



**AIDA**<sup>2020</sup>

Advanced European Infrastructures  
for Detectors at Accelerators

**AIDA-2020**

**TA – Transnational Access Facilities  
(4<sup>th</sup> Year Report)**

F. Arteche

On Behalf of WP10, WP11 & WP12



*This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654168.*



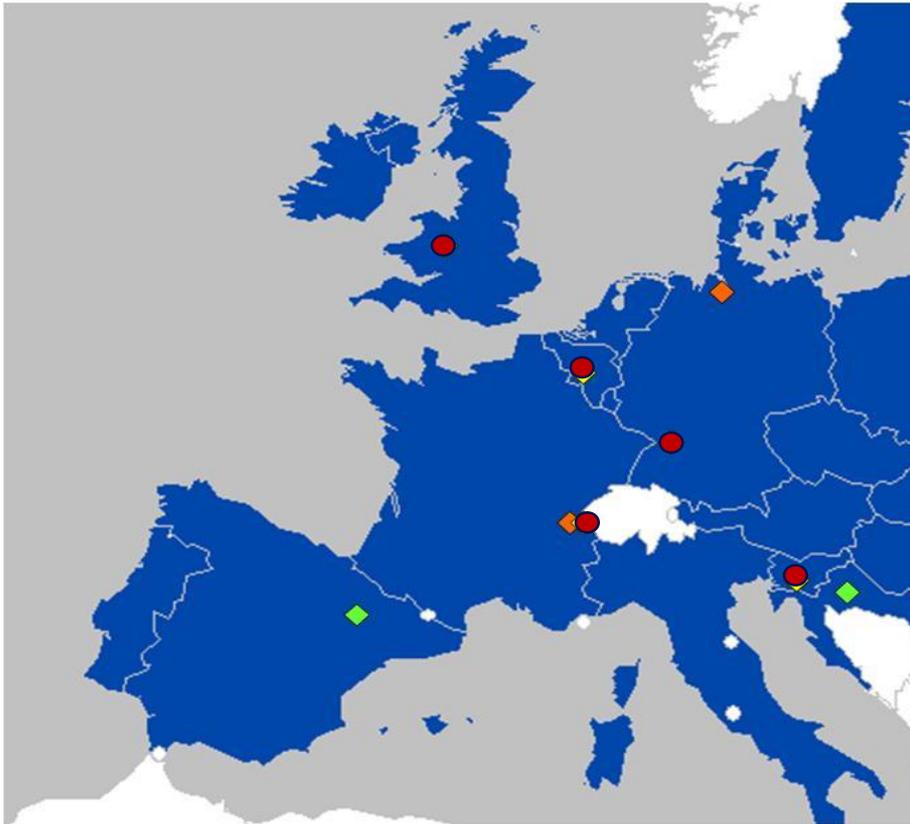
- 1. Introduction
- 2. WP10 – Beam Test Facilities
- 3. WP11 – Irradiation Test Facilities
- 4. WP12 -Detector Characterization Facilities
- 5. Summary



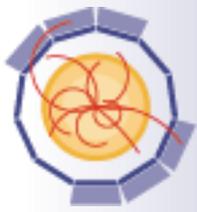
- The main goal of the Transnational access is to provide support for evaluation of detector technologies in terms of radiation hardness, particle response and electromagnetic interference.
  - Resources usage is monitored by User Selection Panel
  - Complemented by WP15: Upgrade of beam and irradiation test infrastructure (JRA3)
- TA facilities are grouped into 3 WP
  - WP10: Test beam facilities (TA1)
  - WP11: Irradiation test facilities (TA2)
  - WP12: Detector characterization facilities (TA3)



## List of TA facilities :



- **WP10.1:** CERN PS and SPS Test Beams
- **WP10.2:** DESY-II Test Beam Facility
- **WP11.1:** CERN IRRAD & GIF++
- **WP11.2:** JSI TRIGA Reactor, Slovenia
- **WP11.3:** KIT KAZ, Germany
- **WP11.4:** UCLouvain CRC, Belgium
- **WP11.5:** UoB MC40 Cyclotron, UK
- **WP 12.1:** RBI-AF, Croatia
- **WP 12.2:** ITAINNOVA – EMClab, Spain



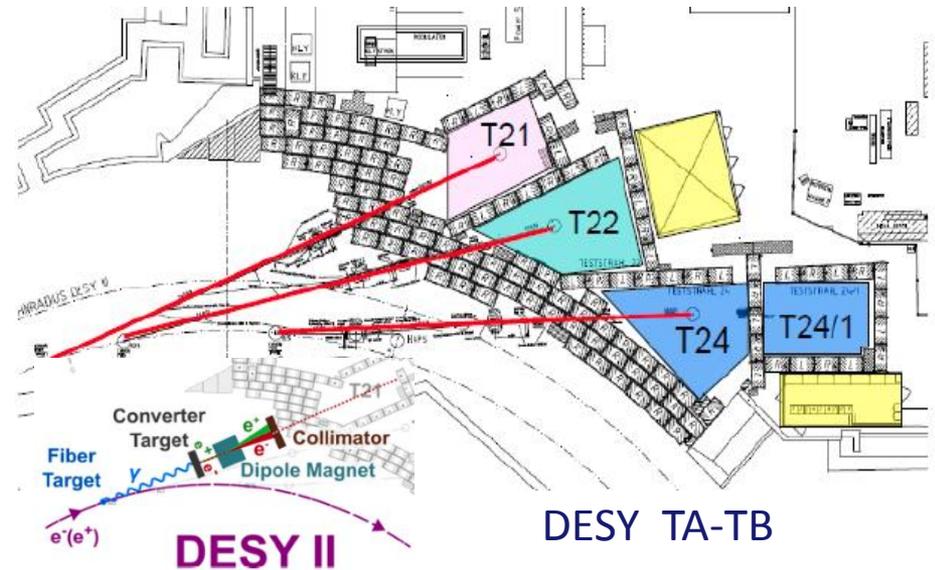
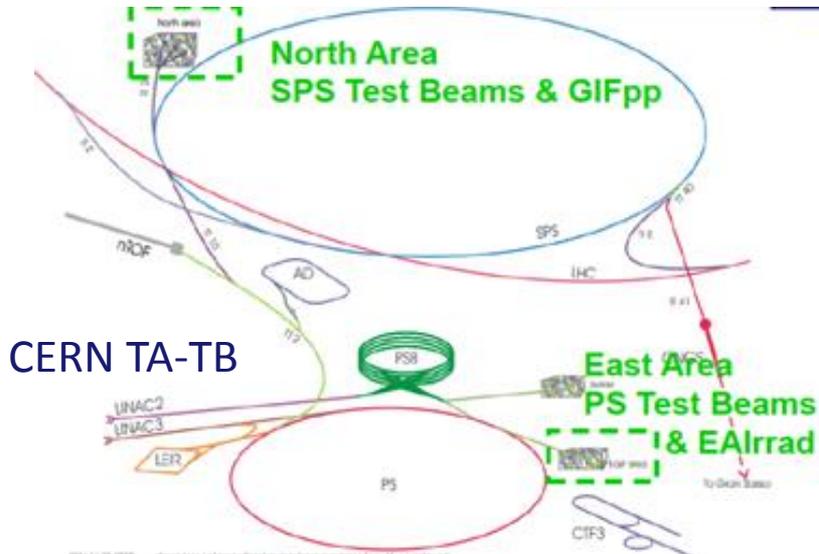
- Wednesday morning we had the TA parallel session
- We had an interesting meeting with talks from each facility reporting progress and issues.
- The meeting has been well attended
  - Some of them present and some remotely
- In the next slides, a few highlights from each facility are presented in order to get a complete picture of the activity.



