DESY II Test Beam Facility.

Status, Plans and Lessons learned - Herding squirrels made easy

Marcel Stanitzki

September 4th, 2025

HELMHOLTZ

DESY.

Thank you, Norbert Meyners

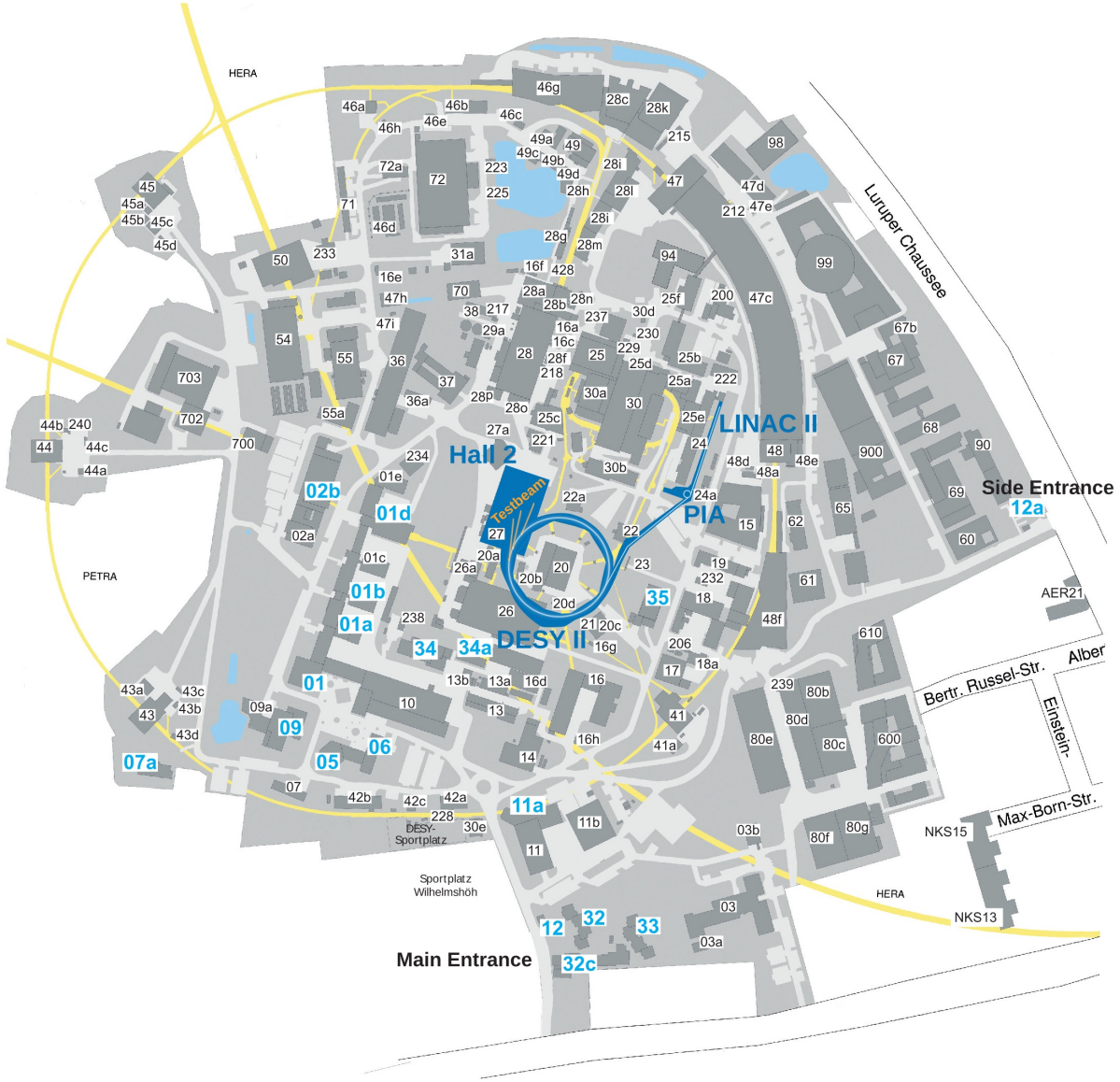
40 years of Test Beams

- Norbert has left in May 2025 to his well-earned retirement
- Without his help, the story of success of the DESY II Test Beam Facility would be impossible
- I want to use the opportunity to thank him in the name of all coordinators and community for his work for the test beam

Facility

Overview and Beam Generation

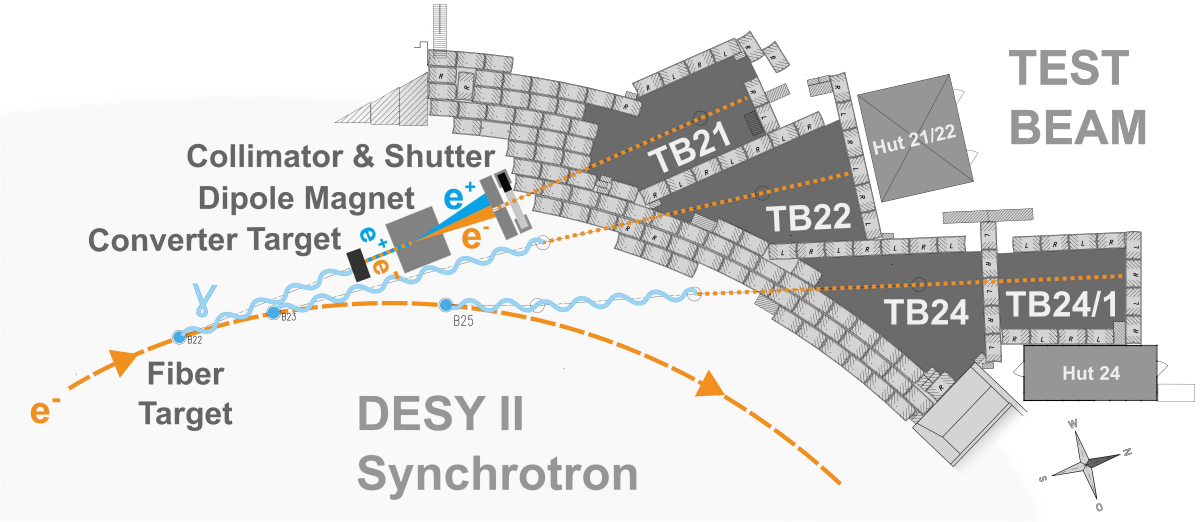
- Fed by the DESY II synchrotron
  - Circumference: 282.9 m
- One bunch per fill
  - Fill frequency: 6.25 Hz
- Sinusoidal energy distribution
  - Minimum Energy: 450 MeV
  - Maximum Energy: 6 GeV
  - Frequency: 12.5 Hz
- Outstanding availability (~ 99 % uptime)
  - ~ 5000-6000 hours available a year



Facility

Overview and Beam Generation

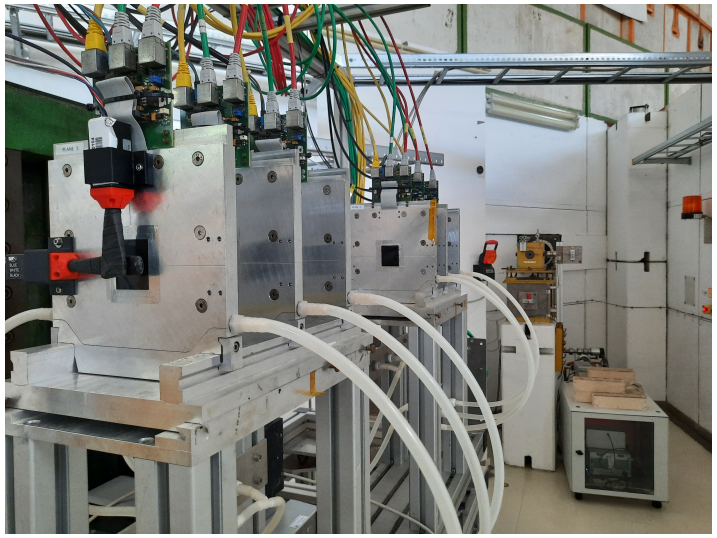
- Carbon fiber targets generate Bremsstrahlung Photons
- Conversion to electron-positron pairs up to 6 GeV
- Energy selection by dipole magnet and collimator
  - Single electrons / positrons
  - Rates $\mathcal{O}$(10k s^{-1} cm^{-1}), depending on beamline, energy, converter target, collimation, machine status,…
- Three individual beam lines, each user can control
    - Shutter
    - Area interlock
    - Converter
    - Momentum
    - Collimation
- When beam is off, beamlines are not considered radiation areas

