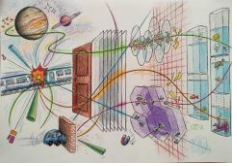
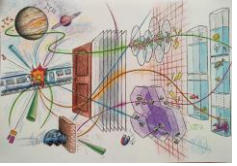


Report to the collaboration

G. Kramberger (JSI)
M. Moll (CERN)
I.M. Gregor (DESY)
S. Seidel (UNM)

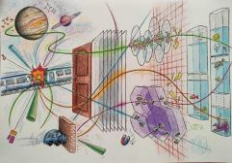


DRD3 collaboration

143 institutions / 700++ people in the community e-group

Main events since the last DRD3 week:

- Lots of scientific meeting across many WGs
- Preparation of WP projects is underway
- MoU is in the final stages of preparation
- We have the endorsed the rules of collaboration which will enable us to move to collaborative work
- New institutes wanting to join us.
- Things are really starting to evolve….



DRD3 – structure of the collaboration

December 2024

Collaboration board

CB Chair: G. Pellegrini (CNM)
Deputy: R. Arcidiacono (INFN-TO)

Steering committee:
DRD3 management + CB Chair + WG conveners

DRD3 management

G. Kramberger (JSI) - SP
M. Moll (CERN)-DSP
I. Gregor (DESY)-DSP
S. Seidel (UNM)-DSP

DRD3 bodies

- Secretariat/administration
- Resource coordinator /Budget Holder (D. Muensterman, HRM/Lancaster)
- Cross-DRD coordination
  CPAD coordination
- Speakers committee
  (U. Parzefall - Freiburg)

R&D activities

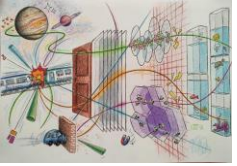
WG 1	WG 2	WG 3	WG 4	WG 5	WG 6	WG7	WG 8
Convener(s)	**Convener(s)**	**Convener(s)**	**Convener(s)**	**Convener(s)**	**Convener(s)**	**Convener(s)**	**Convener(s)**
Monolithic silicon technologies	Hybrid silicon technologies	Radiation damage & extreme fluences	Simulations	Characterization techniques and facilities	Wide band-gap and innovative sensor materials	Interconnections and device fabrication	Dissemination & outreach
H. Pernegger (CERN) E. Vilella (Liverpool) J. Baudot (Strasbourg)	A. Macchiolo (UZH) M.v.Beuzekom (NIKHEF) A. Tricoli (BNL)	Ioana Pintilie (NIMP) J. Schwandt (Uni. HH) TBD	*H. Wennloef (DESY)* M. Mandurrino (INFN-TO)	I. Vila (IFCA) B. Hiti (JSI)	A. Oh (Manchester) X. Shi (IHEP), T. Yang (LBNL)	G. Calderini (LPNHE) D. Dannheim (CERN) F. Huegging (Bonn)	C. Nellist (NIKHEF) U. Parzefall (ex-officio)

WP1	WP2	WP3	WP4
Leader(s)	**Leader(s)**	**Leader(s)**	**Leader(s)**
Monolithic CMOS sensors	Sensors for 4D-tracking	Sensors for extreme fluences	3D-integration& Interconnections

.....

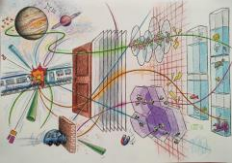
one convener position in WG3/WP3 is still to be filled

Strategic/Targeted R&D projects



MoU – July-November developments

- MoU template (https://cds.cern.ch/record/2914779?ln=en) has been written by CERN (first version received in June) and several meetings were held with CERN managements and DRDs to converged on common MoU (distributed to DRDs in October).
- The MoU is very general in its core and confirms the validity of the collaboration structure
  - WGs as long term organizational entity
  - WPs tool to address short to mid-term strategic goals
- CERN would like to keep the “core MoU” almost identical across the DRDs. It is a wish by CERN that so called “core MoU” would be signed by most of the institutions
  - It defines the general rules and structure of the collaborations (also Intellectual property)
  - In case of DRD3 already has financial implications of 2000 CHF/year for CCF (**sum is not defined in the core**).
- The real content is in the Annexes – important ones:
  - Annex 1 and Annex 2 – participating institutions and their funding agencies (CB representatives **are urged again** to fill in the tables if not done already). Each institution can be represented by more than one FA (e.g itself + national FA).
  - Annex 4 – collaboration structure and our collaboration internal rules
  - Annex 7 – WP part (next slide)
  - Annex 8 – WG description
  - Annex 9 – Common Collaboration projects – now part of the MoU annexes – new with respect to RD50



