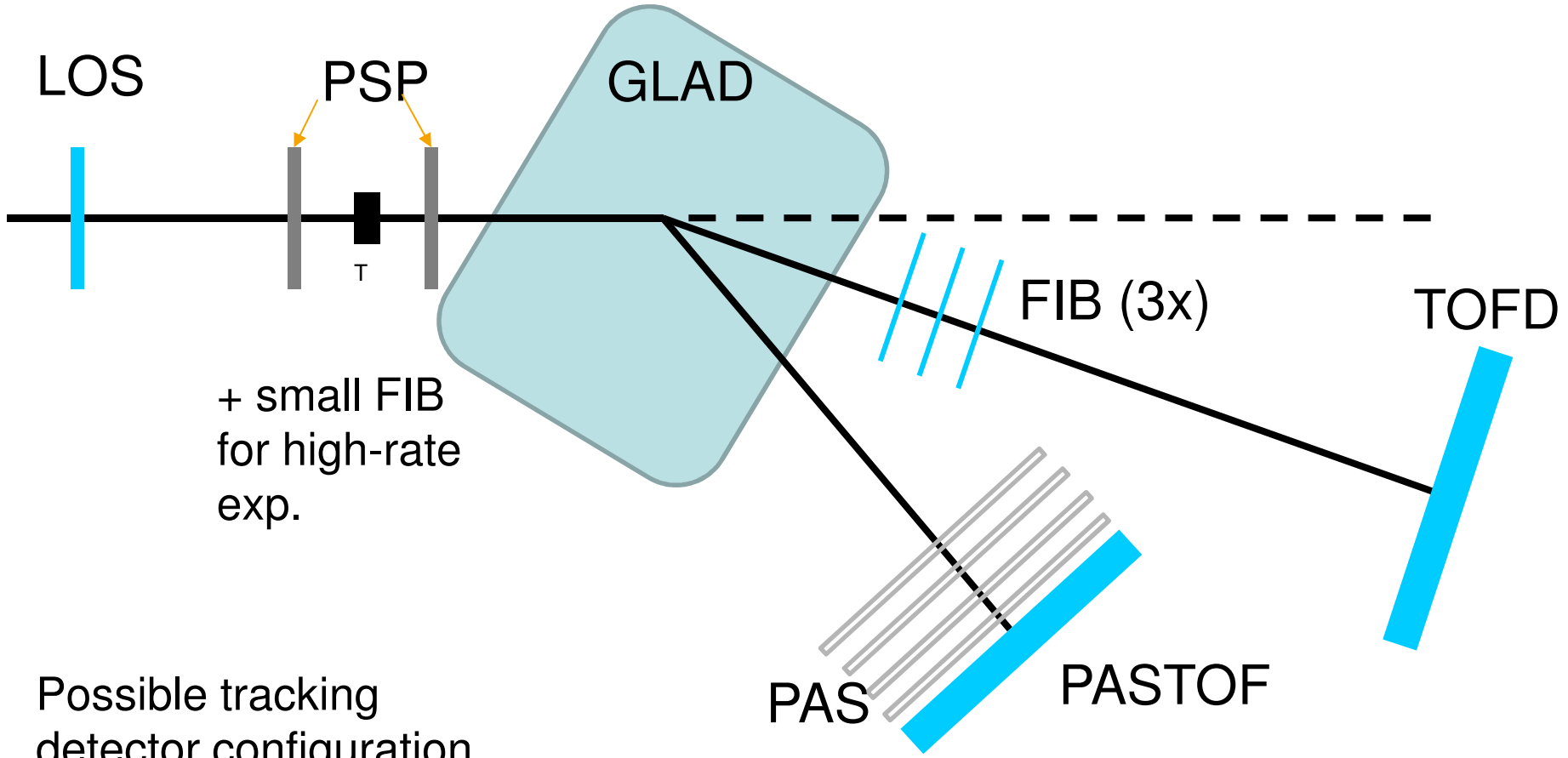
Coils have all been superconducting

Busbars still to be commisioned

Revision 11/2017
New cooldown 12/2017

Tracking detector overview

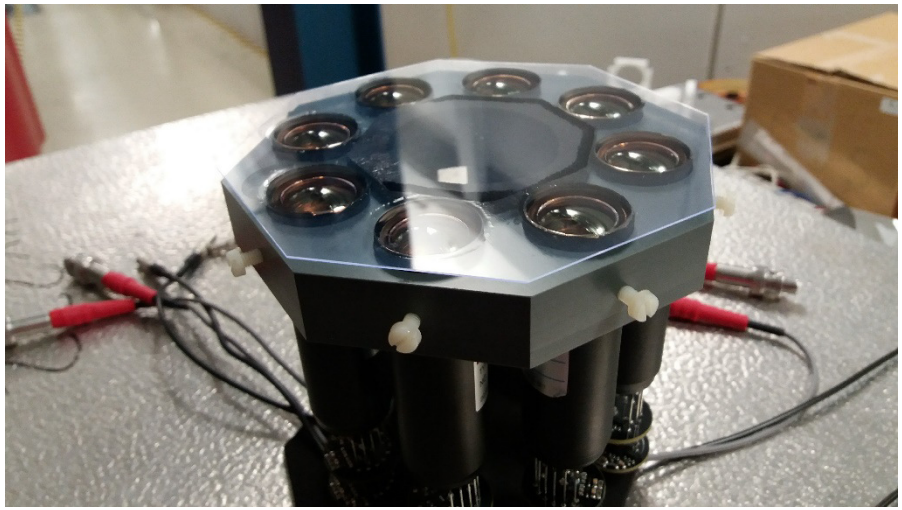
