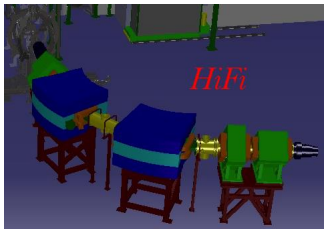


HiFi

Hie Isolde Fragment Identifier

Olof Tengblad

ISCC 7th November 2017

Demands from experiments for a spectrometer at HIE-ISOLDE

Technische Universität Darmstadt
Thorsten Kröll (TU Darmstadt)

16 approved proposals would profit from a Spectrometer

Coulomb excitation

- Energy: about 4 - 5.5 MeV/u
- Intensities: > 10^2/s … 10^8/s

- Large range of scattering angles
  … event-by-event identification not possible

3 LoIs mention A and Z determination for scattered particles
➔ large area Bragg detector

- Spectrometer/separator used to determine
  - Beam composition for normalisation
  - Integral measurement sufficient

Transfer reactions with light targets

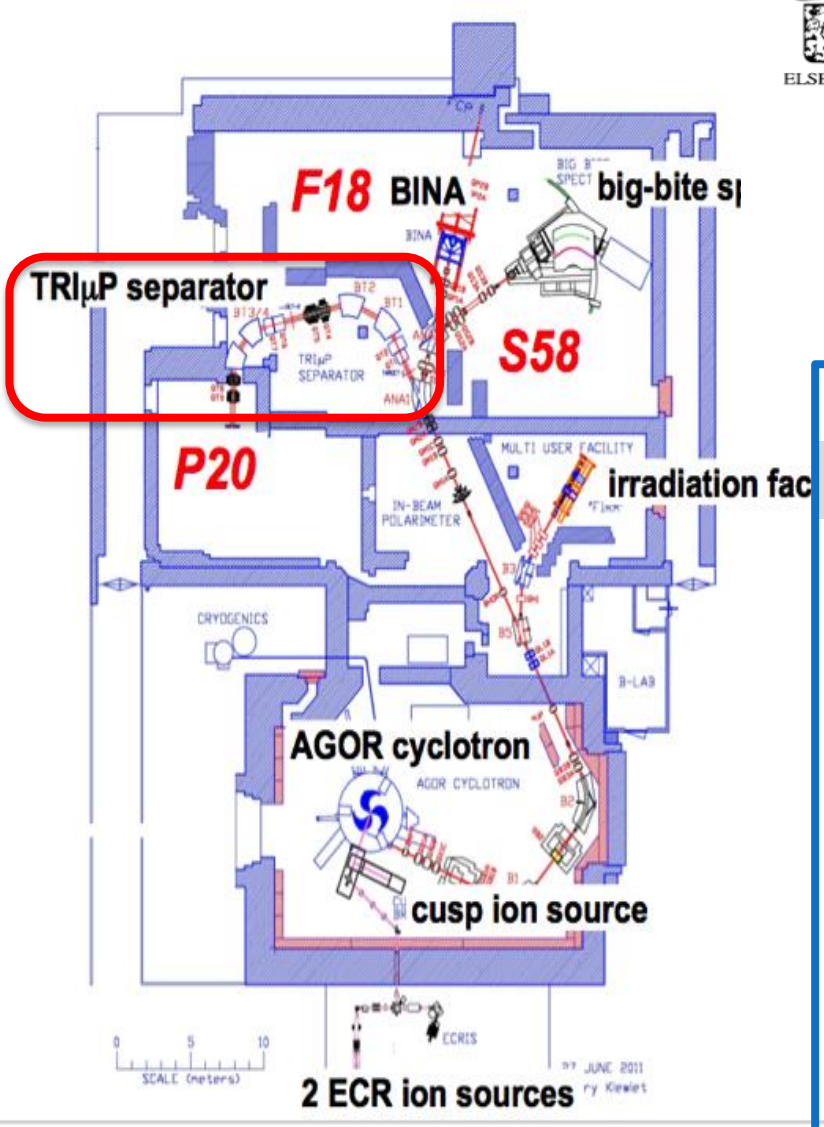
- Energy: 5.5 - 10 MeV/u
- Intensities: > 10^5/s