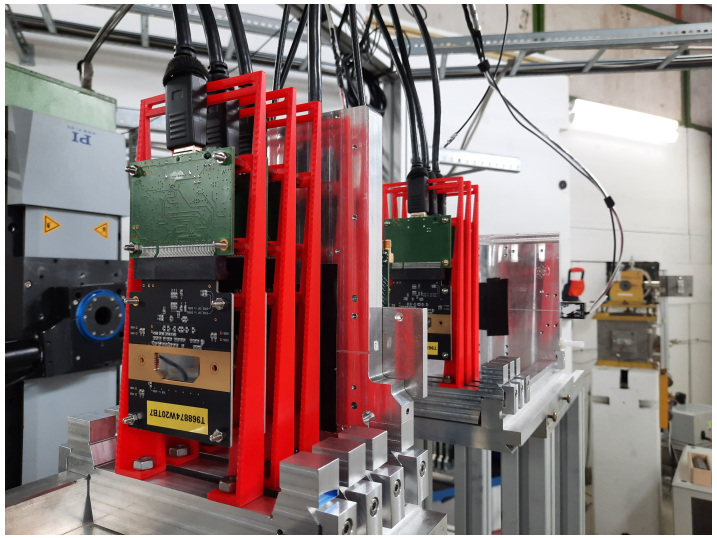


The Beam Telescopes

Our bestseller

- Telescopes in all three beam lines
  - 2 Mimosa-based (legacy)
  - 1 ALPIDE-based (new)
  - More ALPIDE-based telescopes are under construction, they'll also be provided to CERN
  - 2-3 and 4-5 micron resolution respectively
- Timing and Region-of-interest trigger layers – TimePix4 and Telepix
- Telescope Ecosystem
  - AIDA TLU - Trigger and Clock distribution hardware
  - EUDAQ2 – DAQ Software
  - Corryvreckan – Reconstruction
- The telescope coordinator
  - To maintain/extend the infrastructure and to support the users
- Telescopes can be easily replicated ! Designed for small series

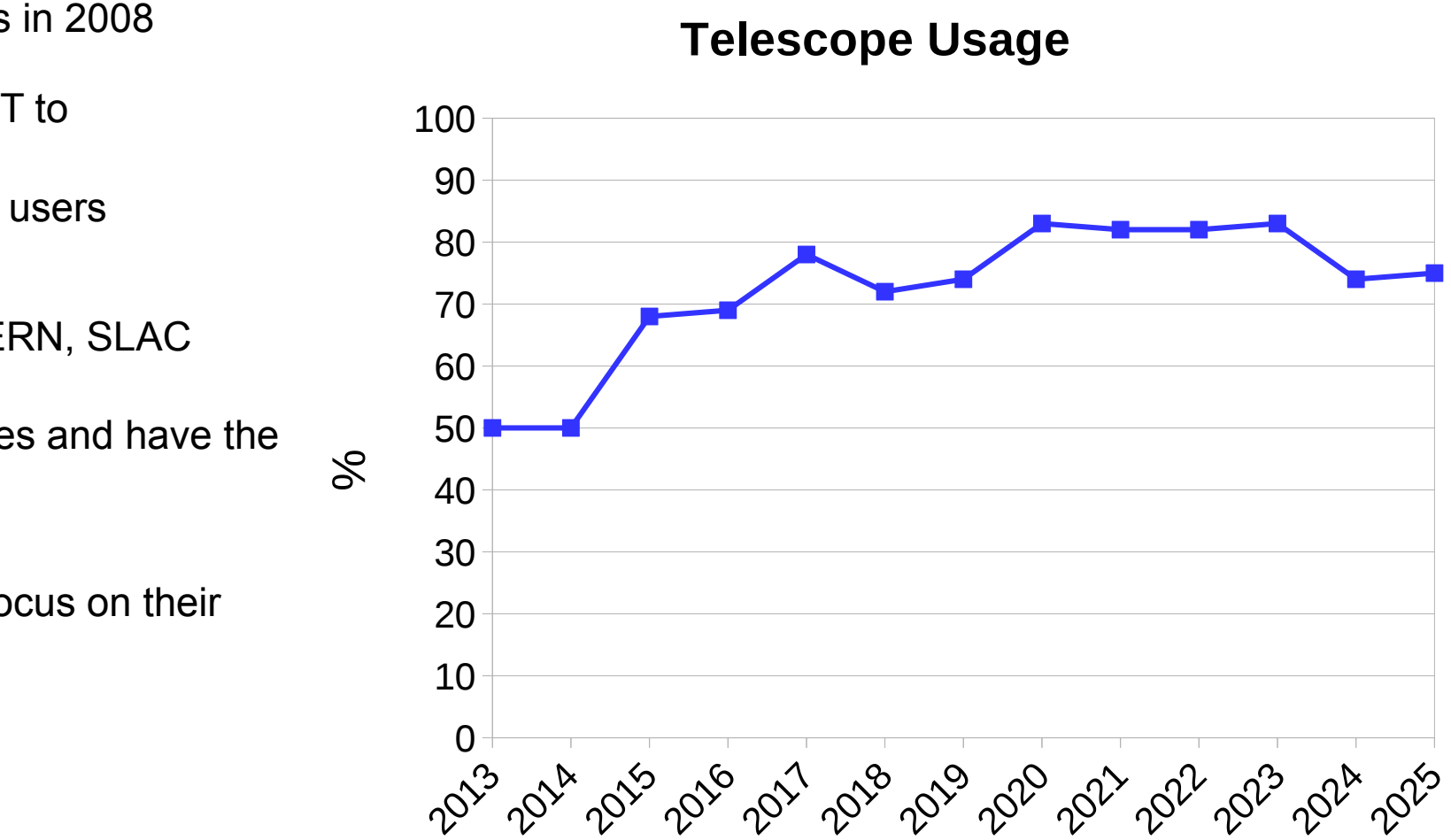




Beam Telescopes (II)

A Success Story

- First roll-out of EUDET-Style telescopes in 2008
  - Co-Funded by the EU from EUDET to AIDAInnova
  - Make a common infrastructure for users
- It worked and they spread
  - Telescopes available at DESY, CERN, SLAC ESTB and ELSA
  - User can move between beam lines and have the same infrastructure
- Reason for the success
  - Full package for the users – can focus on their sensors
  - Stable interfaces
  - Long-term support
  - Continuous improvements



Other Infrastructure

On-site Amenities

- Test magnets with large bores
  - Normal conducting 1.35 T dipole (TB21)
  - Superconducting 1 T solenoid (TB24/1)
- Other things
  - Remote controlled stages (up to 1 t)
  - Hall crane (up to 25 t)
  - Cameras
  - Dry nitrogen
  - Cooling water
- User hut
  - Additional desks
  - Espresso machine
  - Big screen for Zoom/Meetings