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- The WP10 Transnational Access is focused on Test Beam.
- It covers two different test beam locations.
  - **CERN TA-TB** (Switzerland) provides 2 beam lines: CERN PS (1 to 12 GeV/c) and SPS (15 to 400 GeV/c)- East / North Areas
  - **DESY TA-TB** (Germany) provides 3 beam lines at DESY II (1 to 6 GeV, energy spread 5% / electron – positron)





CERN PS & SPS	User Projects		Total users	AU
	Submissions	Selected		
M1-M48	42	42	198	15624
M1-M48	47		210	11280

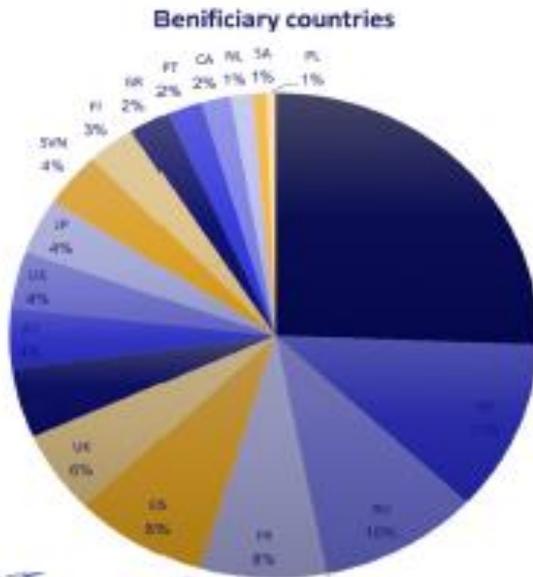
DESY	User Projects		Total users	AU
	Submissions	Selected		
M1-M48	27	27	155	> 7750
M1-M48	30		120	8400

**ALMOST 100% of the pledged access hours delivered**





- Participants from 19 countries

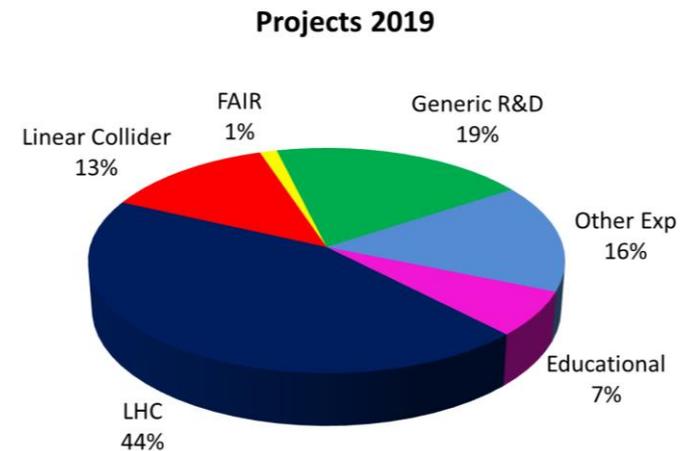
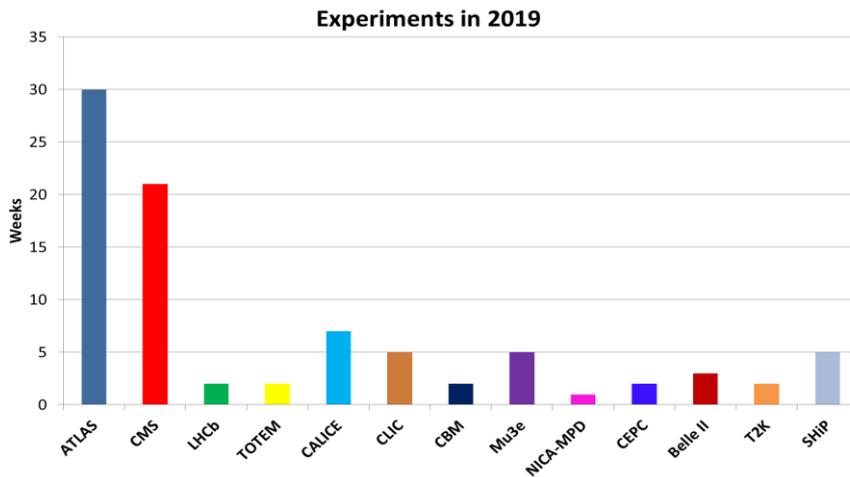


- WP10.1 still allows to simplify test beam users registration at CERN, when they have no affiliation to a CERN experiment.
- CERN test-beams stopped for the Long Shutdown 2 (2019-2020).
- Only a few projects haven't reported publications yet. Some more publications are being written. (40 / 42)



- Very productive activity during the 3<sup>rd</sup> / 4<sup>th</sup> year of the project and for 2019

➤ Telescopes are as popular as ever



- DESY will be able to give support only for a small group in 2019
- Publications
  - 14 out of 27 have publications
  - There are many more out but ...(acknowledgement is an issue)



