

# Status of the 30-keV MR-TOF project and relation to PUMA

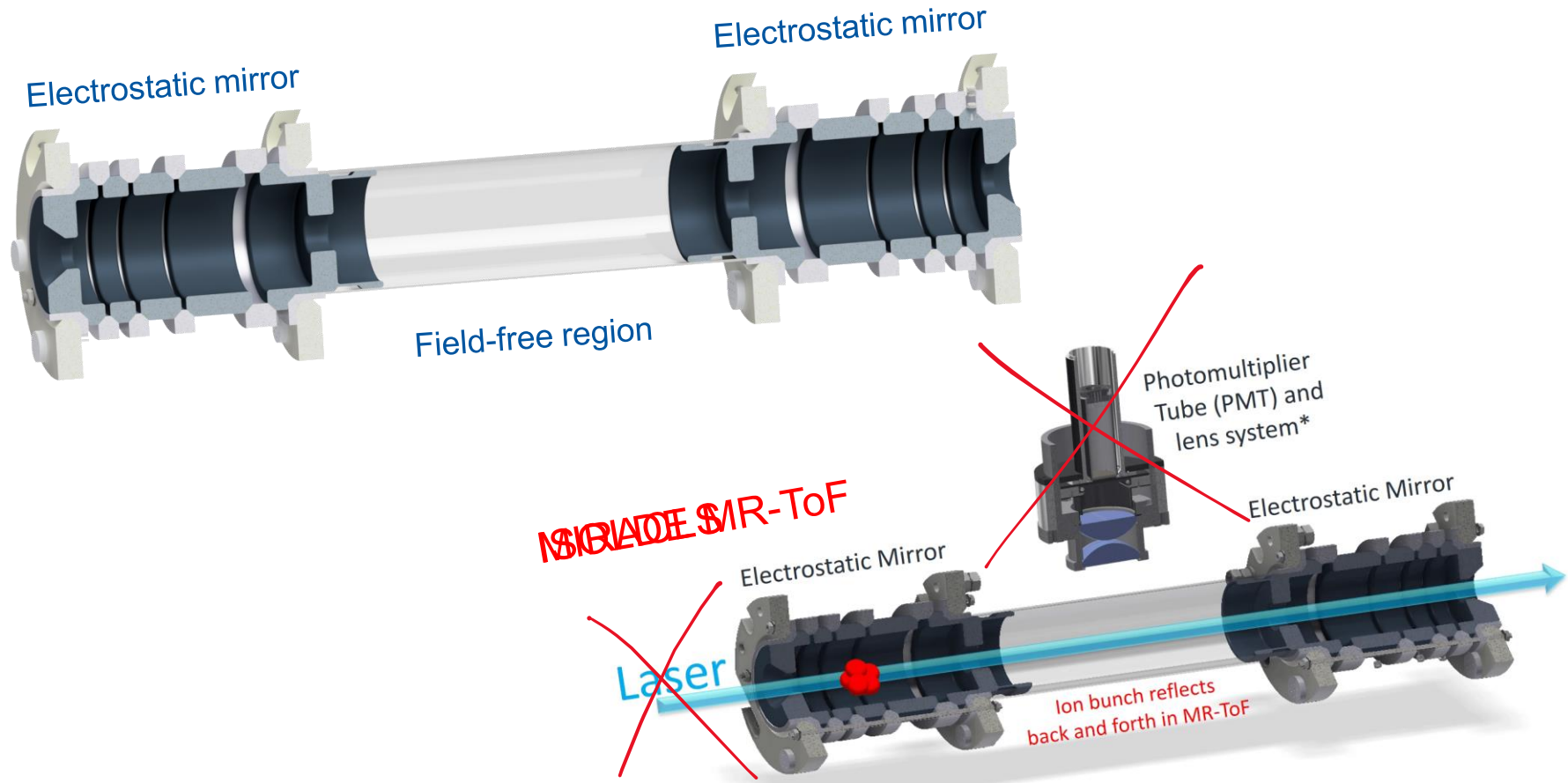
Markus Vilén  
CERN

# Outline:

- Introduction
  - MIRACLS and ISOLDE MR-ToF
  - ISOLDE MR-ToF goals
  - Performance as mass separator
- Milestones
- Remaining work and challenges
  - MIRACLS
  - ISOLDE MR-ToF and PUMA
- Timeline