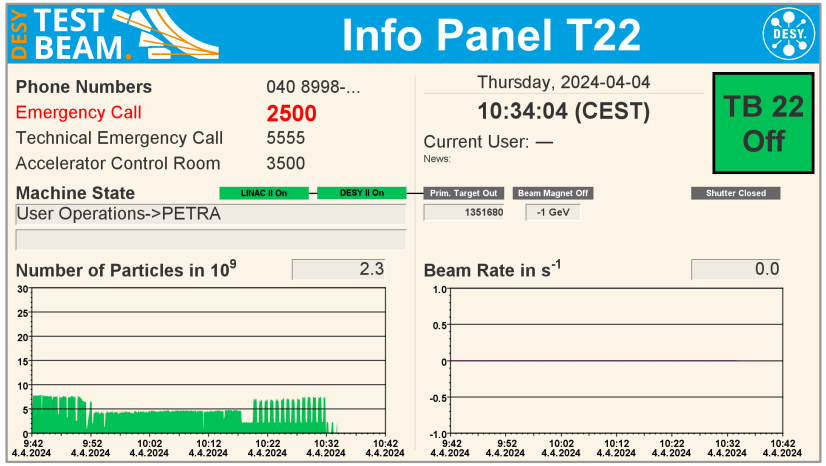
- Gas cabinets in TB22, TB24, flammable gas mixtures possible
- Weather station, slow control system, laser alignment
- Beam monitors
- Patch panels: SHV, BNC coax, RJ-45, optical fiber (single/multi-mode)

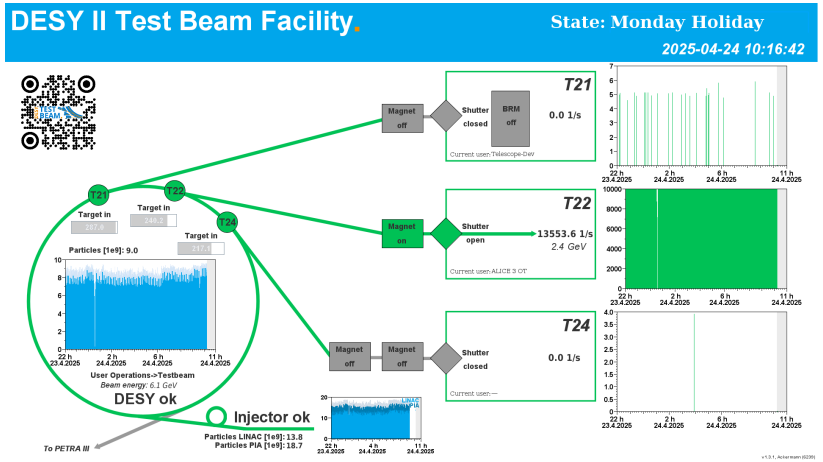
Infrastructure

Information displays

- In the huts
  - Dedicated panel for each beam line
  - Overview of beam generation chain
  - Short term histories

- Globally
  - Accessible worldwide
  - Status of accelerator chain
  - History of operation
  - Also on displays distributed around the campus (e.g. canteen)

