WP4:
Access to Research Infrastructures for Detectors Status and Outlook

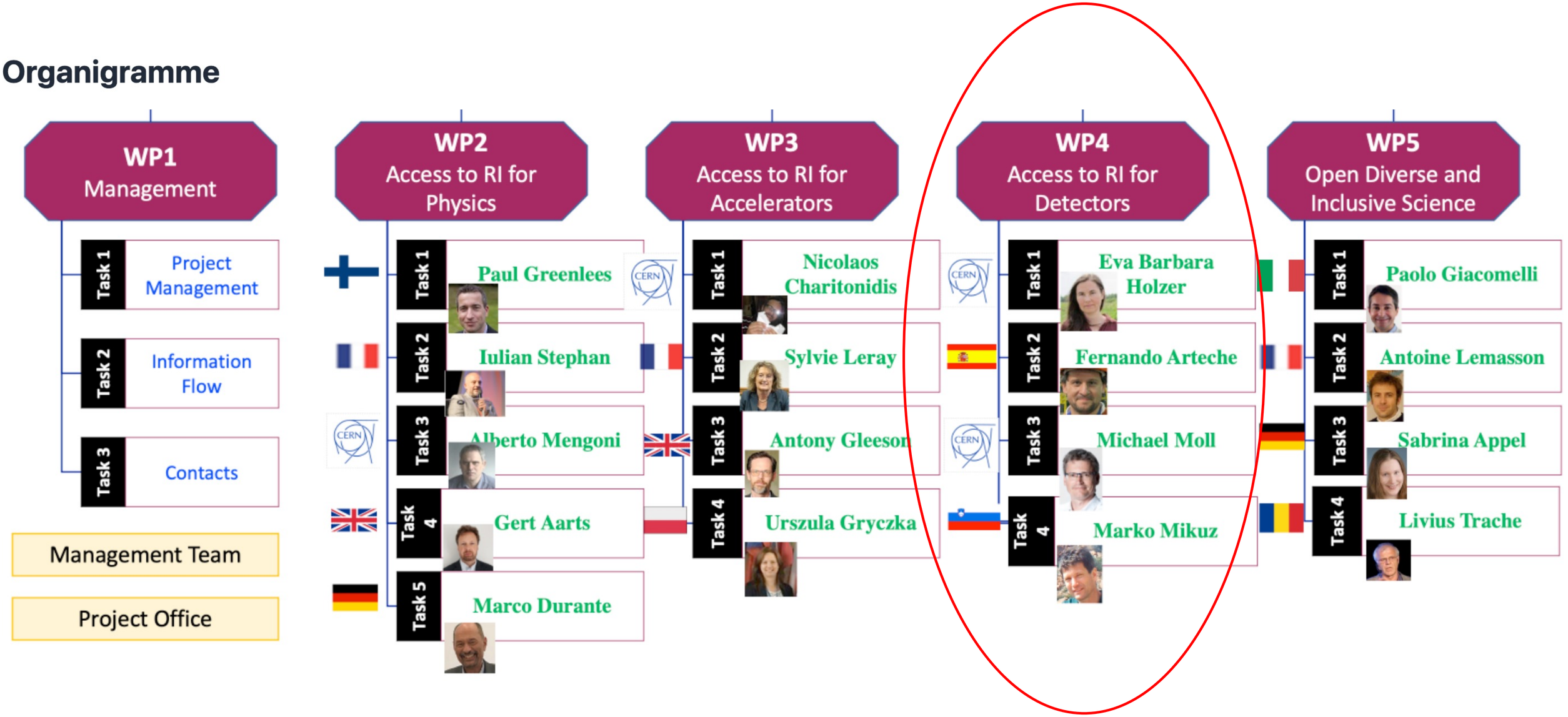
Marko Mikuž

University of Ljubljana and Jožef Stefan Institute, Ljubljana, Slovenia

This project has received funding from the European Union's Horizon Europe Research and Innovation programme under Grant Agreement No 101057511.

