

The Cryo-Platform at DESY

A Helmholtz Network of Excellence

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FLC Retreat
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Introduction

- The University of Hamburg is currently preparing applications for excellence clusters in the framework of the excellence initiative
 - One in particle physics: The Quantum Universe
- Helmholtz wants to be part of the Excellence Initiative
 - Call for proposals for „Networks of Excellence“
 - Support excellence cluster proposals with HGF involvement
- 1st phase:
 - 80 kEUR for help in preparing pre-proposal
 - happened 2016, money gone
- 2nd phase:
 - 350 kEUR for support during the main proposal writing
 - Can be spent on almost anything:
 - preparatory scientific work, pre-recruitment, invest/material, coordination, etc.
- 3rd phase:
 - If UHH main proposal is successful:
 - 500 kEUR per two more years (2018/19), 1 MEUR total
 - If main proposal fails:
 - 150 kEUR in 2019
- Has to be a common project UHH/DESY



Ausschreibung vom 14. März 2017

Helmholtz Exzellenznetzwerke (Säule 2a)

gefördert aus dem Impuls- und Vernetzungsfonds des Präsidenten

Wissenschaftspolitischer Rahmen und Fokus der Ausschreibung

Für die Zusammenarbeit mit strategisch wichtigen Partnern wird die Helmholtz-Gemeinschaft künftig die effektivsten Kooperationsformate gezielter einsetzen. Hier sind die Universitäten für die Helmholtz-Gemeinschaft die wichtigsten Partner, neben anderen qualifizierten Institutionen im nationalen und internationalen Wissenschaftssystem und aus der Wirtschaft.

Network of Excellence for QU

- Discussions between FH and QU members on what could be done
- Discussed:
 - Detector-related YIG
 - not really unique for the idea of this cluster, fits better into QU main proposal
 - funding scheme problematic, 1y/3y
 - „Big“ infrastructure
 - is a selling point for Helmholtz
 - is something the UHH cannot do so easily
- Decided on infrastructure:
 - the Cryo Platform at DESY
 - cryogenic infrastructure for QU related experiments
 - linked to ALPS-II (which will happen)
 - liquid He supplies for possible QU experiments
 - create a common platform for „smaller“ in-house experiments with cryogenics

The Cryo Platform Proposal at DESY

- Centre is the HERA North Hall
 - Location is defined by synergies with ALPS-II
 - ALPS-II has to be in HERA North section because
 - no cryo connection possible to HERA-South anymore
 - in HERA-West ALPS-II would extend to HERA beam dump site - very problematic radiation conditions
- Re-start the cryo line from the DESY cryo plant (near HERA-West) to HERA-North
 - anyhow needed for ALPS-II
- Provide distributed cold gas infrastructure in the H1 hall for up to three users:
 - MADMAX (see dedicated talk)
 - cold mirror setup (connected to gravitational wave R&D)
 - other users like KOMAG 5T magnet
- NB: Platform will only provide cryo connections, not additional user infrastructure
- Start with liquid He (4K, 2K), maybe other cold gases later
- Create a common research platform

Proposal

- Edited by Thomas, Marcel, KB
- Many inputs from UHH and QU workers
- Letter of support from UHH president

- Submitted mid of October
- Approved by Helmholtz first week of November
 - that was fast...

- Project starts 1.1.2018

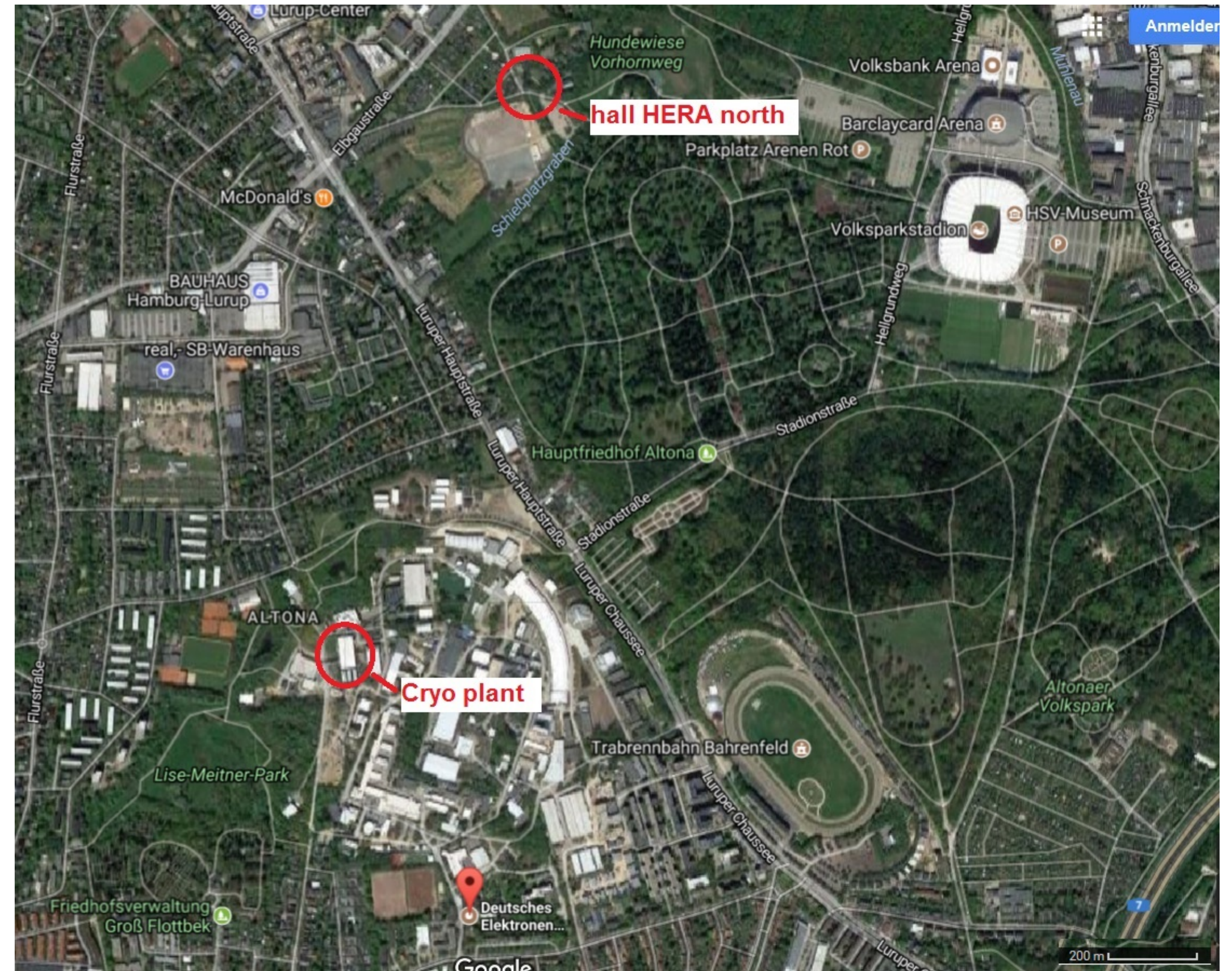
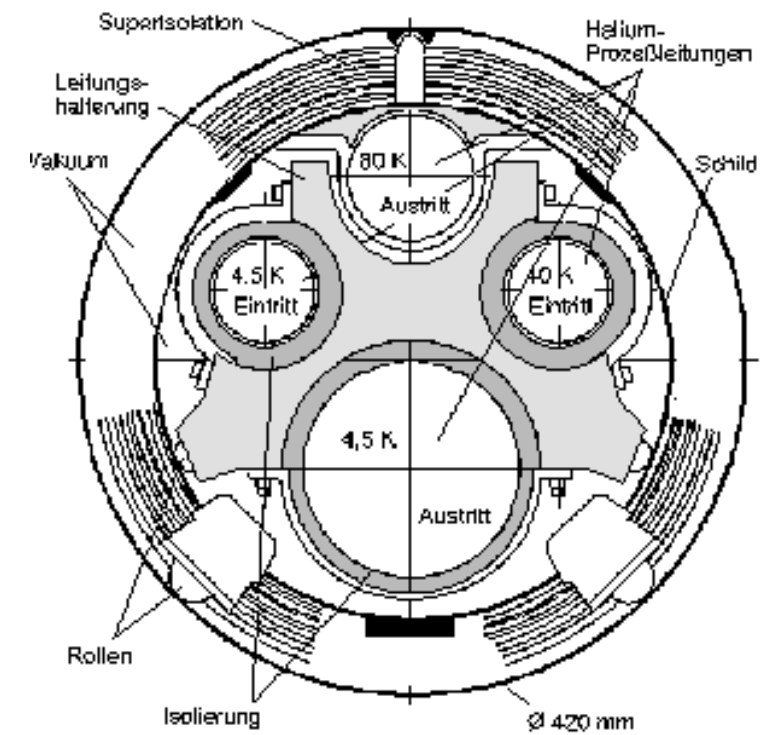
Antrag auf Förderung eines *Helmholtz-Exzellenznetzwerks*
**A CRYOGENIC PLATFORM FOR COLD EXPERIMENTS
AND DETECTOR DEVELOPMENT AT DESY**