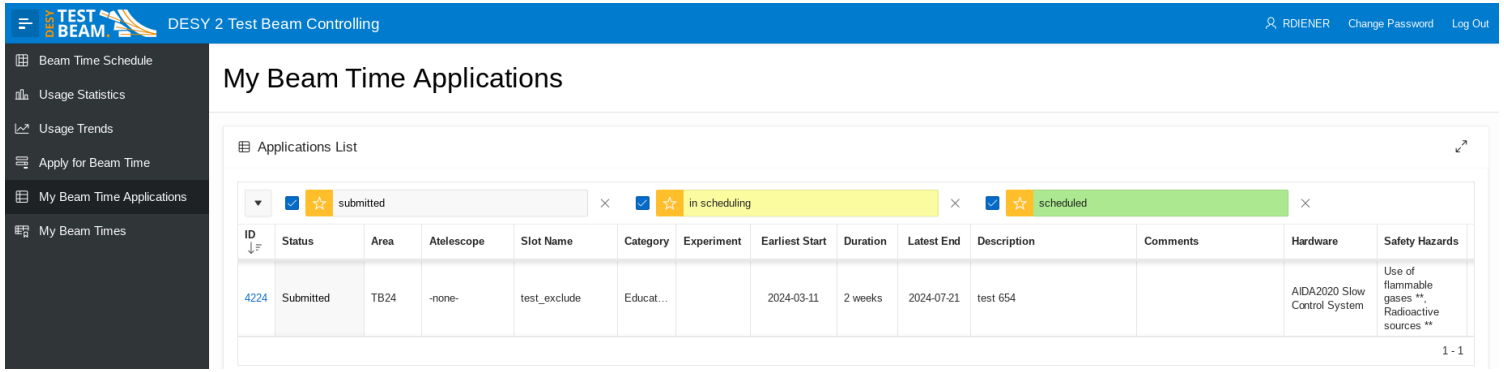


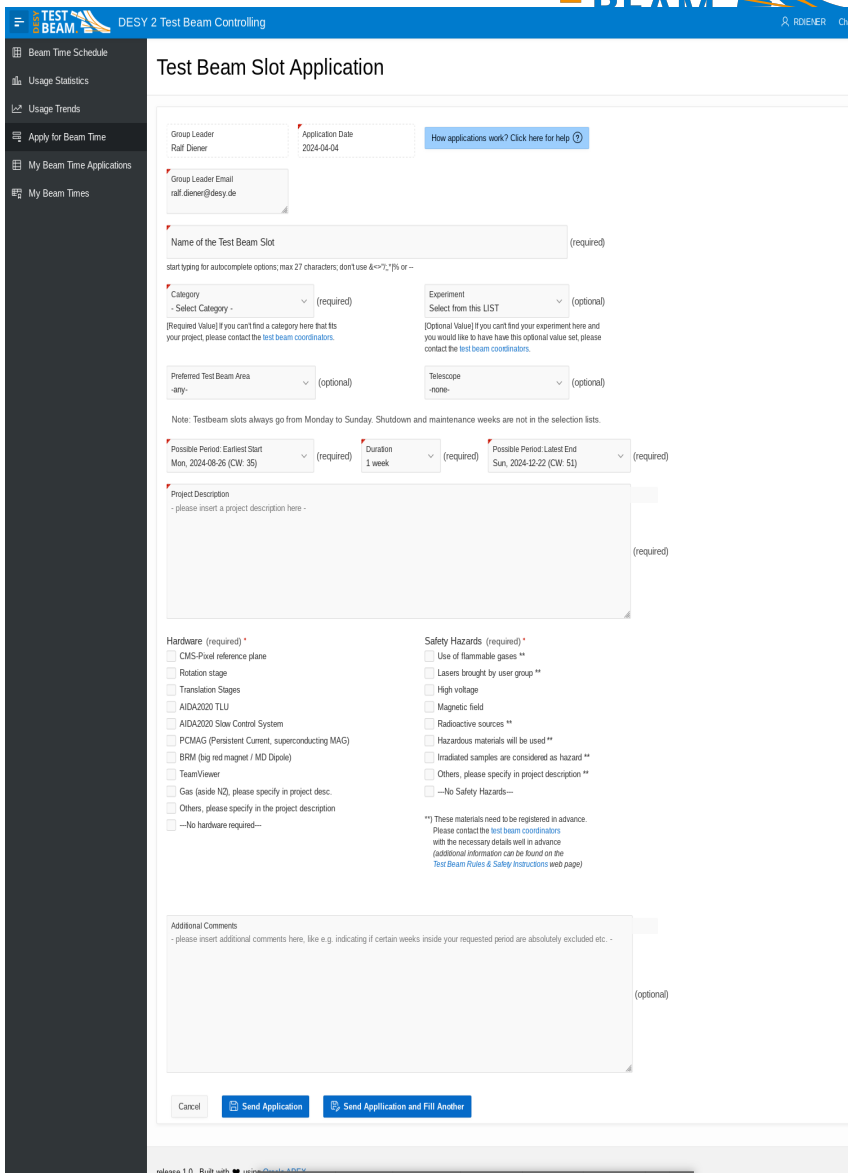


Registration tool

Beam time application

- One-Stop shop
  - Running since 2023
  - Reduces administrative overhead

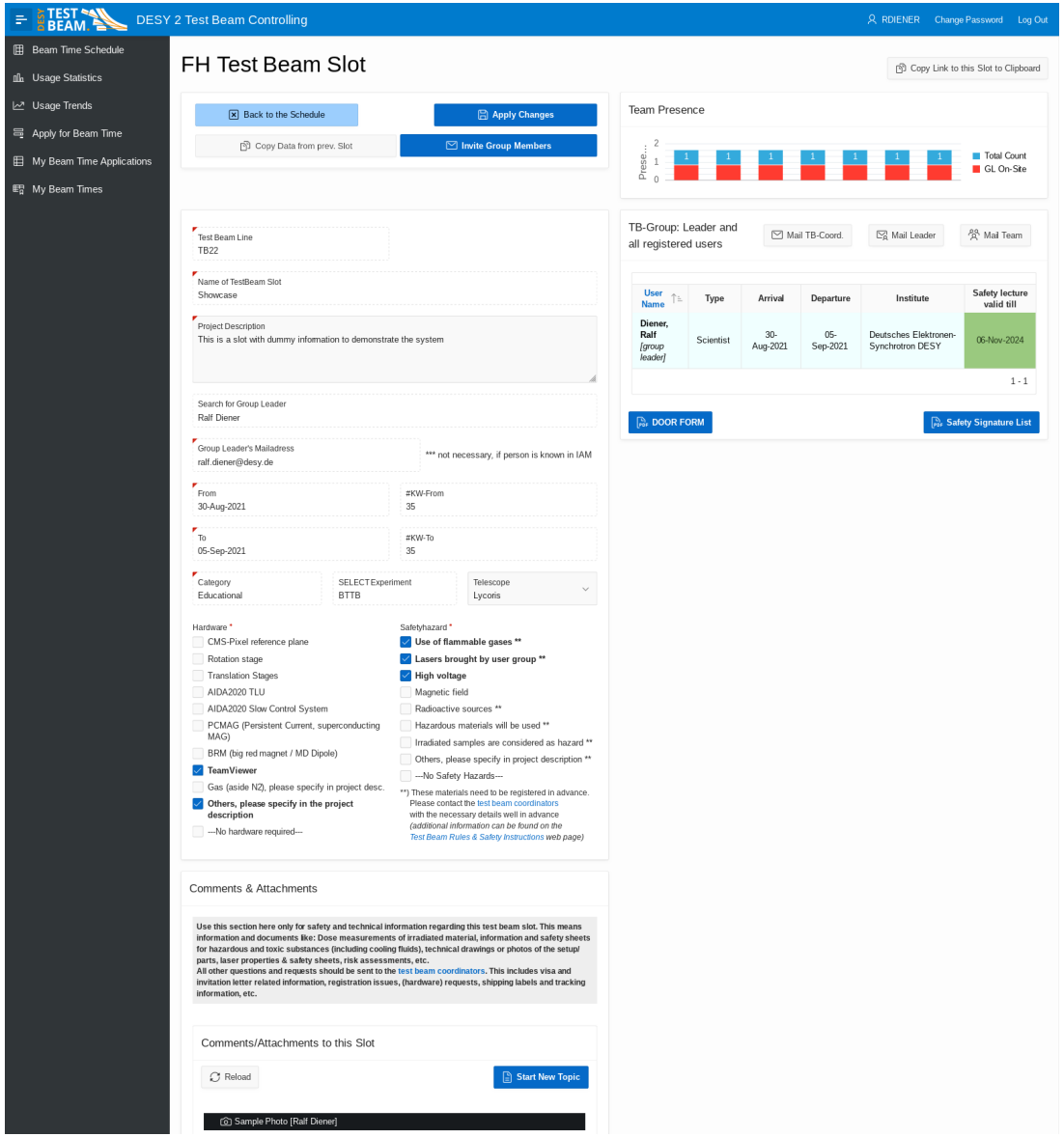




Registration tool

Beam time application

- Move to one single registration tool completed
  - Beam time application
  - Scheduling
  - User registration
  - Beam time handling
  - Description
  - Hardware requests
  - Safety handling
  - Safety document upload
  - Visa Invitation Request



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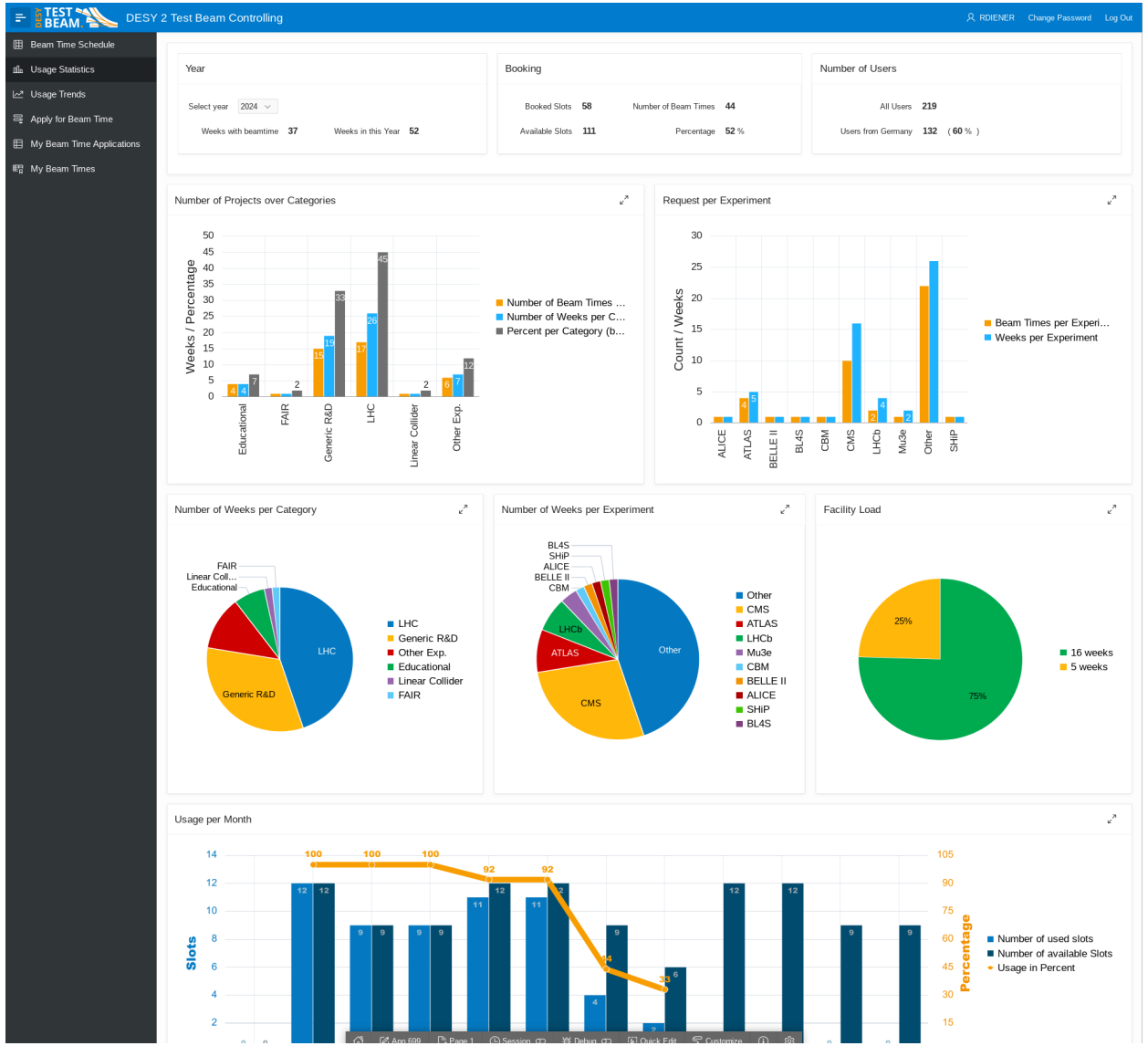


Schedule 2025

Booking, User Statistics, and Outreach Activities

- Run ongoing
- Slots (aka week)
  - 105 available, 92 booked 89%
  - 314 users so far
- EURO-LABS Transnational Access
  → financial support for user travels
- User groups can apply, where the team leader and the majority of the members are employed at an institution outside Germany
- More details:
  https://particle-physics.desy.de/test_beams_at_desy/euro_labs_ta/