Annex 7 : WP – strategic funding

Annex 7 Work Packages

7.1 Structure of the Work Packages

(1) Work Package 1: (title)
  (a) Deliverable 1.1: (title)
  (b) Deliverable 1.2: (title)
  (c) …
(2) Work Package 2
  (a) Deliverable 1.1: (title)
  (b) Deliverable 1.2: (title)
  (c) …
…

7.2 Work Package 1: (title)

7.2.1 Description

The purpose of this Work Package is to build and test a prototype of XYZ. The Work Package carries the number WPi.

7.2.2 Participating Institutions

Country	Collaborating Institution	Town	Institution Code	Contact

7.2.3 Funding Agencies

Country	Funding Agency	Funding Agency Code	Representative	Institution(s) represented[b]

HM **Helge Meinhard**
As mentioned before, this could include funding agencies that are not signatories of the MoU.

7.2.4 Start And End Date, Deliverables and Time Scale

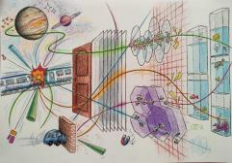
The Work Package starts on start_date and ends on end_date.

The deliverables, time scales and contributing institutions are indicated in the table below.

Number	Title	Description	Start date	End date	Institutions
Di.1					
Di.2					
Di.3					

NOTE: WPs can be signed by FAs that are not signatory of the MoU!

DRAFT 6



Annex 7 : WP – strategic funding

DRD3

7.2.5 Contributions of Participating Institutions and Funding Agencies to the Work Package

The estimations in the table below are the person-power (FTE, or full time equivalent) and costs for designing, constructing and testing XXX for the lifetime of the Work Package.

Institution / Funding Agency	Deliverable Di1			Deliverable Di2			Deliverable Di3			Total		
	Material / kCHF	Physicists: FTE months	Engineers and technicians: FTE months	Material / kCHF	Physicists: FTE months	Engineers and technicians: FTE months	Material / kCHF	Physicists: FTE months	Engineers and technicians: FTE months	Material / kCHF	Physicists: FTE months	Engineers and technicians: FTE months
Major (e.g. national) Funding Agencies												
FA A via Institution 1												
FA A via Institution 2												
Total FA A												
FA B via Institution 3												
FA B via Institution 4												
Total FA B												
…												
Total Major Funding Agencies												
Contributions from other sources												
DEF via Institution 5												
GHI via Institution 6												
…												
Total other sources												
Total (Major Funding Agencies plus other sources)												

HM Helge Meinhard
As said in the main body, this could include Funding Agencies that are not signatories of the MoU.

HM Helge Meinhard
In the DRD Managers' Forum meeting on 14 October 2024, it was proposed to replace "Physicsts" by "Scientists" without reaching clear consensus. This point still needs to be resolved.

HM Helge Meinhard
Codes from Annex 7.2.2 and 7.2.3

Resource board (MoU) – composed of all institutions/FA, not necessary CB representatives, which decides on financial matters. One of the possibilities is for CB to act as RB with exception for WP projects.

Resource coordinators – acting as a person for interaction with FAs?

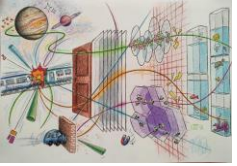
7.2.6 Management Structure of the Work Package

The management structure of the Work Package is described in **Annex 4.1.**

7.2.7 Persons Currently Holding Functions of Specific Responsibility in the Work Package

Function	Name
Work Package Leader	
Work Package Deputy Leader	

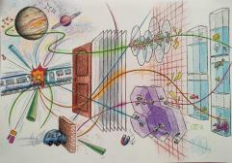
DRAFT



MoU – DRD3 perspective

- Such Annex 7 structure needs a better granularity in the form of WP projects
  - Definition of the WP project leaders – some FA will not commit unless it is in MoU that people they gave money to are responsible
  - Reduction of deliverables may lead to some of the institutions not being listed to taking part in the deliverables list.
  - **Adding new WP project requires less complicated procedure than modification of all existing tables in a given WP, but also means that WP projects need to be properly shaped so that we don't have duplication of projects dealing with the same topic!**
- WP project structure and collection of them on the other hand can lead to very large MoU – example of DRD1
- Deliverables and tables in Annex 7 will be updated regularly
  - need the vote and approval of the FA representatives for each WP project – but not a resigning of the MoU!
  - we can also extend already approved WP project tables
- CERN wanted at least some WP projects to be reviewed by us and approved by CB and RB (includes FA representatives) before signing the MoU!
  - ➢ The system is incompatible with grant awarding schemes of some FA (Spain, USA,…)
  - ➢ Groups don't want to put forward project proposal with their FA listed without previous consent of their FA (catch 22 problem)