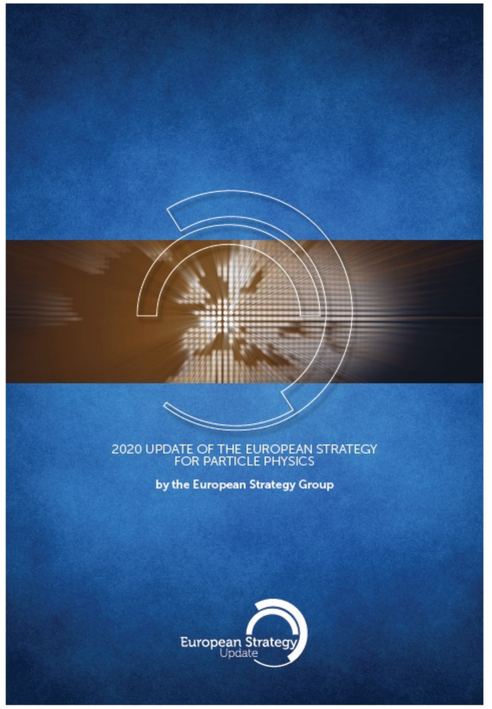
WP4:Access to RI for Detectors in EURO-LABS

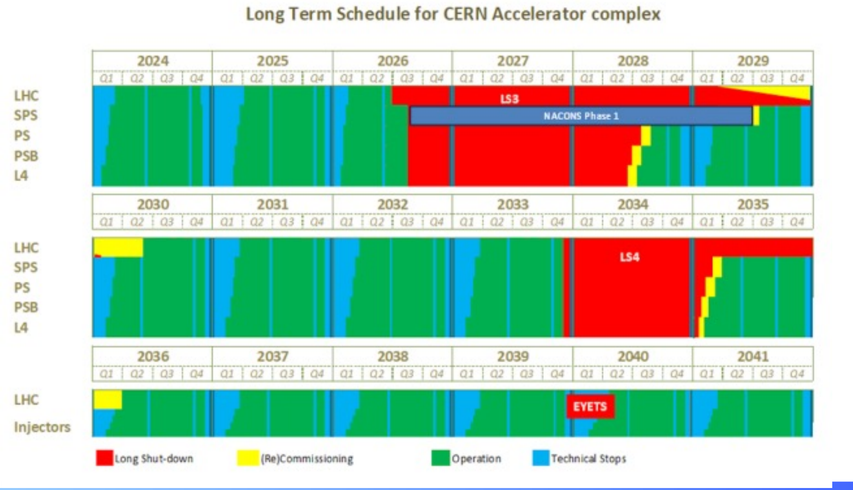
Organigramme



Placing of WP4 in European HEP (present)

- Core HEP Detectors endeavour today - construction of upgraded detectors for operation at the HL-LHC
  - In line with the stipulations of the 2013 European Strategy for Particle Physics (ESPP) report and their secondment in the 2020 ESPP update – "*The successful completion of the high-luminosity upgrade of the machine and detectors should remain the focal point of European particle physics, together with continued innovation in experimental techniques.*"
  - Associated detector R&D almost entirely finished, large orders placed, construction activities are under way, but accumulated delays required shift of schedule with **start-up in June 2030**
    - Collateral impact on EURO-LABS WP4: CERN RIs now **operational in 2026**
  - Load still expected for WP4 - few remaining parts of late R&D, like LGAD and SiPM for the timing layers
    - Main load (on ~same set of RIs) driven by sensor QA activities to monitor production quality – not serviced by EURO-LABS
    - Production Readiness Review adopted as the dividing line – allow QA of preproduction (~5 %)
  - Exception to the grand picture - inner tracker part of ATLAS and CMS
    - No solution found to survive the entire HL-LHC lifetime
    - Replace the inner pixel detector at mid-point after ~2/ab of integrated luminosity
    - Existing detector solution could serve as a viable replacement, but R&D for technologically more advanced detectors is being pursued vigorously
  - LHCb - major upgrade in LS4
    - Radiation load to detectors - close to the inner parts of ATLAS&CMS trackers; their R&D in obvious need of EURO-LABS WP4 RIs.