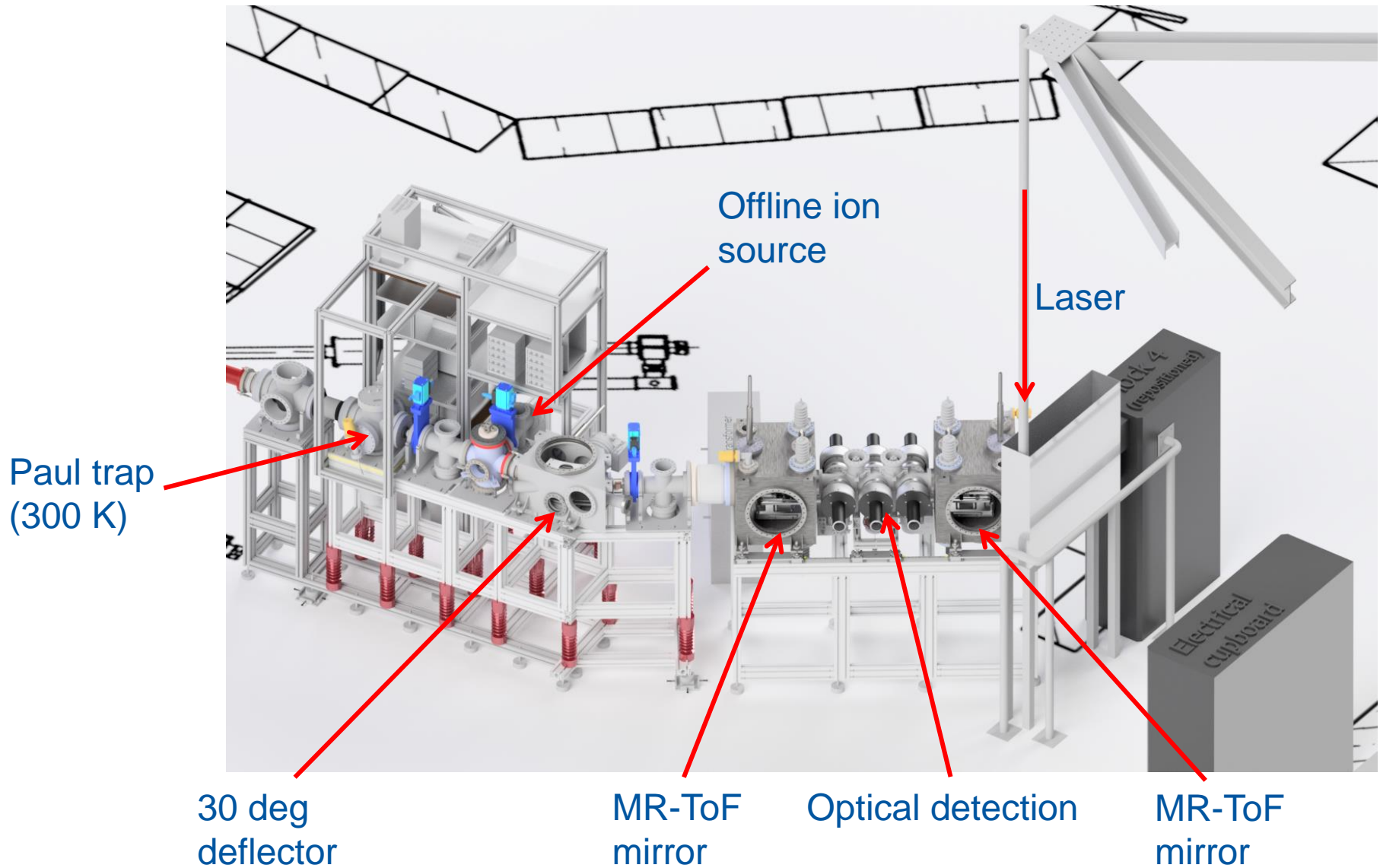
# MR-ToFs in brief

- MR-ToF, Multi-Reflection Time-of-Flight