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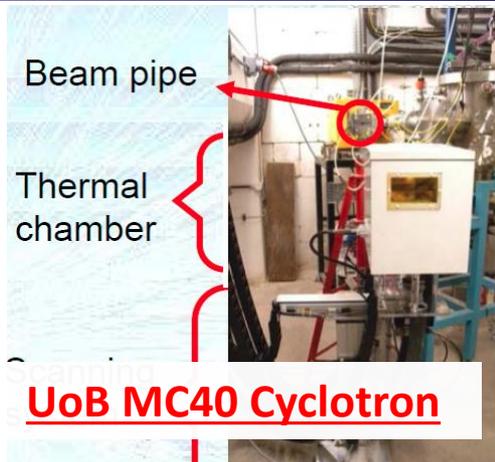
- The WP11 Transnational Access is focused on irradiation test.
- It covers six different irradiation facilities.
  - **CERN IRRAD & GIF++**, Switzerland
    - 24 GeV protons, mixed field, gammas
  - **JSI TRIGA reactor**, Slovenia
    - Reactor neutrons, gammas
  - **KIT KAZ**, Germany
    - Accelerator protons (23 MeV)
  - **UCLouvain CRC**, Belgium
    - Accelerator neutrons (NIF), heavy ions (HIF) – SE Studies
  - **UoB MC40 Cyclotron**, United Kingdom
    - Accelerator protons (27 MeV)



## 3. WP11 –Irradiation Test Facilities



**JSI –TRIGA Mark II Reactor**



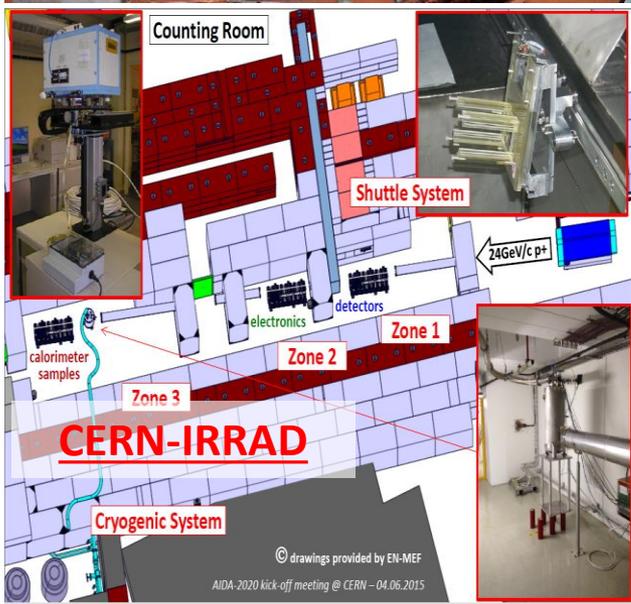
Beam pipe

Thermal chamber

**UoB MC40 Cyclotron**



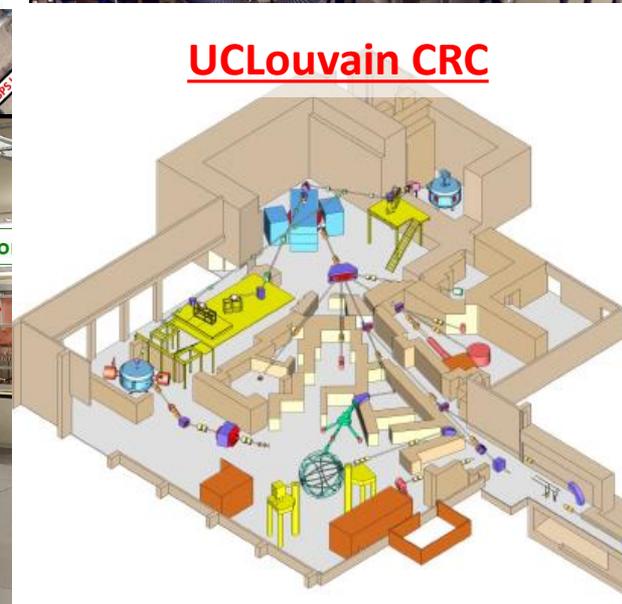
**KIT-KAZ**



**CERN-IRRAD**



**CERN- GIFF+**



**UCLouvain CRC**



CERN IRRAD	User Projects		Total users	AU
	Submissions	Selected		
M1-M48	18	18	76	4550
M1-M48	30		60	4032

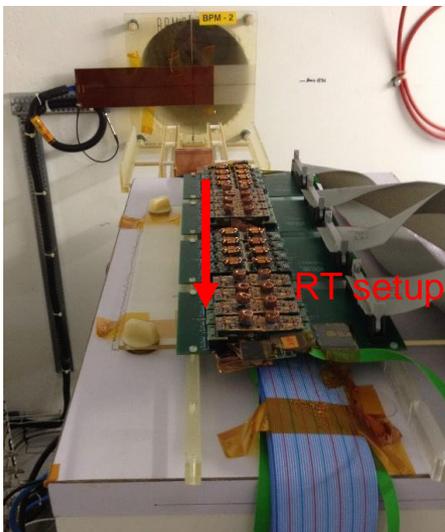
CERN GIF++	User Projects		Total users	AU
	Submissions	Selected		
M1-M48	15	15	105	4210
M1-M48	20		50	4032

JSI	User Projects		Total users	AU
	Submissions	Selected		
M1-M48	100	100	272	515
M1-M48	50		150	500

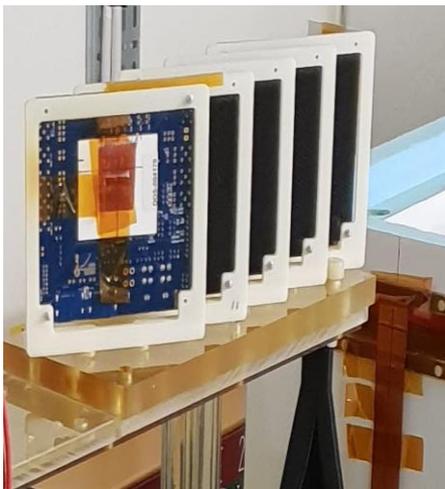
KIT	User Projects		Total users	AU
	Submissions	Selected		
M1-M48	24	24	75	91.2
M1-M48	30		90	100

UCLouvain	User Projects		Total users	AU
	Submissions	Selected		
M1-M48	8	8	27	80
M1-M48	10		50	80

