Detector R&D in AIDA-2020

Felix Sefkow

Report to the SPSC

CERN, June 21, 2016

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement no. 654168.

Outline

- Overview of the project
- Scientific Highlights
- Test beam needs

Fact sheet

- Integrated infrastructure initiative in EU FP8 “Horizon 2020”
  - Following success of EUDET and AIDA
- “infrastructure” = common interest
- Duration: 1.5.2015 – 30.4.2019
- EU contribution 10 M€
- Total budget 29.7 M€
- Coordinating institute: CERN
- Scientific coordinator L.Serin (LAL) (-30.4.2016), F.Sefkow

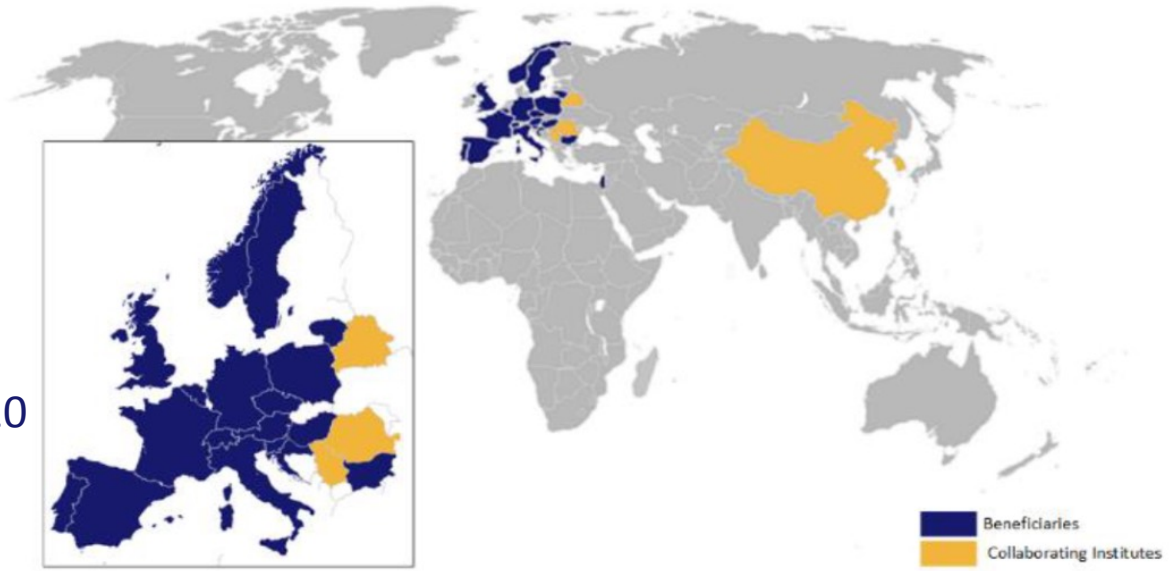
https://aida2020.web.cern.ch

First Annual Meeting

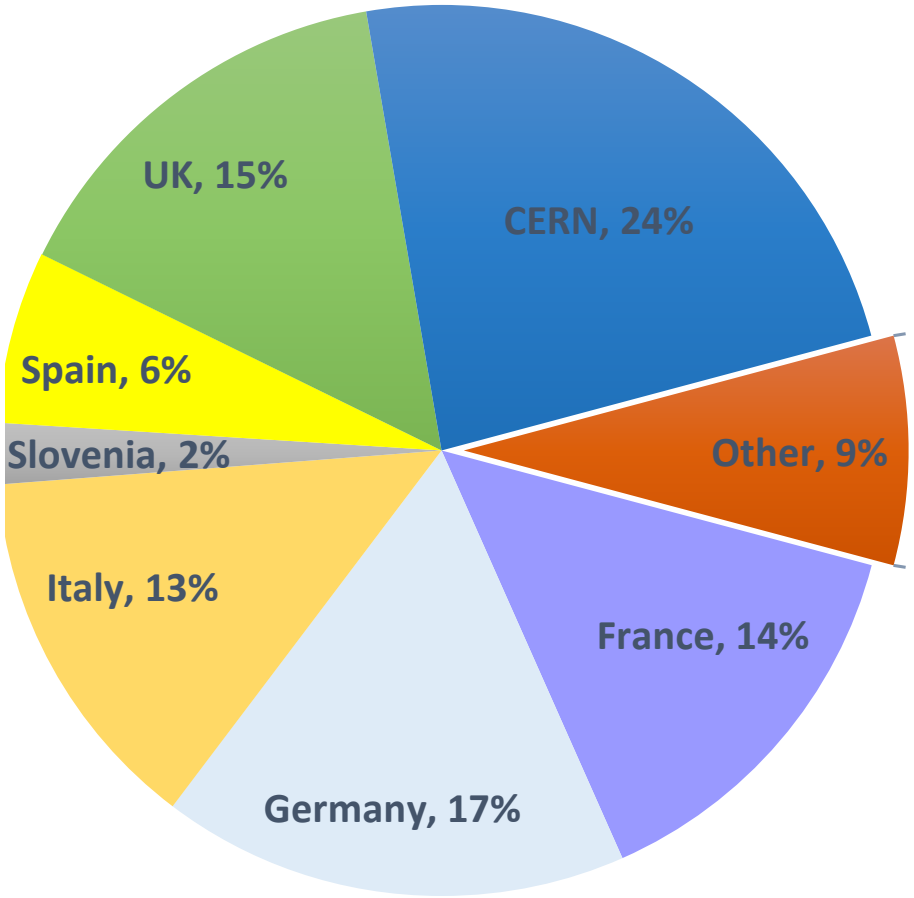
- Last week at DESY, 135 participants

Participants

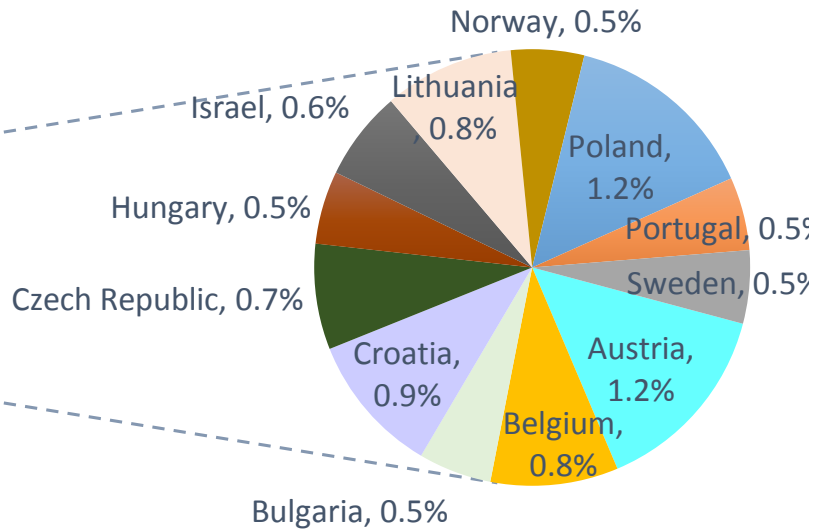
- 19 countries
- 38 beneficiaries
  - Duties wrt EC and AIDA-2020
- 12 partner organisations
  - Duties w.r.t. AIDA-2020
- 9 collaborating institutes
  - Roles, but duties
  - Still counting…