mass spectrometer

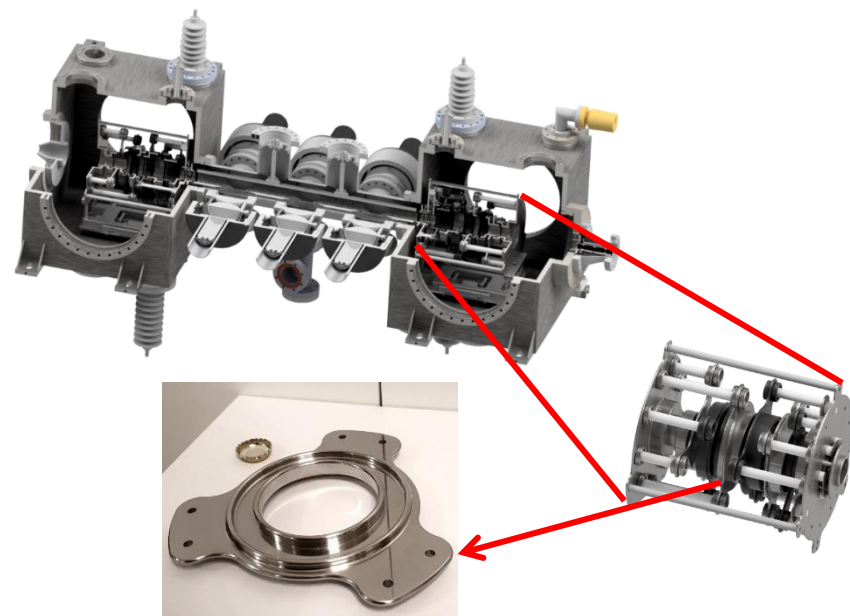
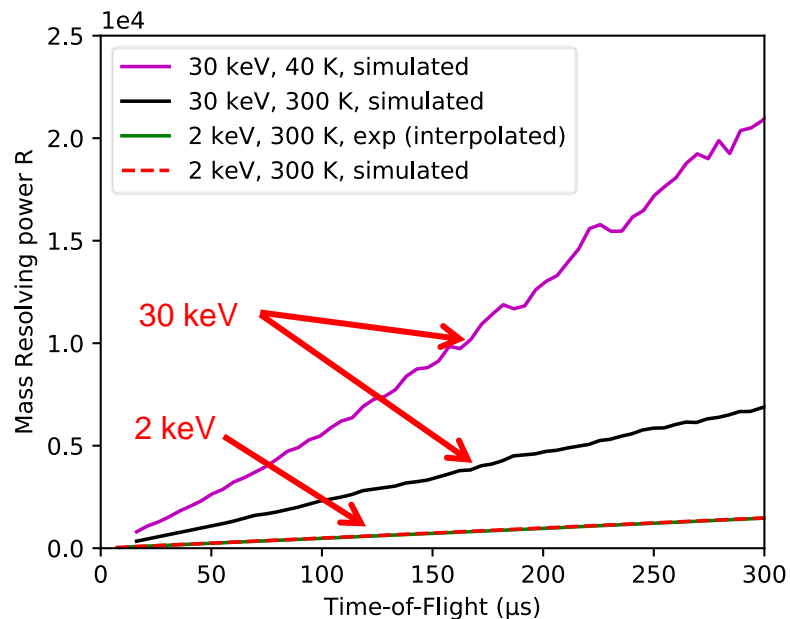