Associated DFG Cluster of Excellence proposal:
Quantum Universe
**Understanding mass and gravity at the interface between
quantum physics and cosmology**

Proposing Helmholtz Center	DESY
Leading University	Universität Hamburg (UHH)
Further Partners of the Cluster	-
Helmholtz Research Area	Matter
Relevant Helmholtz Programs	Matter and the Universe, Matter and Technologies
Names of Helmholtz PIs	(see list in section 6)
5 - 10 Keywords	“Quantum Universe”, cryogenic platform, particle physics, gravitational waves, particle detector development
Contact Person (Name, Phone , Email)	Prof. Dr. Joachim Mnich DESY Director for Particle & Astroparticle Physics +49 40 8998 1921, joachim.mnich@desy.de
Cluster of Excellence spokespersons	Prof. Dr. Jan Louis Universität Hamburg +49 40 42838 4476, jan.louis@uni-hamburg.de Prof. Dr. Peter Schleper Universität Hamburg +49 40 8998 2957, peter.schleper@uni-hamburg.de Prof. Dr. G��rldine Servant DESY and Universit��t Hamburg +49 40 8998 1484, geraldine.servant@desy.de
Proposal geared towards Phase 2 or 3	Phase 2

Cryo Infrastructure

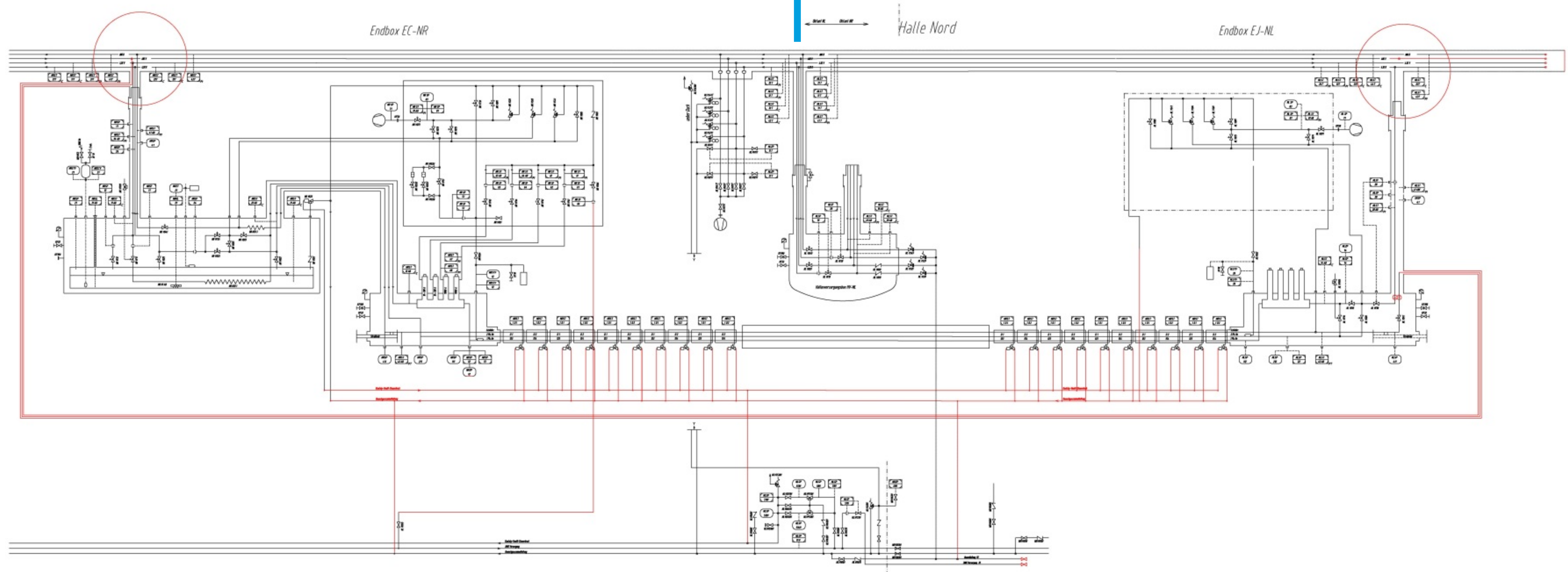
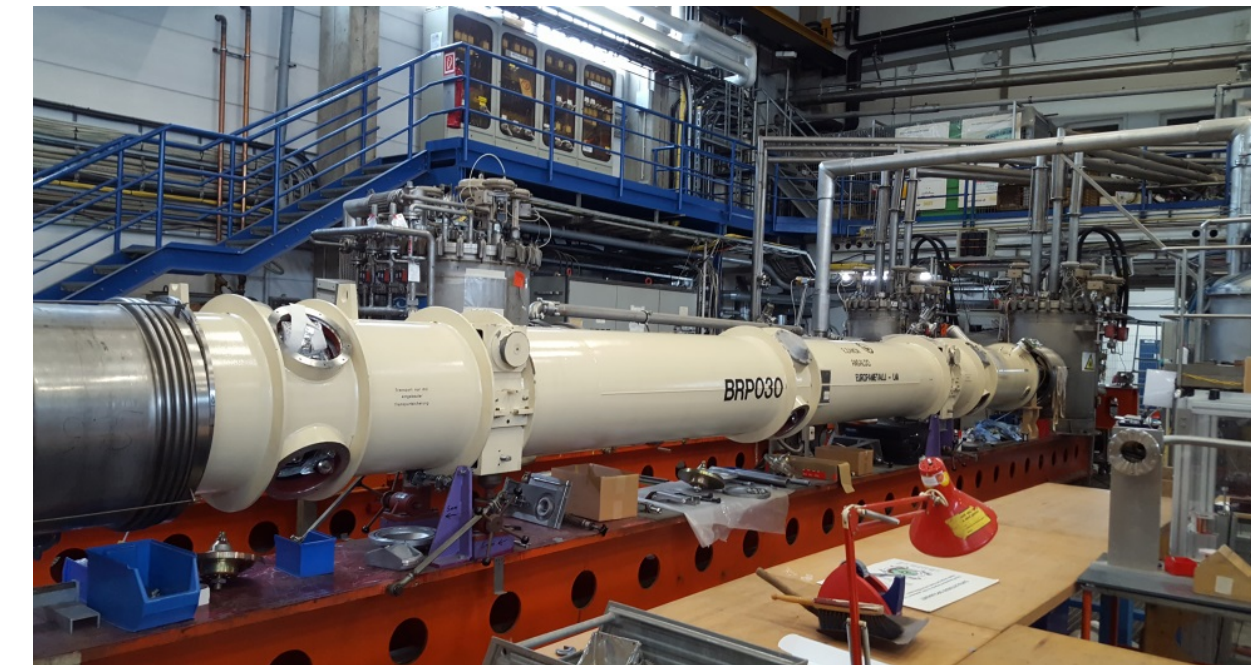
- Existing Cryoplant on DESY site
 - built for HERA
 - then used for FLASH, AMTF
 - re-furbished for XFEL
- Existing Cryoline to HERA-North