Budget

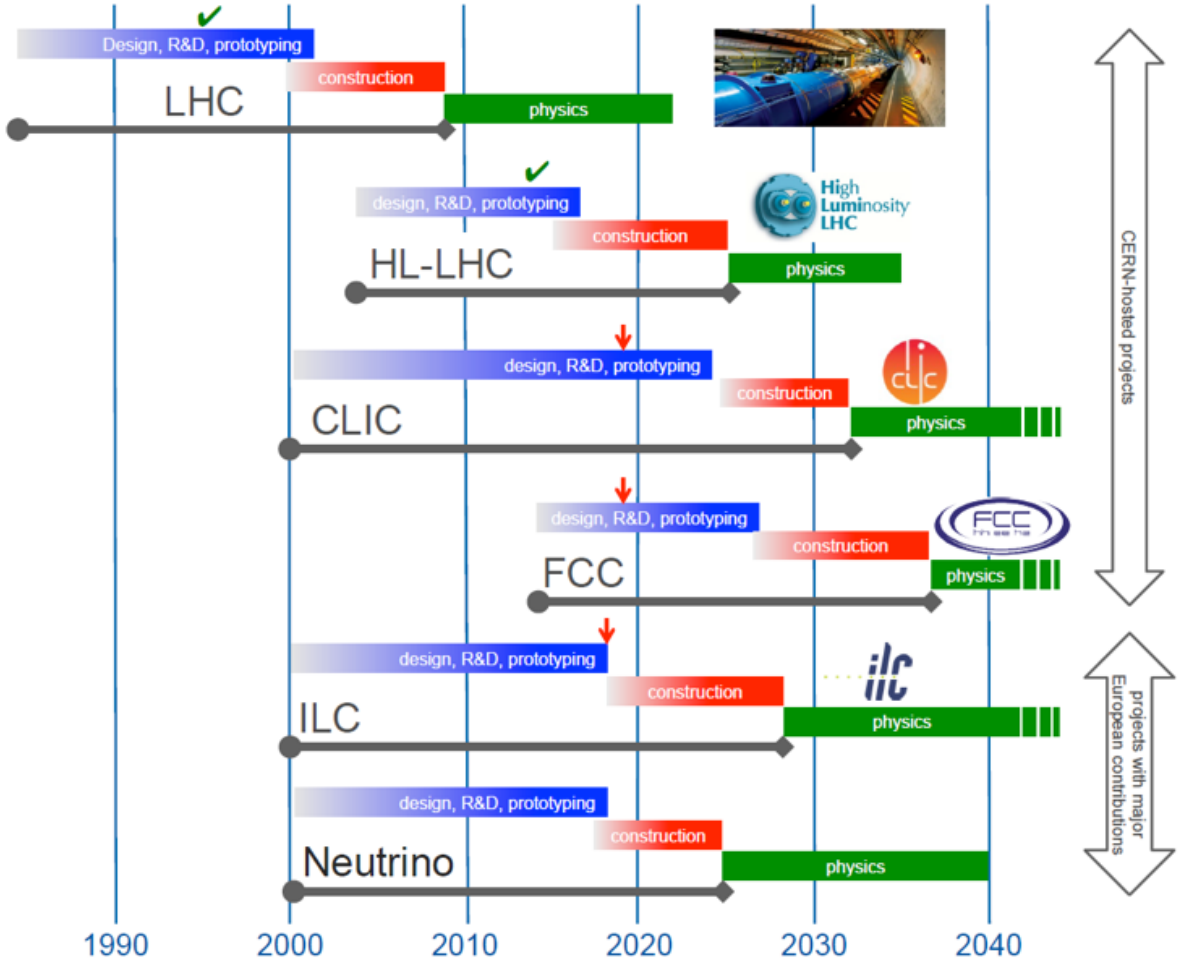


Distribution of EC funding



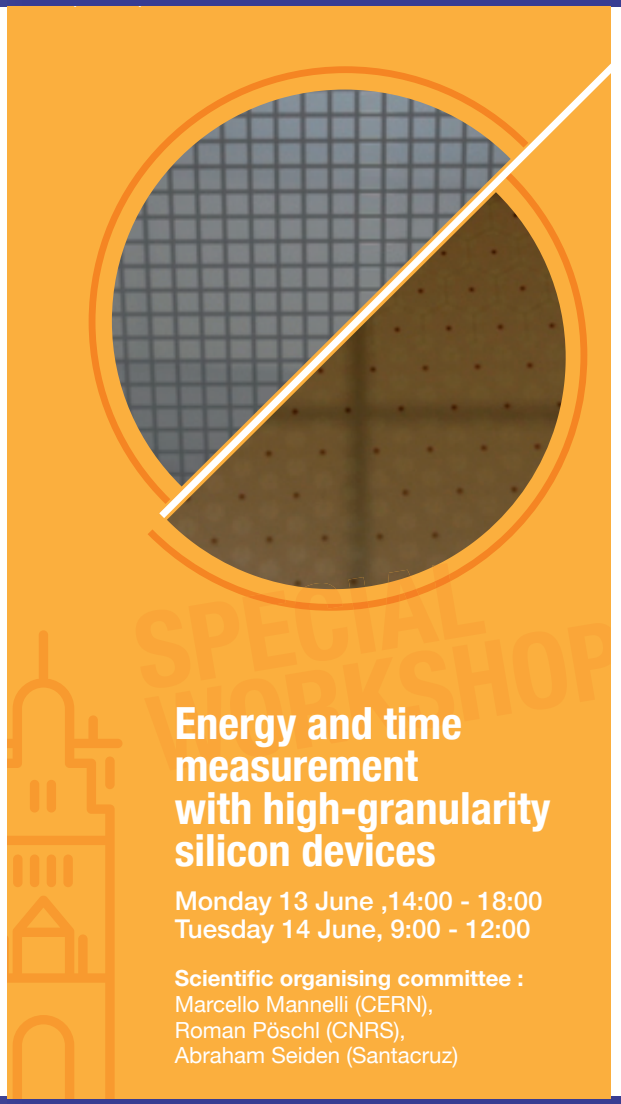
Context

- Follow closely the European strategy for particle physics
- Many R&D issues in common
- ~50% LHC, ~25% LC
- Build on AIDA achievements
  - test beam, irradiation
  - software
  - micro-electronics

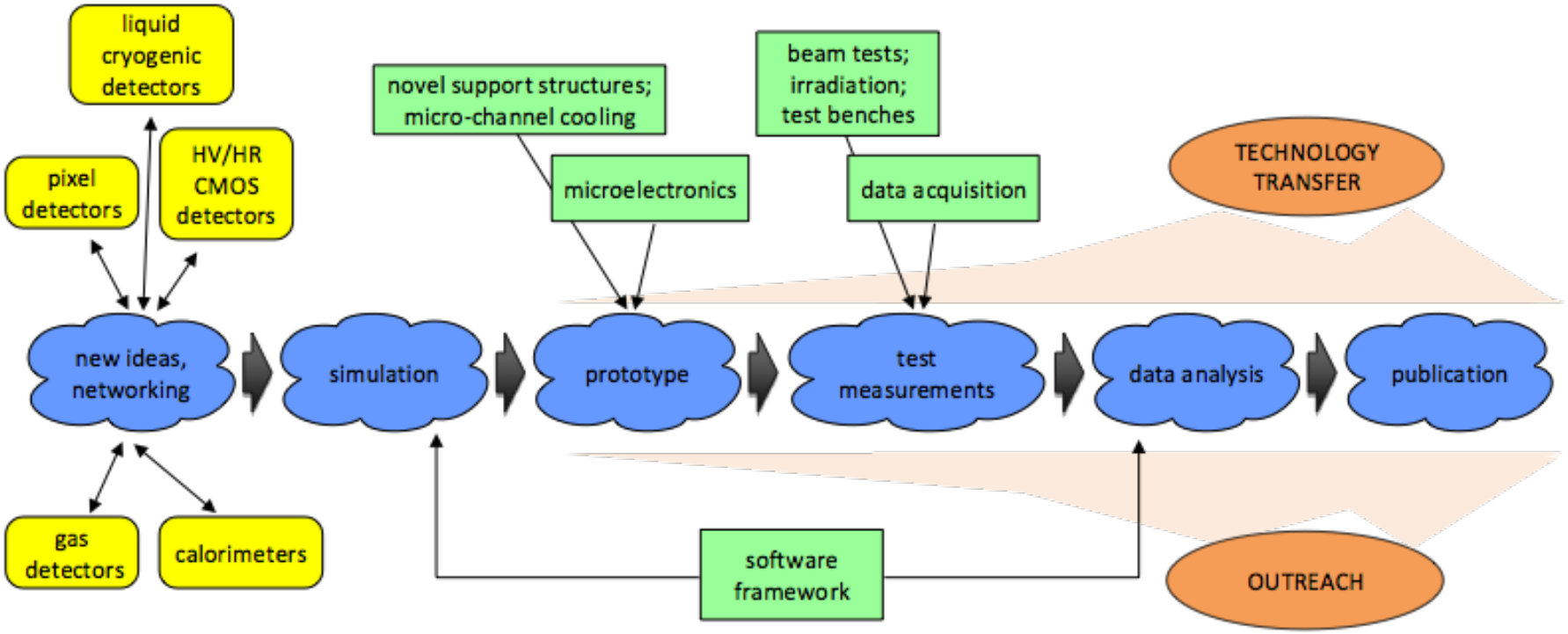


Workshop

- Big success
- 88 participants
- Excellent talks
- Lots of discussions
  - Across communities
  - ATLAS, CMS, CALICE, generic…
- Organisers:
  - Marcello Mannelli
  - Roman Poeschl
  - Abe Seiden