\* Not to scale

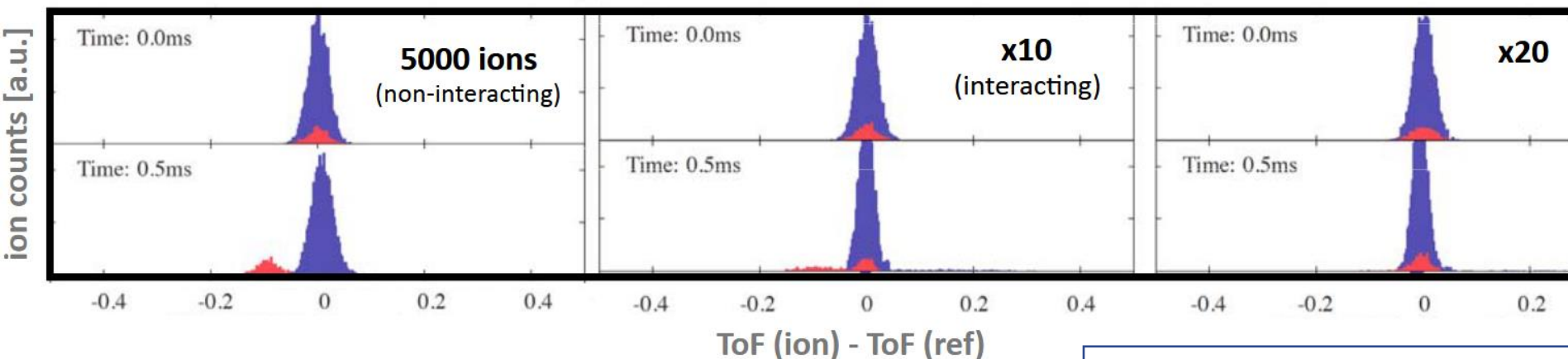
# MIRACLS at LA2



# ISOLDE MR-ToF performance



## Simulation:



*M. Rosenbusch et al., AIP Conf. Proc. 1521, 53 (2013)*

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# Milestones

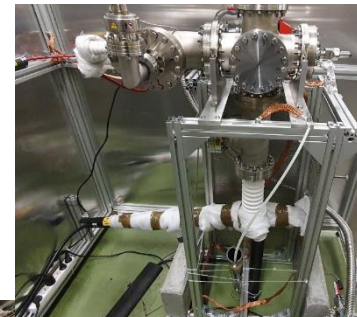
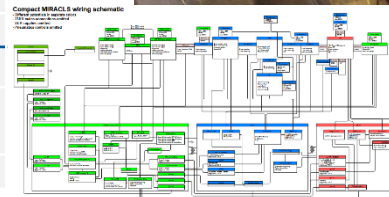
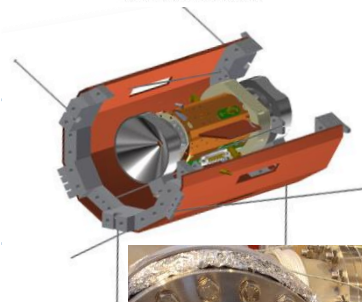
	MIRACLS	ISOLDE MR-ToF	Both
2018			
Proof-of-Principle experiment (PoP) started			X
Simplified 30 keV MR-ToF design functional in simulations			X
2019			
MIRACLS concept validated at the PoP	X		
First simulation benchmarks at the PoP			X
2020			
Cryogenic Paul trap design completed		X	X
300 K Paul trap design completed			X
Preliminary ion optics design (LA2)			X
2021			
Complete system functional in simulations (LA2)			X
Full mechanical and electrical design completed (LA2)			X
Laser access hole drilled from ISOLDE to 508	X		
Paul trap constructed (UHV clean)			X
First optical detection system module constructed	X		
space-charge studies at the PoP		X	
2022			
HV beamline support structure completed (first 'long term' equipment at LA2)			X
Offline ion source operational			X



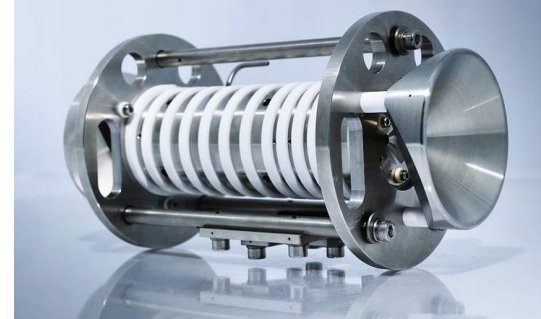
First steps in the development of the Multi Ion Reflection Apparatus for Collinear Laser Spectroscopy

S. Selb<sup>a,\*</sup>, P. Fischer<sup>b</sup>, H. Heylen<sup>c</sup>, V. Lagaki<sup>d,e</sup>, S. Lechner<sup>a,c</sup>, F.M. Maier<sup>a,c</sup>, P. Plattner<sup>d,f</sup>, M. Rosenbusch<sup>g</sup>, F. Wiersholtz<sup>h</sup>, R.N. Wolf<sup>i</sup>, W. Nörtershäuser<sup>j</sup>, L. Schweikhard<sup>k</sup>, S. Mallebnest-Eisenauer<sup>a</sup>

<sup>a</sup>DESY, DESY Experimental Physics Department, DESY DESY 22605 Hamburg, Germany  
<sup>b</sup>James Franck Institute, Universität Göttingen, 37077 Göttingen, Germany  
<sup>c</sup>Physikalisches Institut, Universität Göttingen, 37077 Göttingen, Germany  
<sup>d</sup>Physikalisches Institut, Universität Göttingen, 37077 Göttingen, Germany  
<sup>e</sup>Physikalisches Institut, Universität Göttingen, 37077 Göttingen, Germany  
<sup>f</sup>Physikalisches Institut, Universität Göttingen, 37077 Göttingen, Germany  
<sup>g</sup>Physikalisches Institut, Universität Göttingen, 37077 Göttingen, Germany  
<sup>h</sup>Physikalisches Institut, Universität Göttingen, 37077 Göttingen, Germany  
<sup>i</sup>Physikalisches Institut, Universität Göttingen, 37077 Göttingen, Germany  
<sup>j</sup>Physikalisches Institut, Universität Göttingen, 37077 Göttingen, Germany  
<sup>k</sup>Physikalisches Institut, Universität Göttingen, 37077 Göttingen, Germany