DESY 2 Test Beam Schedule 2025 - Status from 03/SEP/2025

DESY 2 Test Beam Coordinators: Sven Ackermann, Ralf Diener, Marcel Stanitzki

Startdate	Week W	TB21	T	TB22	T	TB241	T	TB24	T
30.12.2024	1	Shutdown		Shutdown		Shutdown		Shutdown	
06.01.2025	2	Shutdown		Shutdown		Shutdown		Shutdown	
13.01.2025	3	Shutdown		Shutdown		Shutdown		Shutdown	
20.01.2025	4	Shutdown		Shutdown		Shutdown		Shutdown	
27.01.2025	5	Shutdown		Shutdown		Shutdown		Shutdown	
03.02.2025	6	Shutdown		Shutdown		Shutdown		Shutdown	
10.02.2025	7	Startup		Telescope-Dev	X	Startup		Startup	
17.02.2025	8	MONOPIX2	X	Tangerine	X			EEEMCAL	
24.02.2025	9	MONOPIX2	X	ATLAS HGTD	X			EEEMCAL	
03.03.2025	10	CMS HGCAL	X	ATLAS HGTD	X			DRD6 SiW ECAL AIDAinnova	X
10.03.2025	11	Telescope-Dev	X	DCRSD	X			CMOS LGAD	X
17.03.2025	12	CMS ETL ETROC	X	Tangerine	X			IPHC-Mimosis2.1	
24.03.2025	13	CMS ETL ETROC	X	ATLAS-ITk-Strips	X			EEEMCAL	
31.03.2025	14	Belle II CMOS	X	CMS ETL	X			EEEMCAL	
07.04.2025	15	Belle II CMOS	X					UHH-LGAD	X
14.04.2025	16	Maintenance		Maintenance		Maintenance		Maintenance	
21.04.2025	17	Telescope-Dev	X	ALICE 3 OT		Monday Holiday		ALICE 3 OT	X
28.04.2025	18			ALICE 3 OT				CalVision	X
05.05.2025	19	CMS ETL ETROC	X					CalVision	X
12.05.2025	20	CMS ETL ETROC	X	AIDAinnova-WP8.4.1					
19.05.2025	21			TelePix	X				
26.05.2025	22			TelePix	X				
02.06.2025	23	Maintenance		TelePix	X	Maintenance		Maintenance	
09.06.2025	24	Monday Holiday		TelePix	X	Monday Holiday		LUXE ECAL and DRD6	X
16.06.2025	25	MDI-2/KIPT		Tangerine	X			LUXE ECAL and DRD6	X
23.06.2025	26	MONOPIX2	X	Tangerine	X			TJ-Monopix DESY	X
30.06.2025	27	ATORCH		RD50 HV-CMOS	X			Telescope-Dev	X
07.07.2025	28	ATORCH		ATLAS-ITk-Strips	X				
14.07.2025	29	BL4S preparation	X	ATLAS-ITk-Strips	X			EPIC BTOF FCFD	X
21.07.2025	30	BL4S preparation	X	Shutdown		Shutdown		Shutdown	
28.07.2025	31	BL4S preparation	X	Shutdown		Shutdown		Shutdown	
04.08.2025	32	BL4S preparation	X	Shutdown		Shutdown		Shutdown	
11.08.2025	33	Startup		Startup		Startup		Startup	
18.08.2025	34	Startup		Startup		Startup		Startup	
25.08.2025	35								
01.09.2025	36	BL4S preparation	X					Telescope-Dev	X
08.09.2025	37	BL4S 2025	X	SHiP Straw Tube RD	X			CMS HGCAL	X
15.09.2025	38	BL4S 2025	X	ATLAS-ITk-Strips	X			Telescope-Dev	X
22.09.2025	39	Maintenance		Maintenance		Maintenance		Maintenance	
29.09.2025	40	CMS ETL ETROC	X						
06.10.2025	41	CMS ETL ETROC	X						
13.10.2025	42	DCRSD_irrad		HVMAPS Mu3e	X			HEP for Teachers	
20.10.2025	43	Telescope-Dev	X	HVMAPS Mu3e	X			UHH-LGAD	X
27.10.2025	44	Maintenance		Maintenance		Maintenance		Maintenance	
03.11.2025	45	CMS HGCAL	X	PSI-MAPS	X	CEPC Pixel Readout TPC			
10.11.2025	46	Bonn CMOS	X	CMS ETL	X	CEPC Pixel Readout TPC			
17.11.2025	47	ATLAS HGTD		AstroPix	X			LHCb-ECAL	
24.11.2025	48	ATLAS HGTD		CMOS LGAD	X			LHCb-ECAL	
01.12.2025	49	CMS ETL ETROC	X	NLGAD				FCC-SEED	
08.12.2025	50	CMS ETL ETROC	X	ATLAS-ITk-Strips	X			EEEMCal	
15.12.2025	51	EIC AC-LGAD Sensors		P2Pix DESY	X			EEEMCal	
22.12.2025	52	Shutdown		Shutdown		Shutdown		Shutdown	

Schedule 2026 (preliminary)

More and less beamtime

- Testbeam operation will already start in January
- It will be stopped for one month mid-February
- There will be a two week maintenance in July
- Starting September 1st, there will be no beam for the rest of the year for the renovation of the pre-accelerator PIA
- Alongside, we'll also renew the Interlock systems for DESY II

➔ **The next call for beamtime in 2026 cover the entire year is out. Please apply!**

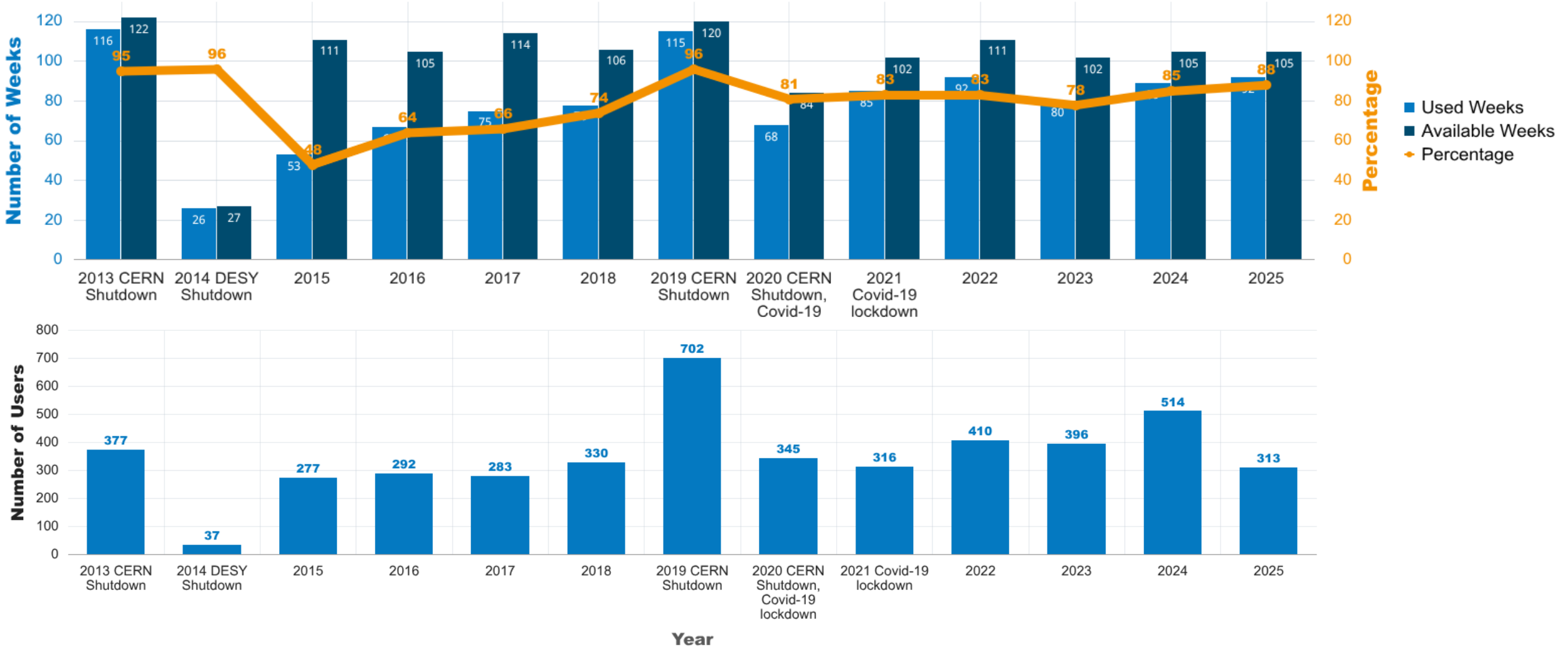
DESY 2 Test Beam Schedule 2026 - Status from 03/SEP/2025