- Small scattering angles around 0°
- Event-by-event PID
  - Identification of heavy transfer product
  - Reactions of beam contaminants
  - Fusion-evaration reactions with target / carrier (CH_2, CD_2, Ti+^{3}H, ^{9,10}Be, X+^{3}He, X+^{4}He, X+^{16}O, …)

- Beam composition for normalisation
  - Integral measurement sufficient

Crucial for transfer reactions on light targets
➔ Device capable to be operated at 0° required
➔ Full support from the Miniball community

TRIμP @ KVI-CAR Built 1994, commissioned 2004, in use until 2013



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Nuclear Instruments and Methods in Physics Research B 204 (2003) 532–535

NIM B
Beam Interactions with Materials & Atoms

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TRIμP – a radioactive isotope trapping facility under construction at KVI

G.P. Berg, P. Dendooven *, O. Dermois, M.N. Harakeh, R. Hoekstra, K. Jungmann, S. Kopecky, R. Morgenstern, A. Rogachevskiy, R. Timmermans, L. Willmann, H.W. Wilschut

Kernfysisch Versneller Instituut, Rijksuniversiteit Groningen, Zernikelaan 25, 9747 AA Groningen, The Netherlands

owner of TRIμP

university of groningen 2014 | 400 years

Van Swinderen Institute for Particle Physics and Gravity

Researchgroup Ions:

People of the ions group

Klaus Jungmann (group leader)

Klaus Jungmann

VSI interest @ ISOLDE:
Radium isotopes for ATOMIC Fundamental Symmetries Studies

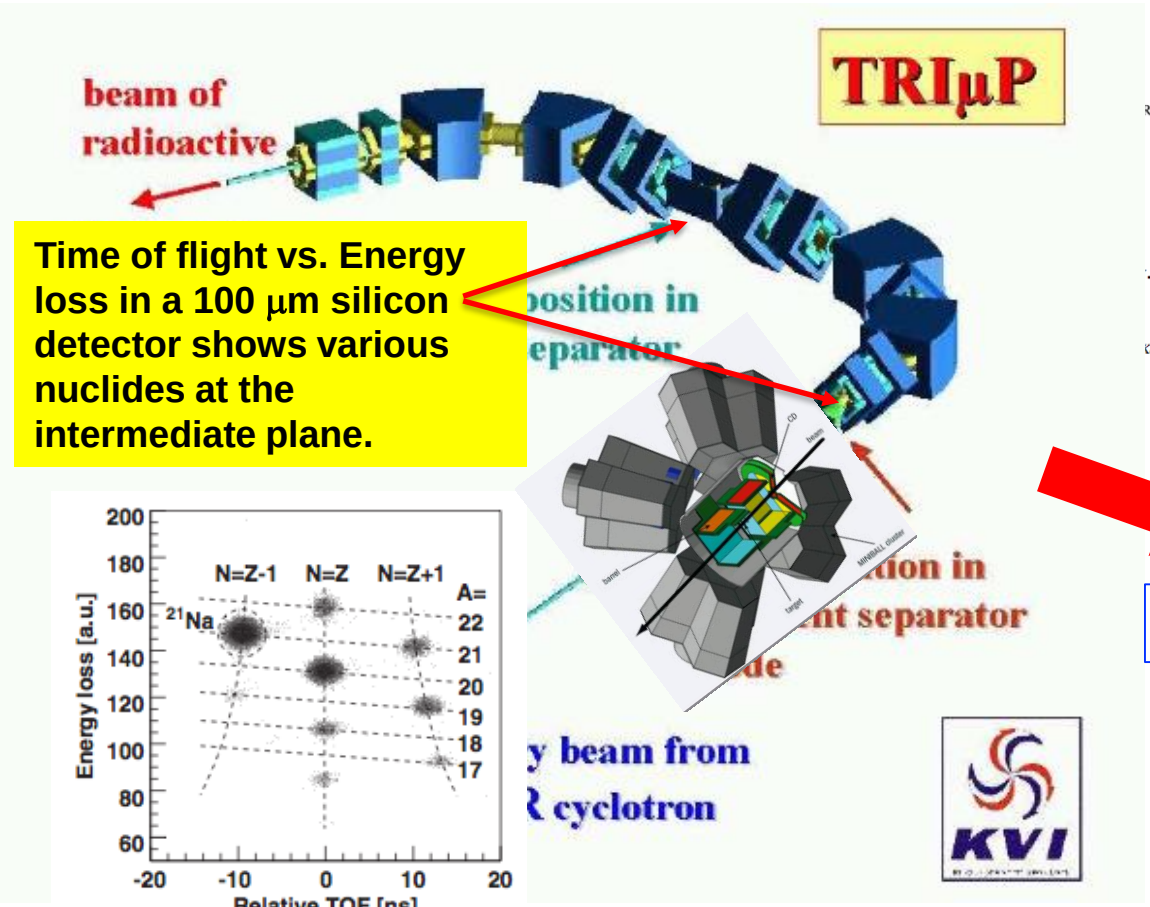
Lorenz Willmann (associate Professor)