Placing of WP4 in European HEP (future)

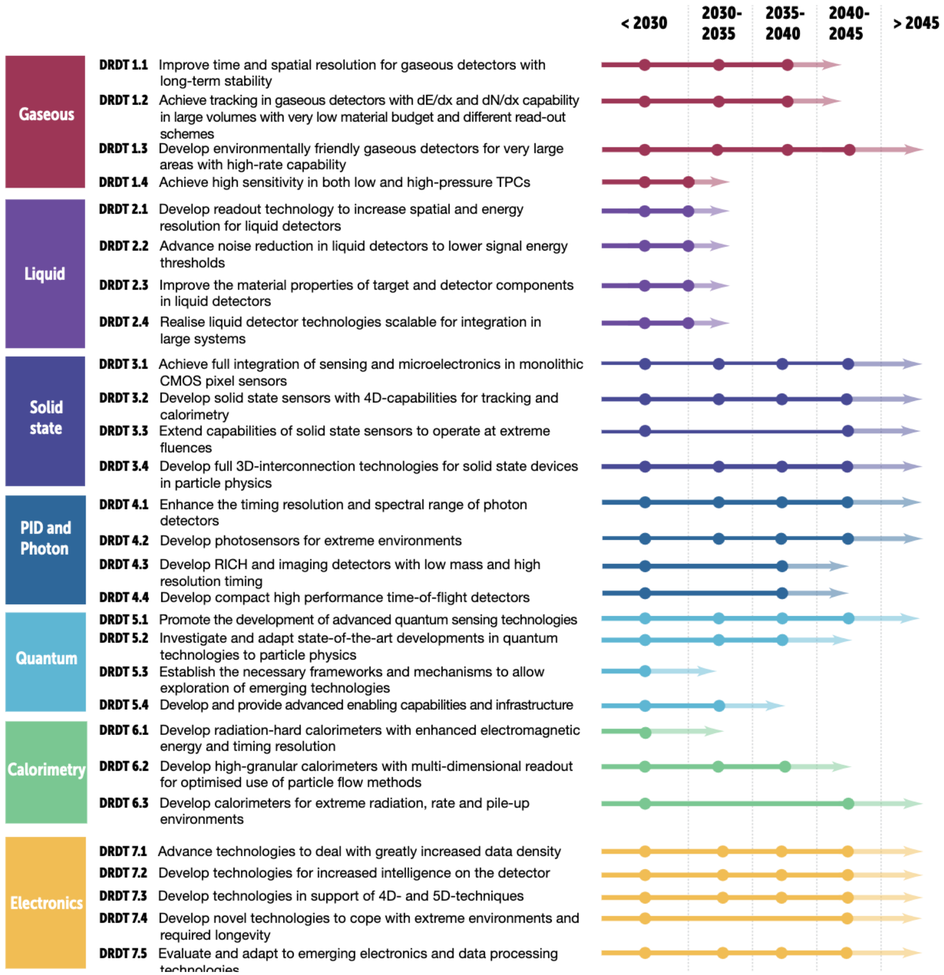
- The **2020 ESPP** establishes **two project initiatives** as high-priority
  - "*the highest-priority next collider*": "*an **electron-positron Higgs factory***"
  - for the longer term: "*a proton-proton collider at the highest achievable energy*", dubbed as the ***FCC-hh** project*.
- Facility choice for these aim(s) expected from on-going **Strategy update** in 2026
- Detector R&D for these two goals: supported by *AIDAinnova* EC project
  - Other focal points: CERN DRD collaborations, developments within (big) experiments
- Development cycle towards the use of a new technology in detectors for HEP experiments spans over **10 to 20 years.**
  - ***prospective*** detector R&D ("Blue Sky" research) – TRL 1
  - ***strategic*** detector R&D, according to needs of future projects – TRL 2-5
  - ***focussed*** detector R&D of approved experiments – TRL 5-7
- These detector development phases - supplemented by providing access to the RIs of EURO-LABS WP4