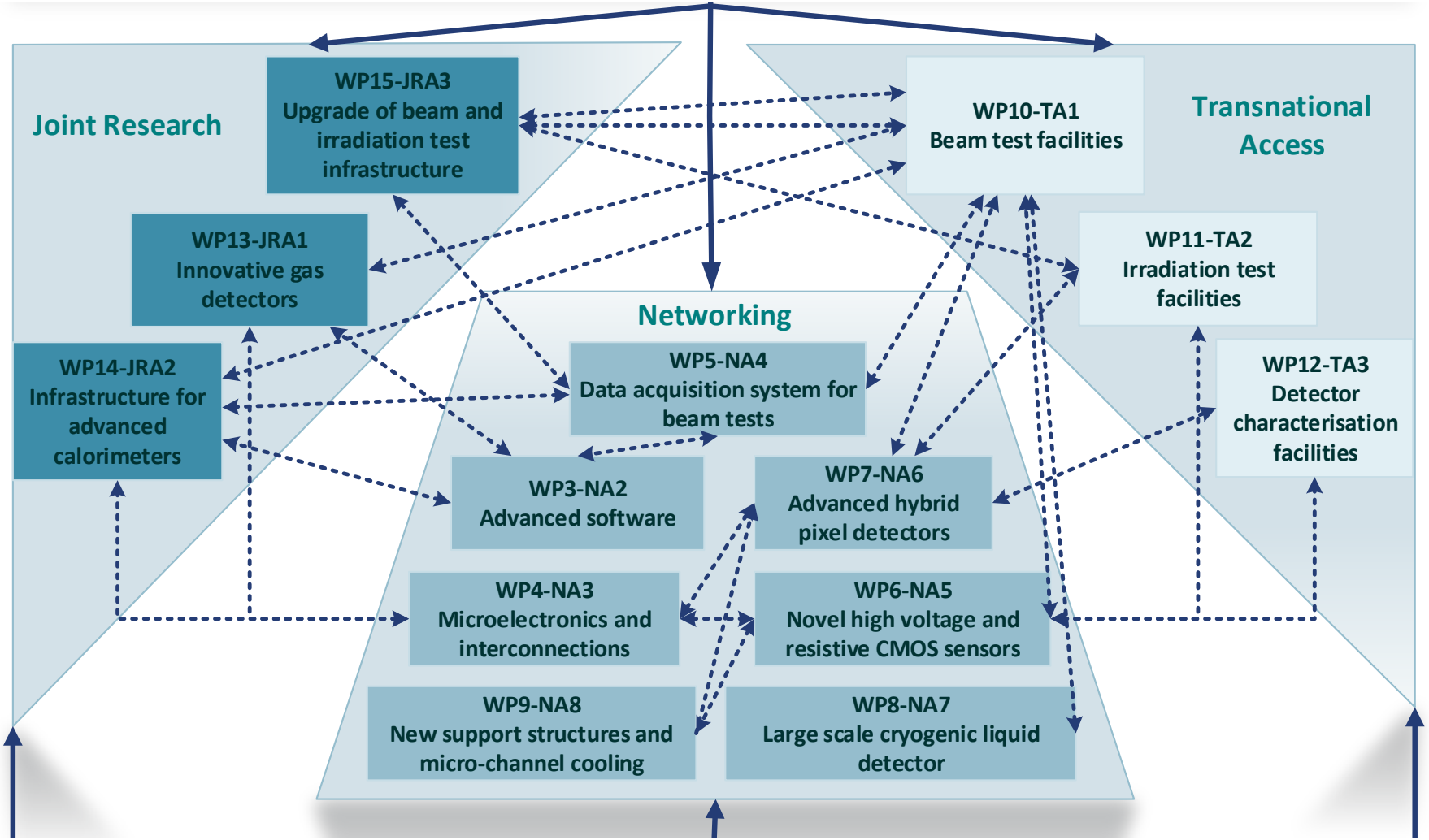


Detector life cycle

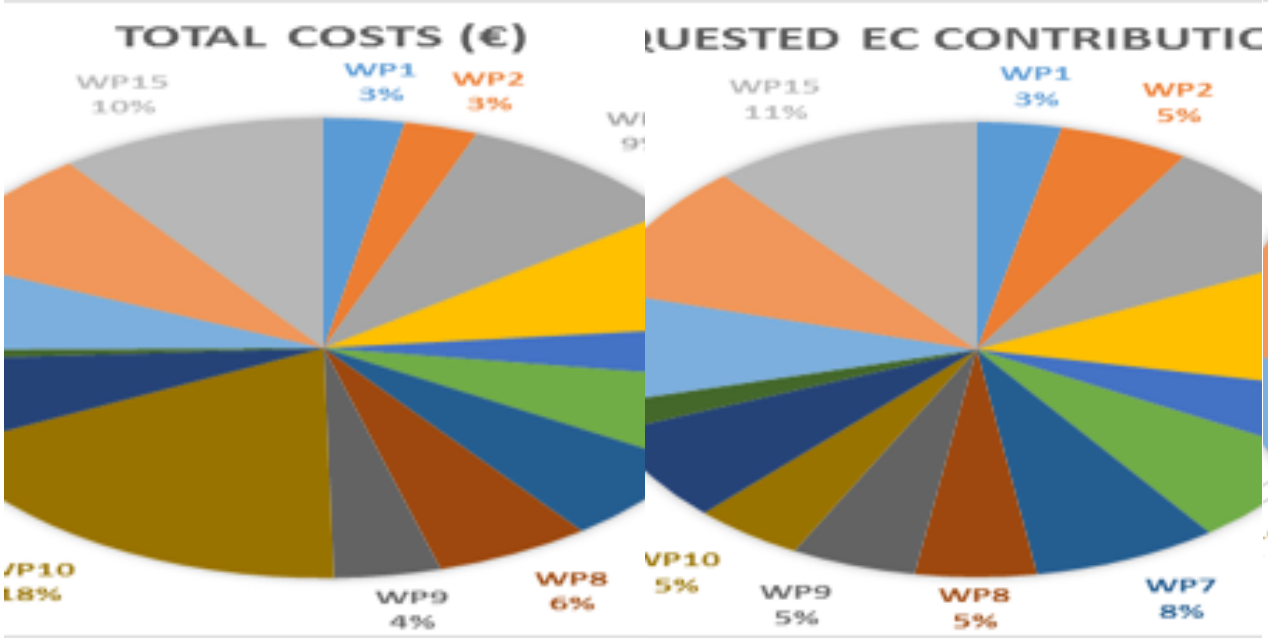


- Guides the work package structure of AIDA-2020

Work packages



Budget by WP



- Management 3.5%
- TA user support 14%
- WPs 0.5-1.0 M

Steering group

Meeting (vidyo, 3h) 5x per year, short reports per WP every 4-6 months

No	Type	WP	WP Coordinators	Institute
WP1	MGT	Project management and coordination	Laurent Serin	CERN, CNRS
WP2	NA1	Innovation and outreach	Marcello Lossasso Agnes Szeberenyi	CERN CERN
WP3	NA2	Advanced software	Witold Pokorski Frank Gaede	CERN DESY
WP4	NA3	Micro-electronics and interconnections	Christophe De La Taille Valerio Re	CNRS INFN
WP5	NA4	Data acquisition system for beam tests	Matthew Wing David Cussans	UCL UNIBRIS
WP6	NA5	Novel high voltage and resistive CMOS sensors	Ivan Peric Gianluigi Casse	KIT UNILIV
WP7	NA6	Advanced hybrid pixel detectors	Anna Macchiolo Ivan Vila	MPG-MPP CSIC
WP8	NA7	Large scale cryogenic liquid detectors	Dario Autiero Sebastien Murphy	CNRS ETHZ
WP9	NA8	New support structures and micro-channel cooling	Paolo Petagna Georg Viehhauser	CERN UOXF
WP10	TA1	Beam test facilities	Henric Wilkens Natalia Potylitsina	CERN DESY
WP11	TA2	Irradiation facilities	Marko Mikuz	JSI
WP12	TA3	Detector characterisation facilities	Stjepko Fazinic Fernando Arteche	RBI ITAINNOVA
WP13	JRA1	Innovative gas detectors	Silvia Dalla Torre Imad Laktineh	INFN CNRS
WP14	JRA2	Infrastructure for advanced calorimeters	Roman Poeschl Frank Simon	CNRS MPG-MPP
WP15	JRA3	Upgrade of beam and irradiation test infrastructure	Federico Ravotti Marcel Stanitzki	CERN DESY

Management News

- In May 2016 I took over from Laurent Serin as scientific coordinator
- Paolo Giacomelli (INFN Bolgna) continues as deputy coordinator
- Daniela Bortoletto (U Oxford) elected as second deputy
- GB chair for year 2: L.Serin elected to succeed D.Bortoletto
  - New election after year 2
- Svet Stavrev (CERN) administrative manager since start of AIDA

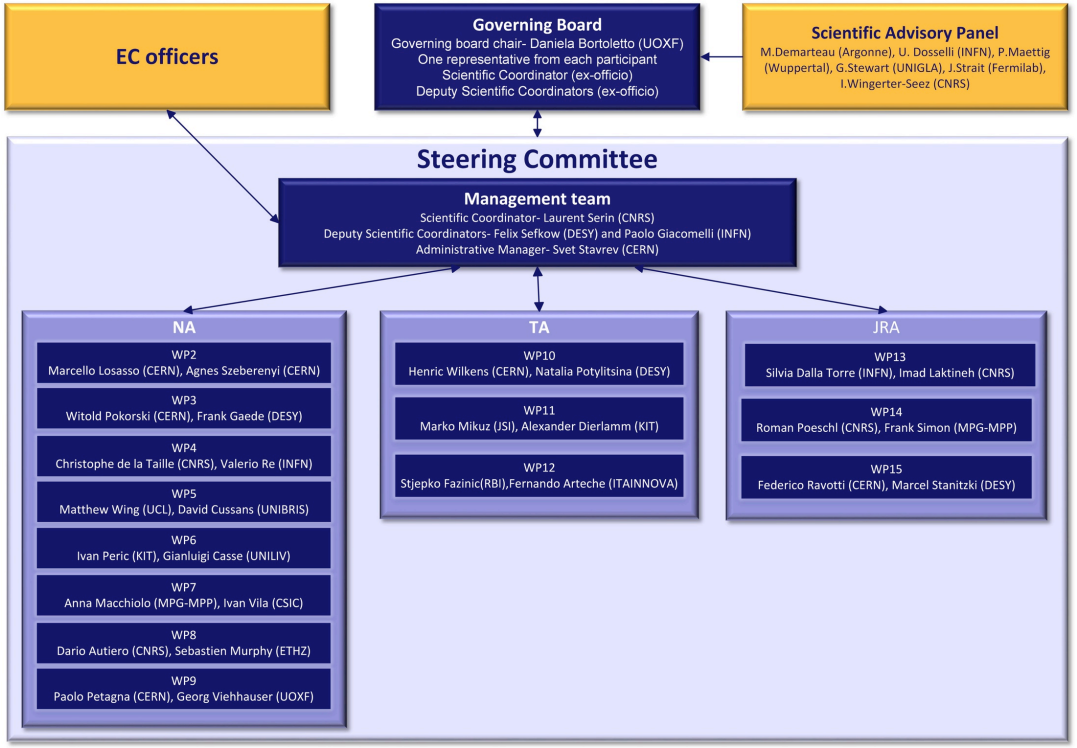
Scientific Advisory Panel

- External body
- Advise the GB in technical and strategic matters related to the AIDA-2020 scientific programme
- First feedback last Friday

- Members:
  - Marcel Demarteau, Argonne
  - Ariella Cattai*,CERN
  - Peter Mättig, Wuppertal
  - Graeme Stewart, Glasgow,
  - Jim Strait, Fermilab
  - Isabelle Wingerter-Seez, CNRS

  - *stepping in for Umberto Dosselli

- New EC officer
  - Meeting in September



Reporting obligations

- Interim Report: M12
  - internal, ready, 99p
- Periodic Reports: **M18**, M36, M48
  - Due Mx+2, reimbursement of cost by EC only after validation
  - Delays by one affect all
- Final Report: M48
  - Last 15% of EC grant only after validation
- Deliverables
  - Contractual
  - Objects if any, + report
- Milestones
  - Not contractual, but being reported
  - Short report

Grant Agreement No: 654168

AIDA-2020

Advanced European Infrastructures for Detectors at Accelerators

Horizon 2020 Research Infrastructures project AIDA-2020

PERIODIC TECHNICAL REPORT

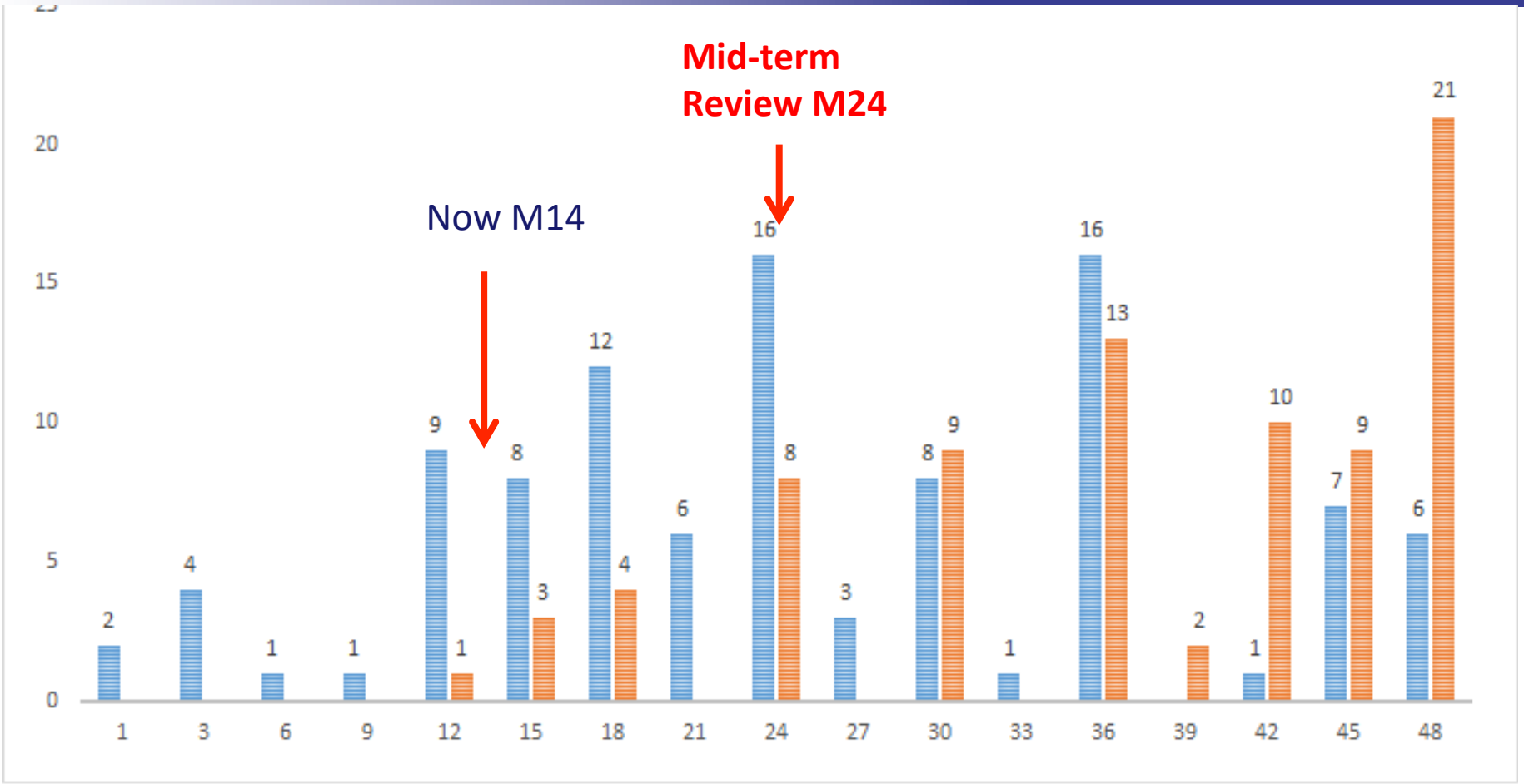
AIDA-2020: YEAR 1 REPORT

Grant Agreement number:	654168
Project Acronym:	AIDA-2020
Project title:	Advanced European Infrastructures for Detectors at Accelerators
Start date of the project:	01/05/2015
Duration of the project:	48 months

Period covered by the report:	from 1 May 2015 to 30 April 2016
Periodic report:	Year 1
Date:	08/06/2016

In AIDA, all reports were delivered in time, and so was the funding.