UoB	User Projects		Total users	AU
	Submissions	Selected		
M1-M48	14	14	41	287.5
M1-M48	60		180	240



2x **FEAST2 DC/DC converters** test in cold-box & RT with “thin” 10mm Cu target (EP-ESE)



**RD53A modules** for ATLAS ITk

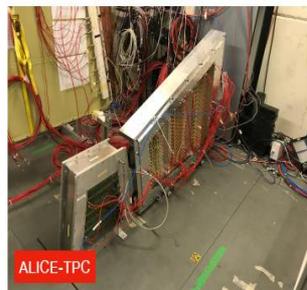


▶ **ATLAS MicroMegas (NSW)**

First LM2, SM1 & SM2 chambers tested during last weeks of 2018. Tests restarted in mid January and lasting throughout 2019

▶ **ATLAS sTGC (NSW)**

First chambers tested. 5-6 chambers, expected to continue throughout 2019 (2-4 chambers per week)



▶ **ATLAS RPC - gas gap**

100 gaps (5mm x 1.80m x 1.20m) to be installed for burn-in test, 10 qualified gas gaps per week, for a total of 10 weeks. 2/3 access per week

▶ **ALICE TPC chambers**

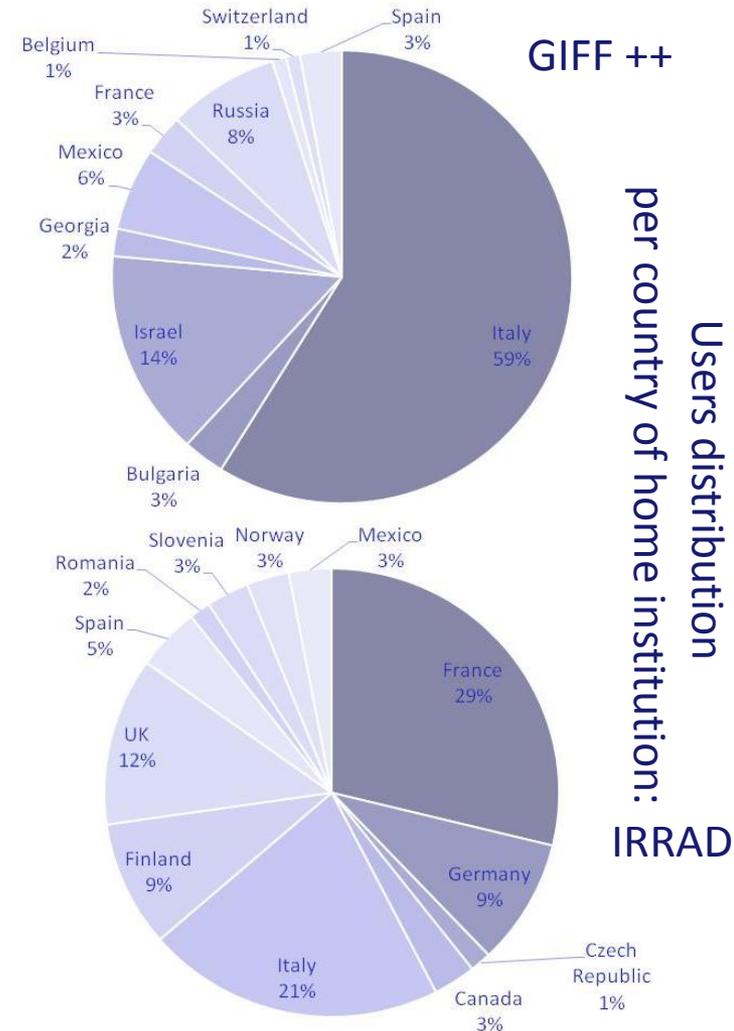
6 chambers per week of production chambers to identify faulty chambers. 20-30 chambers in total. Full gamma field / unshadowed. Finishing end of March.

Mass production tests will have a significant impact on the irradiation program. Multiple access needed per week (to swap chambers) in addition to frequent absorption filter change and source ON/OFF intervals.

- This TA has given support to different types of projects (18+15)
  - Diagnosis ( DC-DC converters analysis at CMS Pixel phase I)
  - Development ( RD53A ROC)
  - Mass production test (ATLAS RPC ....)

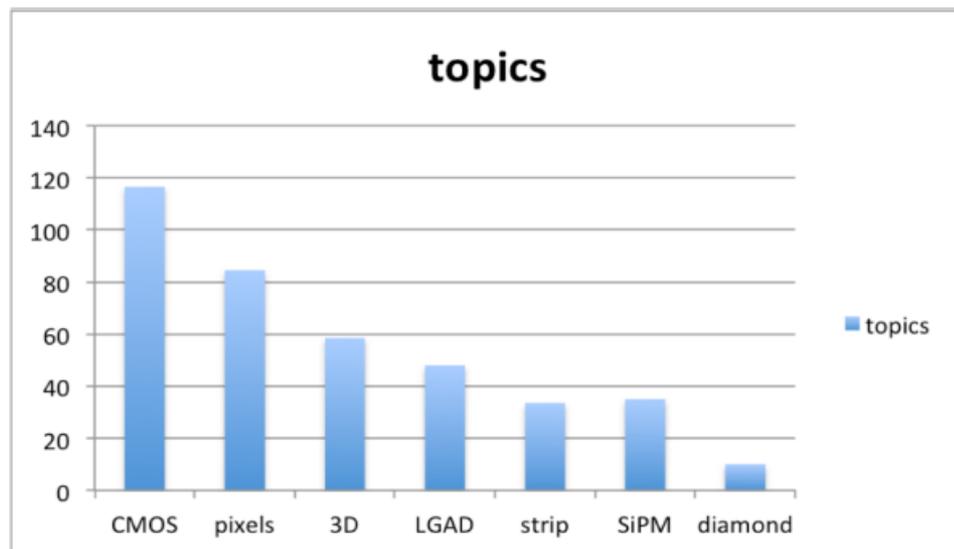
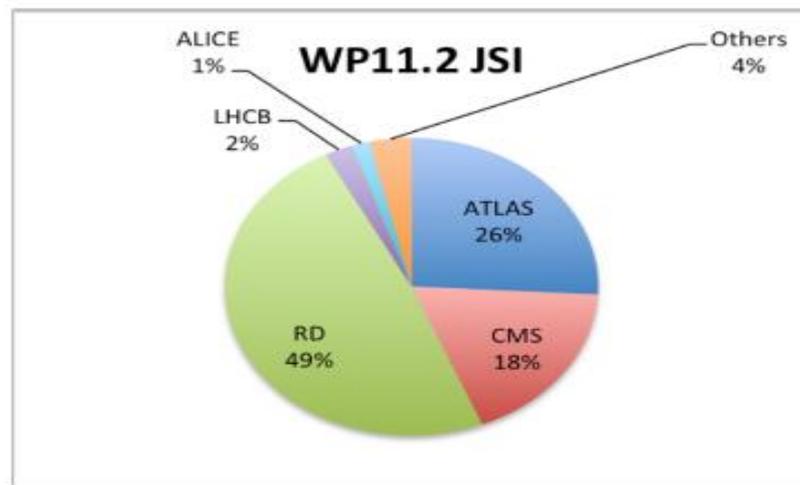