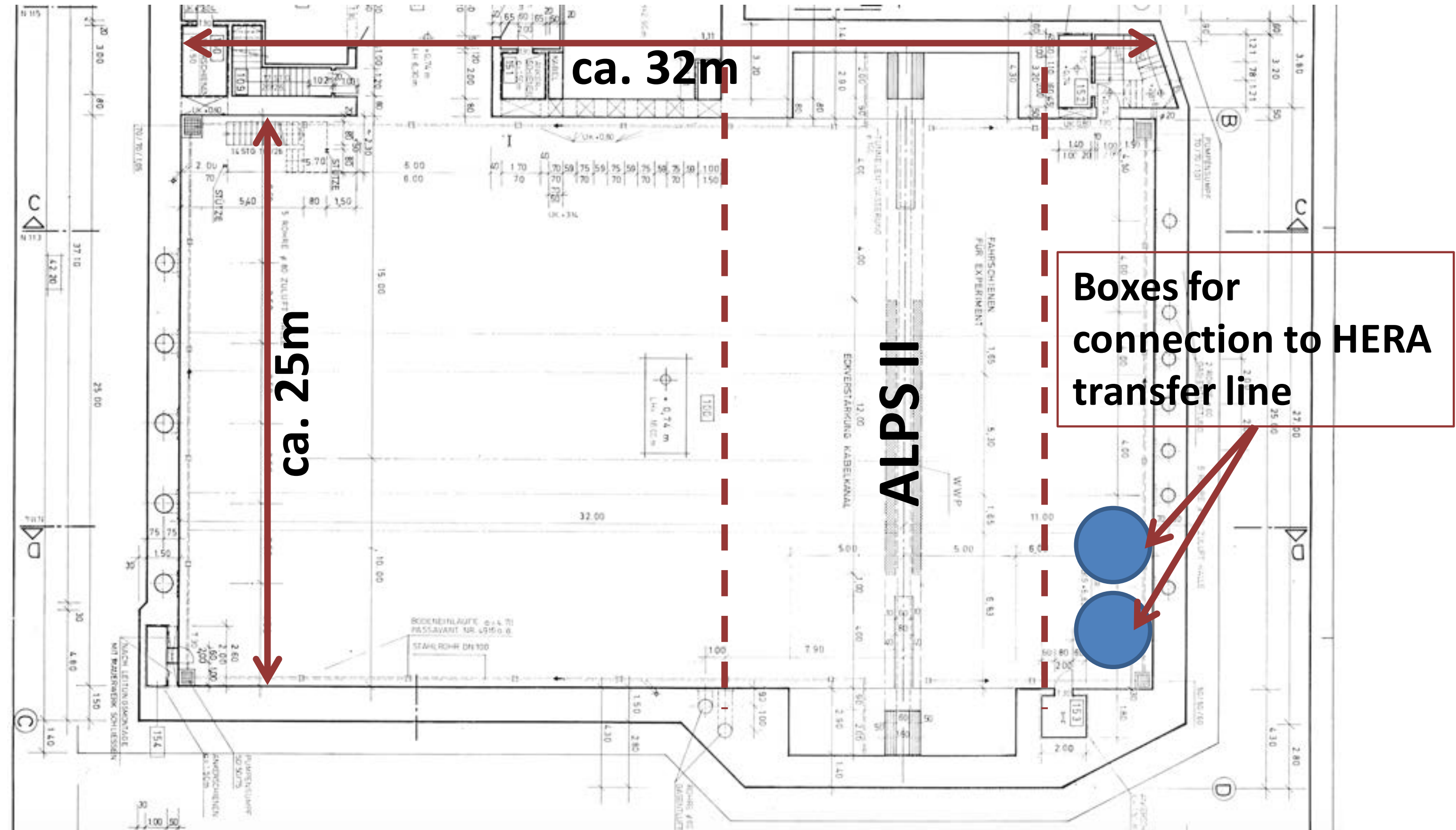
ALPS-II Cryogenics

- Details being worked out

HERA North

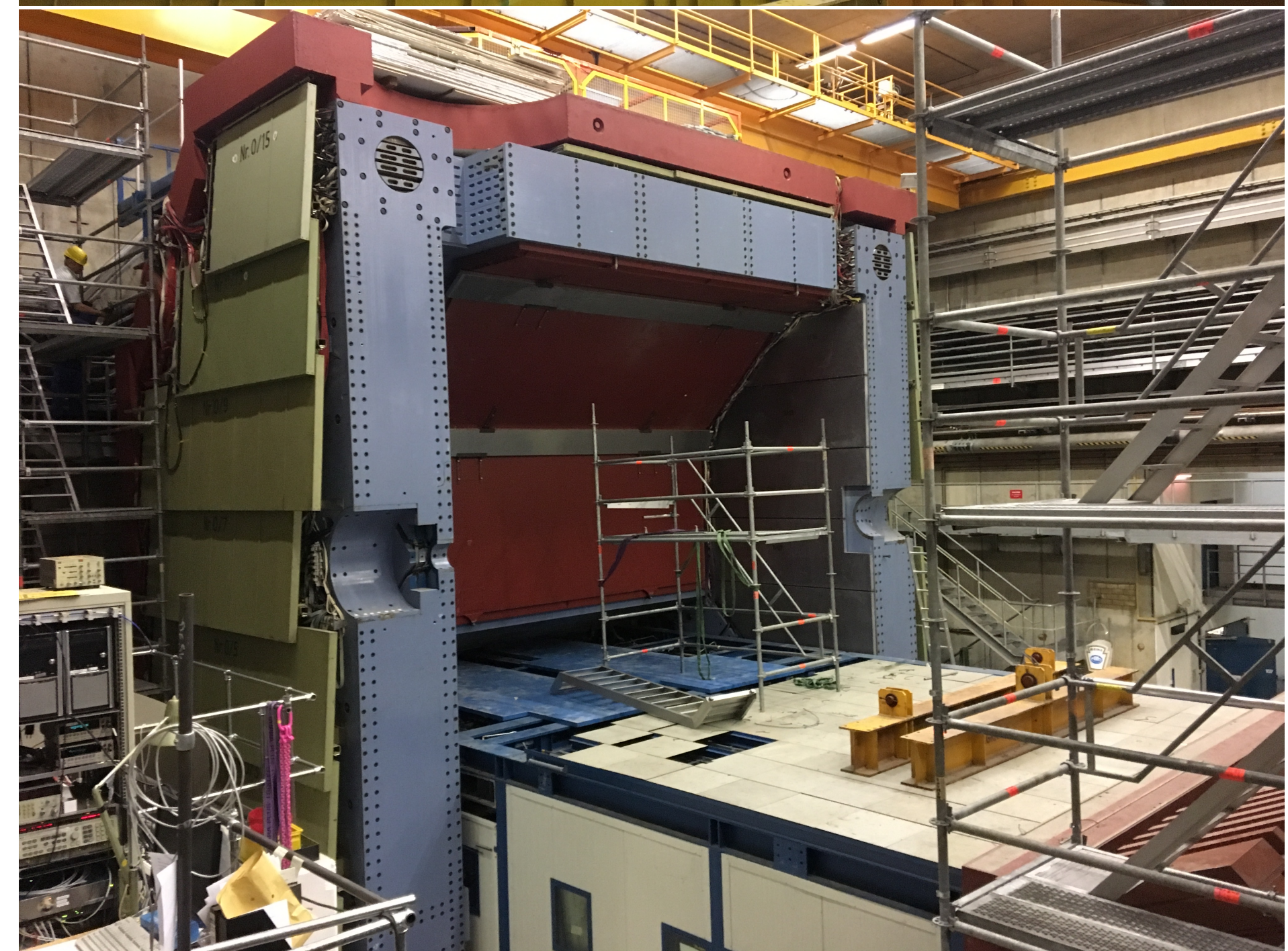


HERA-North Cryogenics



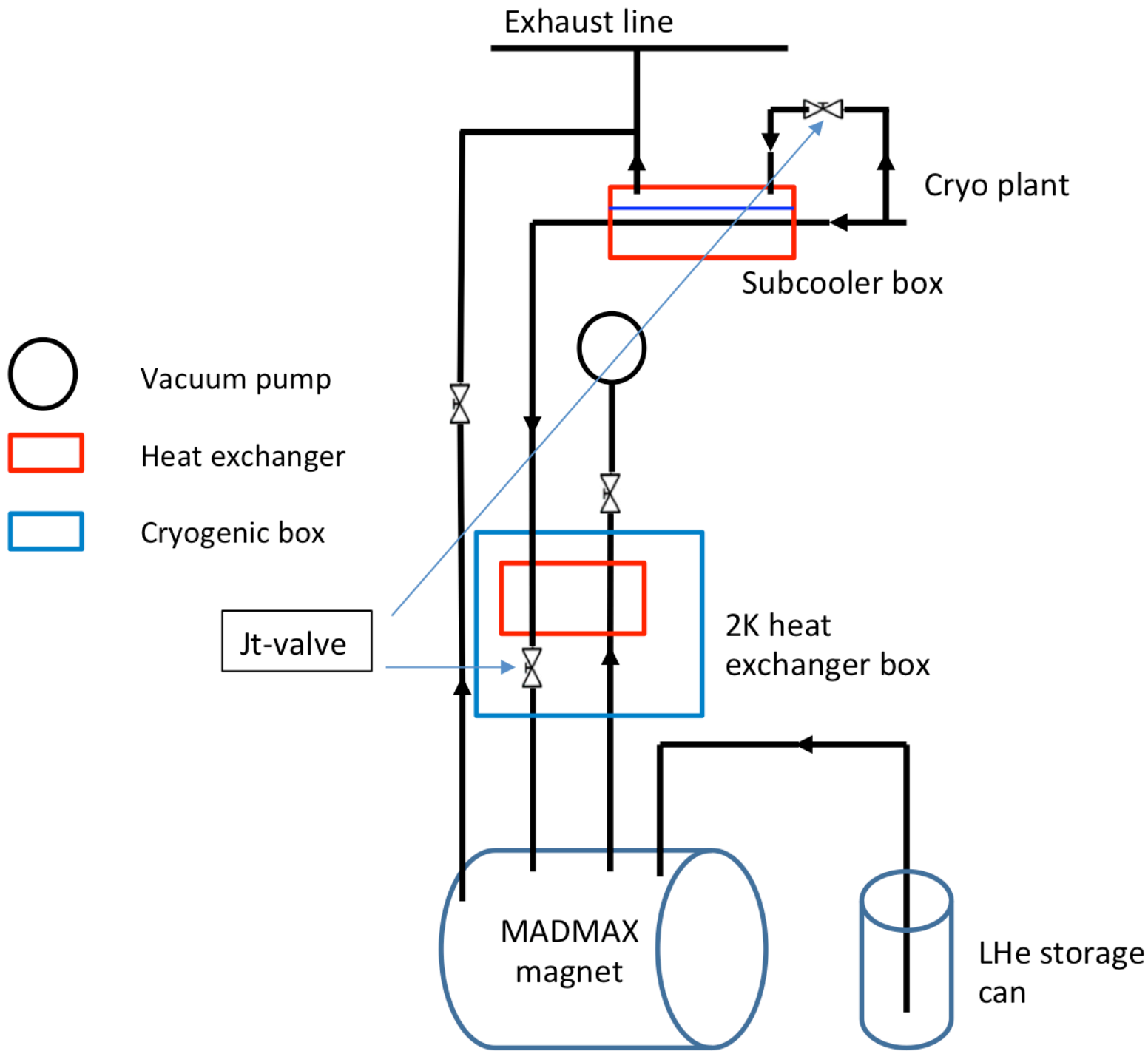
HERA-North Infrastructure

- HERA-North hosted H1
- A lot of useful infrastructure still exists:
 - H1 yoke (see MADMAX talk)
 - but magnet will go
 - Counting rooms with electronic racks, etc.
 - Cranes, workshop, cooling water, HVAC, etc.