https://cds.cern.ch/record/2914779?ln=en



MoU - DRD3 perspective

Possible solutions:

- CERN may accept the initial signature of MoU without explicit obligations (financial and labour) listed in Annex7.
- The same is also true for Annex 8 where participating institutions need to estimate the FTE involvement in the WGs.
- The signatory of Annex 1 (members of DRD3) can be also institutes acting as their own funding agency (tables allow contributions from other sources).

12/2024 — Please fill in the Annex tables in CERN box and make sure you will be able to sign core MoU

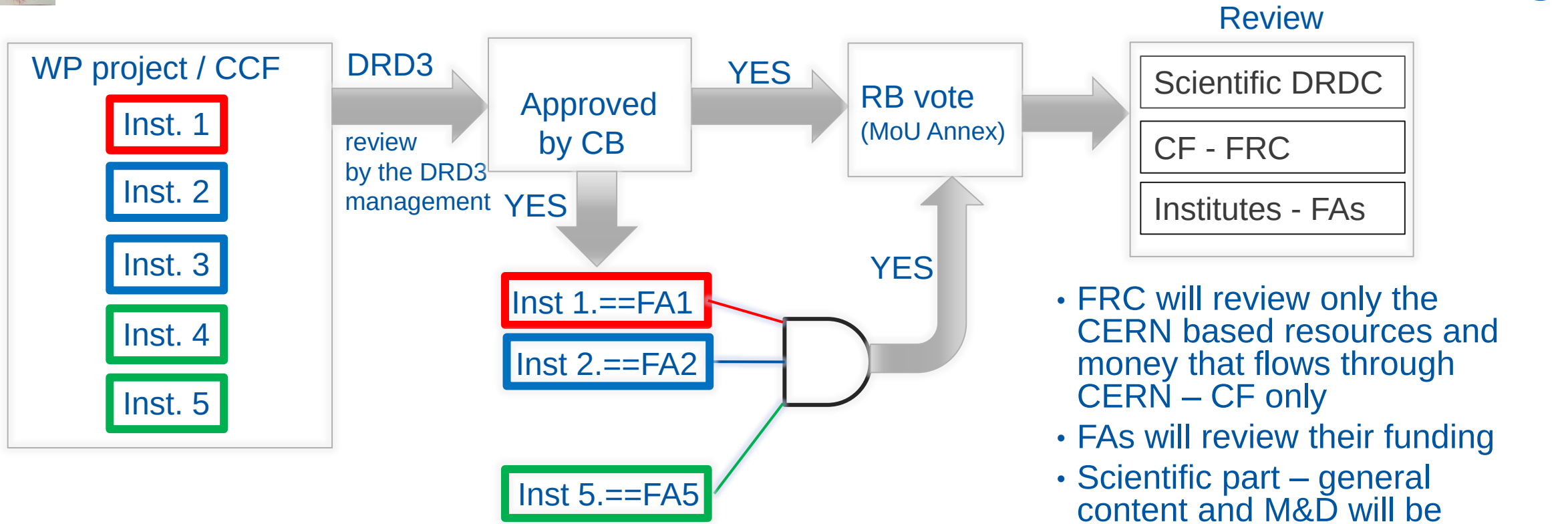
12/2024 1/2025 — Completion of the WP project proposals – becoming part of Annex7 (w/wo obligations)

1-2/2025 — DRD3 review WP projects

3/2025 — MoUs ready by CERN for signature

Although institutes would benefit by signing the MoU (access to CERN facilities as DRD3 members, advantages at project calls…) it is unlikely that all the groups will sign the MoU. **This should not prevent the groups from being a DRD3 member: contribution to CCF and commitment to adhere the collaboration rules are the conditions for the membership.**