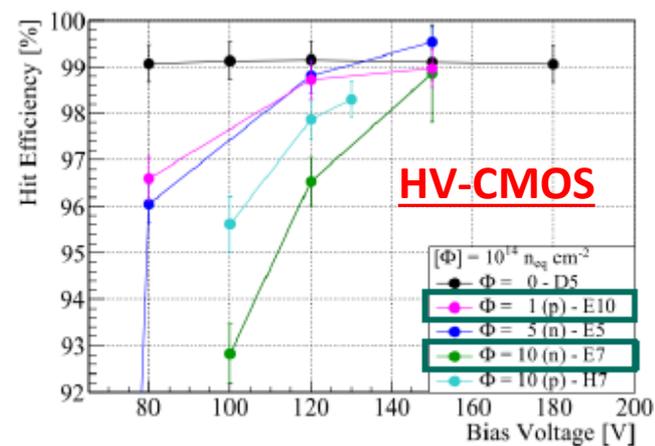
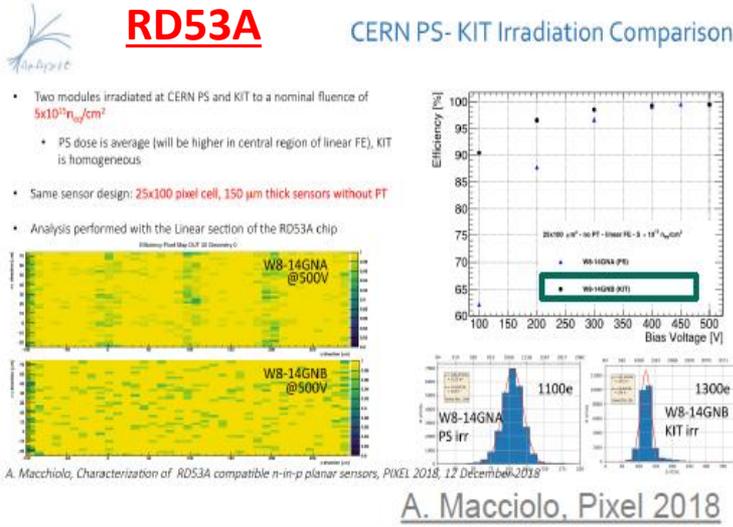
- 181 users from different countries
  - 12% of them are working outside EU or associate country.
- Long Shutdown 2 at CERN: No more particle beams
  - IRRAD facility in shutdown (no more AIDA2020 TA irradiations)
  - GiFF++ facility TA continuing with gamma irradiations (without particle beam)
- A few resources still available for users
- Publications: Still waiting for further to come in, so far only 13 for IRRAD, 2 for GiFF++





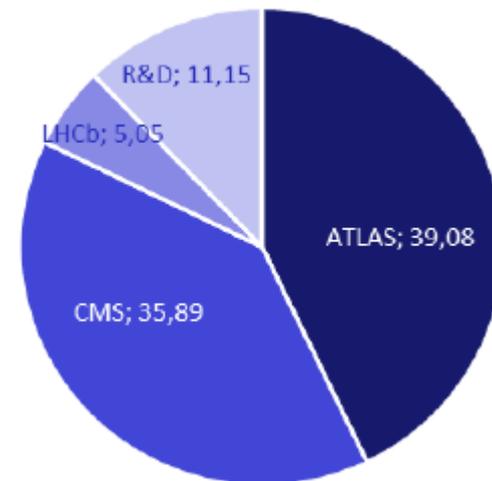
- 100 projects have been supported by JSI-Triga
  - Experiments & R&D
  - Wide variety of topics
- 43 publications have been already presented
- JSI still has a high demand but it runs out of AU
- JSI will continue giving support but users will be charged for operation cost.





(b) Hit efficiency vs Bias Voltage, zoom

- 24 projects have been approved
  - Several topics (RD53A, HV-CMOS,....)
  - AUs are well balanced between two big experiments.
  - 1 proposal is pending – CMS pixel modules (8h)
- 20/24 projects have already publications





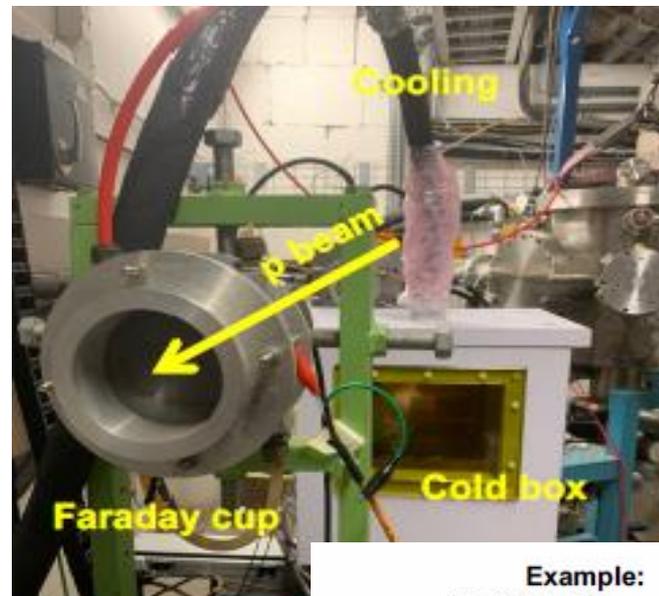
Acronym	Experiment	Users	Irrad	Institute
AIDA-2020-CRC-2015-01	ALICE ITS	2	11.5 h	CERN
AIDA-2020-CRC-2016-01	ATLAS calo ASIC	2	6.5 h	Columbia Univ.
AIDA-2020-CRC-2016-02	LHCb FPGA RICH	5	10.0 h	IFIN-HH
AIDA-2020-CRC-2016-03	LHCb CLARO	3	8.0 h	INFN
AIDA-2020-CRC-2016-04	LHCb calor	6	13.0 h	CNRS/Barcelona
AIDA-2020-CRC-2017-01	CMS tracker	3	12.0 h	Imperial College
AIDA-2020-CRC-2017-02	LHCb CLARO	3	8.0 h	INFN
AIDA-2020-CRC-2017-03	ATLAS Pixel	3	11.0h	Wuppertal