D. Rossi TU-Darmstadt

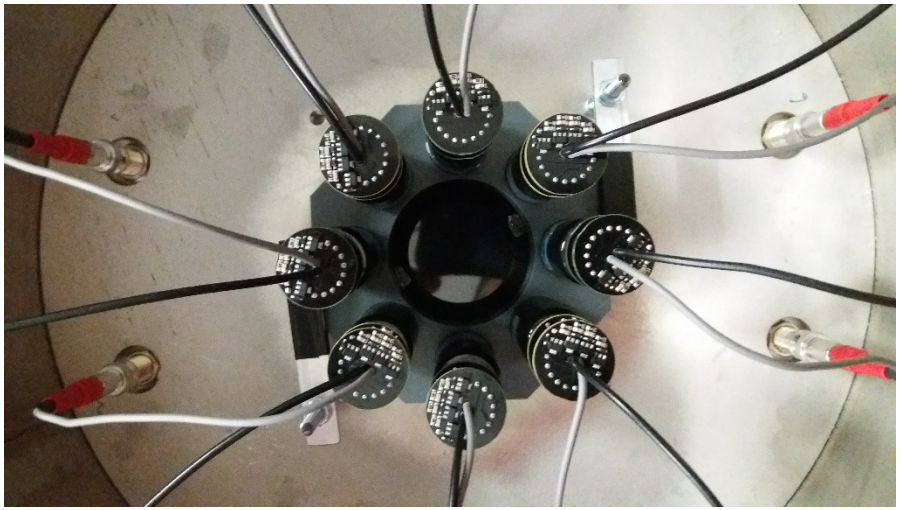


Possible tracking
detector configuration

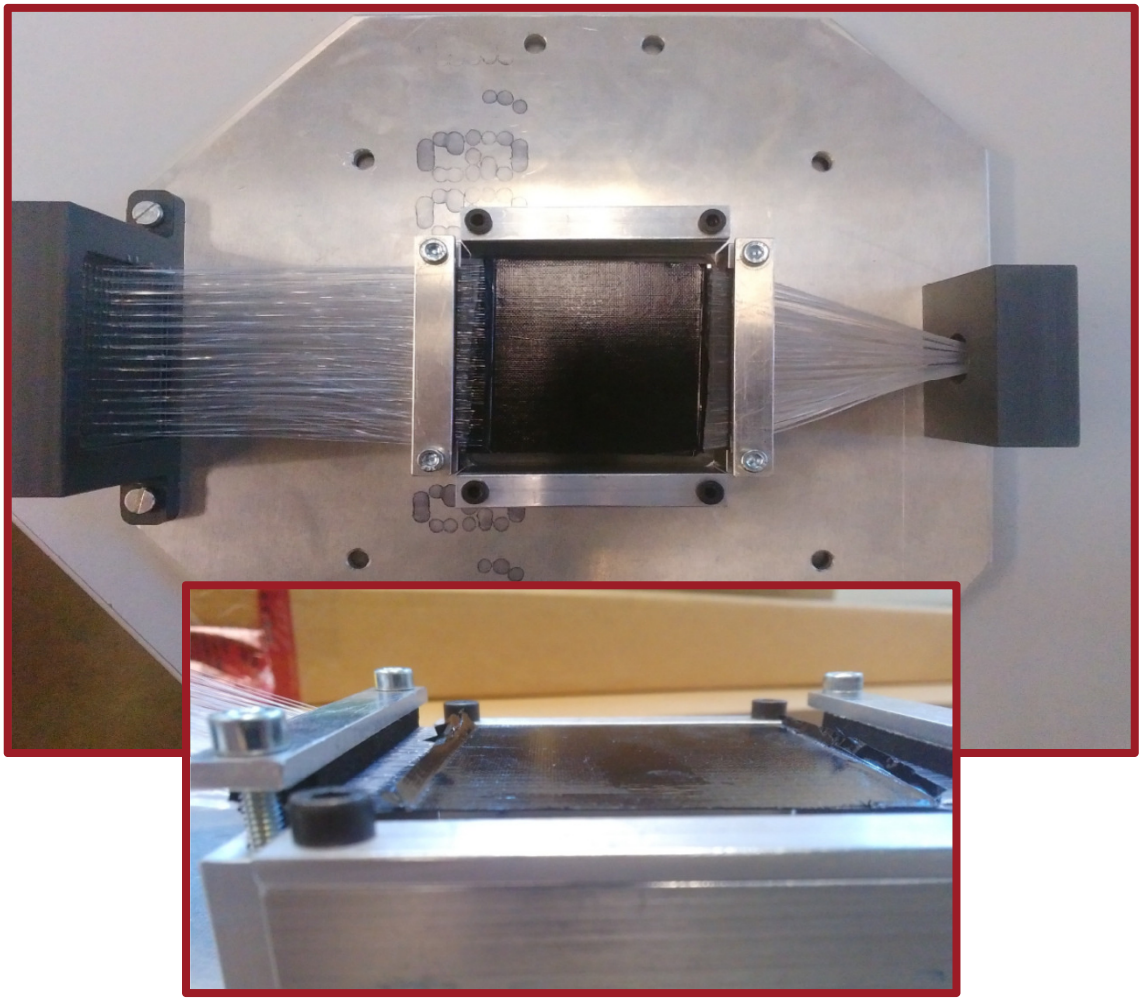
New LOS detector (Start detector)

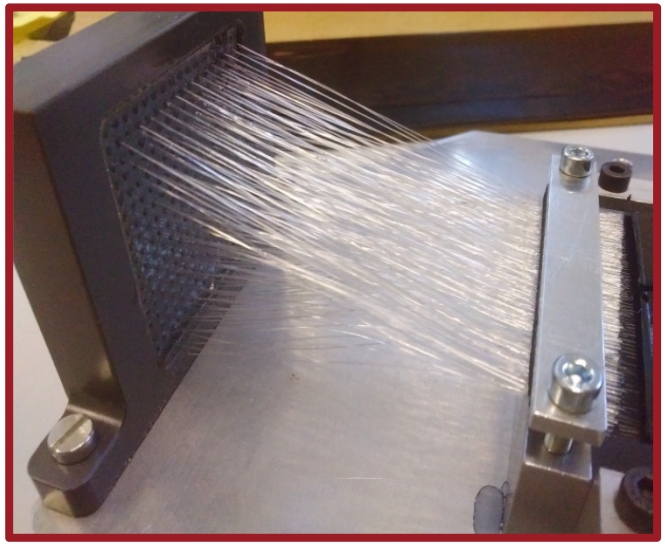
- PMTs not at the side but on top of scintillator.
- This leads to more light for thin foils.
- Easy way to hold thin scintillator foils.
- Measurements with laser ongoing (position and time resolution).