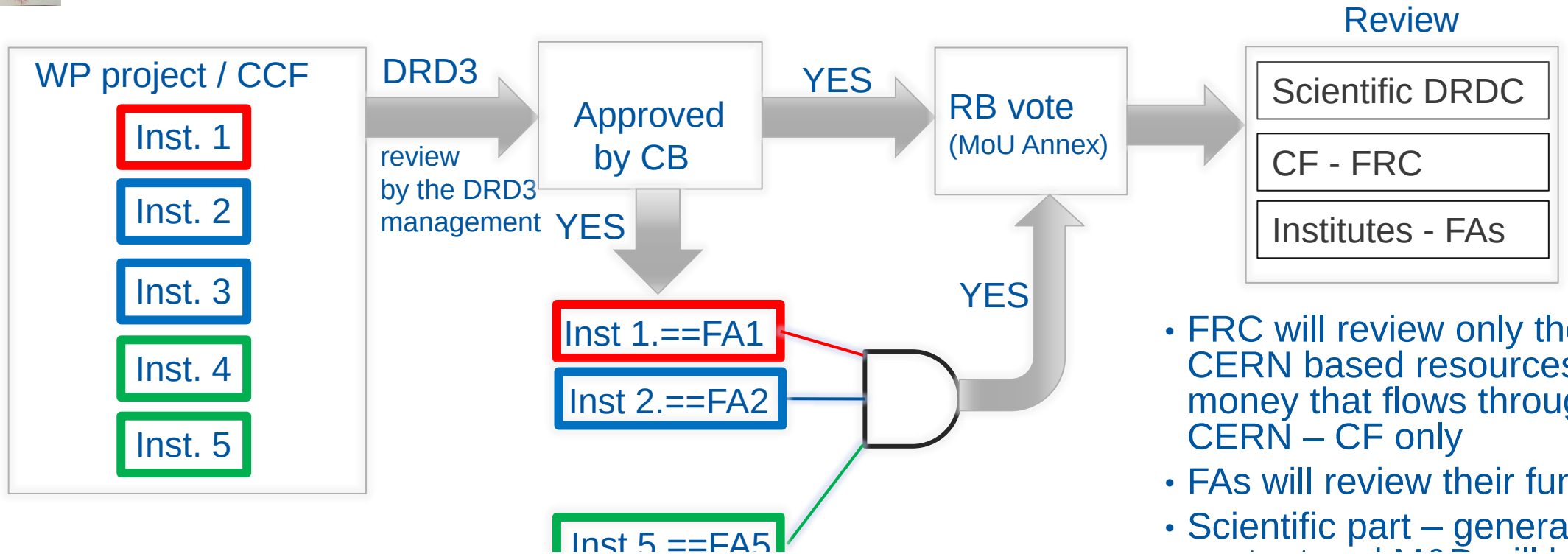
Workflow of the WP/CCF financing (case 1)



- FRC will review only the CERN based resources and money that flows through CERN – CF only
- FAs will review their funding
- Scientific part – general content and M&D will be reviewed by DRDC

- All institutes act as its own FAs and **have resources to deliver the project – the origin or resources is on them (industrial projects, already approved national/EU projects, special agreements with FA).**
- The difference between CCF and WP is the level od commitment and objectives of the project (WP – Annex7, CCF – Annex9)

Workflow of the WP/CCF financing (case 1)