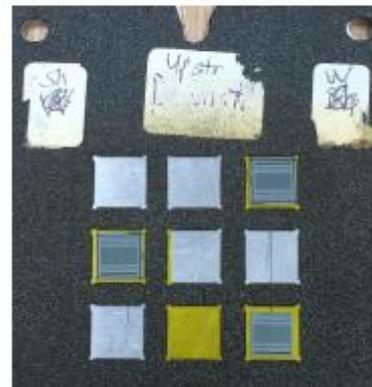
- 8 projects for different experiments have been approved
  - ALICE, CMS, ATLAS & LHCb
- Activity is already complete
- The support during the 5<sup>th</sup> year need to be clarified
- Publications is an issue – Not many (2)



- Last year UoB had an upgrade
  - New cold box, pillars, software
- 14 projects of different topics/experiments have been completed
  - Sensors, AISICs, LHCb, ATLAS,..
- 12 publications have been already presented
- Activity is complete but some support can continue
- The users will not be charged but irradiations will be dealt with on a priority basis as follows
  - Irradiations for ATLAS ITk components
  - Irradiations for R&D projects (they are directly involved with)
  - Irradiations for AIDA-2020 projects

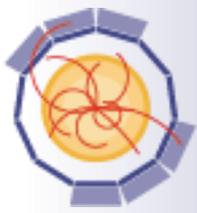


Example:  
ATLAS12 mini strip sensors

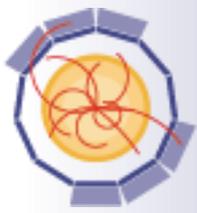


Example:  
ABC130 chip on PCB

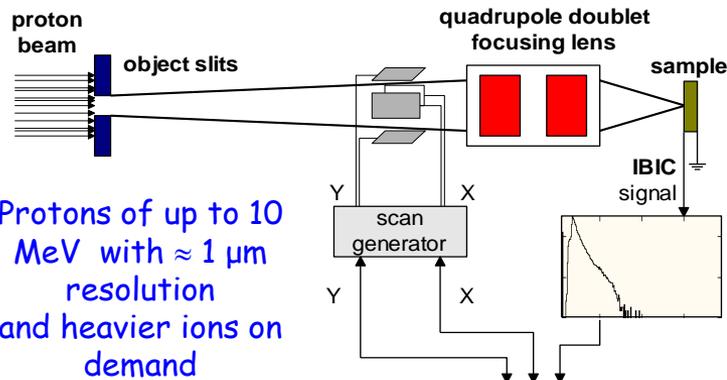




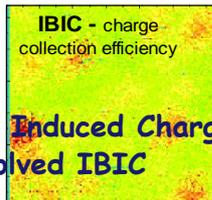
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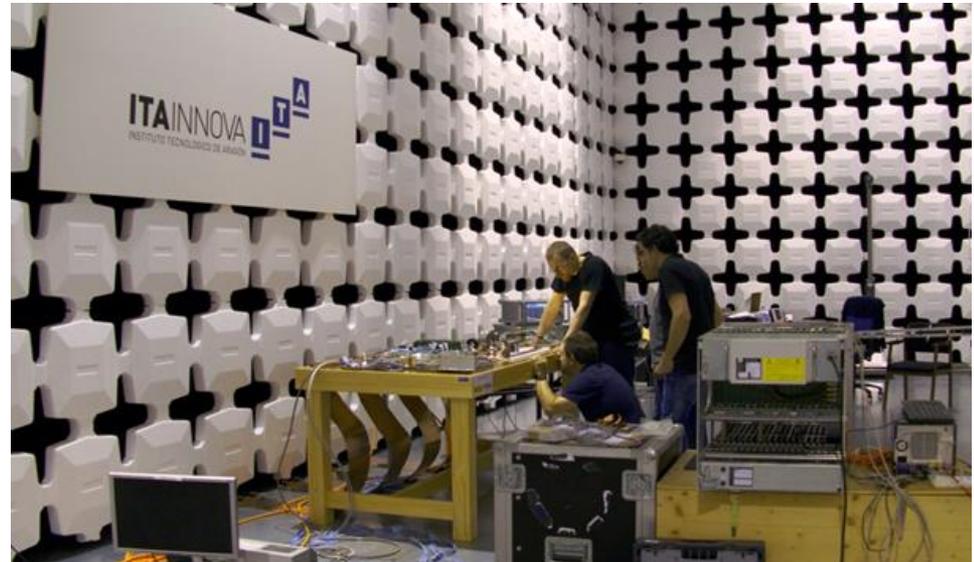
- The WP12 Transnational Access is focused on special detector and system characterization
- It covers two different types of characterization.
  - The multi-MeV ion micro-beam at Rudjer Boskovic Institute (**RBI**) in Croatia for detector **radiation characterization (sensors and ASCIC)**
  - Electromagnetic Compatibility Laboratory of Instituto Tecnológico de Aragon (**ITAINNOVA**) in Spain for **EM noise characterization**.