Deliverables & Milestones



- Typically 5-8 tasks per WP, one milestone and one deliverable per task

Publications Y1

- Target in the proposal:
  - 180 publications, including 60 journal publications and 50 conference proceedings
  - 10 articles in newsletters and other communication channels

- Status publications Y1 per WP

WP	No. of journal publications	No. of conference / workshop proceedings	Other publications
WP2 = 4 publications	0	0	4 press articles
WP3 = 2 publication	1	0	1 presentation workshop
WP6 = 6 publications	6	0	0
WP7 = 13 publications	8	3	2 posters
WP9 = 1 publication	0	0	1 presentation
WP13 = 3 publications	0	0	3 posters
WP14 = 3 publications	1	2	0
WP15 = 9 publications	2	0	4 Scientific notes, 3 posters
TOTAL Y1 = 41	**18**	**5**	**18**
% Y1 vs. target = 22%	**30%**	**10%**	**-**

WP4, WP5, WP8 have not included any publications in their Y1 reports

Some highlights

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement no. 654168.

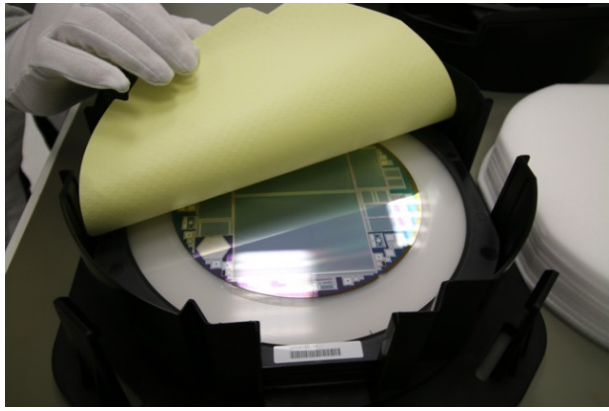
Communication

- Very useful and transparent web site
- Publicising facilities for TA (video clips)
- On Track: a newsletter to the detector community
  - Contact Jennifer Toes (CERN) or Barbara Warmbein (DESY) to have your story told
- Social media

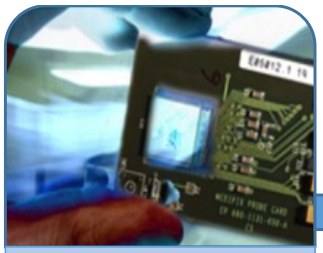
n track
News for the Detector Community

Innovation and Outreach

- Industrialisation of large area silicon production
- "Academia meets industry" events
  - open for suggestions
- Proof of Concept fund (200k) for spin-offs
  - Call launched last week
  - Strongly emphasised on EC side



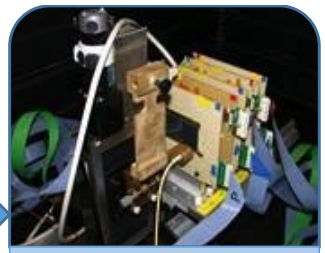
8" wafer from *Infineon*
World largest Si detector



Identification of key technologies

Search for suitable industrial partners

Selection of projects for PoC funding



Testing and validation of concepts and technologies

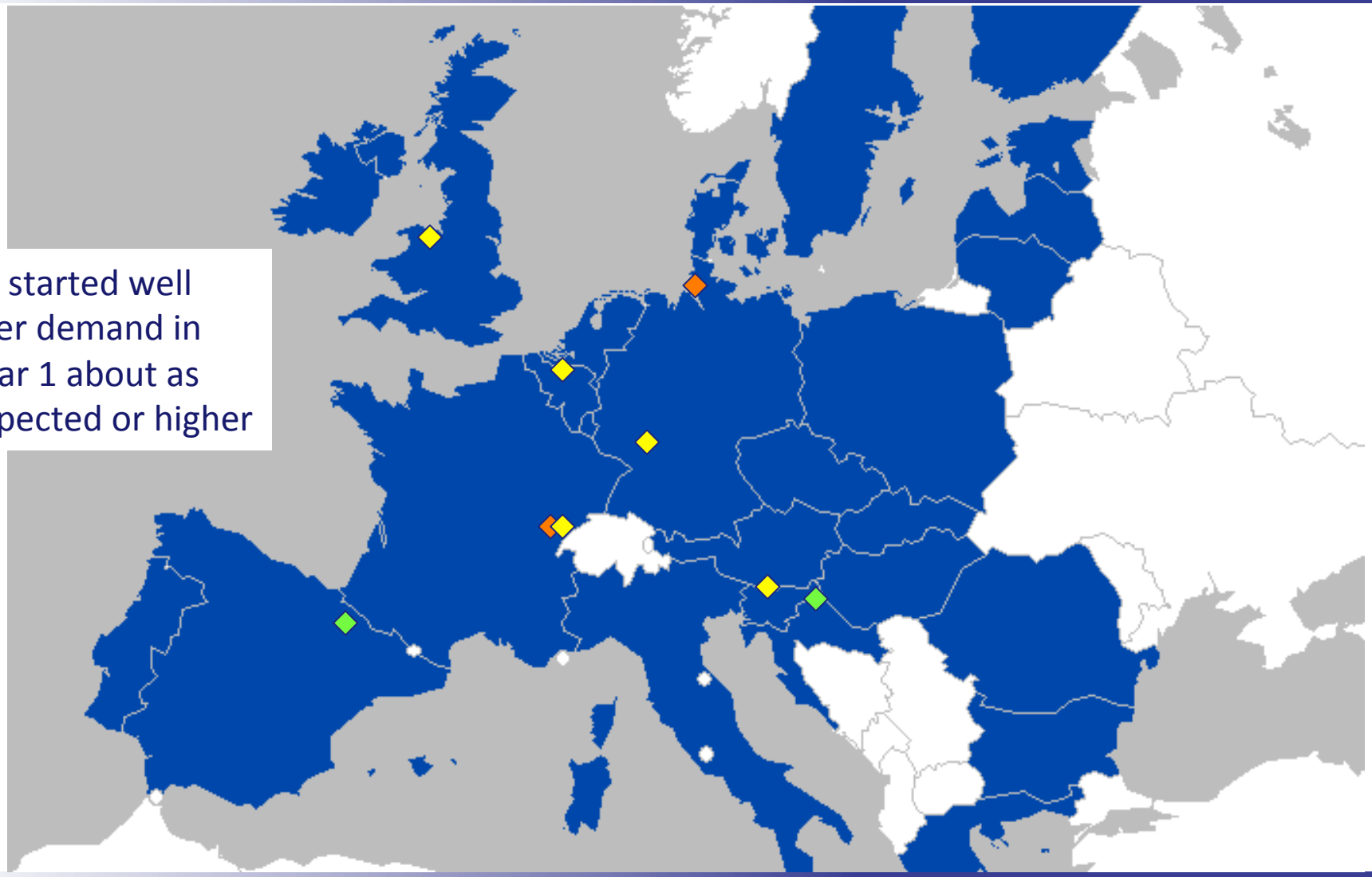
Transnational access

- Enhanced w.r.t. AIDA. 13.4% of total budget
- Travel support (and/or fees) for access to
  - WP 10 test beams at DESY and CERN (no fees)
  - WP 11: various irradiation facilities (e.g. KIT)
  - WP 12: characterisation facilities: ion beams, electromagnetic compatibility
- Group leader and majority from foreign country
  - Also open for non-AIDA institutes
  - New: also non-Europeans (<20%); already many users from Japan, US, …
  - Check web site for exact condition
- New infrastructures:
  - GIF++ @ CERN
  - Birmingham cyclotron
  - RBI (Ruđer Bošković Institute, Zagreb: ion beams)
  - ITAINNOVA, Zaragoza: EM compatibility

User Selection Panel
K.Einsweiler, LBL
D.Lazic, Boston
E.Garutti, Hamburg
H.Wilkens, CERN
M.Mikuz, JSI
F.Arteche. ITINNOVA

Research infrastructures

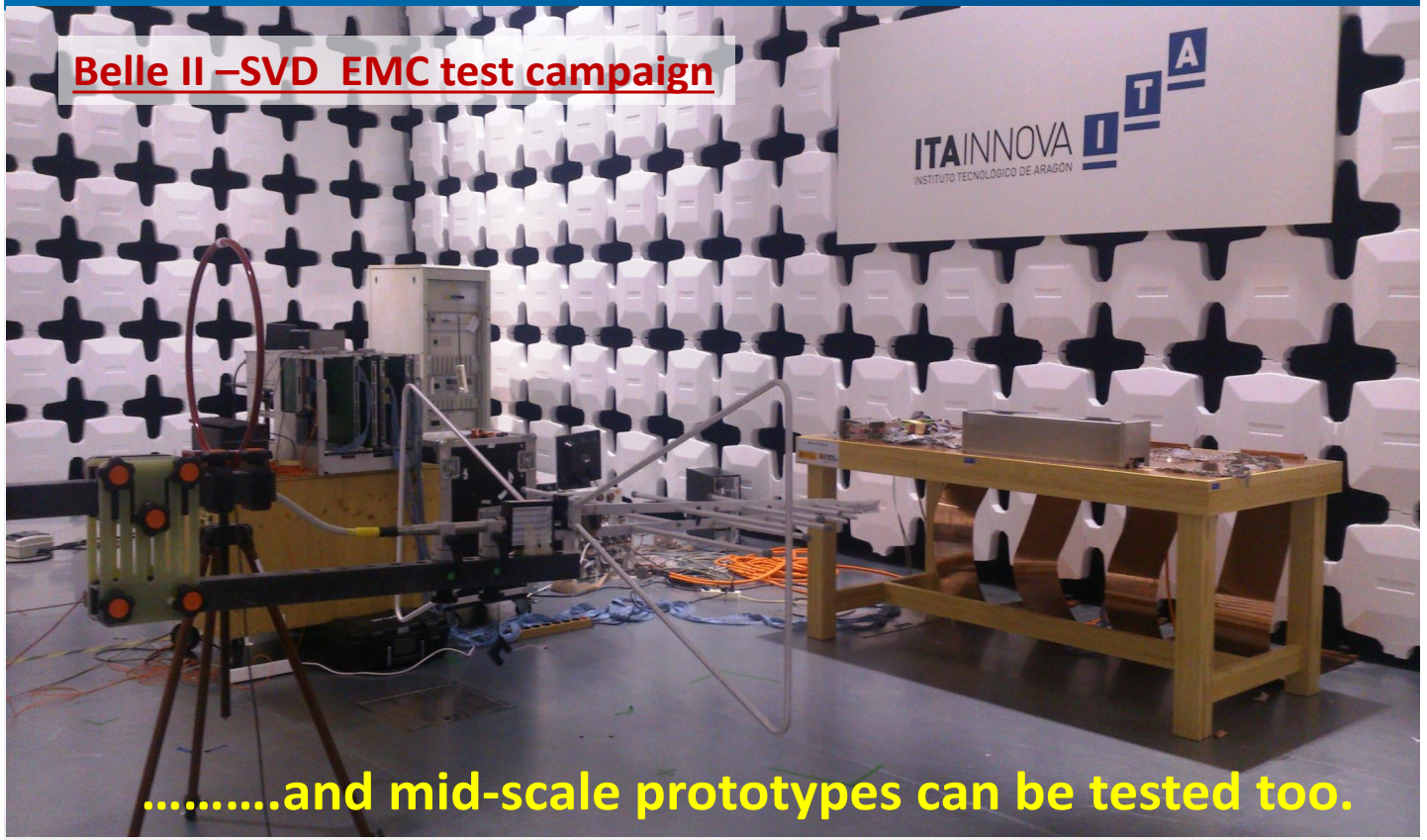
All started well user demand in Year 1 about as expected or higher