+ 4 PhD students

Lorenz Willmann

HIE-ISOLDE

TRIμP as 0-degree spectrometer



Time of flight vs. Energy loss in a 100 μm silicon detector shows various nuclides at the intermediate plane.

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Cernfysisch Versneller Instituut, Rijksuniversiteit Groningen, Zernikelaan 25, 9747 AA Groningen, The Netherlands

Hie Isolde Fragment Identifier

References:

- Emil Traykov: Production of radioactive beams for atomic trapping, PhD thesis 27.10.2006, Rijksuniversiteit Groningen
- G.P. Berg et.al. NIM B204 (2003) 532
- H. W. Wilschut & Klaus Jungmann, Nuclear Physics News Vol. 17, No. 1, 2007,

university of groningen

VSI, VAN Swinderen Institute for Particle Physics

INITIATIVE: agreement to move TRIμP to ISOLDE

ISOLDE

Meeting at RUG/VSI 15.04.2016 1:st agreement was taken, and plans for the move were initiated

Present: RUG/VSI -- Klaus Jungmann, Lorenz Willmann, Hans Wilschut,

HiFi Collaboration -- María José García Borge, Joakim Cederkall, Olof Tengblad

Move and installation of TRIμP at ISOLDE

2016-17:

- Power-supplies: donation from LUND University and **already delivered to CERN**
- Dismount at KVI-CAR and transported to CERN 2017
- The equipment will first be mounted at CERN in building B180.

2018 B180 CERN:

- where all the tests of vacuum, power supplies etc. will be performed.
- The detection system to be implemented and tested, will consist in a row of Double sided Si strip detectors, to be tested with alpha source and if possible to mount an external ion-source.

Summary of the main components of TRIμP

Dipole BT1
weight: 13 000 kg
size: 1.5 m x 2 m x 0.6 m

Dipole BT2
weight: 13 000 kg
size: 1.5 m x 2 m x 0.6 m

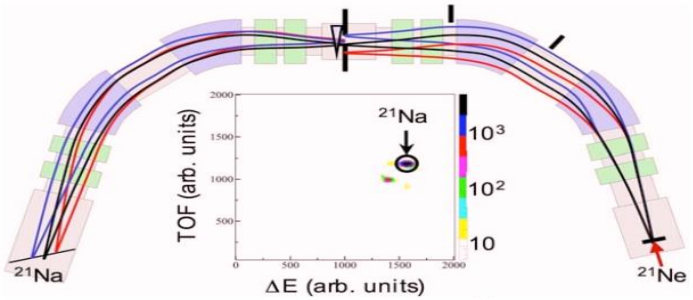
Dipole BT3
weight: 12 000 kg
size: 1.5 m x 2 m x 0.6 m

Dipole BT4
weight: 12 000 kg
size: 1.5 m x 2 m x 0.6 m

Quadrupole doublets QT1-2 and QT4-5
weight 8 500 kg
size: 1.5 m x 2 m x 0.6 m

Quadrupole doublets QT6-7 and QT8-9
weight 8 500 kg
size: 1.0 m x 2 m x 0.6 m

Supports: 8 pcs, 500 kg each, 1.5 m x



Installation downstream Miniball

The idea is to couple half of the spectrometer downstream the Miniball setup. Footprint 5x5 m^2
Pick the best components to obtain the optimum separator and use the rest as replacement units.