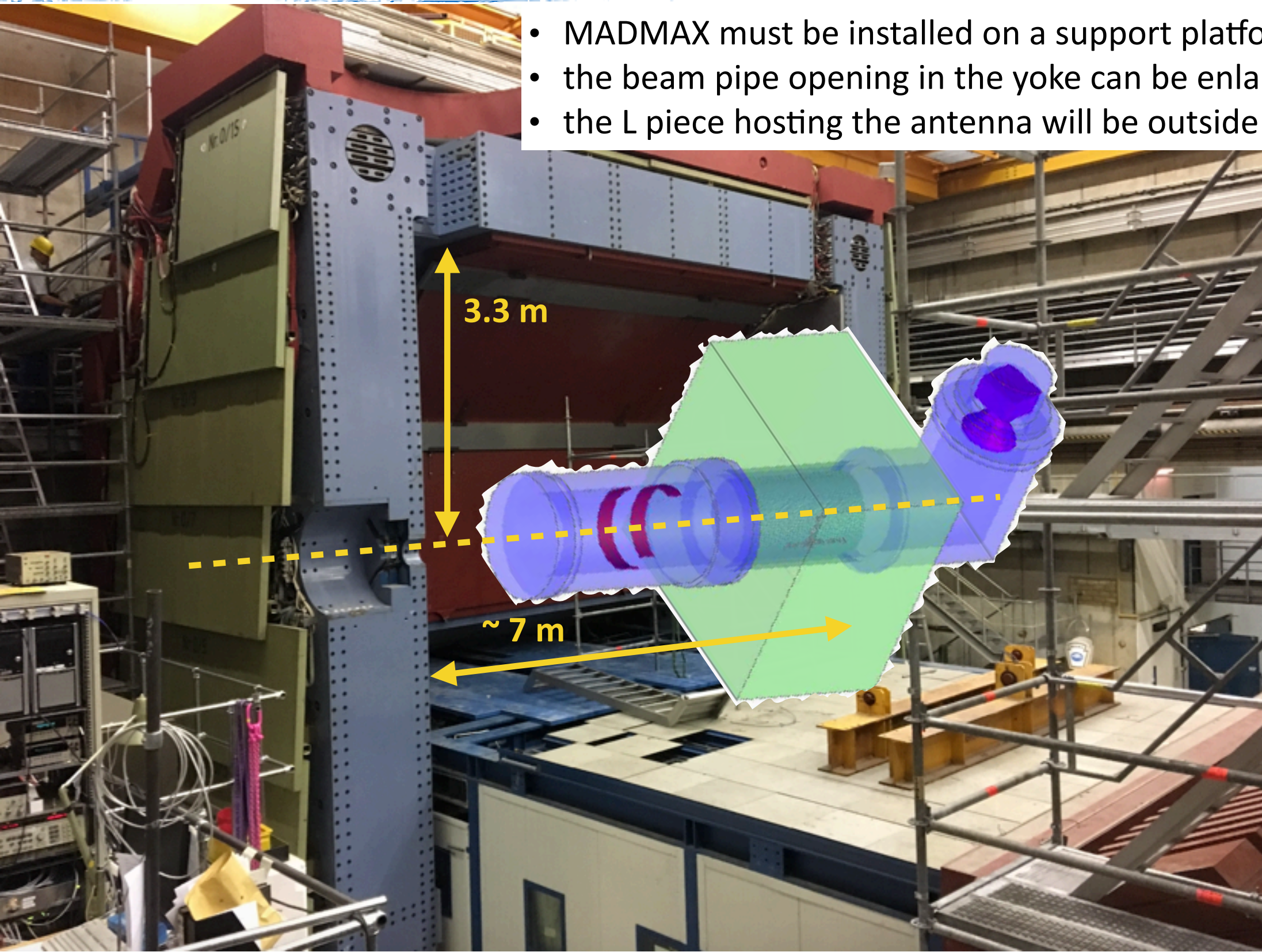


Cryo Platform User Examples: MADMAX

- MADMAX Magnet Infrastructure

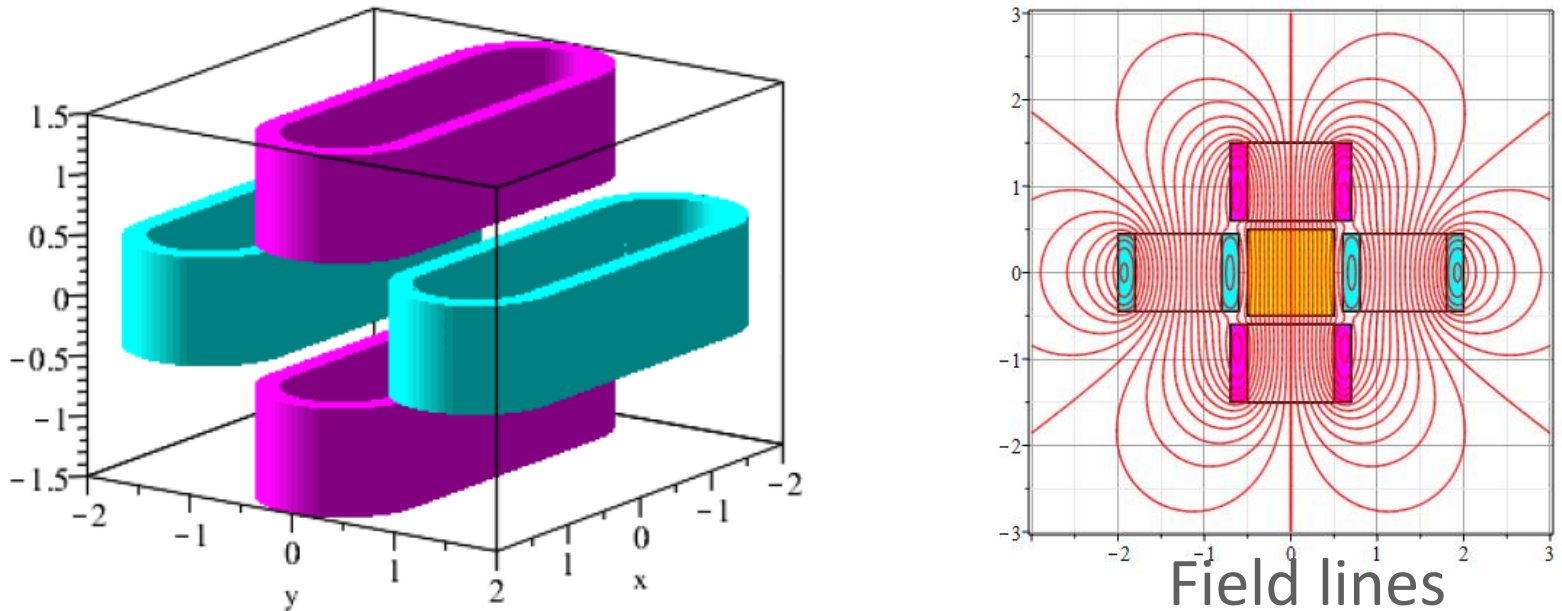


E. Garutti



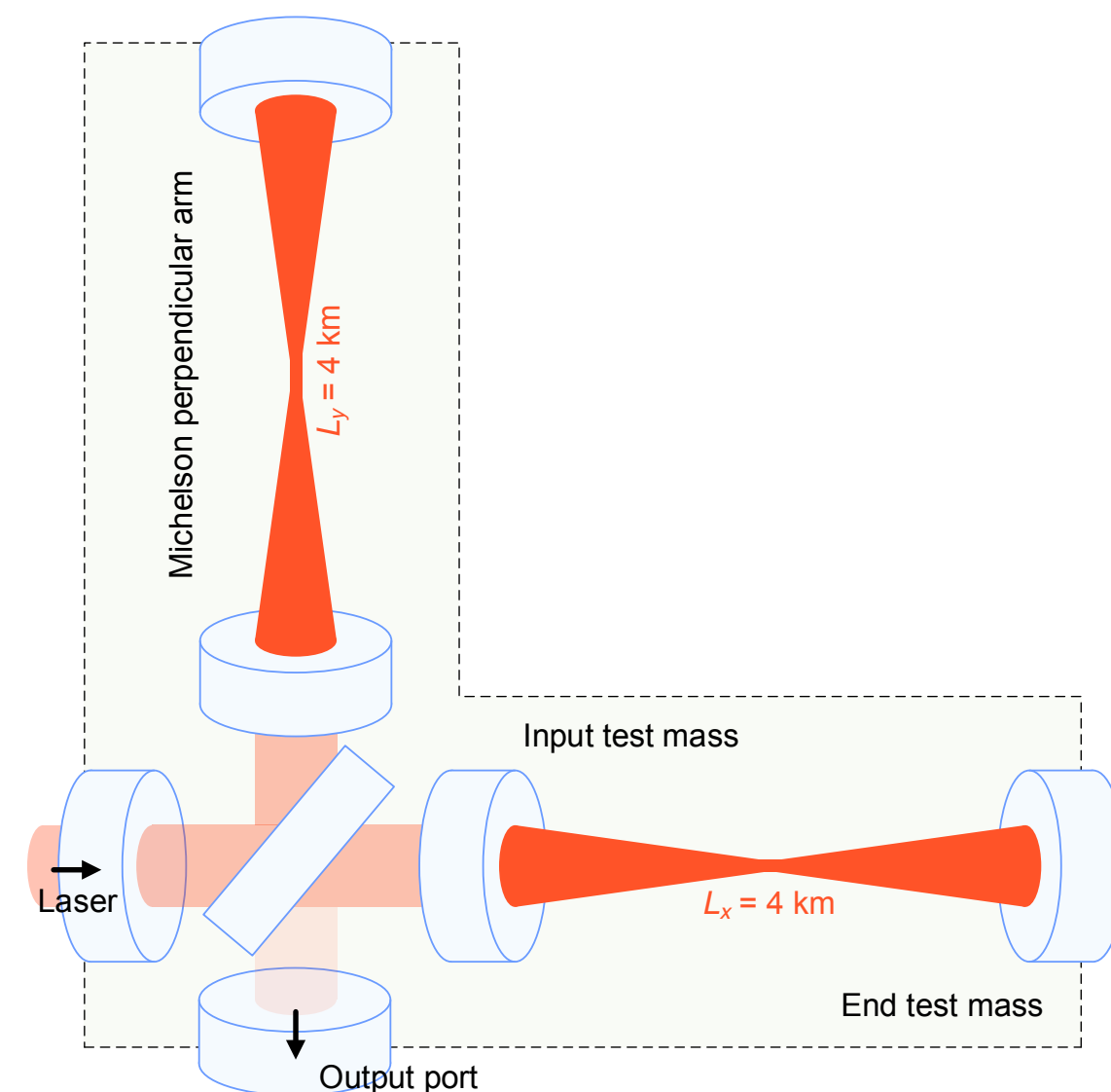
- MADMAX must be installed on a support platform
- the beam pipe opening in the yoke can be enlarged
- the L piece hosting the antenna will be outside the yoke

Figure 1: Schematics of cryogenics connections and installations for an example experiment (“MADMAX”).