ITAINNOVA

2.1 Scientific issues: Activities

ITAINNOVA

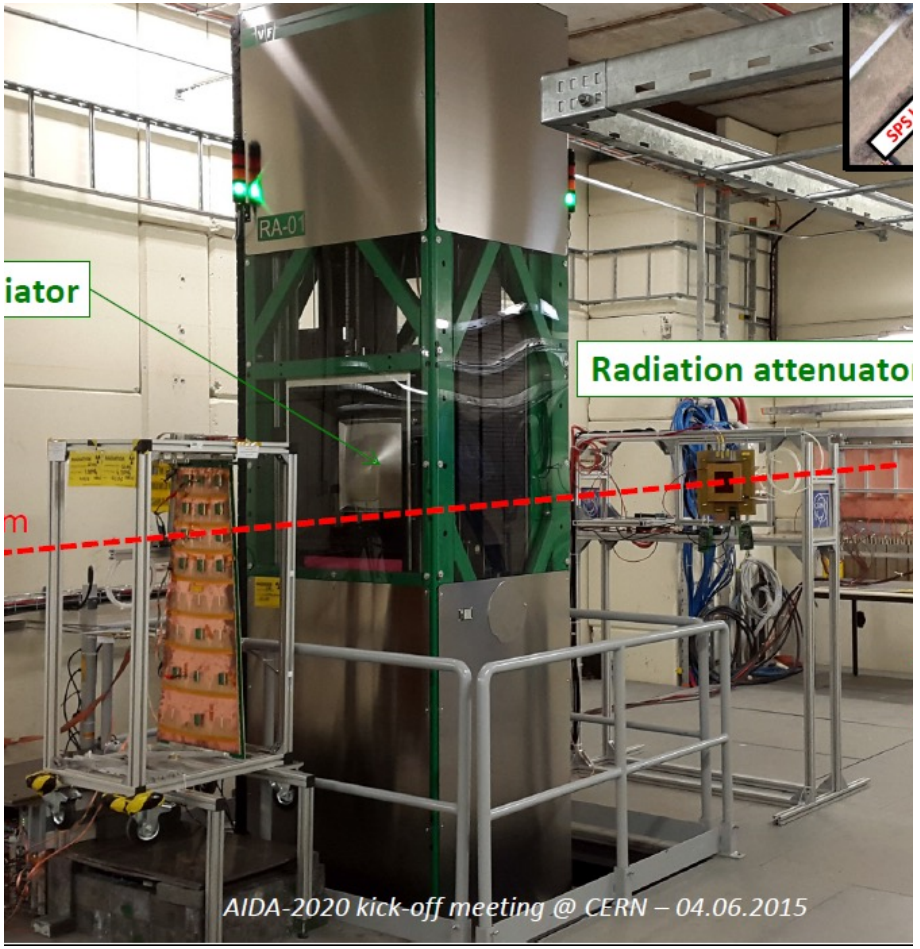


This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654168. **9 / 19**

GIF++

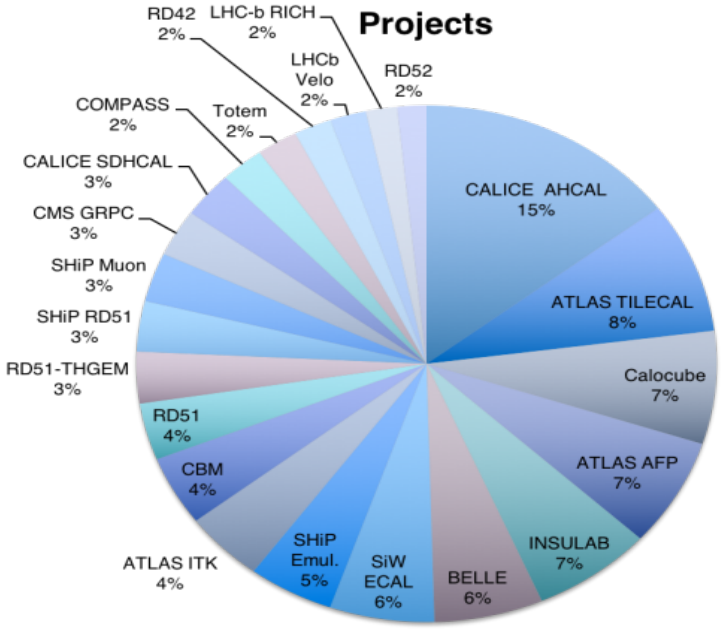
- In-situ test beam for samples under irradiation

CERN GIF++	User Projects		Total users	TA units
	Submissions	Selected		
M1-M12	4	4	13	960 (24%)
M1-M48	20		50	4032



2.1 WP10.1– CERN Beam Test

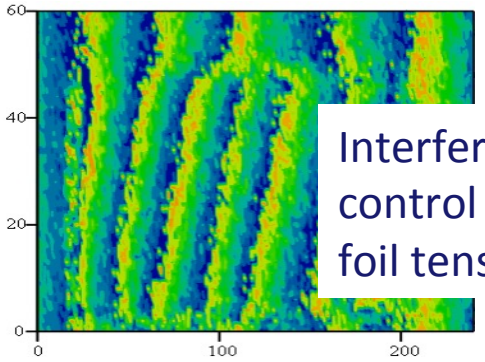
- **CERN TB activity is ahead of schedule**
  - Over 50% of the budget has already been consumed
  - Some restrictions are being planned
- Many projects from experiments and R&D working lines
  - CMS, ATLAS, LHCb, COMPASS , BELLE , CALICE



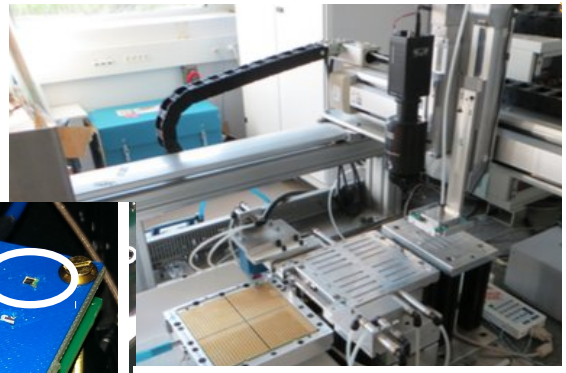
- **Projects & Scientific output of the users**
  - AIDA-2020-CERN-TB-2015-15: The **RD42** collaboration **tested for the first time poly-crystalline diamond 3D** devices in a test beam.
- Many publications have been produced **(19 publications and conference contributions)** and still several will be generated in the near future.
- New improvements in the Test beam area - East Area Consolidation

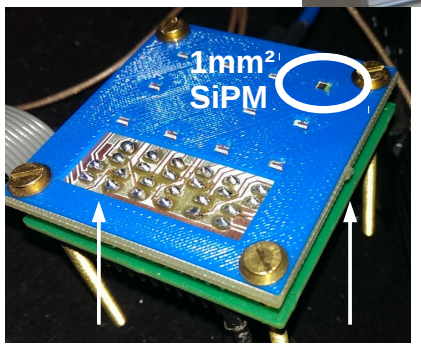
Joint Research Activities

- WP 13: Gas detectors (CNRS, INFN)
  - RPCs, Micro-pattern gas detectors (GEMs, µMs) for muon systems, TPCs and calorimeters
  - Preparation for large area production
- WP 14: Calorimeters (CNRS, MPP)
  - Silicon and scintillator for LC and LHC
  - Close interaction CALICE CMS
  - Read-out and mechanics: DAQ, cooling,..
- WP 15: Test beam & Irrad upgrades (DESY, INFN)
  - Telescope support & a new one for CERN PS
  - Si reference tracker for TPC magnet
  - Irrad facility data base
  - …



Interferometric control of foil tensions

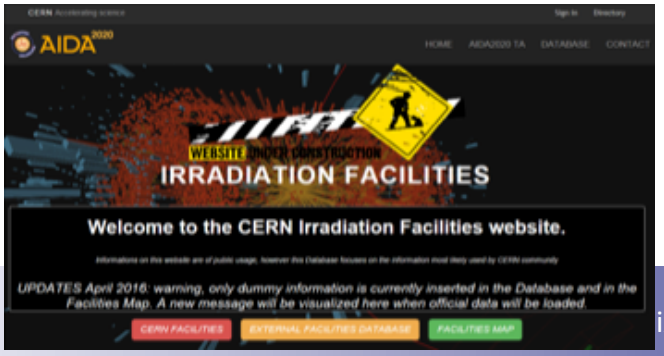




SiPM interconnect & mask

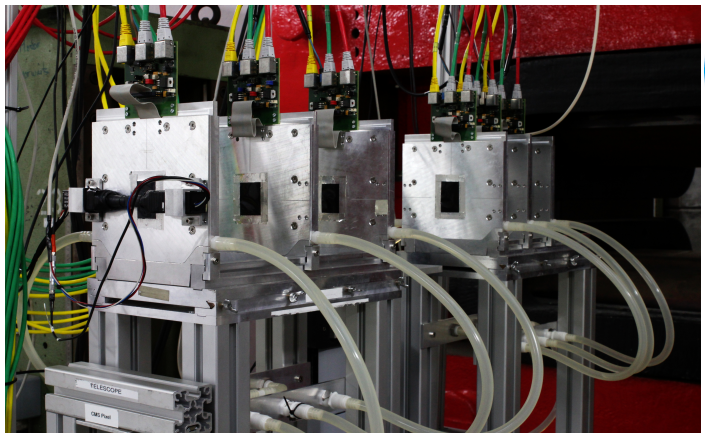
readout ASIC PCB

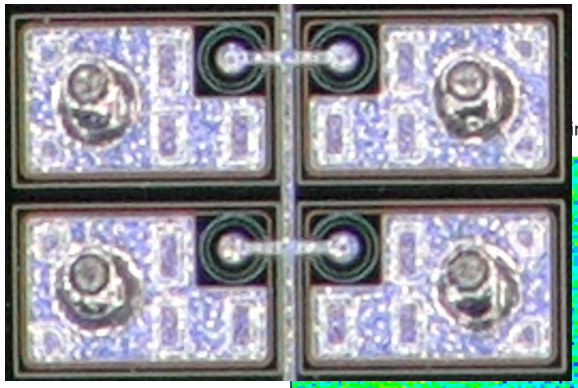
Test beds for optical and Si based calorimeter r/o