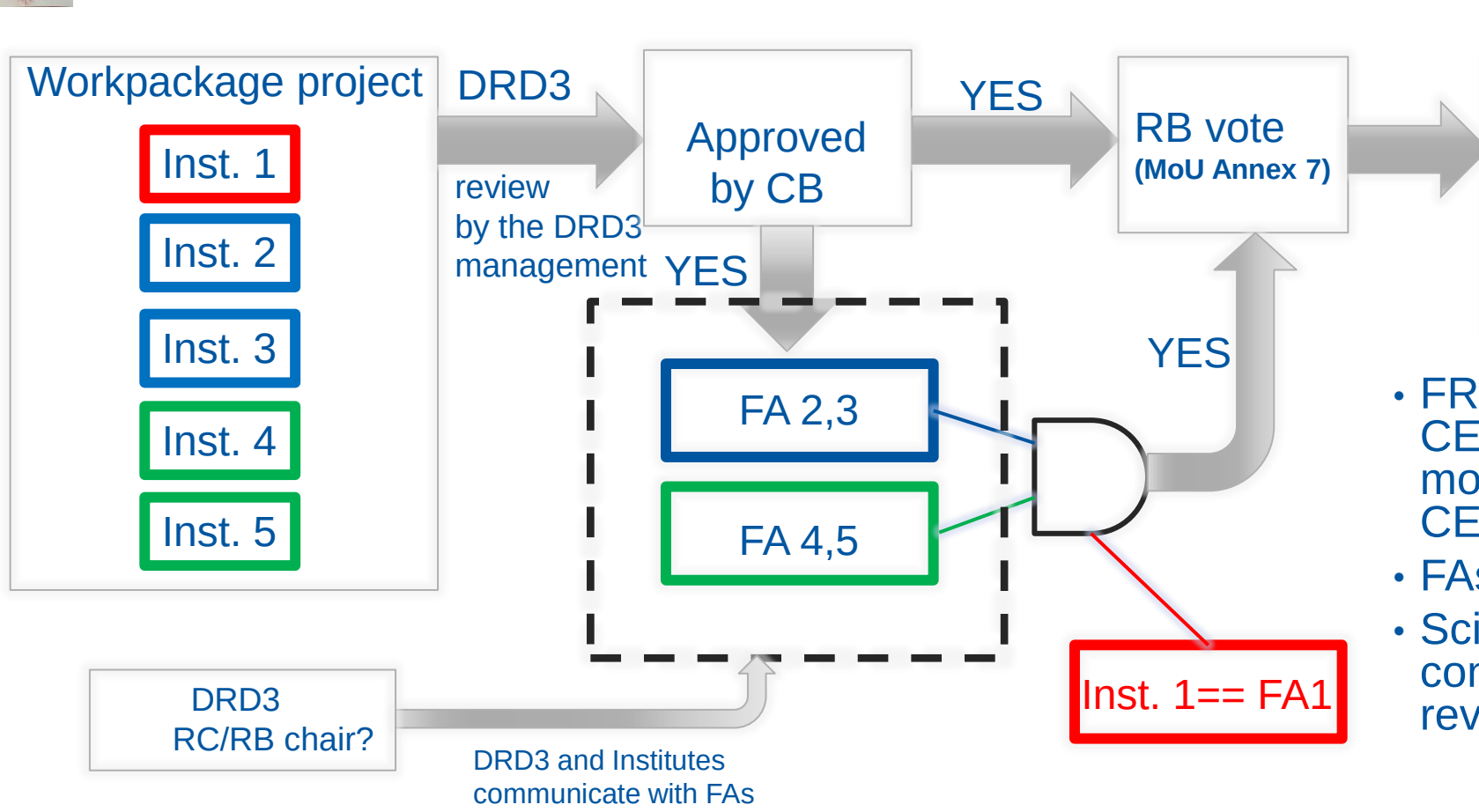


- FRC will review only the CERN based resources and money that flows through CERN – CF only
- FAs will review their funding
- Scientific part – general

Why do we need another review if we already respond to FAs that provide the funds?

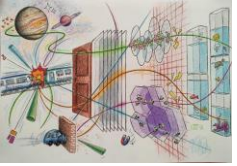
- access to infrastructure in the collaboration
- increase the visibility of the work
- widen the collaboration and exchange of knowledge
- use of CCF
- do good for the community

Workflow of the WP financing (case 2)



- FRC will review only the CERN based resources and money that flows through CERN – CF only
- FAs will review their funding
- Scientific part – general content and M&D will be reviewed by DRDC

- **Inst. 1** – acts as its own FA and **has resources to fulfil the project**
- **Inst. 2,3** and **Inst. 4,5 are asking their FA for resources to take part in the project**
  - Projects should be done in such a way that rejection from one FA doesn't collapse the whole proposal
  - The fact that rejection from one FA may endanger the whole structure may be used as leverage in talking to FAs