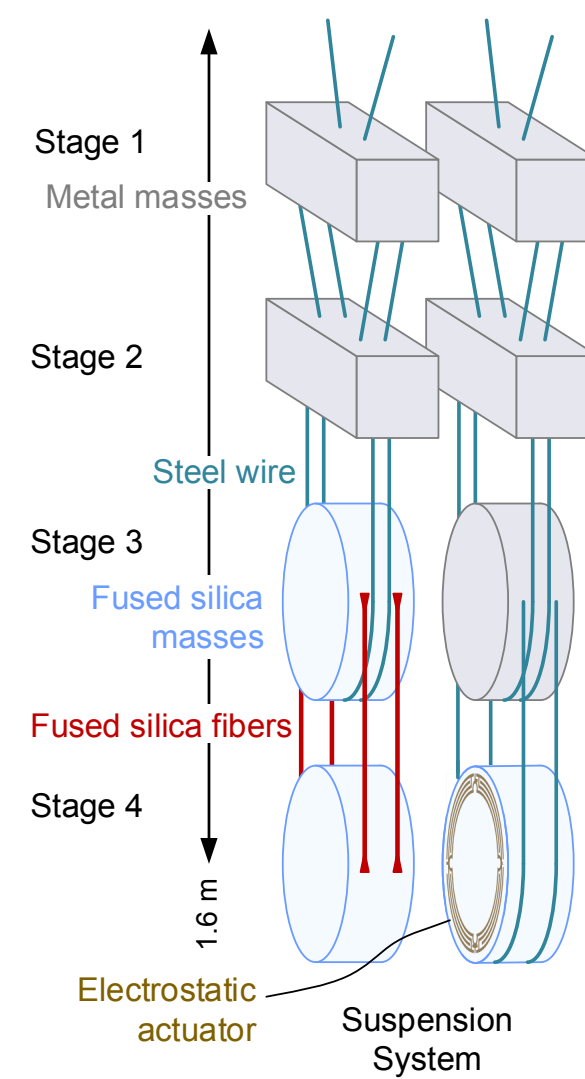


Cryo Platform User Examples: Cold Mirrors

- Thermal noise of mirrors and suspensions is a large source of systematic errors in gravitational wave experiments
- R&D on cryogenic mirrors is being pushed forward for LIGO upgrades, Einstein Telescope, KAGRA, etc.
- Problems: cold mirrors in vacuum being heated by powerful lasers...