**Ion microprobe:**



IBIC = Ion Beam Induced Charge  
TRIBIC = Time Resolved IBIC

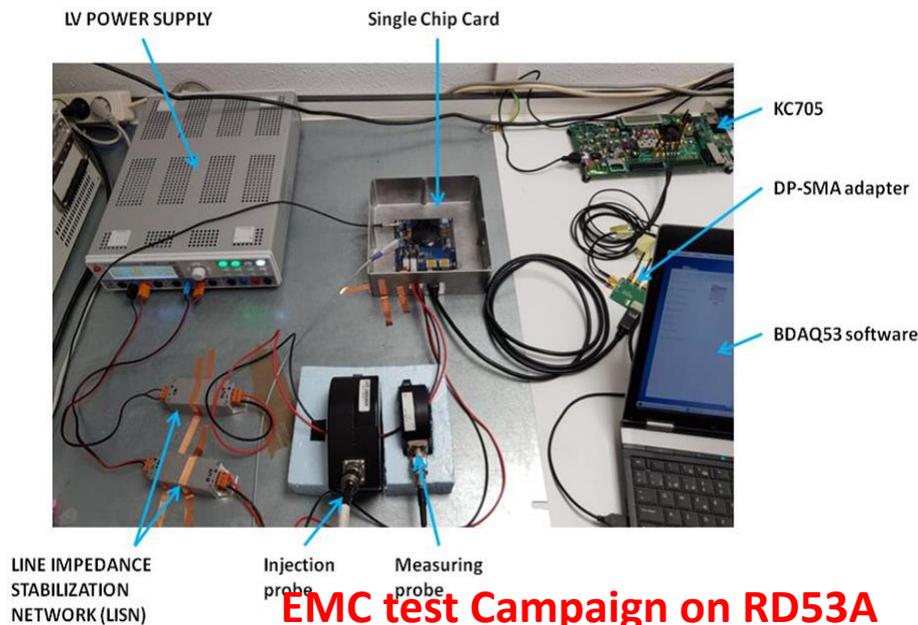
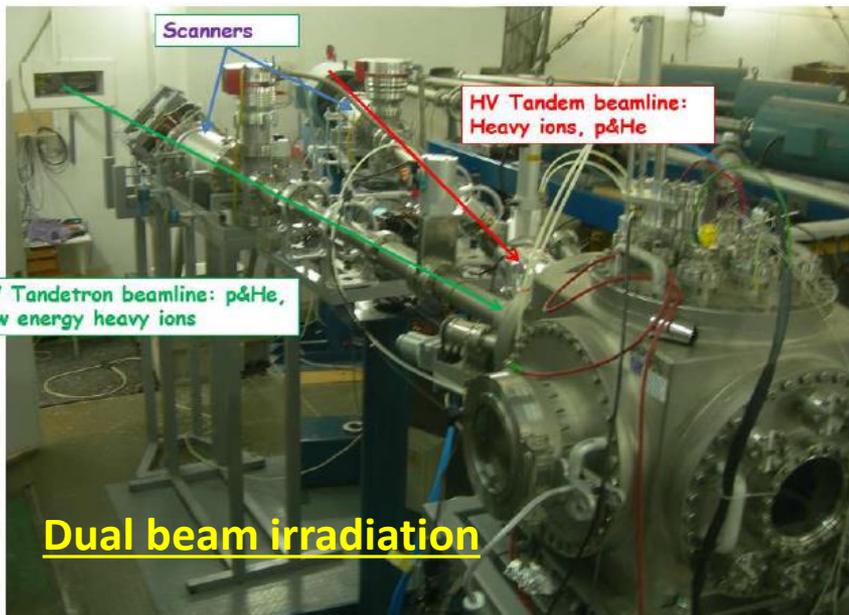




RBI	User Projects		Total users	AU
	Submissions	Selected		
M1-M48	15	15	28	520
M1-M48	16		24	640

ITAINNOVA	User Projects		Total users	AU
	Submiss.	Selected		
M1-M48	7	7	14	950
M1-M48	12		12	1200

**80% of the pledged access hours delivered**

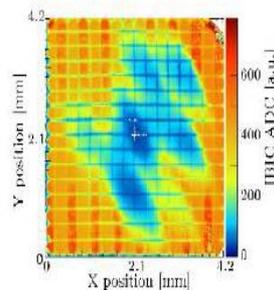
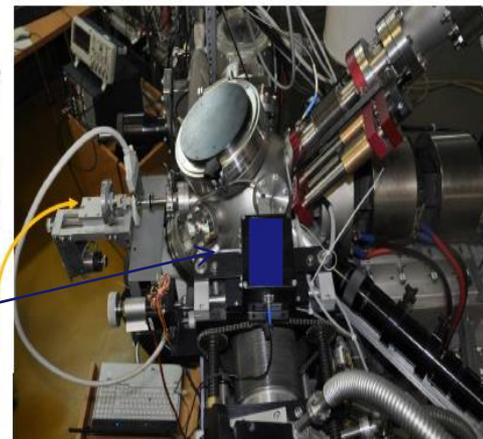
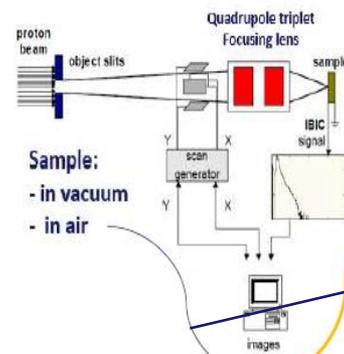




# AIDA<sup>2020</sup> 4.1 WP12 .1 :

## RBI Accelerator Facility

- 13TA projects (81%-AUs) has been completed
  - Two more have been approved and scheduled
  - One more is on the pipeline
  - Users from 8 countries
- Some delays during 4Y due to unscheduled maintenance of accelerators
- Several activities
  - Proton u-beam....
  - broad beam irradiations
- 8 publications have been already submitted.