FIB prototype 3





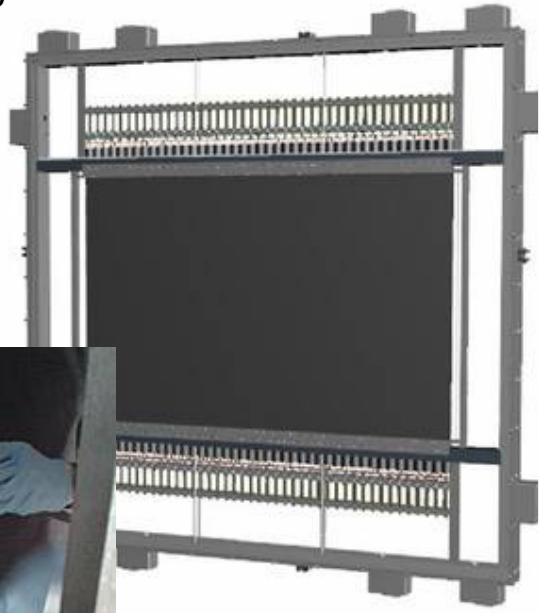
ToF wall

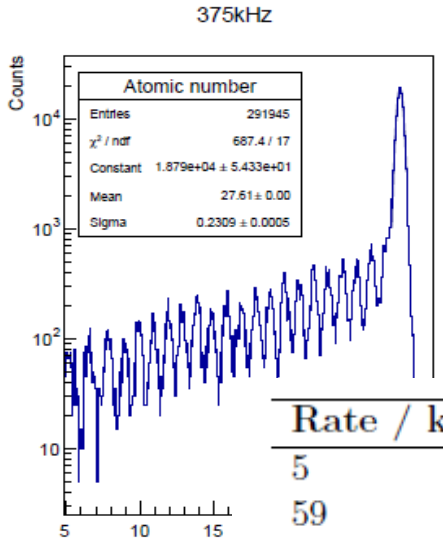
Performance goals:

- Time resolution σ_t/t = 2E-4
  ($\Leftrightarrow \sigma_t$ =20 ps for 20 m flight path at 1 *A*GeV)
- Energy resolution σ_E/E = 1%
- High-counting rate capabilities (~1 MHz)
- Large dynamic range (up to Pb-U).
- FPGA based TDC readout (ΔE via ToT Techniques)

- Size: 120 x 100 cm^2
- No light guide, PMT R8619 coupled directly to scintillator

Detector layout





Excellent time and energy resolution at high rates

Rate / kHz	σ_t / ps	σ_t^{det} / ps
5	41	14
59	41	14
375	45	16
1000	64	23

Prototype studies
@ Cave-C
08/2014
10/2014

Proton Arm Spectrometer

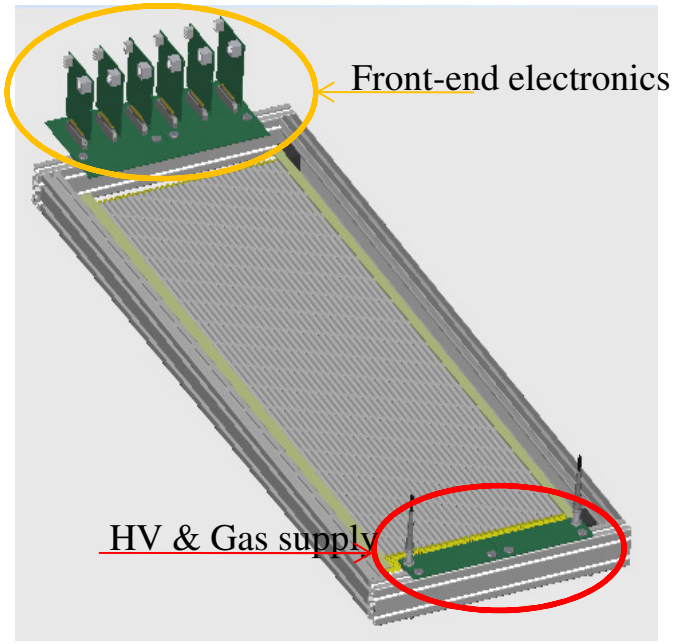
- Large area detectors: 2.1 x 1.0 m^2
- 2000 straws of 10 mm diameter
- 4 planes, 2 x, 2 -y-oriented.

Read-out

- Basic requirement: TDC with time resolution better than 1 ns
- Must fit into R3B DAQ concept → GSI developments