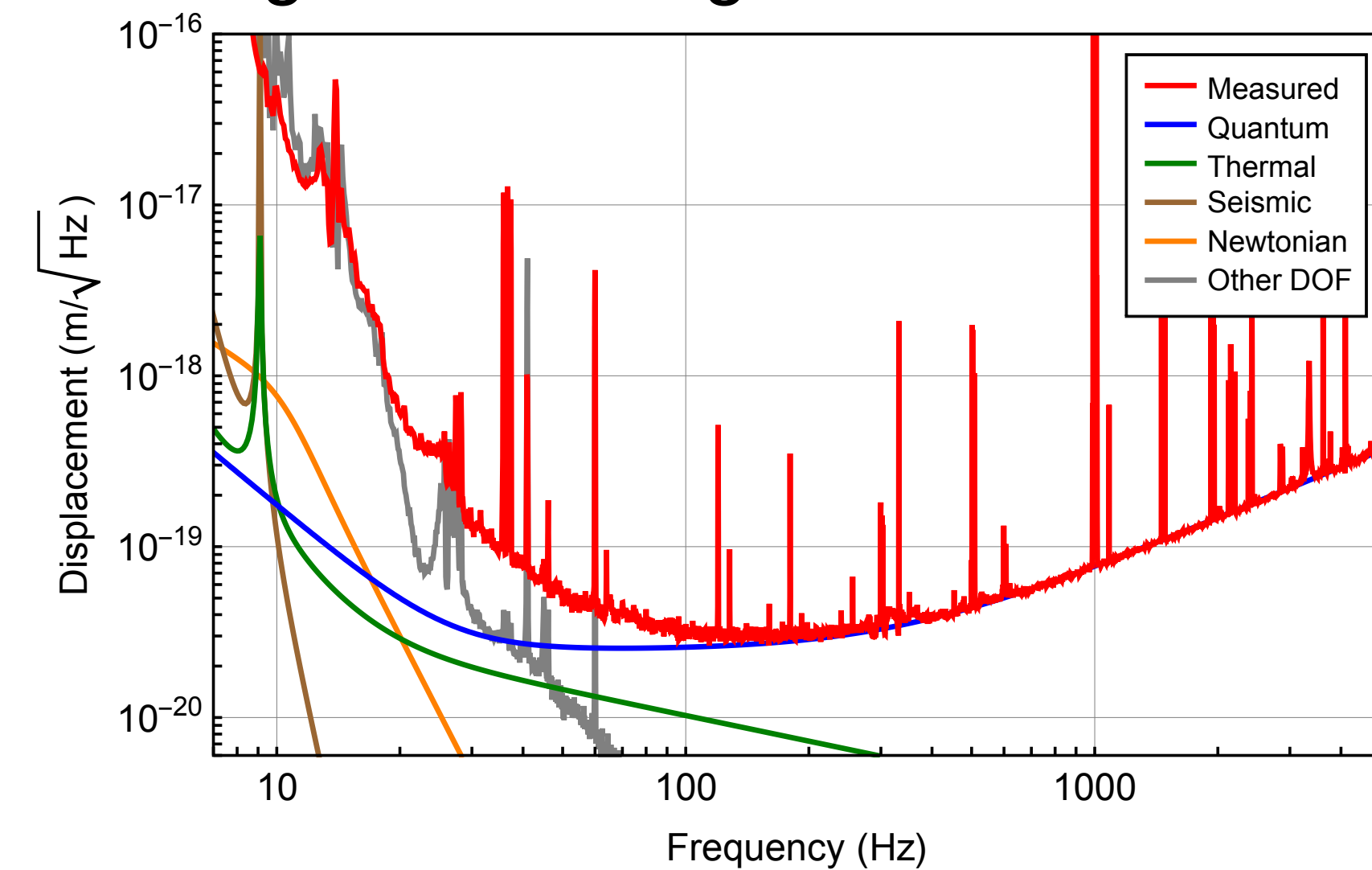


B.P. Abbott et al., arXiv 1602.03838

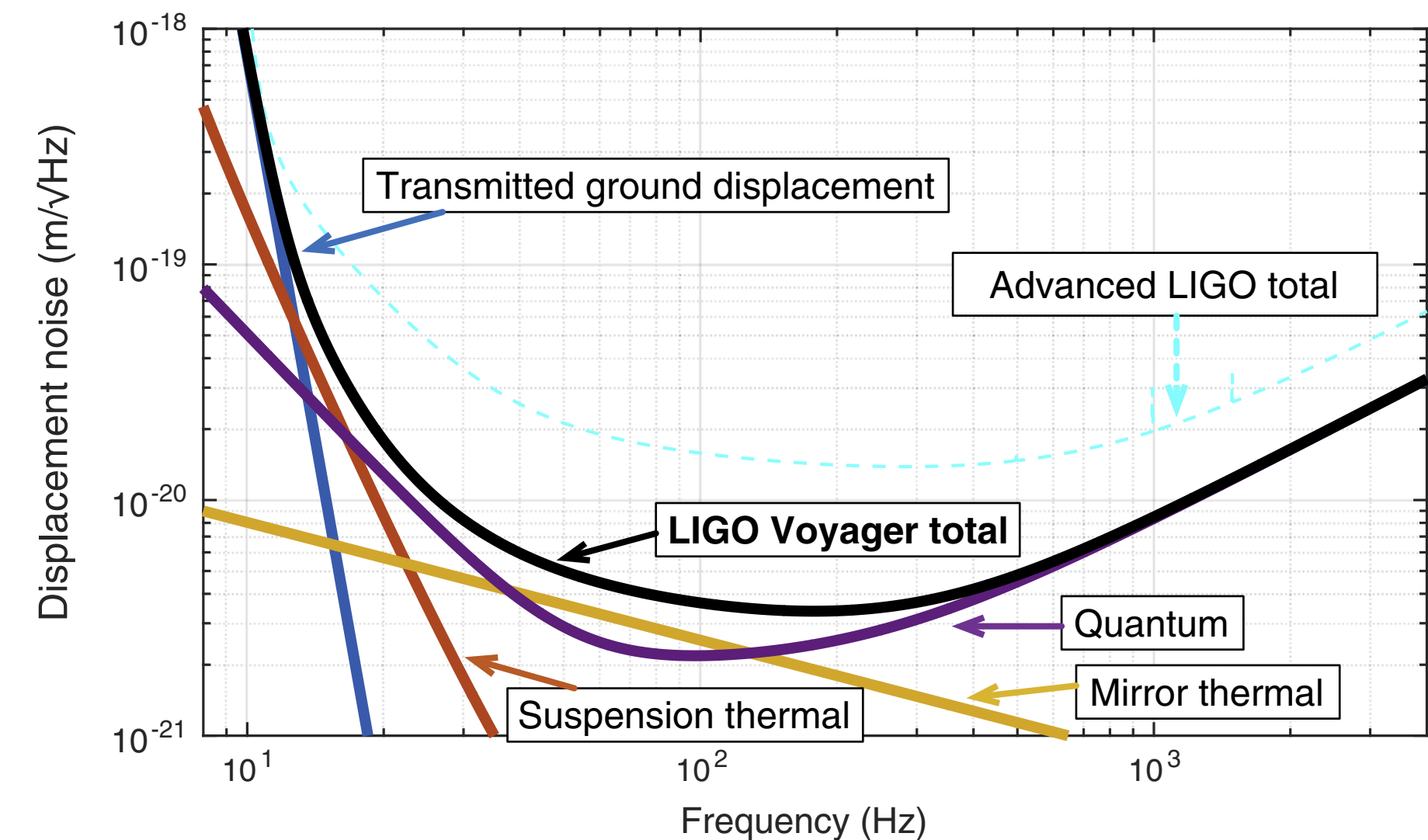


Ligo noise budget

B.P. Abbott et al., PRL 116, 061102 (2016)