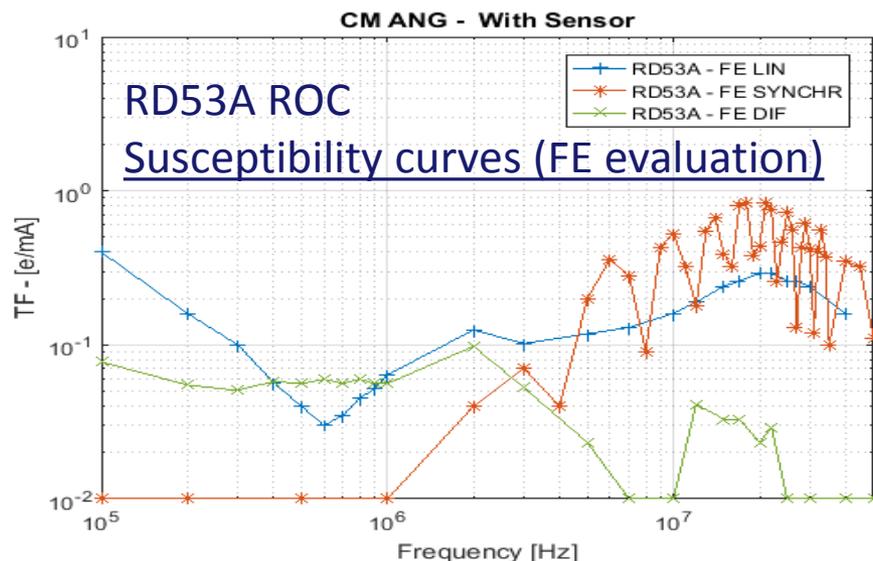
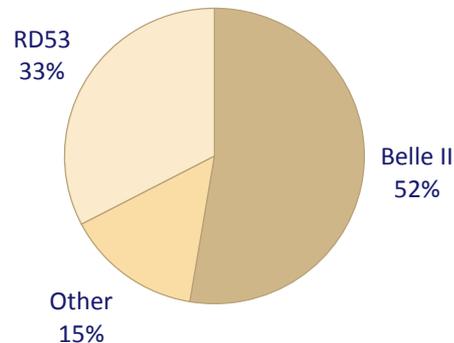
- 2D imaging at the microscale of charge collection efficiency by IBC (Ion Beam Induced Current) technique
- radiation hardness tests
- defects mapping

- RBI has enough funds within AIDA2020 to cover the realization of three remaining planned TA projects (2 already approved)
- In case necessary more access can be discussed with RBI



- 6 TA projects are completed (80 %)
  - Several groups
  - 1 is pending and 2 under discussion
- Users from 7 countries have benefited from TA-EMC
- Once again a group has benefited from several TA
  - RD53 – RD53A test campaign
- TA activity has generated several publications (3), conference talks (4), posters as well as a Thesis (1)

Experiments / RD groups (AU)



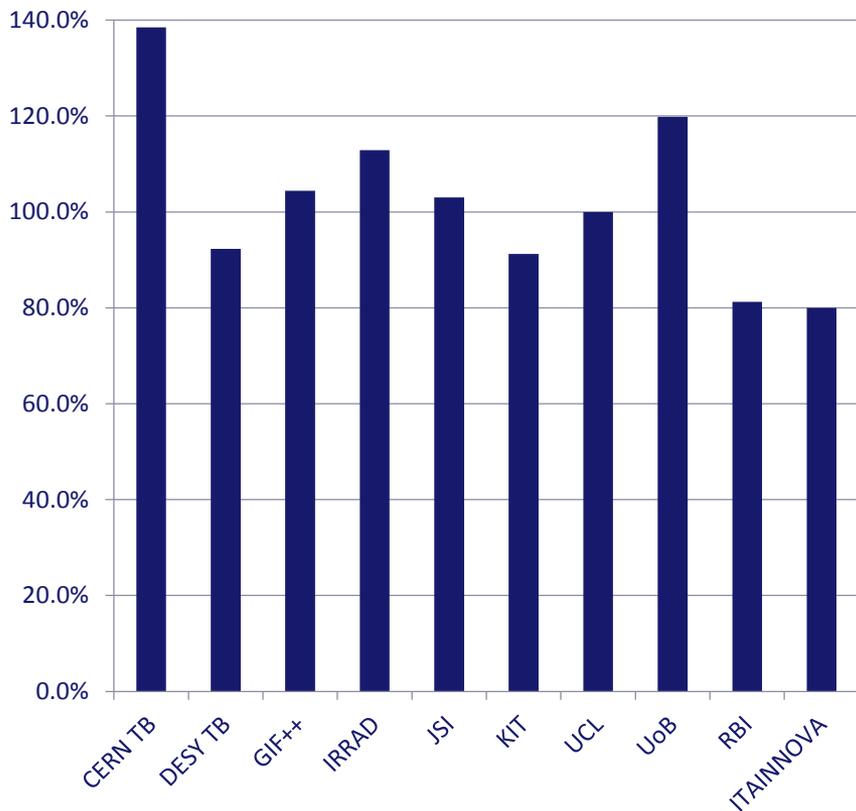


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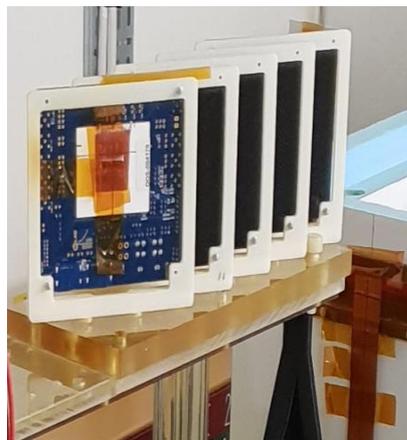
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### AU: % of pledge



### High demand

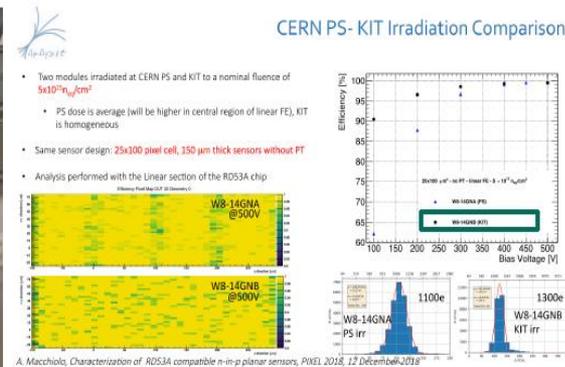
### TA CERN IRRAD: RD53A modules



### TA ITAINNOVA: RD53A modules

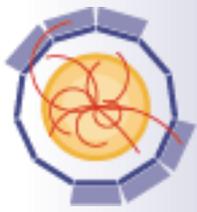


### Complementary support



A. Macchiolo, Pixel 2018

### TA KIT – KAZ: RD53A modules



- Most of TA facilities are complete
  - Some of them can still offer AU but access conditions are different.
- More than 305 projects have been selected and more than 991 users have benefited from TA support.
  - Some of them from non – EU or associate countries
- TA have shown to be a primary tool for R&D for future detector technologies
  - Some R&D activities have benefited from different types of TA access
- Still some activities will be completed during the next year
- Some TA will continue the activity - Different accesses conditions
- TA activities have produced a lot of papers and conference contributions (>154) but still some of them are missing
- TA activity has been a big European success story