Placing of WP4 in European HEP (future)

- Major support of EURO-LABS WP4 for **Higgs factory** detectors
  - **Test Beams** (WP4.1) and **Detector Characterization** (WP4.2) tasks
  - Radiation load is relatively small
    - Still testing at low levels of radiation & checking for single event effects
- Detector studies aimed at **FCC-hh**
  - Detectors at FCC-hh - highest radiation levels (after 30/ab)
    - forward calorimeters : 5000 MGy and 5×10^{18} n_{eq}/cm^2
    - innermost layer of the barrel vertex detectors ~1×10^{18} n_{eq}/cm^2
  - Need fluences in excess of at least 1×10^{17} n_{eq}/cm^2
    - benchmark for a yearly exchange of inner layers
- EURO-LABS WP4 intends to provide access to these conditions, even up to 1×10^{18} n_{eq}/cm^2
  - RI's in the Irradiations task WP4.3
- End of 2021 the *ECFA Detector R&D Roadmap* was approved by the CERN Council
  - Long term HEP Detector R&D goals defined
  - Implementation strategy approved in September 2022

ECFA Detector Roadmap Implementation

- Detector R&D Themes to be tackled by DRD Collaborations being formed now
  - DRD1 Gaseous Detectors
  - DRD2 Liquid Detectors
  - DRD3 Solid State Detectors
  - DRD4 Particle ID and Photon Detectors
  - DRD5 Quantum and Emerging Technologies
  - DRD6 Calorimetry
  - DRD7 Electronics
- Process overseen by CERN's DRD Committee
  - Evaluating submitted proposals
- Collaborations started in beginning of 2024



WP4 Interactions with DRDx Collaborations

- Detector R&D Collaborations expected to provide a major part of load on WP4 RIs in the remaining two years
- Establish direct contact through talks at their workshops
- So far:
  - DRD1 Gaseous Detectors
    - Talk at DRD1 workshop in June 2024
    - Resulted in big upswing in GIF++ usage
  - DRD3 Solid State Detectors
    - Talk at the RD50 (DRD3 predecessor) workshop in June 2022
    - Towards 1E18 irradiations campaign(s), first at TRIGA in August 2024
  - DRD7 Electronics
    - Talk at DRD7 workshop in September 2024
    - Aimed at fostering interest in UCL HIF

EURO-LABS

EUROpean Laboratories for Accelerator Based Sciences

Research Infrastructures for Nuclear and Particle Physics

Marko Mikuž
Univ. Ljubljana & J. Stefan Inst., Ljubljana, Slovenia
RD-50 Workshop, June 21st 2022

EURO-LABS WP4:
Access to Research Infrastructures for Detectors

Marko Mikuž
University of Ljubljana and Jožef Stefan Institute, Ljubljana, Slovenia

DRD1 Meeting, CERN 21/6/2024

EURO-LABS WP4:
Access to Research Infrastructures for Detectors

Marko Mikuž
University of Ljubljana and Jožef Stefan Institute, Ljubljana, Slovenia

DRD7 Meeting, CERN 10/7/2024

WP4.1-3 Deliverables

- Each RI delivers Access Units (~beam hours) to Projects with Users
- Two access modalities: physical/remote access
  - Physical: users at RI (user support)
  - Remote: users send samples to RI (handling, shipment)