CETI 17.037

rijksuniversiteit groningen / office of the university / health, safety and environment

H.F. Boersma PhD
T +31 (0)50 363 61 24
h.f.boersma@rug.nl

Visserstraat 49
9712 CT Groningen
The Netherlands

www.rug.nl/amd

21 JULI 2017

KVI-CART
Prof. dr. A.M. van den Berg
Zernikelaan 25
9747 AA Groningen

Cc
Dr. E.R. van der Graaf

Handled by
Dita Bos

Date
20 July 2017

Our reference
bu17.07657

Subject
Release the 'TRIμP-separator'

Dear Prof. van den Berg,

In accordance with Internal regulation IV11 'Waste and discharge policies' Emiel van der Graaf (KVI-CART) has asked the Radiation Protection Unit to release the 'TRIμP-separator' based on the clearance levels laid down in the Dutch Radiation Protection Decree (article 37.2 sub b), which allows licensees to release radioactivity up to a certain annual limit.

In the report 'Radioactivity measurements on the TRIμP-separator' by Emiel van der Graaf, June 2017, van der Graaf indicates that elevated radioactivity concentrations have been found on three spots. Implicitly it can be concluded from his report that – except for these three spots – the TRIμP- separator shows no signs of activity concentrations exceeding the clearance levels for activity concentrations as referred to in the Dutch Radiation Protection Decree (art. 37.2 sub a). For the three spots a maximum activity can be derived from the report of Van der Graaf.

In the table below the identified nuclides, their maximized activity concentration and their total activity (based on three objects with dimensions 10 x 10 x 0,5 cm³ and density ρ ~ 8 g/cm³) are given.

Nuclide	Max C (Bq/g)	Limit (Bq/g)	Weighthed	A (kBq)	Limit (kBq)	Weighted
22Na	3,4	10	0,34	4,1	1000	0,004
54Mn	1,5	10	0,15	1,8	1000	0,002
57Co	1,0	100	0,01	1,2	1000	0,001
60Co	1,1	1	1,1	1,3	100	0,013
	Weighted sum C		1,5 > 1	Weighted sum A		0,02 << 1

Based on the conclusion that the calculated weighted activity sum of the three spots is well below the legal limit of 1 and that outside these spots the weighted activity concentration

sum can assumed to be well below this limit too, Dutch legislation allows clearance of these objects. I therefore approve clearance of the TRIμP-separator.

Due to changes in national legislation, becoming effective February 6th, 2018, whose implications are not yet fully known, this approval is valid until February 5th, 2018. If clearance is foreseen after February 5th, 2018, you are kindly asked to apply for approval after January 1st, 2018, again.

Yours sincerely,

Dr. H.F. Boersma,
Radiation protection expert,
University of Groningen

ACTION 1: SURVEY OF RADIOACTIVITY

Survey of Radioactivity at KVI-CAR
before possible transport of the TRIμP separato

→ **20 July 2017: Declared non-radioactive**
→ **OK for transport**

Quotation Transport

REMMERS Transport
MUNTENDAM

Duurkenakker 4, 9649 JP Muntendam
Telefoon: 0598 613603
Email: info@remmerstransport.nl
Bank: NL90ABNA0483568287
Bank: NL22INGB0000914140
K.v.K.:02318117 / BTW: NL801947789B01

Nationaal en internationaal zwaartransportbedrijf; diepladervervoer; speciaal ingericht voor het plaatsen van ketels, machines e.d.

Goedemiddag,

T.a.v. Dhr. Harry H. Kiewiet.

Hierbij ontvangt u de offerte voor het intern verplaatsen van 8 focuseerlenzen en 4 buigmagneten bij KVI te Groningen.