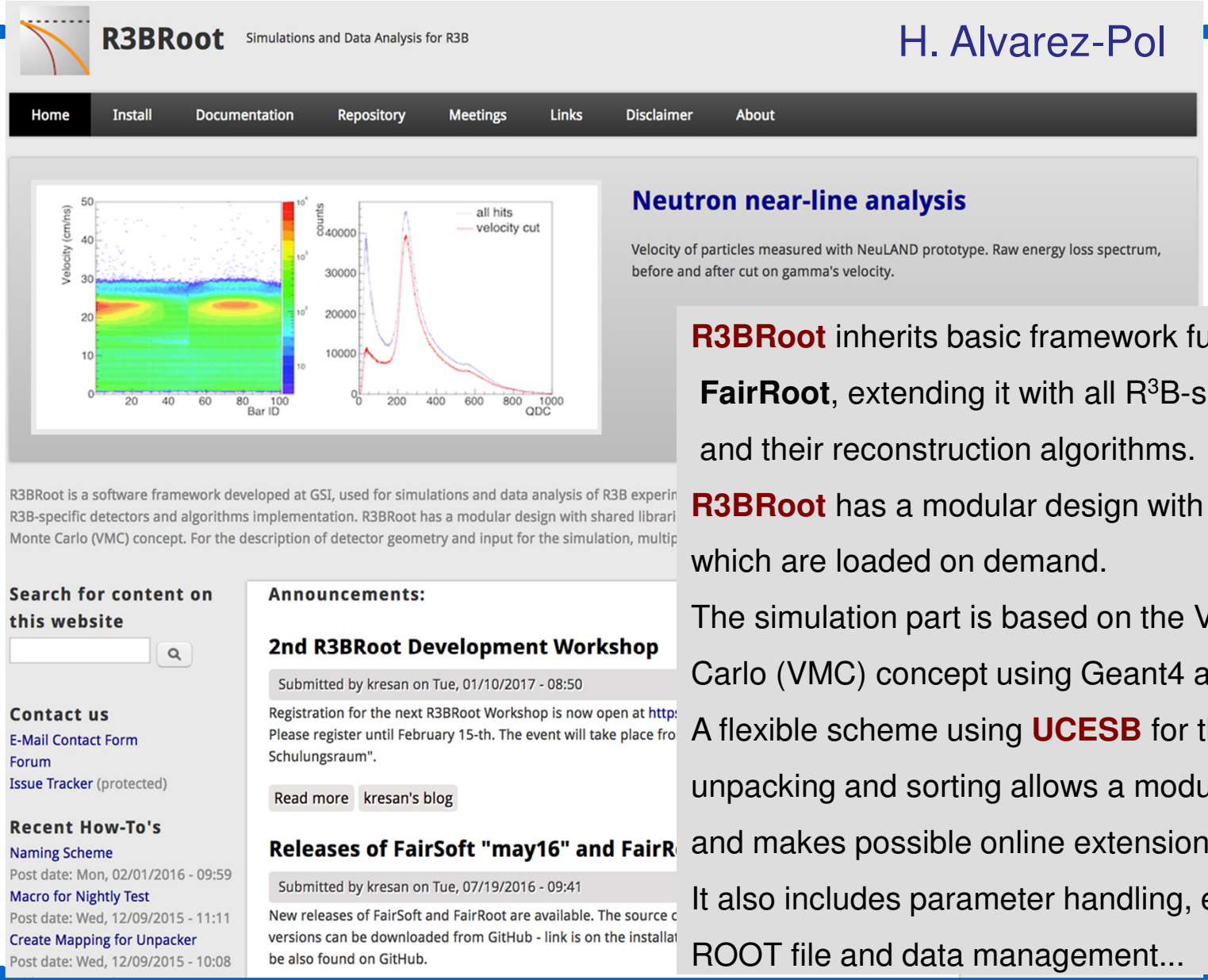
PNPI Gatchina

Efficiency 500-1000 MeV p	>95%



The first plane (x) will contain mylar or kapton straws, all others will be thin Al tubes.

R3BRoot: Simulation and Data Analysis for R^{3}B



R3BRoot inherits basic framework functionality from **FairRoot**, extending it with all R^{3}B-specific detectors and their reconstruction algorithms.