DESY 2 Test Beam Coordinators: Sven Ackermann, Ralf Diener, Marcel Stanitzki

Startdate	Week	TB21	T	TB22	T	TB241	T	TB24	T
29.12.2025	1	Shutdown		Shutdown		Shutdown		Shutdown	
05.01.2026	2	Startup		Startup		Startup		Startup	
12.01.2026	3								
19.01.2026	4								
26.01.2026	5								
02.02.2026	6								
09.02.2026	7								
16.02.2026	8	Shutdown		Shutdown		Shutdown		Shutdown	
23.02.2026	9	Shutdown		Shutdown		Shutdown		Shutdown	
02.03.2026	10	Shutdown		Shutdown		Shutdown		Shutdown	
09.03.2026	11	Shutdown		Shutdown		Shutdown		Shutdown	
16.03.2026	12	Startup		Startup		Startup		Startup	
23.03.2026	13								
30.03.2026	14								
06.04.2026	15	Monday Holiday		Monday Holiday		Monday Holiday		Monday Holiday	
13.04.2026	16								
20.04.2026	17								
27.04.2026	18								
04.05.2026	19								
11.05.2026	20								
18.05.2026	21								
25.05.2026	22	Maintenance		Maintenance		Maintenance		Maintenance	
01.06.2026	23								
08.06.2026	24								
15.06.2026	25								
22.06.2026	26								
29.06.2026	27								
06.07.2026	28								
13.07.2026	29	Maintenance		Maintenance		Maintenance		Maintenance	
20.07.2026	30	Startup		Startup		Startup		Startup	
27.07.2026	31								
03.08.2026	32								
10.08.2026	33								
17.08.2026	34								
24.08.2026	35								
31.08.2026	36	Shutdown		Shutdown		Shutdown		Shutdown	
07.09.2026	37	Shutdown		Shutdown		Shutdown		Shutdown	
14.09.2026	38	Shutdown		Shutdown		Shutdown		Shutdown	
21.09.2026	39	Shutdown		Shutdown		Shutdown		Shutdown	
28.09.2026	40	Shutdown		Shutdown		Shutdown		Shutdown	
05.10.2026	41	Shutdown		Shutdown		Shutdown		Shutdown	
12.10.2026	42	Shutdown		Shutdown		Shutdown		Shutdown	
19.10.2026	43	Shutdown		Shutdown		Shutdown		Shutdown	
26.10.2026	44	Shutdown		Shutdown		Shutdown		Shutdown	
02.11.2026	45	Shutdown		Shutdown		Shutdown		Shutdown	
09.11.2026	46	Shutdown		Shutdown		Shutdown		Shutdown	
16.11.2026	47	Shutdown		Shutdown		Shutdown		Shutdown	
23.11.2026	48	Shutdown		Shutdown		Shutdown		Shutdown	
30.11.2026	49	Shutdown		Shutdown		Shutdown		Shutdown	
07.12.2026	50	Shutdown		Shutdown		Shutdown		Shutdown	
14.12.2026	51	Shutdown		Shutdown		Shutdown		Shutdown	
21.12.2026	52	Shutdown		Shutdown		Shutdown		Shutdown	
28.12.2026	53	Shutdown		Shutdown		Shutdown		Shutdown	