Omschrijving werkzaamheden:
8 focuseerlenzen van statief halen
4 buigmagneten van statief halen
Intern transport
8 focuseerlenzen +statieven laden in vrachtauto
4 buigmagneten + statieven laden in vrachtauto
4 buigmagneten buiten met autokraan beter in auto positioneren
Lossen materialen laden in vrachtauto

Dit voor een prijs van € 4450,- totaal

Transport van 8 focuseerlenzen, 4 buigmagneten, statieven en los materiaal vanaf Groningen naar Geneve (Franse kant)

Dit voor een prijs van € 2250,- per vracht incl. 2 uur laden en 2 uur lossen
Excl. vrachtdocumentatie

KVI maakt een gat in het dak om de magneten er door heen te hijsen.

Met vriendelijke groet,
Pieter Remmers

ACTION 2: Quotation for Transport

Packing at KVI: 4450 €
Transport to CERN: 2250 €
==========
Total: 6.700 €

ACTION 3: Counter performance HiFi vs RUG/VIS; initiate collaboration at ISOLDE

CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

Laser Cooling of Ra ions for Atomic Parity Violation

Presentation at ISCC

CERN, June 27, 2017

Lorenz Willmann

Lorenz Willmann
university of groningen
faculty of mathematics and natural sciences
van swinderen institute for particle physics and gravity

MINUTES 79th ISCC: The Netherlands is not yet a member of the ISOLDE collaboration. Discussions have been ongoing in conjunction with the **TRImP separator**, which is due to come to ISOLDE and will be placed after Miniball. **This could constitute a first step towards the Netherlands becoming a member** of the ISOLDE collaboration. **The committee welcomes the arrival of the TRImP separator and the new area of physics which the Paul trap would make available at ISOLDE**. It is clear that the Dutch group consider membership of the collaboration to be important for the continuation of this project and that the leadership of the project will come via the Dutch groups; the collaborators from existing ISOLDE members would not be expected to be the spokesperson of this experiment.

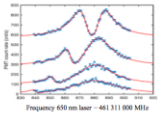
The committee welcomes the physics which is being proposed. There are many uncertainties regarding space and final integration at ISOLDE along with a detailed timeline. **If the submitted letter of intent is endorsed, the group would be encouraged to submit a more detailed full proposal**

Laser Cooling of Ra ions for Atomic Parity Violation

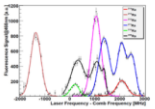
$E1_{APV} = k \cdot Q_W$

Atomic Parity Violation:

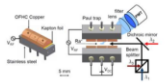
Ba^+
- Developing experimental setup
- Atomic properties determination
- Light shifts and Line shapes



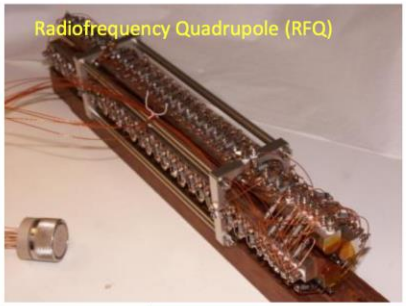
Ra^+
- Atomic Properties from online produced radium
- Trapping and laser spectroscopy done at TRIμP
- Activity on Ra^+ colinear spectroscopy (ISOLDE)
- Muonic Radium experiments for charge radius

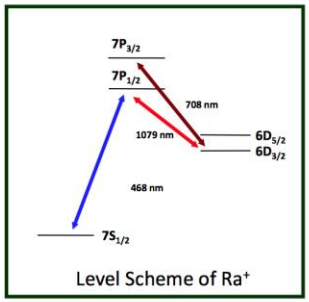


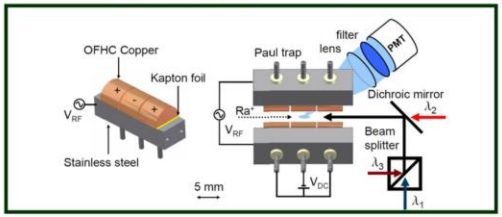
ISOLDE
- Ion trapping permits access to many transitions
- Laser cooling for precision
- Availability of a large range of Ra isotopes
- Lab with experience of precision lasers experiments
- Building up of a collaboration



Trapped Ra^+ Spectroscopy







CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

CERN-INTC-2017-069

HIE-ISOLDE

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Letter of Intent to the ISOLDE and Neutron Time-of-Flight Committee