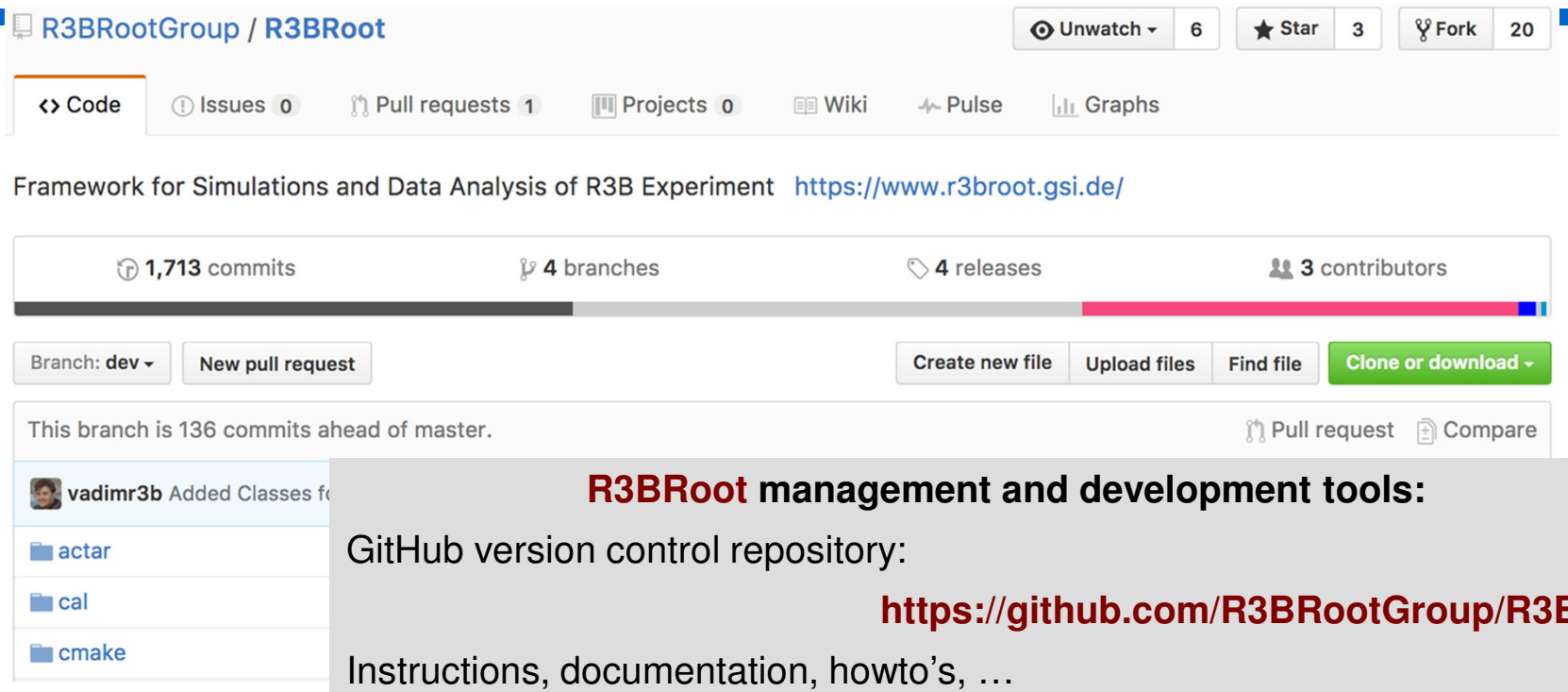
R3BRoot has a modular design with shared libraries, which are loaded on demand.

The simulation part is based on the Virtual Monte Carlo (VMC) concept using Geant4 and Geant3.

A flexible scheme using **UCESB** for the data unpacking and sorting allows a modular construction and makes possible online extensions.

It also includes parameter handling, event display, ROOT file and data management...

R3BRoot: Simulation and Data Analysis for R^{3}B



R3BRoot management and development tools:

GitHub version control repository:

https://github.com/R3BRootGroup/R3BRoot

Instructions, documentation, howto's, …

https://www.r3broot.gsi.de/

Automatic compilation and benchmarking:

https://cdash.gsi.de/CDash/index.php?project=R3BRoot

Activity tracker, calendar, issues, for developers (redmine):

https://www.r3broot.gsi.de/redmine/projects/r3broot

FORUM. The main discussion and information reference:

https://forum.gsi.de/index.php?t=index&cat=40&

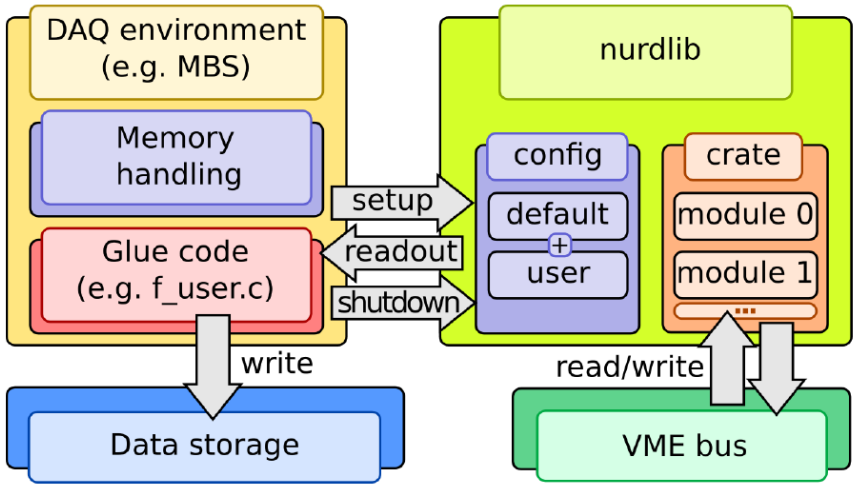
Toolchain: R3BRoot ← UCESB ← Nustar DAQ

R3BRoot describes the simulation and performs the analysis of the following detectors (Aug 17):