(CERN photo service)



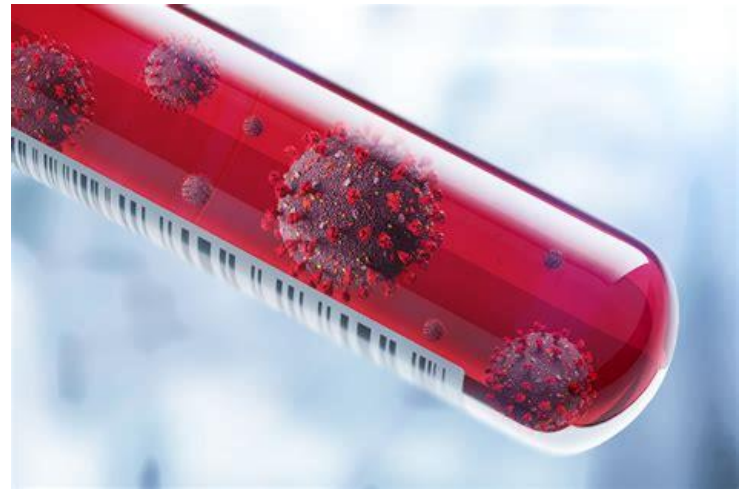
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# MIRACLS: tasks and challenges

## Remaining tasks:

- Construction & commissioning
  - Paul trap commissioning starting
  - HV electronics platform
  - Laser transport system construction
  - Transport beamline construction
  - MR-ToF construction
- Offline testing
- Stable beam from ISOLDE
- First physics

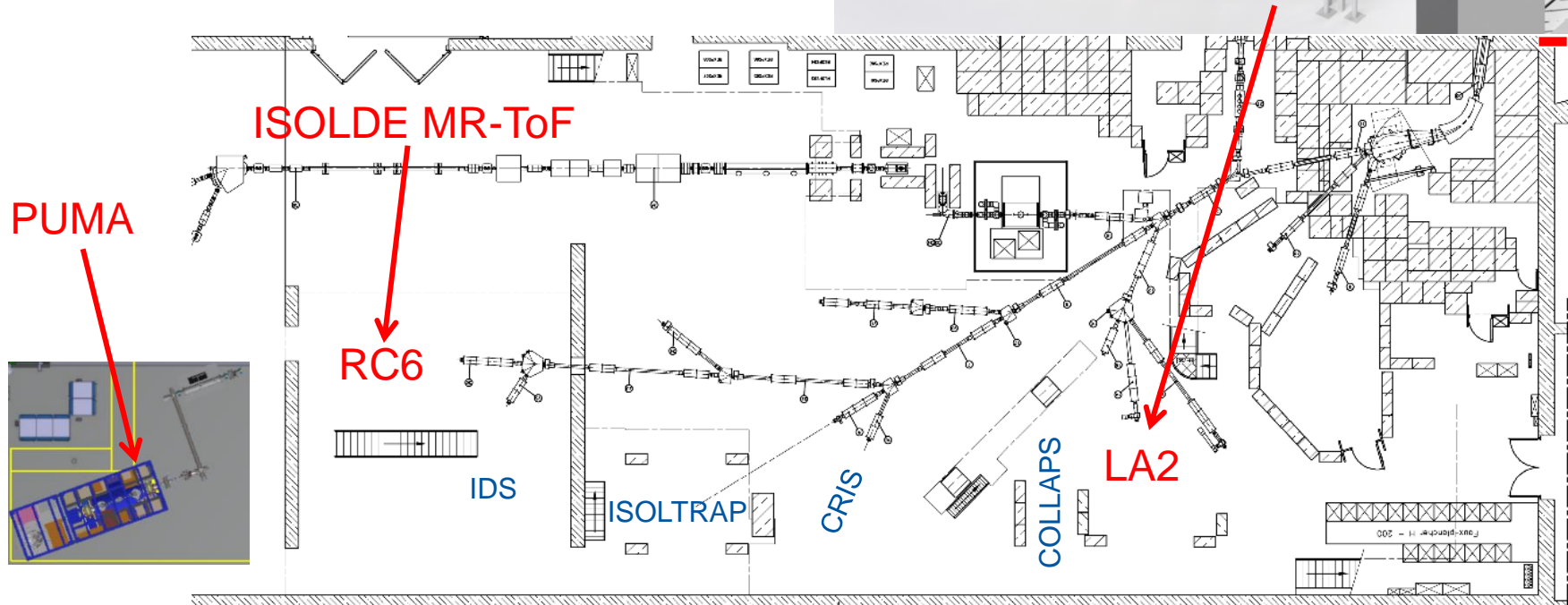
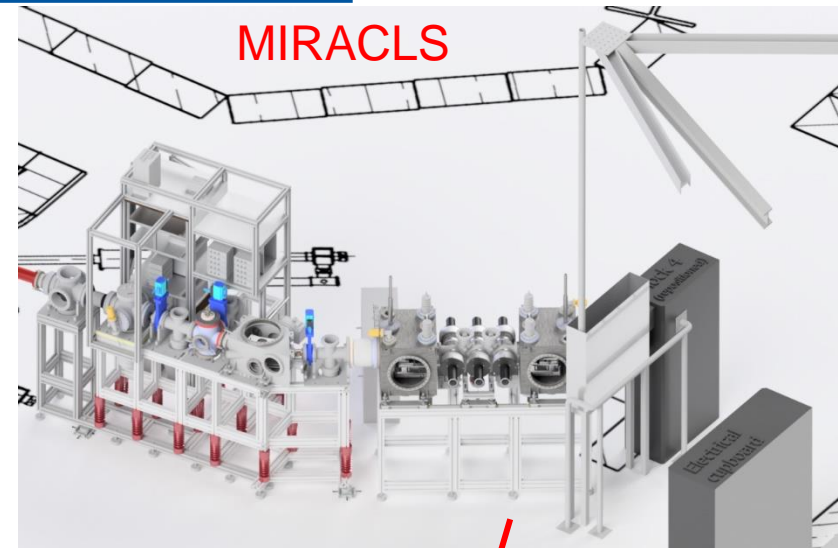