ACTION 4: VSI interest @ISOLDE, Endorsed by the INTC

Laser Cooling of Ra ions for Atomic Parity Violation

May 31, 2017

L. Willmann[1], K. Jungmann[1], N. Severijns[2], K. Wendt[3]

[1] *Van Swinderen Institute, FSE, University of Groningen, The Netherlands*
[2] *University of Leuven, Belgium*
[3] *Johannes Gutenberg University Mainz, Germany*

Spokesperson: [Lorenz Willmann] [l.willmann@rug.nl]
Contact person: [Lorenz Willmann] [l.willmann@rug.nl]

INTC-I-196 Laser Cooling of Ra ions for Atomic Parity Violation

The authors propose to perform laser cooling of Ra ions. Radium is one of the favorable systems for the investigation of atomic parity violation (APV). This provides a way to investigate the contribution of weak interactions at low momentum. Some preparatory studies have already been made by some of the proponents. The INTC recognizes the importance of APV studies and finds the science case attractive. However, it has to be considered that this activity is a long-term endeavour. It requires not only a commitment from the ISOLDE collaboration, but also installation of adequate infrastructure will be needed. The setup should be permanently placed in the ISOLDE hall and the details of this should be discussed with the ISOLDE physics and technical coordinators. The INTC recommends proceeding in this way and eventually to prepare a full proposal.

The INTC recommends 0 shifts for approval by the research board but **endorses the physics motivation and supports the allocation of resources to develop this technique at ISOLDE.**

Summary

Actions for the HiFi Separator Project

Phase A **2017**

- L. Willman presented the VSI interests at ISOLDE to the ISCC and submitted a LOI to the INTC. **DONE – Physics case endorsed by the INTC**
- Identifying radioactive and non-radioactive components of the TRIMUP separator. **DONE - declared non-radioactive signed by Univ. Groningen**
- Preparation for and transport of non-radioactive components to CERN and installation in test area B180. **Quotation for transport obtained, Test area B180 assigned @ CERN**
- CERN– fellow for the preparations, simulations and installation: **Andree Welker**

Phase B **2018** **Workshop at ISOLDE to form the collaboration.**

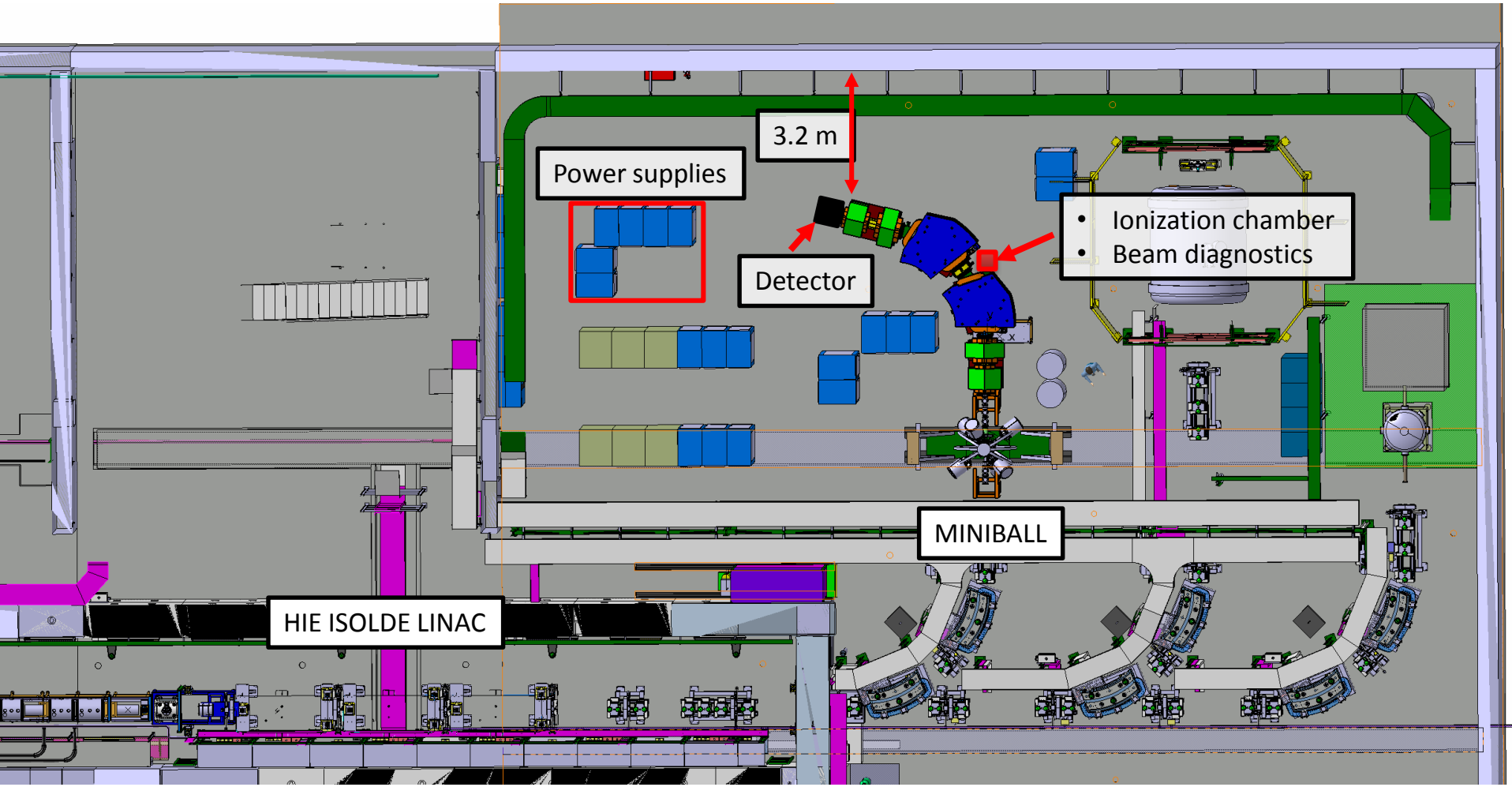
Testing hardware for the HiFi separator, including cooling and power, in test area B180 at CERN. Installation of new detector systems and tests of these.