Task	WP name	Institute	Facility	Access Units	Users	Projects	User support
Test Beams	WP4.1.1	CERN	PS & SPS	8736	504	56	yes
	WP4.1.2	DESY	TESTBEAM	8640	120	30	yes
	WP4.1.3	PSI	PiM1/UCN	5376	136	32	yes
Detector Characterization	WP4.2.1	RBI	RBI-AF	504	24	12	yes
	WP4.2.2	ITAINNOVA	EMCLab	800	56	14	yes
Irradiations	WP4.3.1	CERN	IRRAD	4000	65	16	yes/remote
	WP4.3.2	CERN	GIF++	4060	74	14	yes
	WP4.3.3	JSI	TRIGA	700	150	50	remote
	WP4.3.4	IFJ-PAN	AIC-144	800	140	28	yes/remote
	WP4.3.5	UCL	HIF/LIF/NIF	100	20	10	yes
	WP4.3.6	UoB	MC40	300	36	12	remote

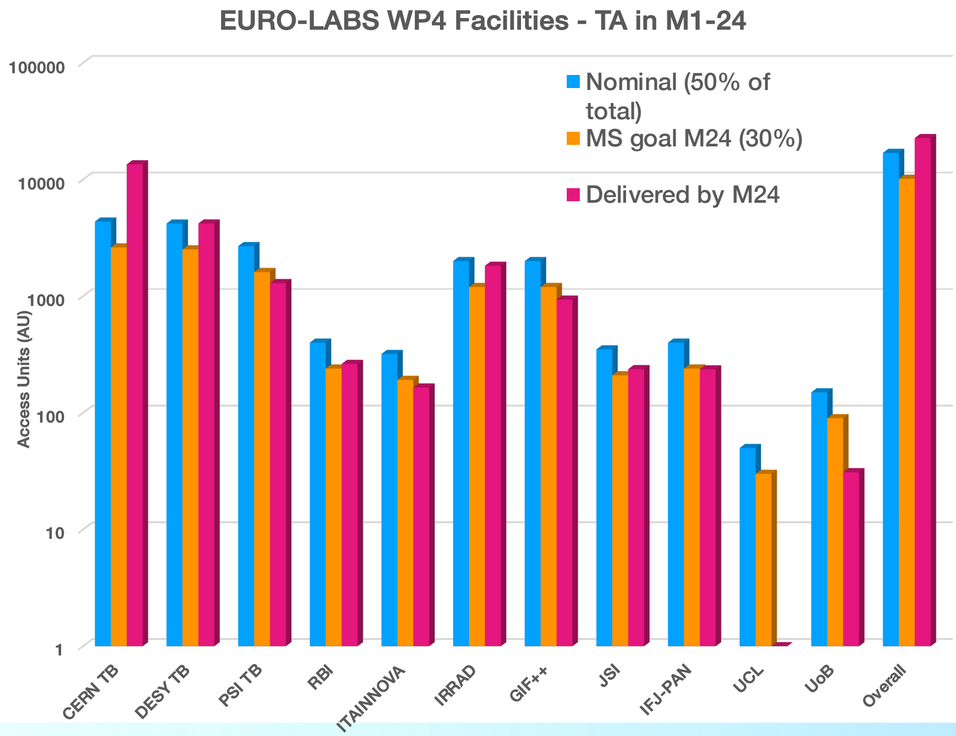
WP4.4 Service Improvements

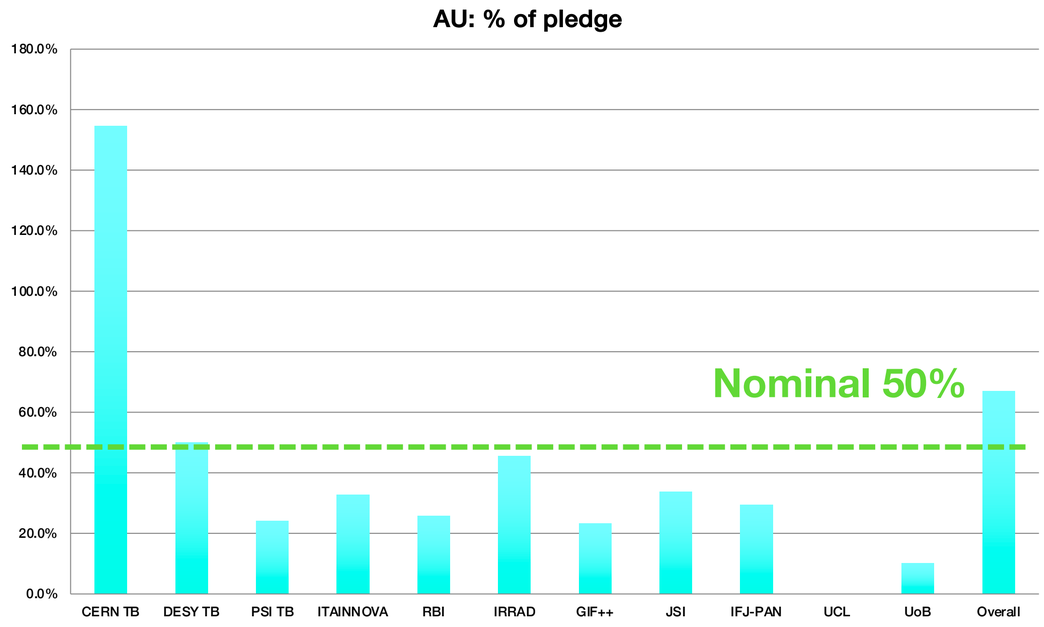
- Aimed at improving access to RIs for EURO-LABS
  - Each RI proposed improvements to maximize impact on user access
  - Improvements required to be ready in Y2 of the project
    - All milestone reports delivered ☺
      - Take a look at them!
    - Some adjustments still on-going
  - EC contributions are matched by RIs own funding, typically exceeding EC
    - Budget adjustment of EC part: equipment -> consumables, manpower (still to be officialized ☹)

CERN TB, IRRAD & GIF++	Data base handling of beam time and irradiation requests
DESY Test Beams	Precision motion stages for large detector setups
PSI Test Beams	Beam monitor
RBI-AF	Ion beam focusing lens
ITAINNOVA	Cooling System and Graphical User Interface for EMC test station
CERN IRRAD	Beam profile monitor
JSI TRIGA	Cadmium shielding in the tangential channel
IFJ PAN AIC-144	2-D scanning table for irradiation
UCL CRC	Test chamber for the heavy ion irradiation facility
UoB MC40	Scanning system upgrade for high fluence delivery

WP4 Performance up to M24