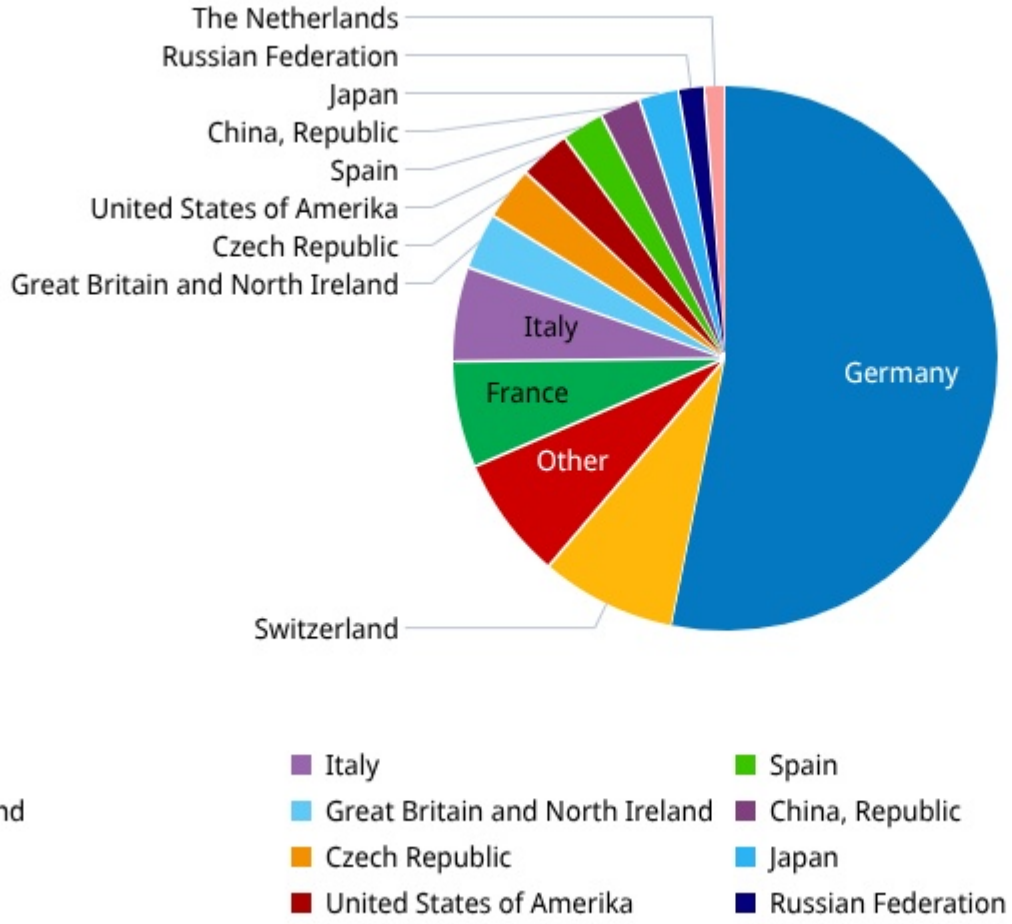
Statistics 2023-2025

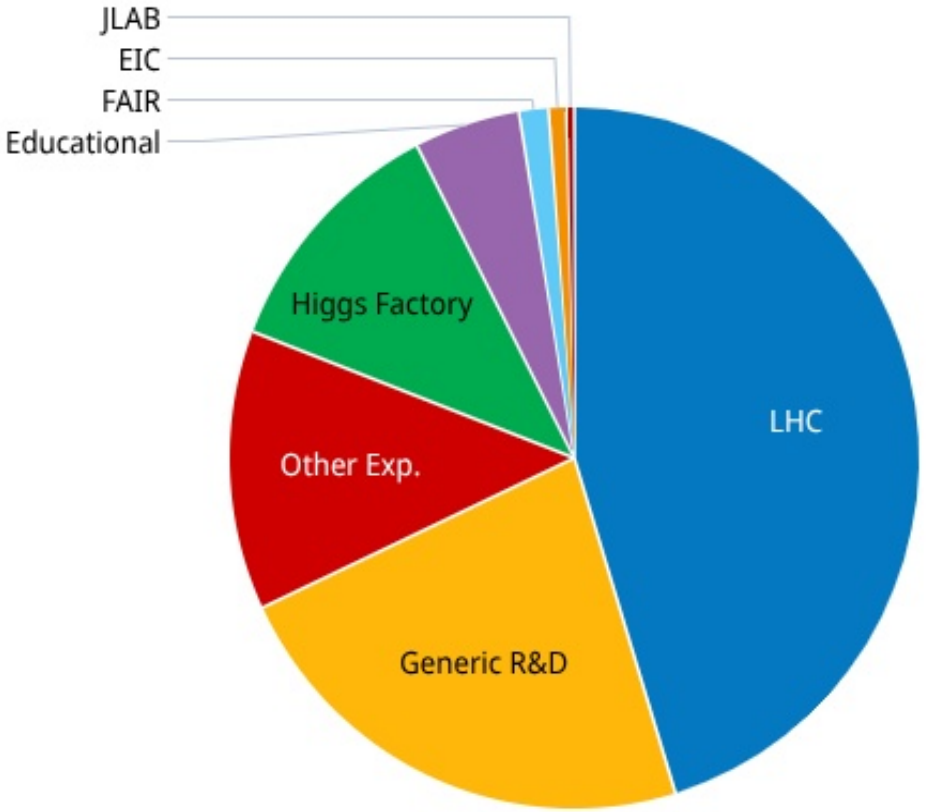
Users, Countries ...



Statistics 2013-2025

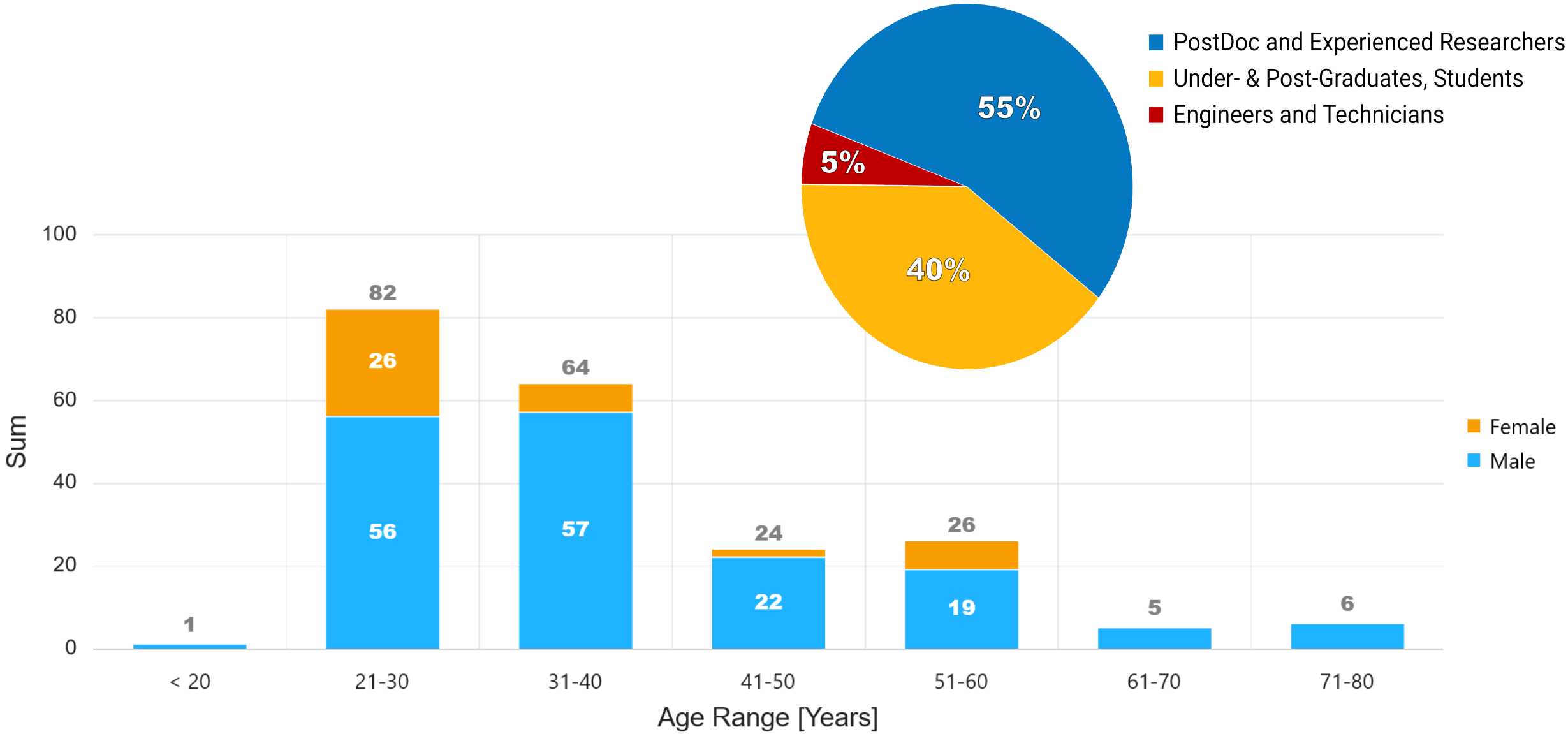
Users, Countries ...





Outreach and Education

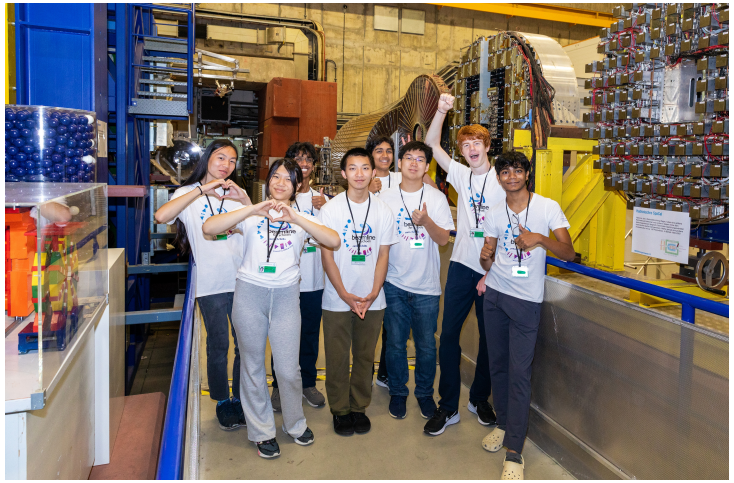
At the DESY Test Beam

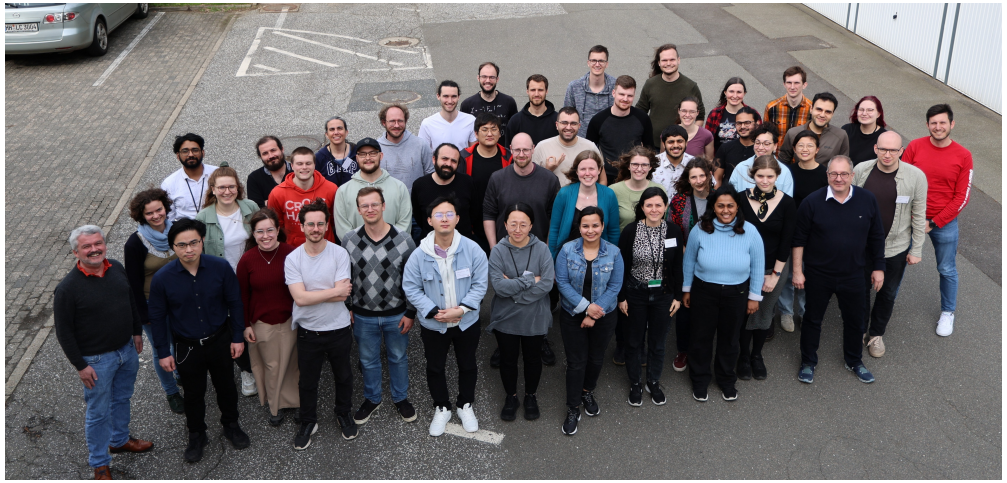


Outreach and Education

On-Site activities

- High RR-School Heidelberg
  - Pure high rate and high resolution detector school
- DESY summer student programme
  - Undergrad students join day-to-day work
- Schwartz-Reismann School
- Beamline 4 Schools
  - Competition for high school students, parallel at CERN and DESY
- Tours, tours, tours
  - MU-Days Tour
  - POF
  - Teacher training
  - …





Test Beam Future

2026 and beyond

- DESY's next big project: PETRA IV, a new synchrotron light source
- Injector still under discussion
  - DESY II with collimation
  - DESY IV (baseline option)
  - LPA injector at full energy („PIP“)
- High-current studies on collimation are recently performed
  - Injection efficiency reduced by 30%.
  - Only 40% of charge can be transported
- Preparation for a 300 MeV injection test using a LPWA is done
  - 2026 a first week of runtime for the LPA (injection to DESY and long-term availability test)
- We intensified the collaboration between PETRA IV team and Test Beam

- We want to thank the members of the PETRA IV project group, and the project leaders R. Bartolini and H. Reichert, for the useful discussions and support

Test Beam Future

Don‘t panic!