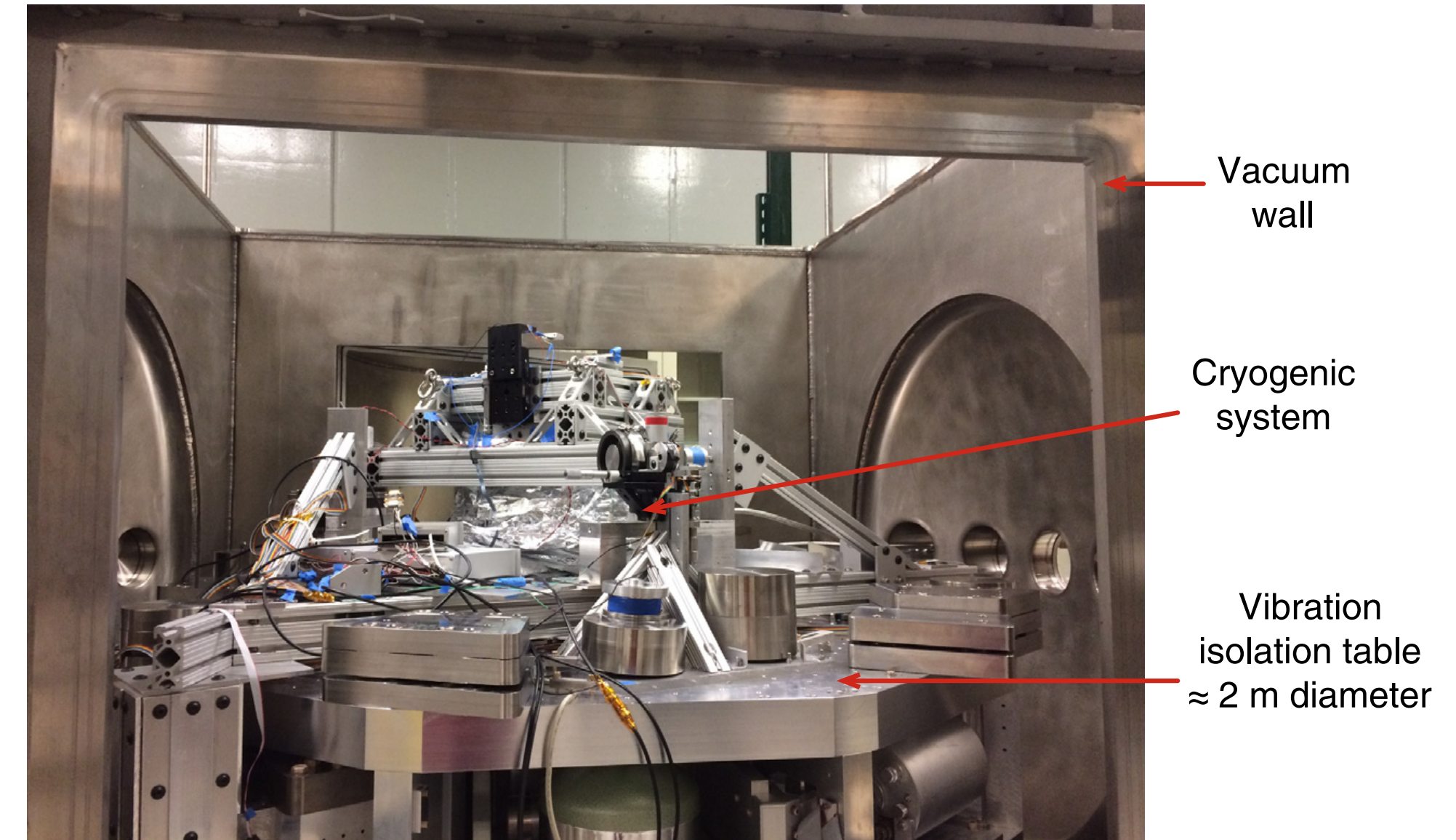
Predicted Ligo Voyager noise budget



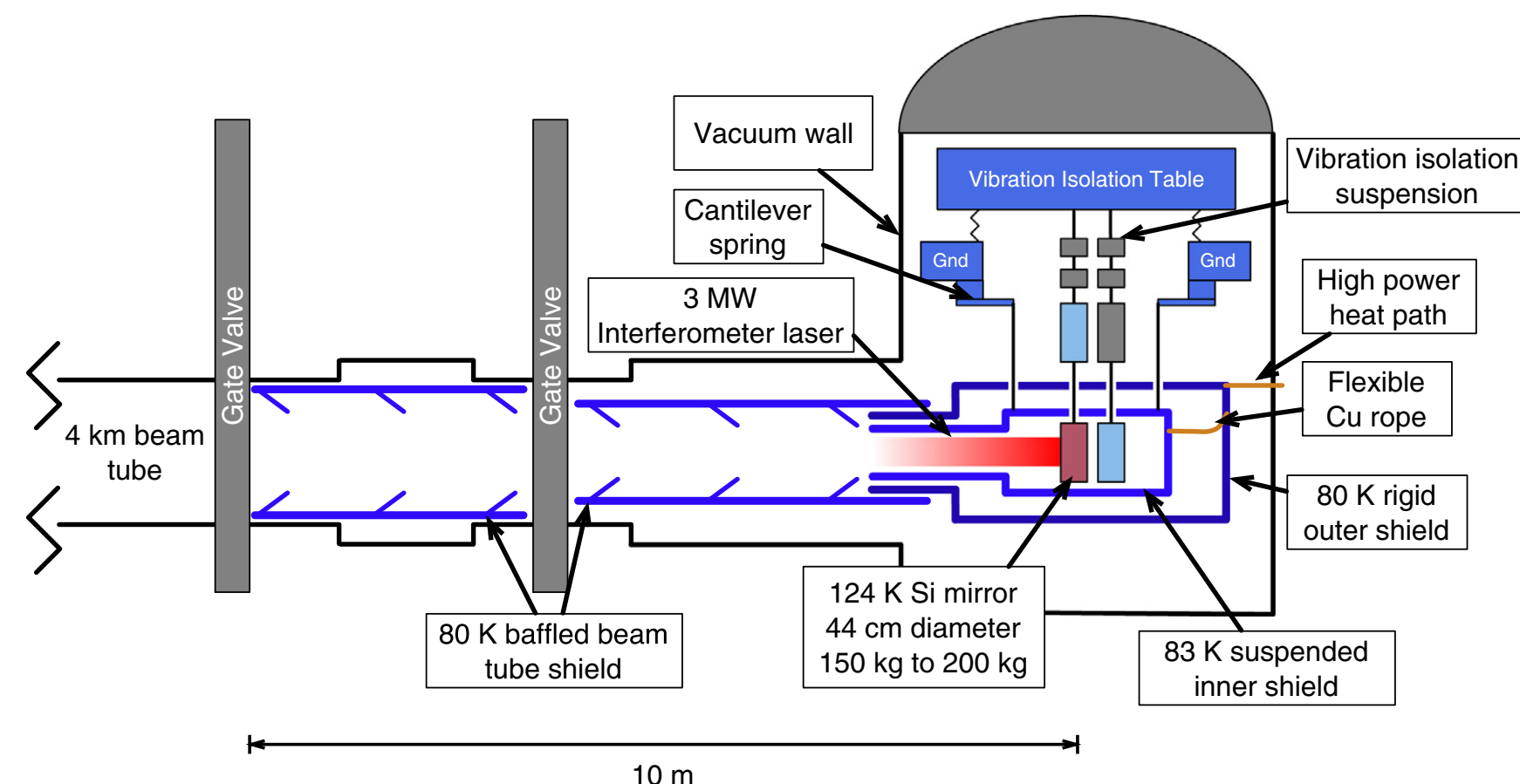
B. Shapiro et al., Cryogenics 81 (2017) 83-92