	LOS	PSPX	TOFd	NeuLAND	Si Tracker	CALIFA	Straw tubes
Mapped					***		
CAL							
HIT							

Mapped - raw data delivered from Ucesb to R3BRoot and stored
CAL - calibrated data: time [ns], charge [MeV]
HIT - physical hits, time [ns], charge [MeV], position [cm], all synchronized

http://web-docs.gsi.de/~land/nurdlib/



UCESB versatile unpacking tool

http://fy.chalmers.se/~f96hajo/ucesb/

➔ Nustar DAQ TDR just in the last step of being accepted (Q3/2017)

Summary

FAIR construction !

- Phase-0 **physics** program (@GSI) for R³B viable and in preparation

→ **GPAC just passed**

- All major components become operational
- Switching to operation mode
- Essential to keep collaborating institutes active

The R3B Collaboration

Aksouh, Farouk; Al-Khalili, Jim; Algora, Alejandro; Alkhasov, Georgij; Altstadt, Sebastian; Alvarez, Hector; Atar, Leyla; Audouin, Laurent; Aumann, Thomas; Pellereau, Eric; Martin, Julie-Fiona; Gorbinet, Thomas; Seddon, Dave; Kogimtzis, Mos; Avdeichikov, Vladimir; Barton, Charles; Bayram, Murat; Belier, Gilbert; Bemmerer, Daniel; Michael Bendel; Benlliure, Jose; Bertulani, Carlos; Bhattacharya, Sudeb; Bhattacharya, Chandana; Le Bleis, Tudi; Boilley, David; Boretzky, Konstanze; Borge, Maria Jose; Botvina, Alexander; Boudard, Alain; Boutoux, Guillaume; Boehmer, Michael; Caesar, Christoph; Calvino, Francisco; Casarejos, Enrique; Catford, Wilton; Cederkall, Joakim; Cederwall, Bo; Chapman, Robert; Alexandre Charpy; Chartier, Marielle; Chatillon, Audrey; Chen, Ruofu; Christophe, Mayri; Chulkov, Leonid; Coleman-Smith, Patrick; Cortina, Dolores; Crespo, Raquel; Csatlos, Margit; Cullen, David; Czech, Bronislaw; Danilin, Boris; Davinson, Tom; Paloma Diaz; Dillmann, Iris; Fernandez Dominguez, Beatriz; Ducret, Jean-Eric; Duran, Ignacio; Egelhof, Peter; Elekes, Zoltan; Emling, Hans; Enders, Joachim; Eremin, Vladimir; Ershov, Sergey N.; Ershova, Olga; Eronen, Simo; Estrade, Alfredo; Faestermann, Thomas; Fedorov, Dmitri; Feldmeier, Hans; Le Fevre, Arnaud; Fomichev, Andrey; Forssen, Christian; Freeman, Sean; Freer, Martin; Friese, Juergen; Fynbo, Hans; Gacsi, Zoltan; Garrido, Eduardo; Gasparic, Igor; Gastineau, Bernard; Geissel, Hans; Gelletly, William; Genolini, B.; Gerl, Juergen; Gernhaeuser, Roman; Golovkov, Mikhail; Golubev, Pavel; Grant, Alan; Grigorenko, Leonid; Grosse, Eckart; Gulyas, Janos; Goebel, Kathrin; Gorska, Magdalena; Haas, Oliver Sebastian; Haiduc, Maria; Hasegan, Dumitru; Heftrich, Tanja; Heil, Michael; Heine, Marcel; Heinz, Andreas; Ana Henriques; Hoffmann, Jan; Holl, Matthias; Hunyadi, Matyas; Ignatov, Alexander; Ignatyuk, Anatoly V.; Ilie, Cherciu Madalin; Isaak, Johann; Isaksson, Lennart; Jakobsson, Bo; Jensen, Aksel; Johansen, Jacob; Johansson, Hakan; Johnson, Ron; Jonson, Bjoern; Junghans, Arnd; Jurado, Beatriz; Jaehrling, Simon; Kailas, S.; Kalantar, Nasser; Kalliopuska, Juha; Kanungo, Rituparna; Kelic-Heil, Aleksandra; Kezzar, Khalid; Khanzadeev, Alexei; Kissel, Robert; Kisselev, Oleg; Klimkiewicz, Adam; Kmiecik, Maria; Koerper, Daniel; Kojouharov, Ivan; Korsheninnikov, Alexei; Korten, Wolfram; Krasznahorkay, Attila; Kratz, Jens