- The darktime will start about 4 years after project approval
- Approval not expected before 2026
- The continuation of test beam operation can be expected until 2030
- The test beam facility has been evaluated:
  - DESY directorate sees the test beam as a core competency
  - DESY PRC stated that the test beam is an outstanding international effort
  - Helmholtz POF evaluation has very positive words on the test beam:

    “Test beam is a world class facility”

➔ **We will continue to push to preserve the test beam in the scope of PETRA IV**

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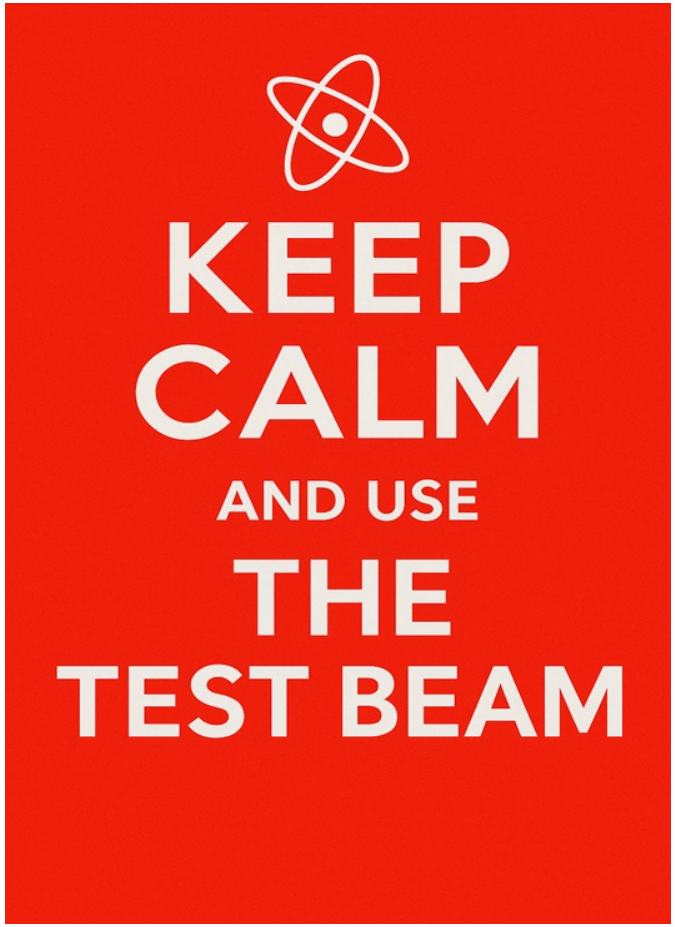


➔ **We will continue to push to preserve the test beam in the scope of PETRA IV**

Lessons learned

My personal view from ten years of coordination

- Test Beam Coordination is a team sport
  - Having three coordinators was valuable to share the load of running 11 month a year
  - Close cooperation with DESY II Coordination essential
- Registration Tool
  - Having all information in one place is invaluable
  - Directorates have always last-minute requests for “how many users did ?”
- International Users (for us Non-EU)
  - Need quick feedback for Visas and Invitation letters
- “Relatively” Open Campus and affordable Guest House makes user’s life a lot simpler
- Doing the Safety Class in-person
  - Users get to meet the coordinators

Lessons learned (II)

My personal view from ten years of coordination

- The daily hall tour of the coordinators
  - Extremely helpful to stay on top, what is happen, where to help or where to intervene
- Support from the EU is extremely helpful -
  - Travel support for users (EURO-LABS)
  - Support for infrastructure and supporting it (EUDET, AIDA, AIDA-2020, AIDAInnova)
- KPI can be a problem
  - Extremely hard to track paper output from the Test Beam Facility
  - We have two kludges with the acknowledgments and a reference paper
  - Some users simply don’t cooperate
- Outreach is important
  - Things like Beamline4Schools are a real Gem
  - But internal outreach is also important – make people aware about the opportunities

Things where we could improve

My personal view from ten years of coordination

- Shipment of irradiated stuff
  - It’s always a one-off
    Can we reduce the workload ?
- Tracking of publications
  - Incentives for reporting ?
- More instrumentation
  - Not shy of ideas but lack the manpower
- General man-power support
  - Dealing with 500+ user is not the same as dealing with 150

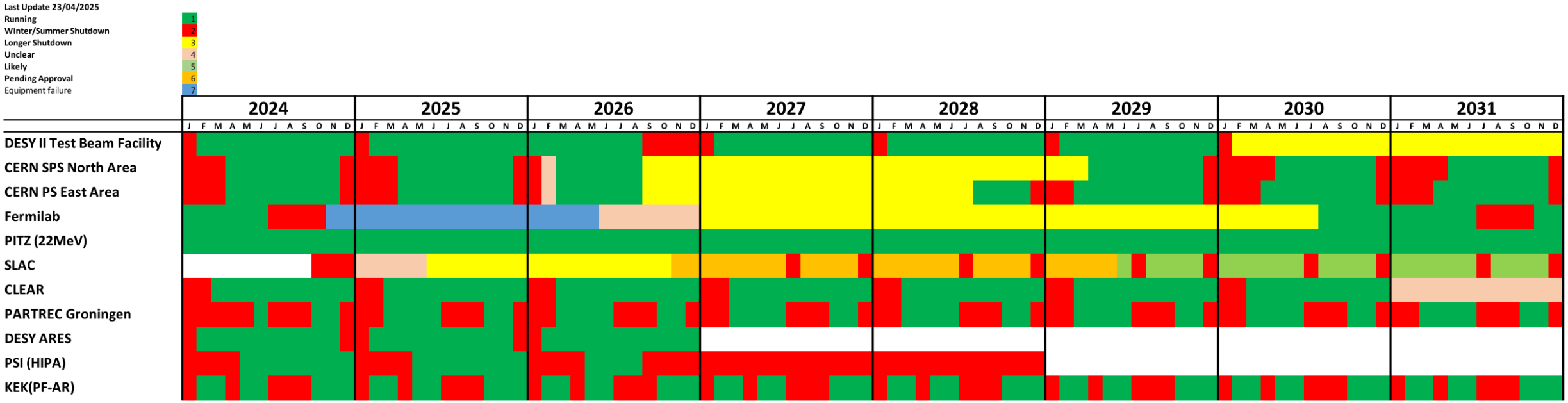
My Recommendations

My personal view from ten years of coordination

- Use Common Tools & Interfaces, don’t re-invent the wheel
  - It’s very often not about the best solution, but the one that is maintained for long-term
- Make management aware, that supporting the users is essential for successful beam campaigns
  - And this requires people
- Site Access for international users
  - Give feedback early, people will be hesitant to travel if they don’t know, that they can get on-site
  - Same for visa applications
- KPIs
  - Push early on to track papers, etc from test beam campaigns
- Outreach
  - It’s very rewarding and incredibly good PR

Why having a testbeam at SLAC is important !

Sooner than later



Do IT !