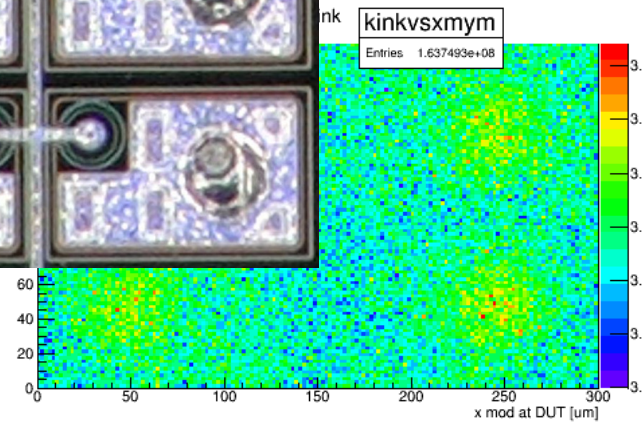
Task 15.2: Telescope for the CERN PS

- **Since Jan. 2016:**
  - Purchasing components – done!
  - Producing cables and electronics – done!
  - Producing telescope frame – nearly done
  - Characterizing sensors – done!
- **In June/July 2016:**
  - Hardware assembly **(MS32, M18)**
  - System setup
  - Commissioning at DESY test beam
- **In August/September 2016:**
  - Shipping to CERN
  - Commissioning at PS T10
- **Way ahead of schedule!** **D15.1 (M24)**



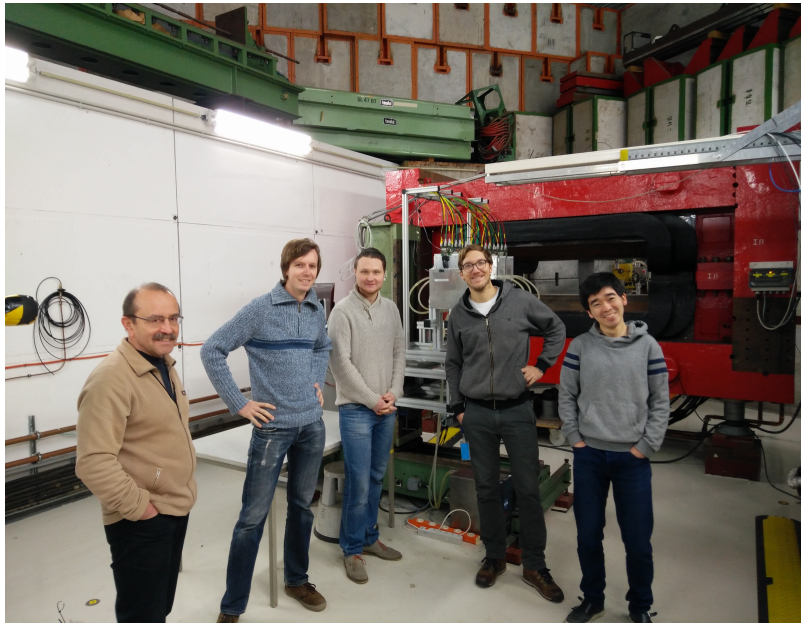


CMS pixel



Telescope support

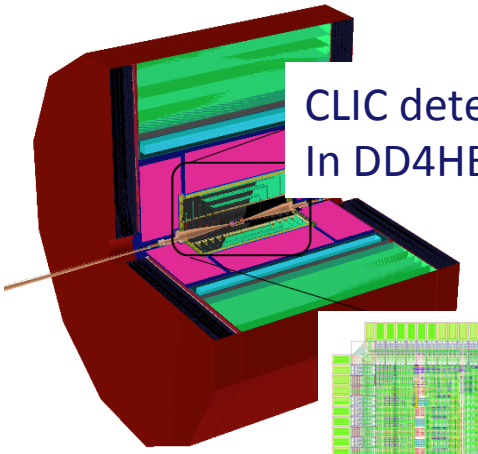
- Expensive hardware, configuration somewhat more complicated than for DWC
- Telescope technical support at DESY
  - Part of test beam user support
  - User integration, hardware and software
  - Mostly provided by DESY HEP groups
  - Partially supported by AIDA-2020
- Telescope technical support at CERN
  - Jointly by DESY and CERN
  - DESY: start-up of test beam period and major repairs
  - CERN: routine user support
  - Worked well in AIDA
  - Solution for AIDA-2020 to be found
    - Complaints, and not well maintained hardware



Telescope Support portal:
http://telescopes.desy.de

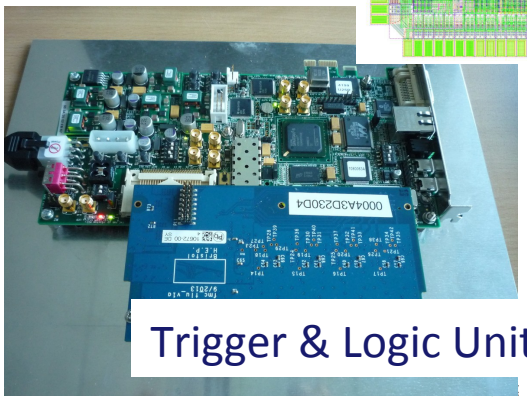
Network activities (1)

- WP 3: Software (CERN, DESY)
  - advanced simulation and reconstruction, e.g. DD4HEP
  - Strong cooperation of LHC, LC, FCC
- WP 4: Micro-electronics (CNRS, INFN)
  - Chips and TSVs for detectors of other WPs
  - 65 nm for tracking, e.g. CLICpix
  - 130 nm for energy and time, SiPM and fast RPC r/o
- WP 5: Common DAQ for LC test beam (Bristol, UCL)
  - Synchronisation, DAQ software, run control, monitoring
  - Build upon EUDAQ success for the pixel telescope
- WP 8: Cryogenic detectors for neutrino exp's (CNRS)
  - Purity, readout, HV, magnetisation
  - Embedded in CERN neutrino platform

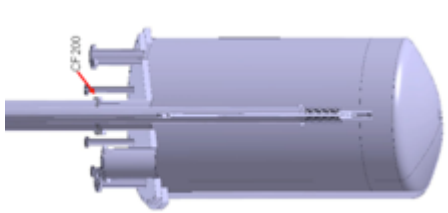


CLIC detector
In DD4HEP

ASIC test
vehicles



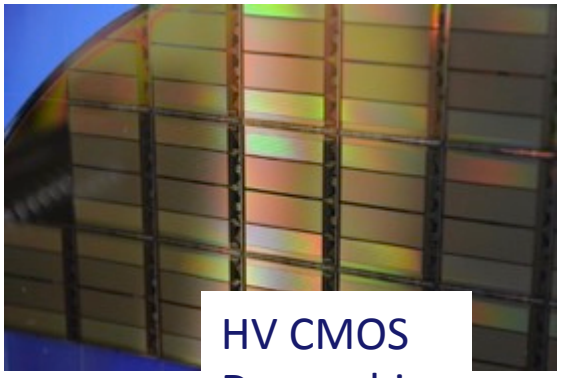
Trigger & Logic Unit



300 kV
Feed-through

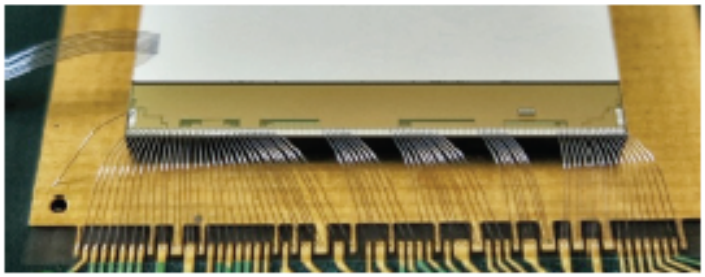
Network activities (2)

- WP 6: HV CMOS sensors (KIT, Liverpool)
  - TCAD process simulation, sensor design and test
  - Hybridisation, e.g. capacitively coupled (CLICpix)
- WP 7: Hybrid pixel detectors (MPP, CSIC)
  - TCAD simulation, optimisation
  - Production, validation for trackers and LGAD
  - Links to WP4 (chip), WP6 (tools), WP9 (cooling)
- WP 9: Mechanics and µ-channel cooling (CERN, Oxford)
  - Facility to characterise deformations of low mass structures
  - Cooling prototypes, connectors, simulations, tests

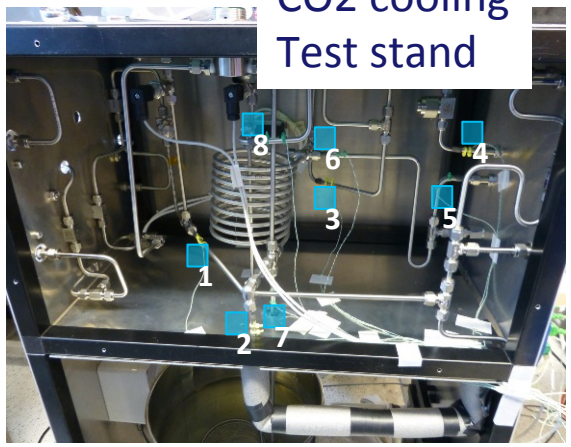


HV CMOS
Demo chips

Timepix assembly with 50 µm thick sensor



CO2 cooling
Test stand



Test beam needs

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AIDA-2020 and R&D collaborations

- The EU projects create structures only where needed
- Most activities are embedded in existing frameworks
  - Upgrades pf LHC experiments
  - CERN RDxz collaborations
  - Linear Collider R&D groups: CALICE, FCAL, LCTPC,..
- EUDET helped to structure the pixel and TPC efforts
  - E.g. around common telescope infrastructure
- Now extending to other detector types
  - "beam telescope and test beam workshop" BTTB
  - Calo and gaseous tracking groups attended
  - Work with WP5 towards common DAQ and timing standards
- Gaseous tracking
  - MPGD well organised in RD51
  - For RPCs, AIDA-2020 turns out to become a home

Test beam requests

- Most test beam requests related to AIDA-2020 will come through existing R&D frameworks
- In some cases, e.g alternative, non-baseline technologies, AIDA-2020 may constitute an “umbrella”
- In general, the need for beam time is expected to remain roughly constant
  - Although all declare they could use some more

- **Pixel**: mostly via ATLAS, CMS or RD51, thanks to low material often parasitic
  - ~ 6 weeks / y, + 3 w/y dedicated time for advanced technologies
- **Gaseous**: mostly via RD51, PPC possibly via AIDA-2020
  - ~8 weeks / y, including GIF
- **Calorimeters:**
  - HGCAL or HGTD via CMS or ATLAS, resp.
  - CALICE 4-8 weeks /y, FCAL 1-2 weeks /y
  - Optical fibre related R&D may come via AIDA-2020, smaller requests
- **Combined** beam tests, e.g. calo plus tracking
  - Possibly via AIDA-2020, to be discussed
  - Few weeks in 2018

Summary

- AIDA-2020 offers exciting possibilities for strengthening European competence and competitiveness in detectors - through cooperation
- Compared to AIDA, there are new topics and much more
  - Cooperation between communities within the same working groups
    - "more precision for LHC, more realism for LC"
    - Network with neutrino community
  - Funds for transnational access
  - Emphasis on industry cooperation
- So far, AIDA-2020 started well and is
  - But deliverables still to come

n track
News for the Detector Community

- Testbeam:
  - Roughly constant, mostly through existing frameworks
  - Some requests under AIDA-2020 flag to be expected

Backup

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement no. 654168.