Volker; Kresan, Dima; Anatoli Krivchitch; Kroell, Thorsten; Krupko, Sergey; Kruecken, Reiner; Kulessa, Reinhard; Kurz, Nikolaus; Kuzmin, Eugenii; Labiche, Marc; Langanke, Karl-Heinz; Langer, Christoph; Lapoux, Valerie; Larsson, Kristian; Laurent, Benoit; Lazarus, Ian; Le, Xuan Chung; Leifels, Yvonne; Lemmon, Roy; Lenske, Horst; Lepine-Szily, Alinka; Leray, Sylvie; Letts, Simon; Li, Songlin; Liang, Xiaoying; Lindberg, Simon; Lindsay, Scott; Litvinov, Yuri; Lukasik, Jerzy; Loeher, Bastian; Mahata, Kripamay; Maj, Adam; Marganiec, Justyna; Meister, Mikael; Mittig, Wolfgang; Movsesyan, Alina; Mutterer, Manfred; Muentz, Christian; Nacher, Enrique; Najafi, Ali; Nakamura, Takashi; Neff, Thomas; Nilsson, Thomas; Nociforo, Chiara; Nolan, Paul; Nolen, Jerry; Nyman, Goran; Obertelli, Alexandre; Obradors, Diego; Ogloblin, Aleksey; Oi, Makito; Palit, Rudrajyoti; Panin, Valerii; Paradela, Carlos; Paschalis, Stefanos; Pawlowski, Piotr; Petri, Marina; Pietralla, Norbert; Pietras, Ben; Pietri, Stephane; Plag, Ralf; Podolyak, Zsolt; Pollacco, Emanuel; Potlog, Mihai; Datta Pramanik, Ushasi; Prasad, Rajeshwari; Fraile Prieto, Luis Mario; Pucknell, Vic; Galaviz -Redondo, Daniel; Regan, Patrick; Reifarth, Rene; Reinhardt, Tobias; Reiter, Peter; Rejmund, Fanny; Ricciardi, Maria Valentina; Richter, Achim; Rigollet, Catherine; Riisager, Karsten; Rodin, Alexander; Rossi, Dominic; Roussel-Chomaz, Patricia; Gonzalez Rozas, Yago; Rubio, Berta; Roeder, Marko; Saito, Takehiko; Salsac, Marie-Delphine; Rodriguez Sanchez, Jose Luis; Santosh, Chakraborty; Savajols, Herve; Savran, Deniz; Scheit, Heiko; Schindler, Fabia; Schmidt, Karl-Heinz; Schmitt, Christelle; Schnorrenberger, Linda; Schrieder, Gerhard; Schrock, Philipp; Sharma, Manoj Kumar; Sherrill, Bradley; Shrivastava, Aradhana; Shulgina, Natalia; Sidorchuk, Sergey; Silva, Joel; Simenel, Cedric; Simon, Haik; Simpson, John; Singh, Pushpendra Pal; Sonnabend, Kerstin; Spohr, Klaus; Stanoiu, Mihai; Stevenson, Paul; Strachan, Jon; Streicher, Brano; Stroth, Joachim; Syndikus, Ina; Suemmerer, Klaus; Taieb, Julien; Tain, Jose L.; Tanihata, Isao; Tashenov, Stanislav; Tassan-Got, Laurent; Tengblad, Olof; Teubig, Pamela; Thies, Ronja; Togano, Yasuhiro; Tostevin, Jeffrey A.; Trautmann, Wolfgang; Tuboltsev, Yuri; Turrion, Manuela; Typel, Stefan; Udias-Moinelo, Jose; Vaagen, Jan; Velho, Paulo; Verbitskaya, Elena; Veselsky, Martin; Wagner, Andreas; Walus, Wladyslaw; Wamers, Felix; Weick, Helmut; Wimmer, Christine; Winfield, John; Winkler, Martin; Woods, Phil; Xu, Hushan; Yakorev, Dmitry; Zegers, Remco; Zhang, Yu-Hu; Zhukov, Mikhail; Zieblinski, Miroslaw; Zilges, Andreas;