Cold Mirror R&D

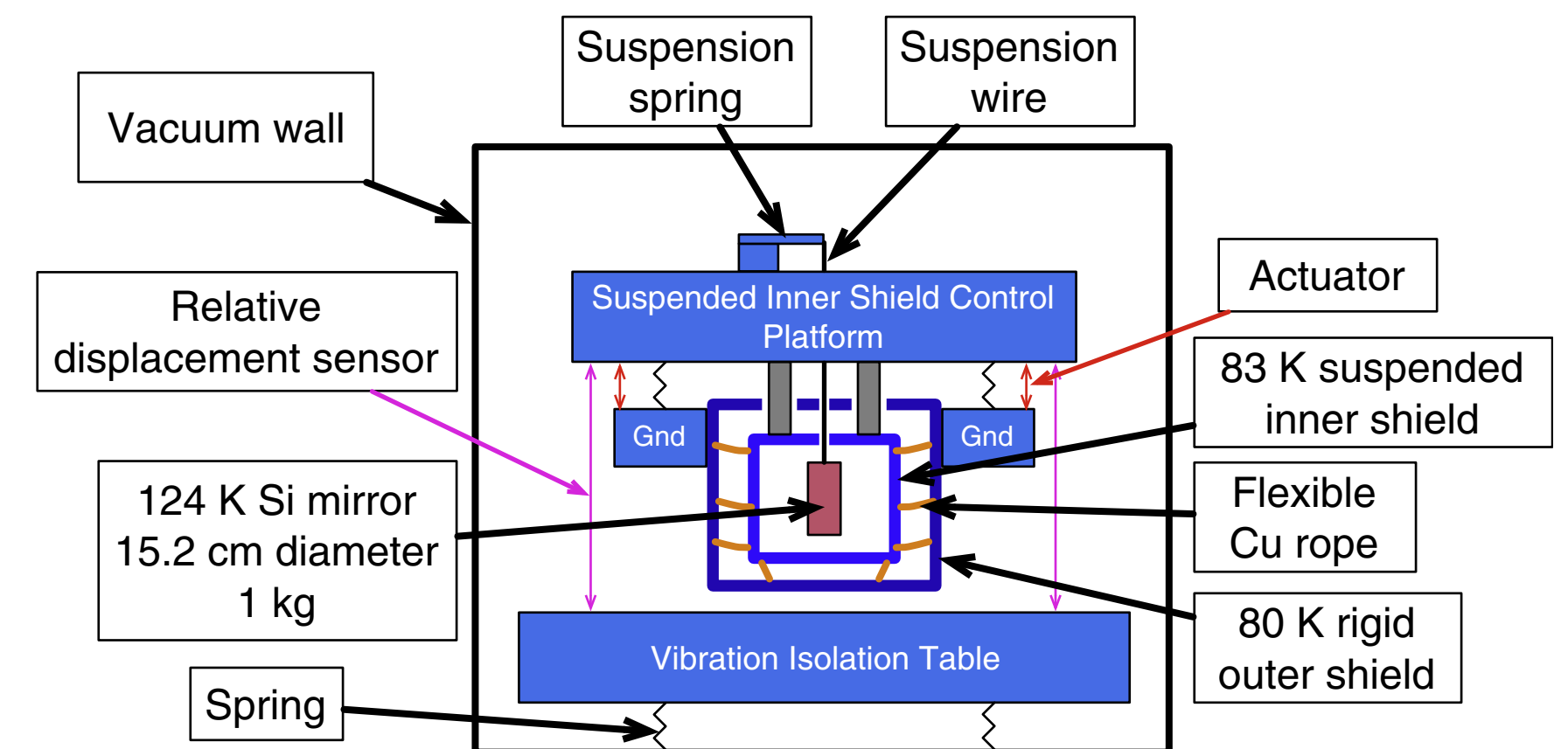
- R&D on cold mirrors is being pursued, e.g. at Stanford
- Biggest challenges:
 - keep vibration from cryogenic infrastructure under control
 - vacuum system design (laser/cryo)
 - cool-down times
- UHH (Roman Schnabel) plans cold mirror R&D in QU proposal
- Cryo Platform would provide the infrastructure
 - DESY plans to start a modest involvement in the science as well (YIG, if QU is successful)



Stanford Cold Mirror R&D



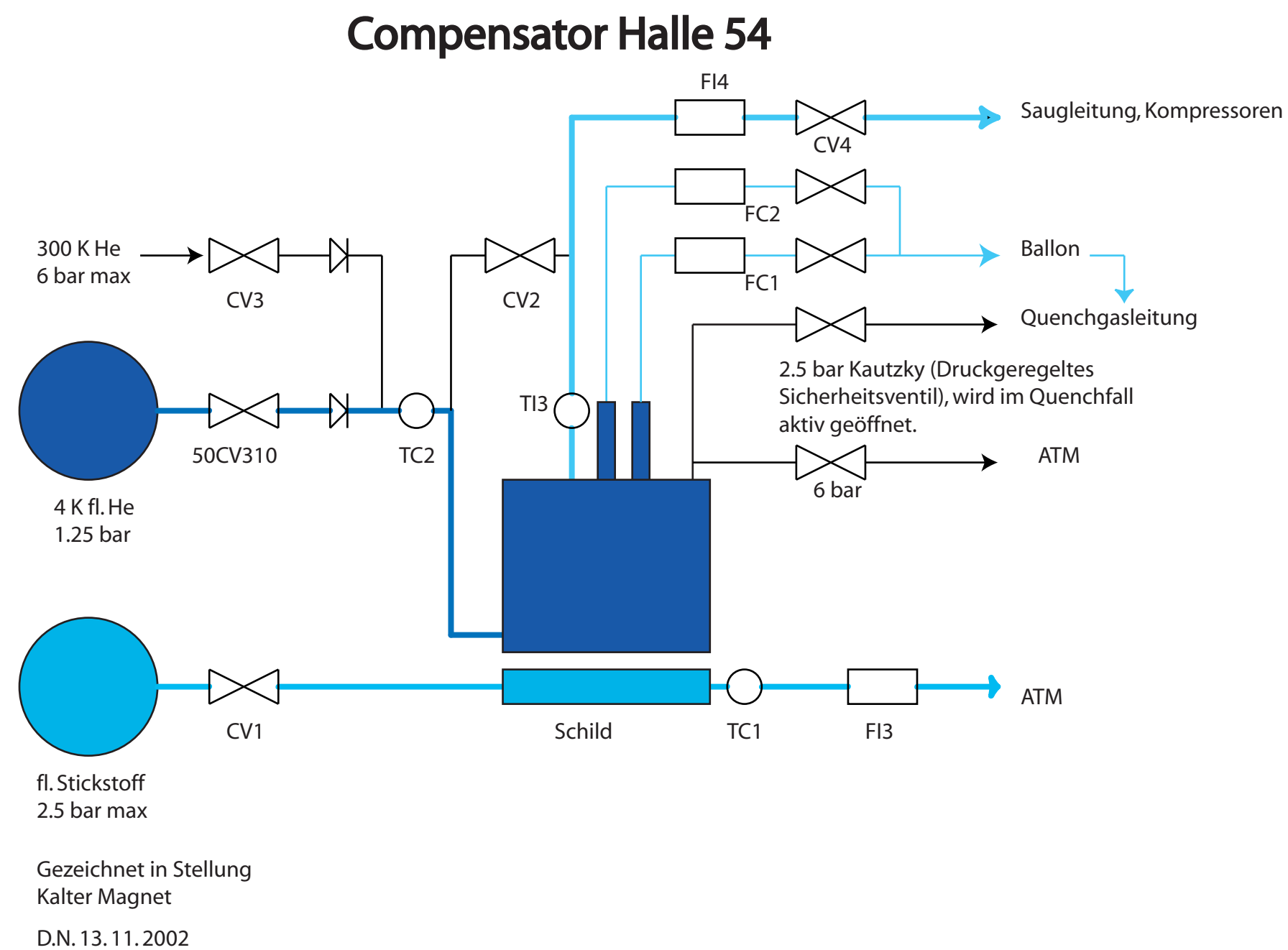
Ligo Voyager Mirror Station (proposal)



all figures: B. Shapiro et al., Cryogenics 81 (2017) 83-92

Cryo Platform User Examples: KOMAG

- 5T Magnet KOMAG
- Was used for ILC detector R&D in the DESY cryo hall (building 54)
- Could get a new life in HERA-North
 - is there demand?



Cryo Platform Budget and Timeline

- 2nd Phase (2018)
- Helmholtz-Money:
- DESY: 250 kEUR, all in Invest
 - matched with Personnel and Invest
- UHH: 100 kEUR, all in Personnel
 - matched with Personnel
- 3rd Phase (2019/20) (if QU successful!)
 - DESY: 800 kEUR Invest
 - matched with Personnel and Invest
 - UHH: 200 kEUR Personnel
 - matched with Personnel
- Total invest in cryo platform
 - 1050 kEUR HGF
 - 400 kEUR DESY (own money)
- If QU not succesful:
 - make sure all work in 2018 is applicable for ALPS-II and MADMAX

Sum of Betrag [kEUR]	Column			
Row Labels	DESY	Helmholtz	UHH	Grand Total
DESY	1050	1050		2100
Invest	200	1050		1250
2018	100	250		350
2019	100	400		500
2020	0	400		400
Personal	850	0		850
2018	150	0		150
2019	300	0		300
2020	400	0		400
UHH		300	300	600
Personal		300	300	600
2018		100	100	200
2019		100	100	200
2020		100	100	200
Grand Total	1050	1350	300	2700

What is in for FLC?

- No direct benefits at this time?
- The idea of a common detector R&D area with cryogenics is charming
 - if we would need cryogenics at some point
- The possibility to revive the KOMAG 5T magnet might be interesting
 - power-pulsing tests still on the table?
- Participating in the creation of R&D infrastructure itself is a value
 - fits to Matter&Technology and Helmholtz portfolio
 - in line with support work for DAF, testbeam, TPC fieldcage, AIDA infrastructure etc.
 - could be seen in a broader framework of a detector R&D, assembly and testing infrastructure
- If we would decide to join MADMAX, ALPS or Cold Mirror R&D, direct impact guaranteed
 - if...
- Any ideas of what we could do with the platform?