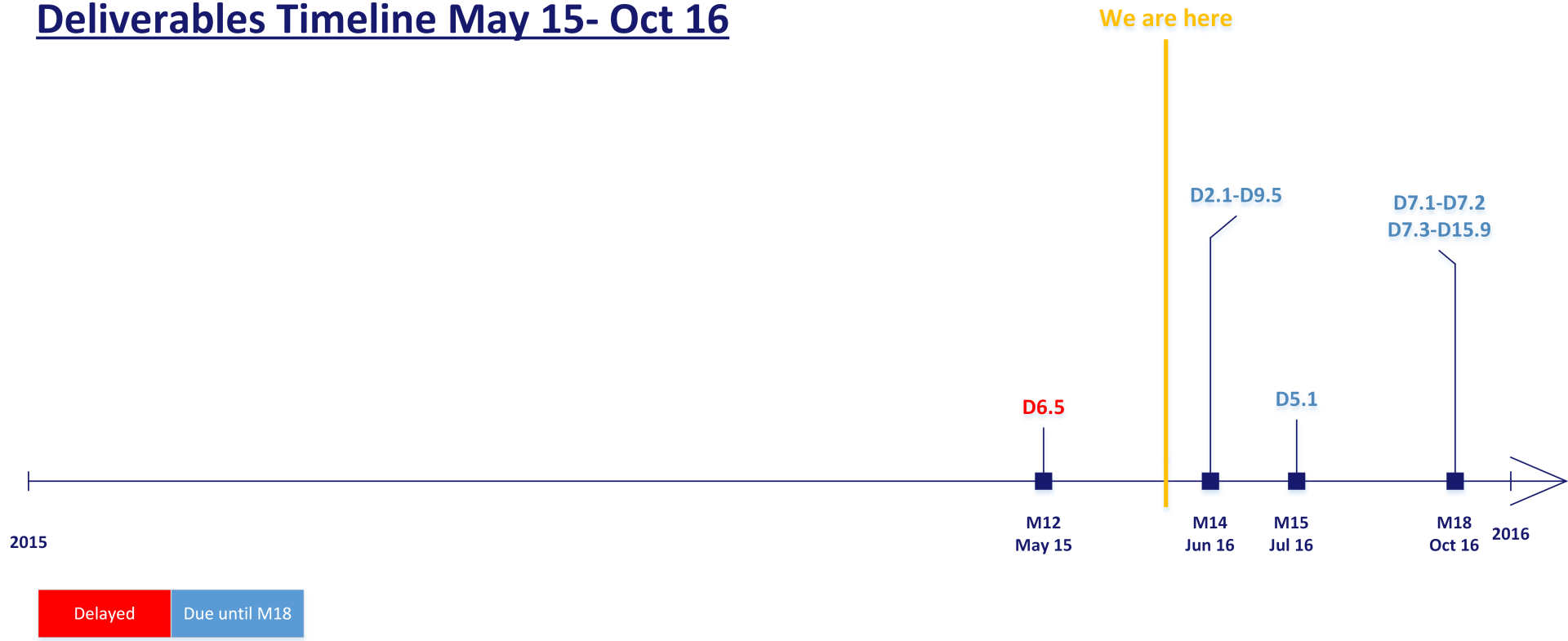
Acknowledgements

- Users receiving TA support are required to acknowledge AIDA-2020 in their publications
  - This requirement is fulfilled only with poor efficiency
- We are obliged to report on dissemination of AIDA-2020 related knowledge, i.e. publications
- Only publications with proper acknowledgement are accepted
  - Adding a cover-page is not sufficient
- EU commission can ask us to recuperate funds from non-complying groups

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement no. 654168.

Deliverables

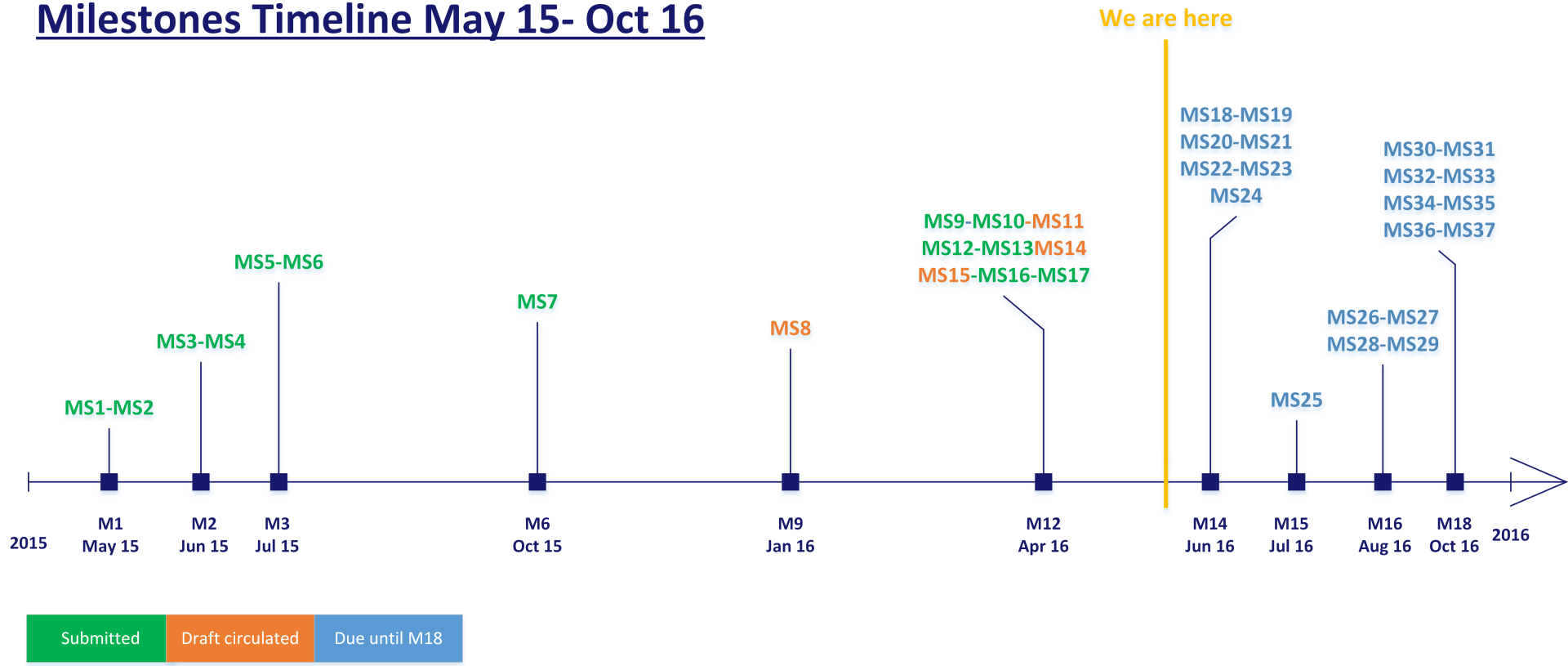
Deliverables Timeline May 15- Oct 16



- Not really started yet
- D6.5 was erroneously scheduled (typo), postponed from M12 to M42

Milestones

Milestones Timeline May 15- Oct 16

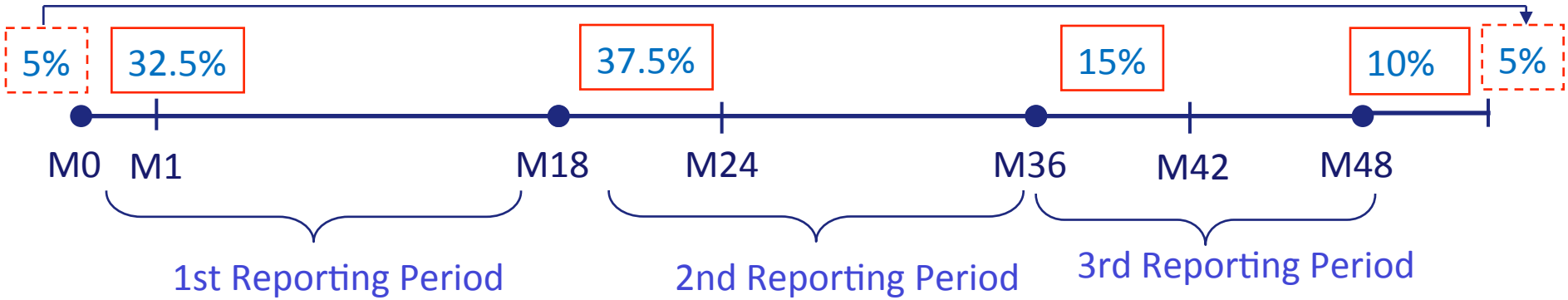


Submitted | Draft circulated | Due until M18

- Few, reasonably justified delays
  - MS7: workskhop postponed to M13, May 16, (WP6)
  - MS8: delayed by 2 months due to late recruitment (WP9)