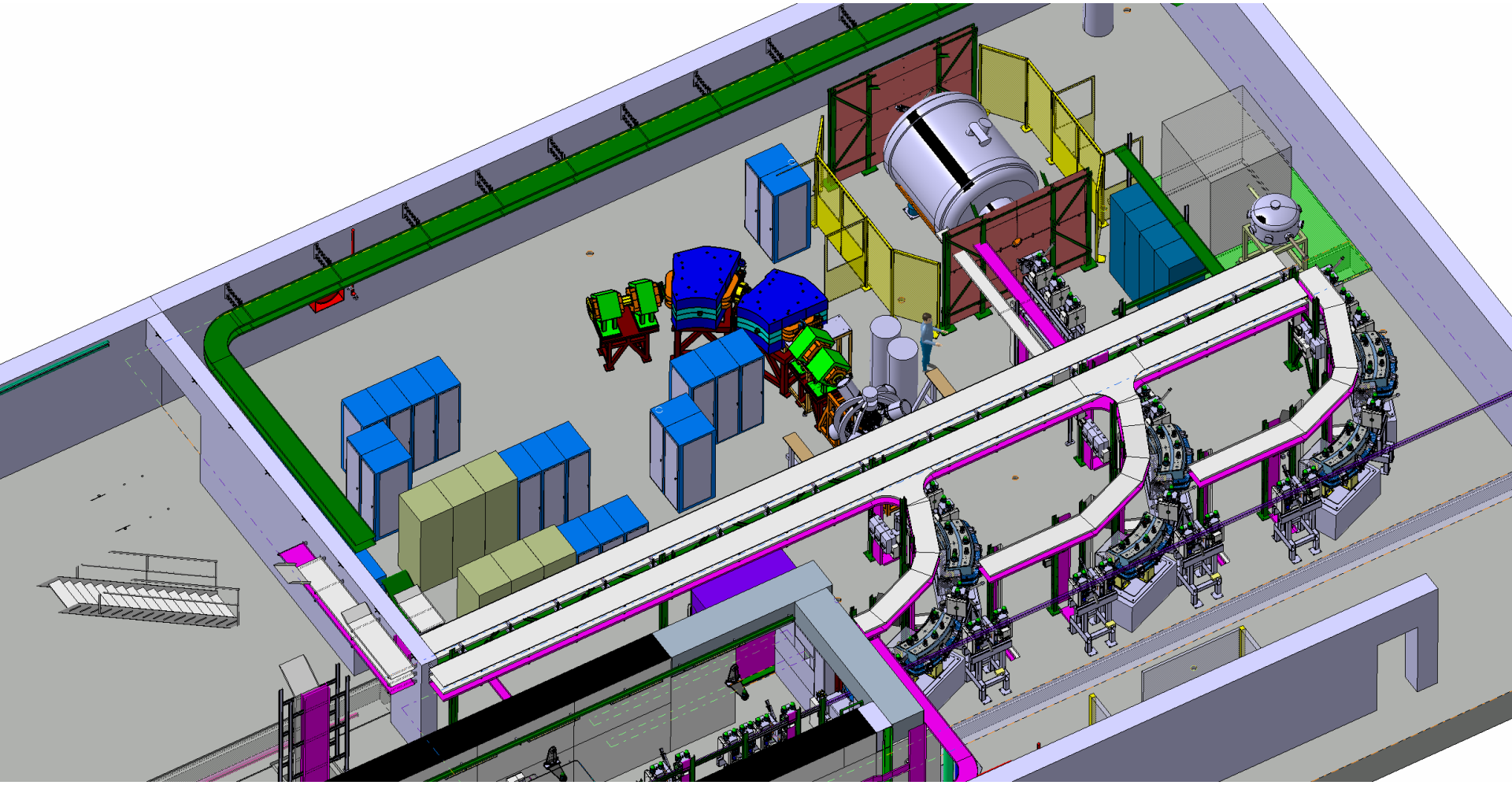
- J. Cederkäll: DANFYSIK Power supplies for Dipoles and Quadropoles
- MJ Borge: Project application for the Vacuum system and a 2nd student
- K.Riisager: Project application for the detection system