- Taking the overall number of AU (the only deliverable!) granted to users by M24, WP4 is doing very well with 68% of total AUs delivered
- In fact, performance must be improved at many places
  - Overall figure dominated by CERN (and DESY) test-beams
  - One RI with no AU delivered at all at half-mark of the project – UCL





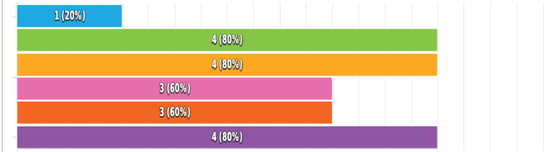
WP4.x Task Performance up to M24

- Three milestone reports MS21-23 due end of August 2024
  - All three titled: *More than 30% of AU delivered in WP4.x: xxx*
- All three tasks successfully passed the milestone criterium
  - But only one (test beams) above the nominal 50% hurdle
- From executive summaries:
  - WP4.1: The M21 milestone provides a checkpoint of RIs' delivery of Access Units (AUs) at project midterm. The overall performance is excellent with the 30% goal exceeded by nearly a factor of three. Detailed analysis by facility reveals substantial differences, yet all the three RIs are expected to fulfil their commitment at the end of the project.
  - WP4.2: The M22 milestone provides a checkpoint of RIs' delivery of Access Units (AUs) at project midterm. The overall performance is acceptable with the 30% goal exceeded. Detailed analysis by facility is provided. Both RIs are expected to fulfil their commitment at the end of the project.
  - WP4.3: The M23 milestone provides a checkpoint of RIs' delivery of Access Units (AUs) at project midterm. The overall performance is acceptable with the 30% goal exceeded by 14%. Detailed analysis by facility reveals substantial differences. Applying proper measures, all the six RIs can still be expected to fulfil their commitment at the end of the project.