## Challenges:

- Global supply line issues
  - Increased lead times
  - Unexpected delays (up to nine months)
  - Article in Physics Today: Supply-chain issues compound research slowdowns
- Academic employment contracts
  - Repeated training of new personnel
- Local delivery issues
  - Packages lost at CERN for months

# ISOLDE MR-ToF and PUMA

- No downstream experiments at MIRACLs
  - relocate to RC6
    - connect to PUMA and traveling experiments
- RC6 system design options
  1. Maximal reuse of MIRACLs
  2. New and upgraded design



# ISOLDE MR-TOF at RC6, upgraded design

From LA2  
Missing

Switchyard

Field-free  
region

MR-ToF  
mirror

Hard  
extraction

Paul trap  
injection

Switchyard

Offline ion  
source,  
50 kV

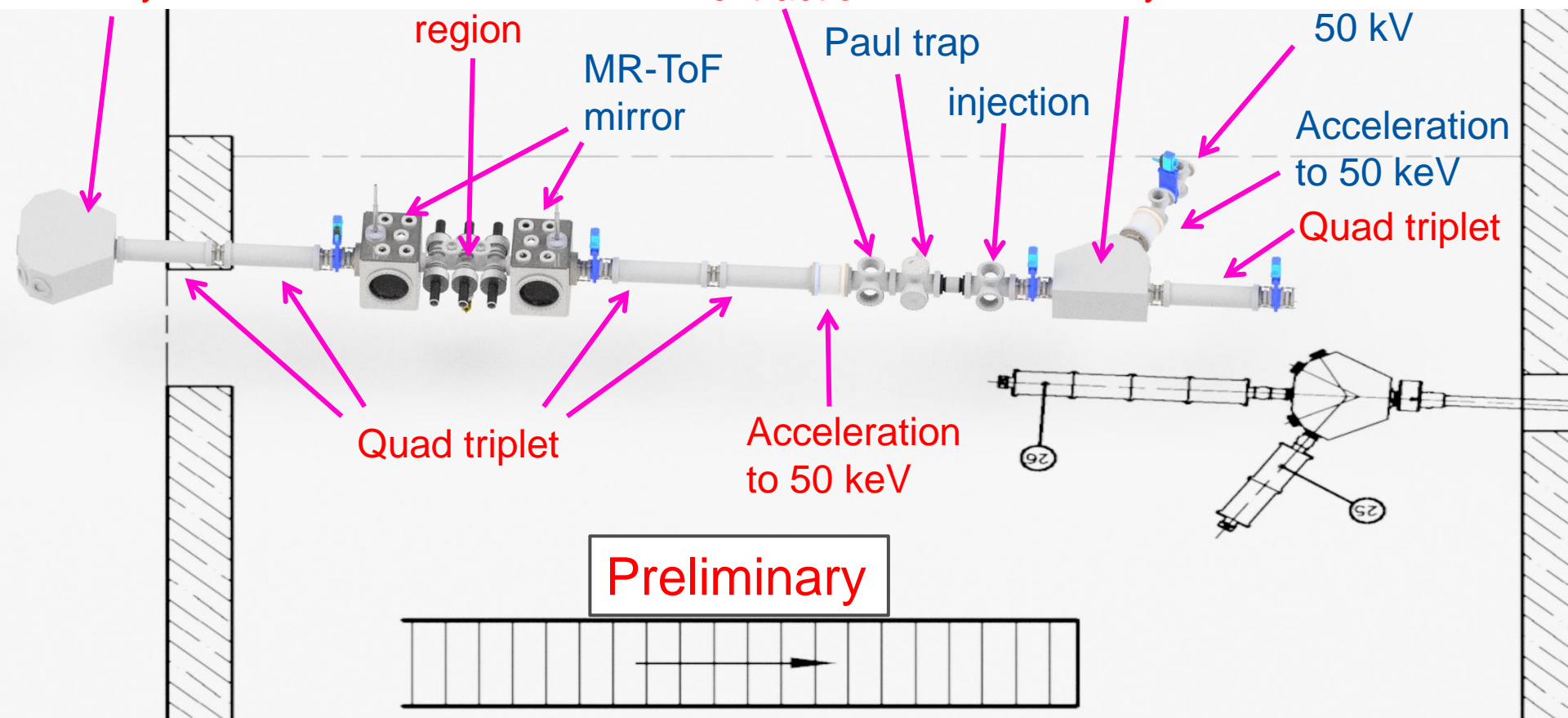
Acceleration  
to 50 keV

Quad triplet

Quad triplet

Acceleration  
to 50 keV

Preliminary



# ISOLDE MR-TOF at RC6, upgraded design

## ➤ Good

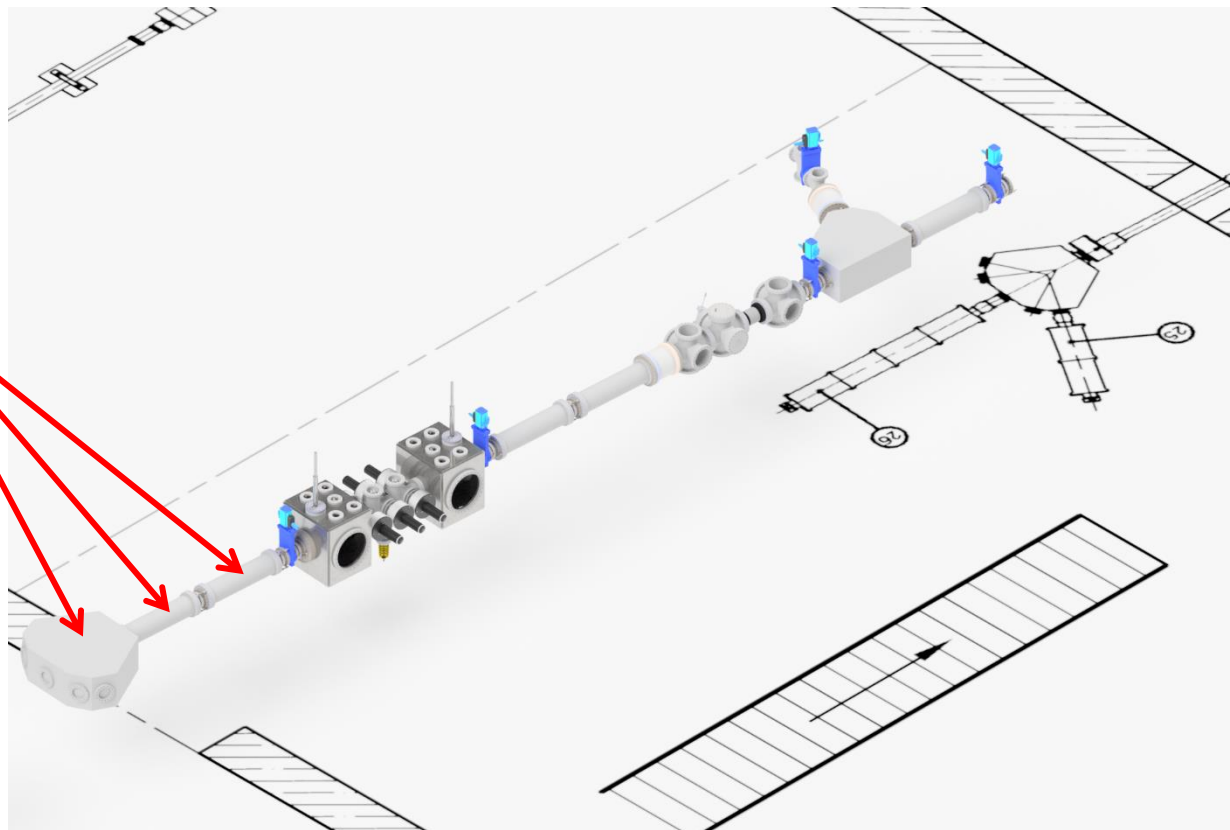
- Performance
- Cryogenic Paul trap?
- Flexible setting for future R&D
- New beamline section needed in any scenario