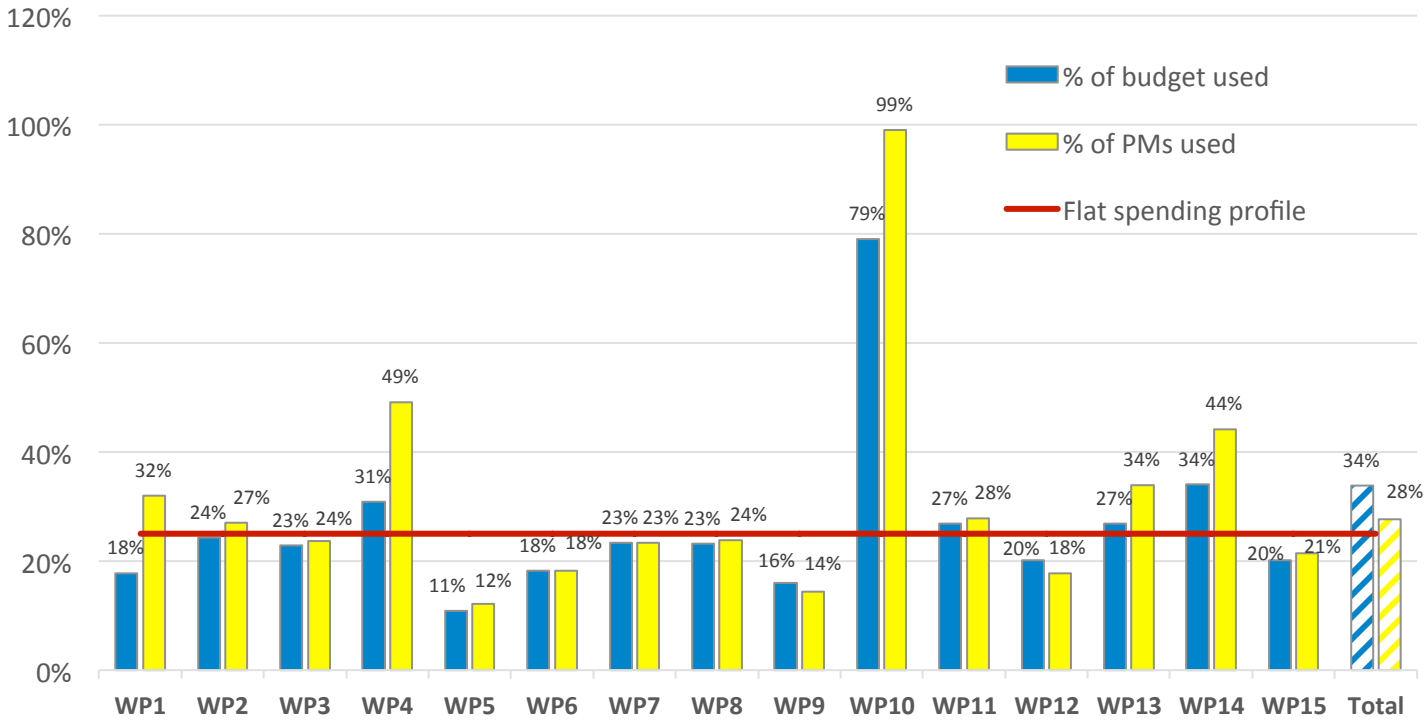
EC payments to AIDA-2020

- Max. EC Grant = 10 M€
- Pre-financing = 37.5 %, including 5% withheld for H2020 Guarantee Fund, to be reimbursed at the end
- Effective pre-financing received = 32.5% of the 10 M€ of which 70% have been paid to each participant (pro-rata to project share) and the other 30% will be distributed after the end of the first year, **provided financial report isreceived**.
  (100 % for beneficiary with less than 100 k€ EC contribution)
- Second EC payment – at (M18+2-3) = reimbursement of costs for the first Reporting Period ~ 37.5% assuming uniform spending profile (18 / 48)
- Third EC payment (limited by 85% of the 10 M€) – at (M36+2-3) ~ 15%
- Final EC payment (10% + 5%) – after the Final Report is approved

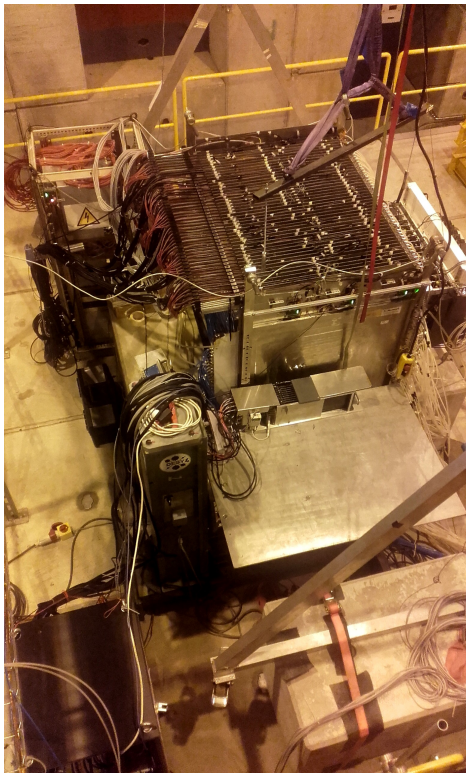


There will a detailed presentation by Svet at the GB meeting

Use of resources per WP



CALICE SDHCAL



Type: Gaseous detector, absorber steel

Size and Weight: 1m^3, several tons
Maybe several long layers 3x1 m2, ~100 kg

Special needs: Gas system (?)

Test beam needs:
Each year about three weeks at SPS
Combined tests with CALICE SiEcal and ScEcal

Roman Poeschl

CALICE AHCAL

Type: Solid state detector, absorber steel (tungsten)

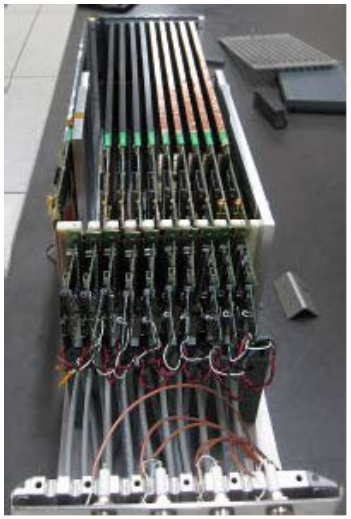
Size and Weight: 1m^3, several tons

Special needs: ????

Test beam needs:
Each year about three weeks at SPS
Combined tests with Si and ScEcal

Roman Poeschl

CALICE SiW ECAL



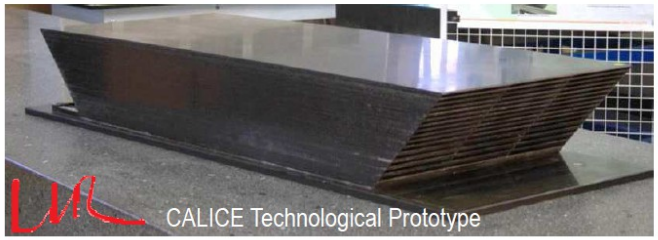
Type: Solid state detector, Si and W

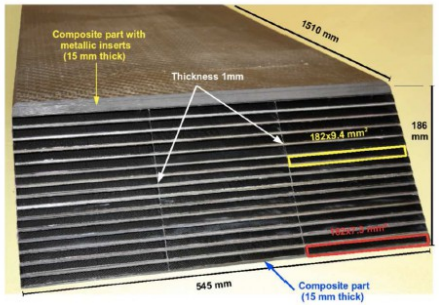
Size and Weight:
Simple setup: 0.04 m^3, ~200 kg
With alveolar structure (2018-2019):0.2 $m^{3,}$, ~500 – 700 kg

Special needs: Maybe telescope

Test beam needs:

Each year about three weeks at SPS
Combined beam tests with SDHCAL and AHCAL envisaged





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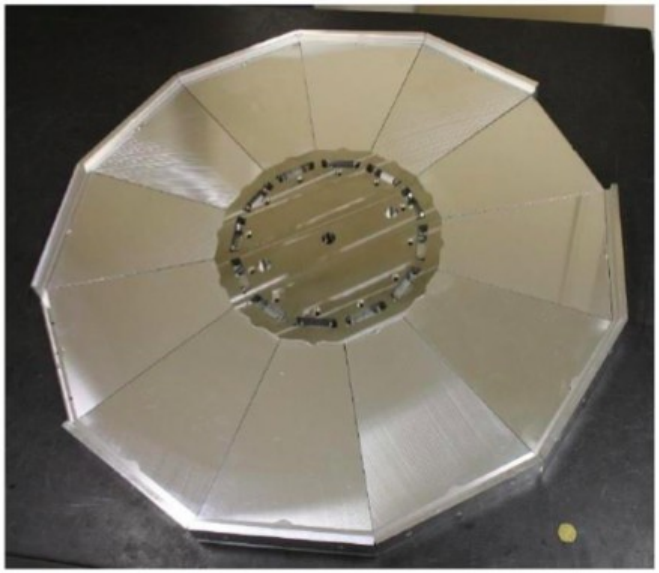
ATLAS & CMS HG structures

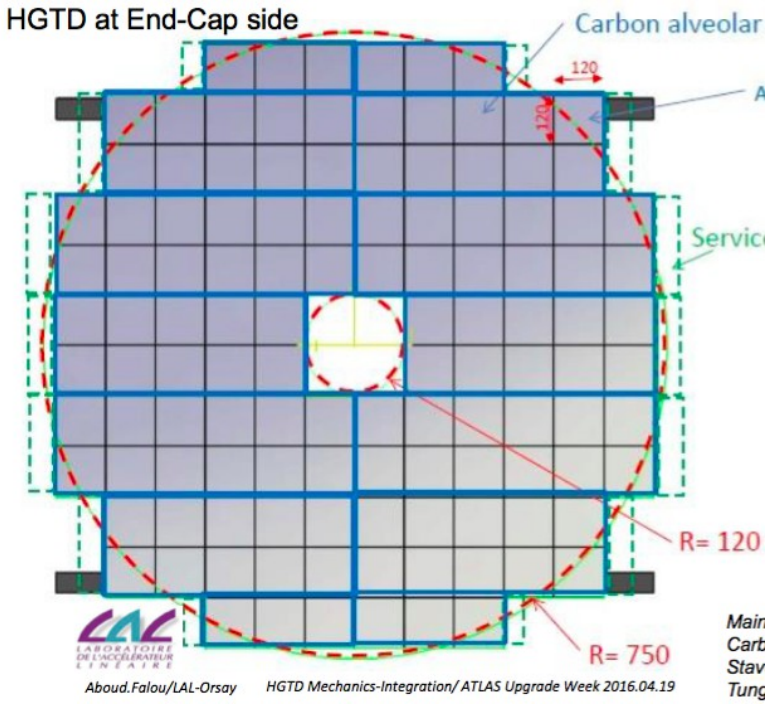
Mould for CMS HGCAL

2 / Unitary mold feasibility for structure



Mould for alveolar disks structure prototype

Mechanics design for ATLAS HGTD



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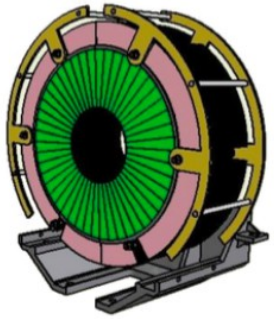
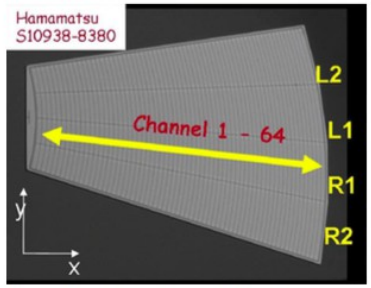
LC Forward Calorimeters

Beam calorimeters for e+e- colliders

LumiCal

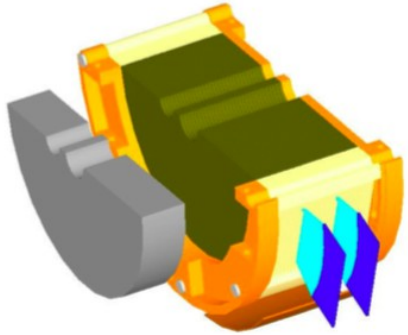


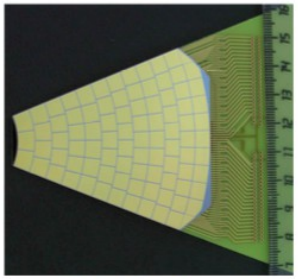


- standard *p* in *n* Si sensors
- 300 um thick, pad pitch 1.8 mm
- Azimuthal/radial segmentation 48 sectors / 64 pads

- Sandwich type sampling calorimeters
  - LumiCal Si-W,
  - BeamCal GaAs(?)-W
- 30 layers at ILC, 40 layers at CLIC. One W layer – 1 X0
- Very compact calorimeters (Moliere radius ~1cm)
- Low polar angle acceptance
  - LumiCal ~100 mrad
  - BeamCal ~10 mrad

BeamCal





- compensated GaAs sensors
- 500 um thick
- uniform segmentation

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