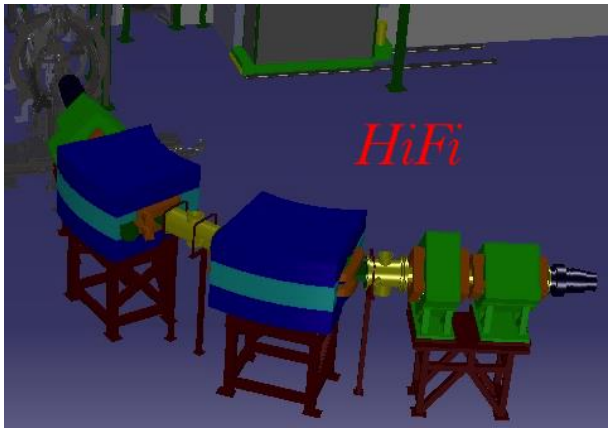
Phase C **2019**

Installation in ISOLDE experimental area and in situ testing

HiFi with MiniBall @ XT01







The HiFi-collaboration Request to ISCC:

- Endorse the installation of the TRIμP separator downstream Minball at XT01 beamline of HIE-ISOLDE **DONE!**
- Pay the transport from KVI to CERN of the separator **AGREED!**

The HiFi-collaboration Request to CERN:

Space in building B180, access to power and cooling water. **AGREED!**

Next to do 2018:

- Initiate the transport
  - Sign the memorandum of agreement with Univ. Groningen to transport and receive the TRIμP at CERN. *HiFi collaboration MJG Borge*
- Transport the equipment
  - Dismount at KVI and package *Transport company with help of VSI, HiFi supervise*
  - Receive and unpack at CERN *HiFI collaboration (Lund and Madrid)*
- Prepare for installation at HIE-isolde
  - Catia drawings for the installation at XT01. *A. Welker*
  - Simulation of the system for real physics cases. *A. Welker*
- ***B180***
  - Coupled the Power supplies to the equipment and perform 1st test *Lund*
  - Change the vacuum system to dry pumps *Madrid*
  - *Install and test focal plane detection system* *Aarhus*