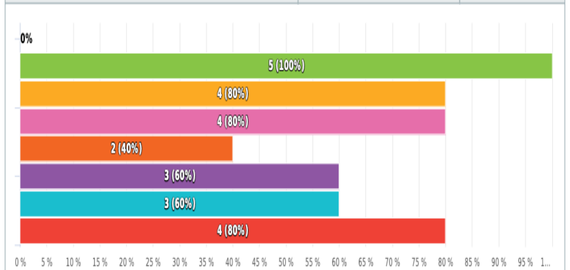
Have we miscalculated ?

- ECFA and LDG have conducted a survey among DRD collaborations of their need of resources for the coming years and beyond (plus a RD resources survey)
  - Findings available in two ECFA Newsletter articles
    - https://ecfa.web.cern.ch/sites/default/files/ECFA_Newsletter_13_Summer2024.pdf
    - https://ecfa.web.cern.ch/sites/default/files/10th%20ECFA%20Newsletter_v6.pdf
- All WP4 facilities are in high demand including the ones with no AU by M24
- Possible reasons for less-than-nominal performance
  - Formation of DRD collaborations posed heavy load on potential users
  - Facilities with few expected projects – large fluctuations
  - Is excluding all HL-LHC production QA to be revised?
- Certainly, development needs to be followed up closely, efforts made to actively solicit users for targeted RIs, eventually also move resources…

Answer Choices	Responses	Ratio
None	1	20.0%
CERN SPS	4	80.0%
CERN PS	4	80.0%
DESY	3	60.0%
PSI	3	60.0%
Other…	4	80.0%



Answer Choices	Responses	Ratio
None	0	0.0%
CERN IRRAD	5	100.0%
CERN GIF++	4	80.0%
JSI TRIGA Reactor	4	80.0%
IFJ PAN AIC-144	2	40.0%
UV Louvain CRC	3	60.0%
UoB MC40 Cyclotron	3	60.0%
Other…	4	80.0%



WP4 Summary

- With WP4 EURO-LABS is providing transnational access to top level European Research Infrastructures for R&D on HEP detectors
  - TA complement to AIDAinnova, workhorse for DRD collaborations
- Acess to RI's free of charge
  - Tailored to detector R&D where dedicated funding is often a problem
- Covers 3 types of research infrastructures, grouped into tasks
  - Test Beams (3 facilities)
  - Detector Characterization (2 facilities)
  - Irradiations (6 facilities)
- Service Improvements at each RI to improve access
- Overall performance excellent in first two project years
  - Large fluctuations between RIs observed by M24 – to be watched
- Targeted effort at potential users of certain RIs indicated and started

Backup slides

Proccessing of WP4 Applications

- Single entry point through the EURO-LABS web page
- Generic review procedure in WP4:
  - *The scientific RI coordinator (“Facility Coordinator”) checks the technical requirements and eligibility of applications. Then the EURO-LABS WP4 User Selection Panel gets notified of the application and decides on the allocation of resources*.
- USP composition: WP4 & WP4.1-3 leaders (4) & representatives of LHC experiments and DRD 1,3,7 (4), awaiting assignment from DRD6
- Some facilities require pre-approval by their Scientific Committees (CERN, PSI…)
- USP receives the proposal from the FC, any member can request discussion within two weeks, otherwise the project can go ahead

WP4 USP

DRD1 (Gas): Eraldo Oliveri (CERN)
DRD3 (Solid): Gianluigi Casse (Univ. Liverpool)
DRD6(Calorimetry): to be nominated
DRD7 (Electronics): Mohsine MENOUNI (CPPM Marseille)
LHC experiments: Anna Macchiolo (Univ. Zurich)
WP4.1: Eva Barbara Holzer (CERN)
WP4.2: Fernando Arteche (Itainnova)
WP4.3: Michael Moll (CERN)
WP4: Marko Mikuz (Univ. Ljubljana & JSI) (Chair)