Overview of WP projects discussed

DRD3

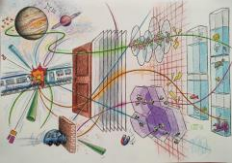
WP2

- 3D silicon sensors as timing detectors (University Freiburg; R2.1,R2.2)
- Development of very small pitch, ultrarad-hard 3D sensors for tracking + timing applications(FBK; R2.1, R2.2)
- Novel silicon 3D-trench pixel detectors based on 8-inch CMOS process (IME; R2.2)
- Development of Ultra Fast-Time Low Mass Tracking Detectors (FNAL/BNL; R2.3)
- 4DRSD: 4D-tracking with Resistive Silicon Sensors (INFN-TO; R2.3)
- TI-LGADs (UZH; R2.3)
- LGAD based timing tracker development for future electron collider (IHEP; RG2.4,RG 2.3)
- ASIC Development for Timing Measurements using LGAD Sensors for CMS Tracker phase III (PSI)
- Advancing the Pixelated Resistive Silicon Readout and Charge Collection Techniques
- Characterizing the Environmental Operational Envelope of Timing and Resistive Silicon Sensors
- NEUROPIX: A neuromorphic computing framework for pixelated detector data processing (ORNL)
- OPTIMA, a board dedicated to Optimized Precision Timing for Multichannel Acquisition (USC) a. Contact: Federico de Benedetti
- LGAD and 3D technology at the IMB-CNM (CNM)

WG2 research goals <2027	
	Description
RG 2.1	Reduction of pixel cell size for 3D sensors
RG 2.2	3D sensors for timing ($\leq 55 \times 55$ μm, < 50 ps)
RG 2.3	LGAD for 4D tracking < 10 μm, < 30 ps, wafer 6" and 8"
RG 2.4	LGAD for ToF (Large area, < 30 μm, < 30 ps)

inter DRD
CDS
already discussed
new this time

- **It is clear that we need shaping of the projects:**
  - Some are important, but don't directly pursue **the research goals of the scientific proposal** (ideal for CCF projects, intra DRD projects)
  - There is duplication of certain activities (e.g. AC-LGADs, 3D …). We need to join/shape WP project proposal and subdivide it in activities; different processing, but joint characterization, testing, simulations… looking for synergies. This will enable more coherent work, better integration of different sites.
  - It is evident that proposals are in different stages of preparation -> we should focus on those that are close to ready and move forward – we can always add more later



Overview of WP projects discussed

DRD3

WP1

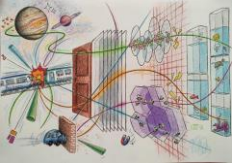
- Fine-pitch CMOS pixel sensors with precision timing for vertex detectors at future Lepton-Collider experiments (DESY/CERN)
- TPSCo 65nm CMOS with high precision timing (IP2I; FCC-ee, RG1.1,1.5)
- CMOS Strip Chip for Future Tracking Detectors (IHEP)
- Development of MAPS using 55nm HVCMOS process for future tracking detectors (IHEP)
- HV-CMOS Multi-chip integration for large area silicon trackers (INFN-MI, also WP4)
- Cactus: Large electrode designs for timing with and without intrinsic amplification (IRFU)
- Thin monolithic High Voltage CMOS sensors with excellent radiation tolerance (L'pool)
- Radiation hard read-out architectures (CERN)
- MAPS developments at SLAC (SLAC)
- CASSIA - CMOS Active SenSor with Internal Amplification (CERN)

+ more on Thursday/Friday

WG1 research goals <2027	
	Description
RG 1.1	Spatial resolution: ≤ 3 μm position resolution
RG 1.2	Timing resolution: towards 20 ps timing precision
RG 1.3	Readout architectures: towards 100 MHz/cm^2, 1 GHz/cm^2 with 3D stacked monolithic sensors, and on-chip reconfigurability
RG 1.4	Radiation tolerance: towards 10^{16} n_{eq}/cm^2 NIEL and 500 MRad
RG 1.5	Low-cost large-area CMOS sensors

inter DRD
CDS
already discussed
new this time

We need the decision on shaping of the projects according to e.g:
- **Technology**
- Design (small/large electrode)
- Performance goals (ee machines, hh machines,…)
- Segmentation type (strip/pixel/active)
- Novel approaches (gain CMOS)



Overview of WP projects discussed

DRD3

WP3 (WG3/WG6):

- Radiation hardness of 25um 3D diamond detectors (Manchester)
- SiC LGAD Detector (IHEP)
- Development of radiation-hard GaN devices for MIP detection (Carleton)
- Towards a Radiation Damage Model for 4H-SiC with SiC Schottky Diodes/Material and radiation hardness studies of planar SiC diodes (ÖAW)
- Radiation damage in Si PiN and LGAD sensors (NIMP)

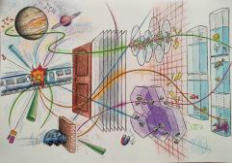
WG3 research goals <2027	
	Description
RG 3.1	Start of building up data sets on radiation-induced defect formation in WBG materials
RG 3.2	Continue developing silicon radiation damage models based on measured point and cluster defects
RG 3.3	Provide measurements and detector radiation damage models for radiation levels faced in HL-LHC operation
RG 3.4	Expand the measurements and models of silicon and WBG sensors properties in the fluence range 10^{16} to $1 \cdot 10^{18}$ n_{eq}/cm^2