## ➤ Bad

- More personnel needed
- Higher costs
- Longer timeline

- Refine both plans based on experience at LA2

- Sufficient workforce currently not available



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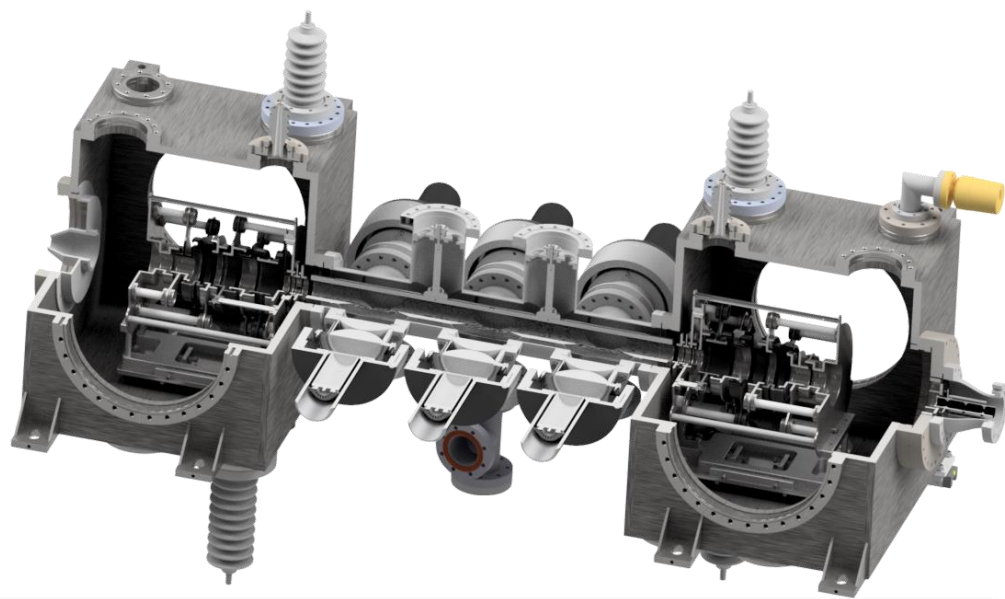
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# Timeline

	2022				2023		
	Q1	Q2	Q3	Q4	Q1	Q2	later
MIRACLS @ LA2							
construction and commissioning							
Online operations							
Tuning for mass separation							
RC6 system design work							
Relocation to RC6							

# Summary

- MIRACLS under construction at LA2
- ISOLDE MR-ToF goal:
  - High-purity beams at improved ion capacity
- Two tentative approaches to integration with PUMA
  - Maximal reuse of MIRACLS components
  - Upgraded design (with cryogenic Paul trap?)
- Timeline
  - First physics in summer 2022
  - ISOLDE MR-ToF in 2023



# Thank you for your attention!

L. Croquette, F. Buchinger, P. Fischer, S. J. Freeman, C.  
Kanitz, S. Lechner, F. Maier, P. Plattner, G. Neyens, W.  
Nörtershäuser, L. Schweikhard, R. Simpson, M. Vilén, F.  
Wienholtz, S. Malbrunot

UNIVERSITÄT GREIFSWALD  
Wissen lockt. Seit 1456



European  
Research  
Council