WG6 research goals <2027	
	Description
RG 6.1	Development of small cell 3D diamond detectors (cages / interconnects, base length 25 μm) and possible exploitation of impact ionization
RG 6.2	Fabrication of large area SiC and GaN detectors, improve material quality and reduce defect levels.
RG 6.3	Improve tracking and timing capabilities of WBG materials
RG 6.4	Apply graphene and/or other 2D materials in radiation detectors, understand signal formation.

WP4 (WG7):

- Development of in-house plating, hybridization and module integration technologies for pixel detectors (CERN, Fondazione Bruno Kessler, LPNHE Paris, Univ. Geneva, 7.1 / 7.2 / 7.3)
- Ultrathin hybrid pixel detectors using wafer-to-wafer bonding (U. Bonn, IZM)
- 2 Project proposals at the interface with DRD7 for which groups had expressed interest (ongoing) RG 7.2 / 7.5.
  - Improving classical bump-bonding process
  - Module 2.5D integration

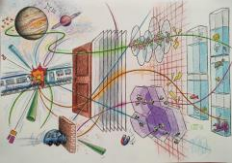
inter DRD
CDS
already discussed
new this time



Provisional agreement - October

- The collaboration has endorsed the provisional collaboration agreement.
- The agreement is needed to ensure that procedures are agreed and should steer the collaboration until the MoU is ready and signed.
  - accepting new members
  - election and endorsement procedures
  - rules to fund CCF projects
  - rules of spending RD50 CCF
- The DRD3 collaboration by-laws (Annex 4.3 of the MoU) will be only slightly modified by the exact procedures on approval of the projects.

  WP project proposal – DRD management review – CB approval – RB approval (FA representatives included)



Scientific activities in the last months

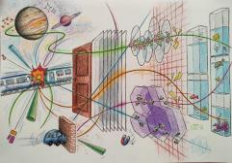
Note: **only those listed in the indico – many more in smaller circles!**

- WG1 – 3 meetings (mostly WP project proposals)
- WG2 – 3 meetings (WP project proposals and recent scientific results)
- WG3 – 1 meeting (organizational)
- WG4 – 7 meetings (scientific and WP project proposal related)
- WG5 – 2 meetings
- WG6 – 7 meetings (scientific and WP project proposal related)
- WG7 – 1 meeting (organizational)
- WG8 - associated to other e.g. DRD3 TCT-School presentation

Most of the meetings are half day events – so the scientific activities are on-going

WGs 4,5 are very active (TB organization, TCT school, Lots of simulation and DAQ developments)
WG8 has started to ramp up the activities – promotion of the school, logo…

https://indico.cern.ch/category/17387/



Presentations and events

We are still not in the state to start submitting the collaboration review papers, but we were invited to some (all DRD3 related talks should be in CDS:

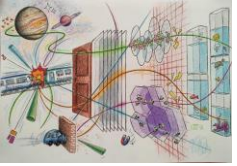
- CEPC workshop (WG1/WP1, WG2/WG2, Outlook for DRD3)
- Pixel 2024 – WG6/WP3 presentation Alex

DRD3 is organizing TCT school (4-6.3.2024 at CERN):

- Duration 2.5 days
  - Half day plenary with introductory talks
  - 3x half day hands-on parallel sessions (SPA-TCT, TPA-TCT, Signal formation & simulation)
  - Conclusion – half day analysis session
- Up to 18 participants + demonstrators (lab space constraints)

DRD3 web page:

- job announcements!, conferences of interest, meetings, school, contacts
- we should fill it with outreach material



Conclusions

- We are progressing well with few bumps on the road …
- Scientific meetings are regular and number of proposals is growing.
- We need to converge with finalization of the WP projects
  - Please upload the proposals to the CDS
  - Indicate where you would need help
  - Communicate with WP leaders and try to shape the WP projects into MoU ready form.
- We don’t need to have all WP projects ready soon, but we need some ...
- We will collect CCF contributions in 2025 and CCF projects can start (the ones including the DRD3 money)

Many thanks and let’s get to work….

(no AI generated and HI-edited image for closing slide - not a decent **scientific** talk)