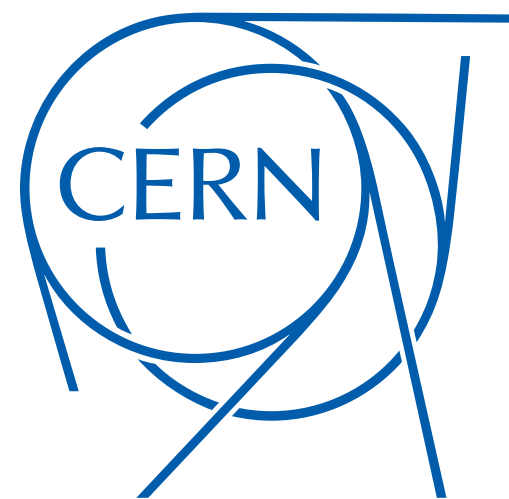


CERN – Status and News

Eckhard Elsen

Director Research and Computing

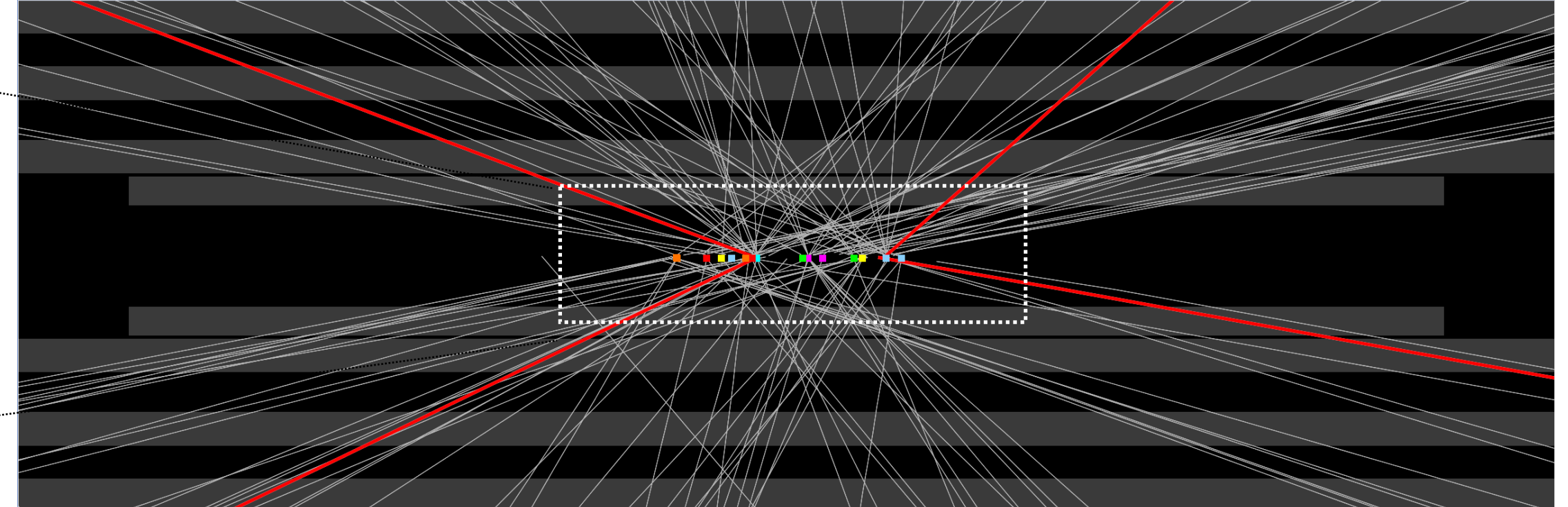
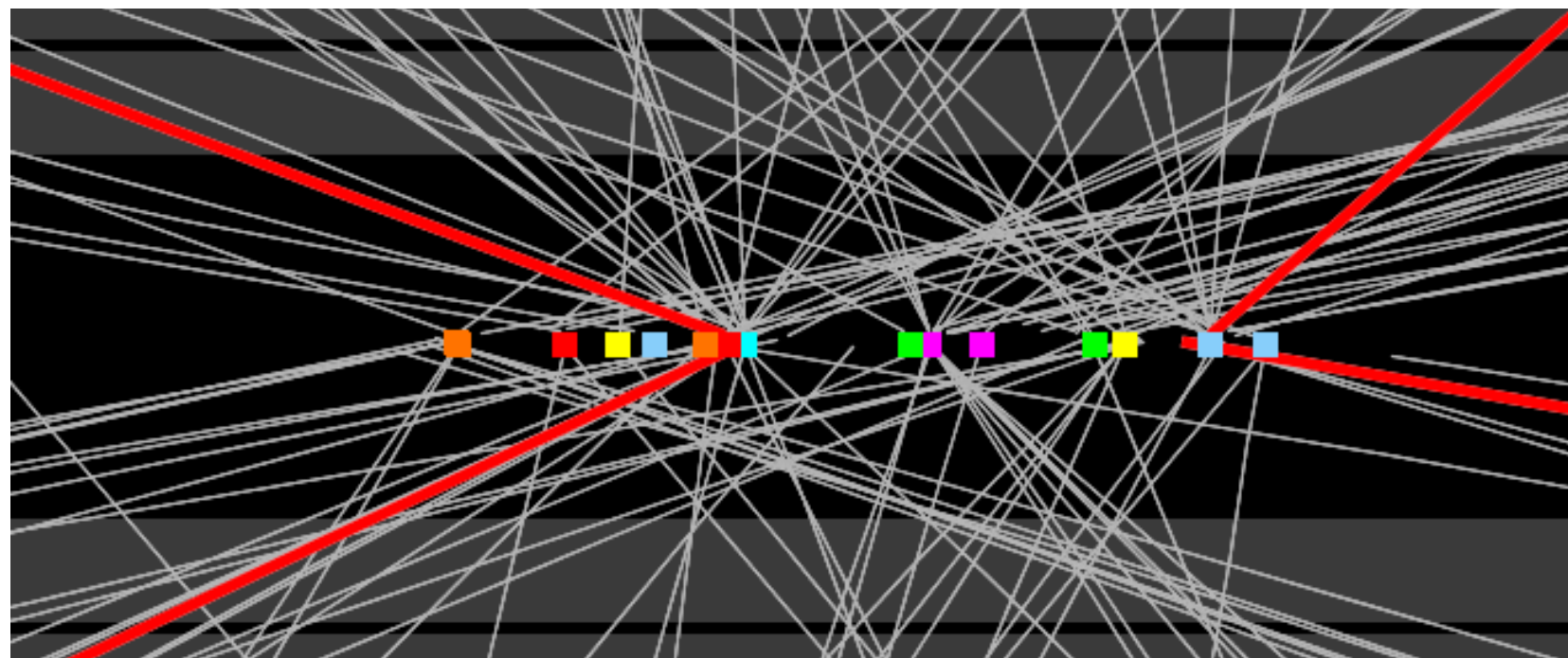
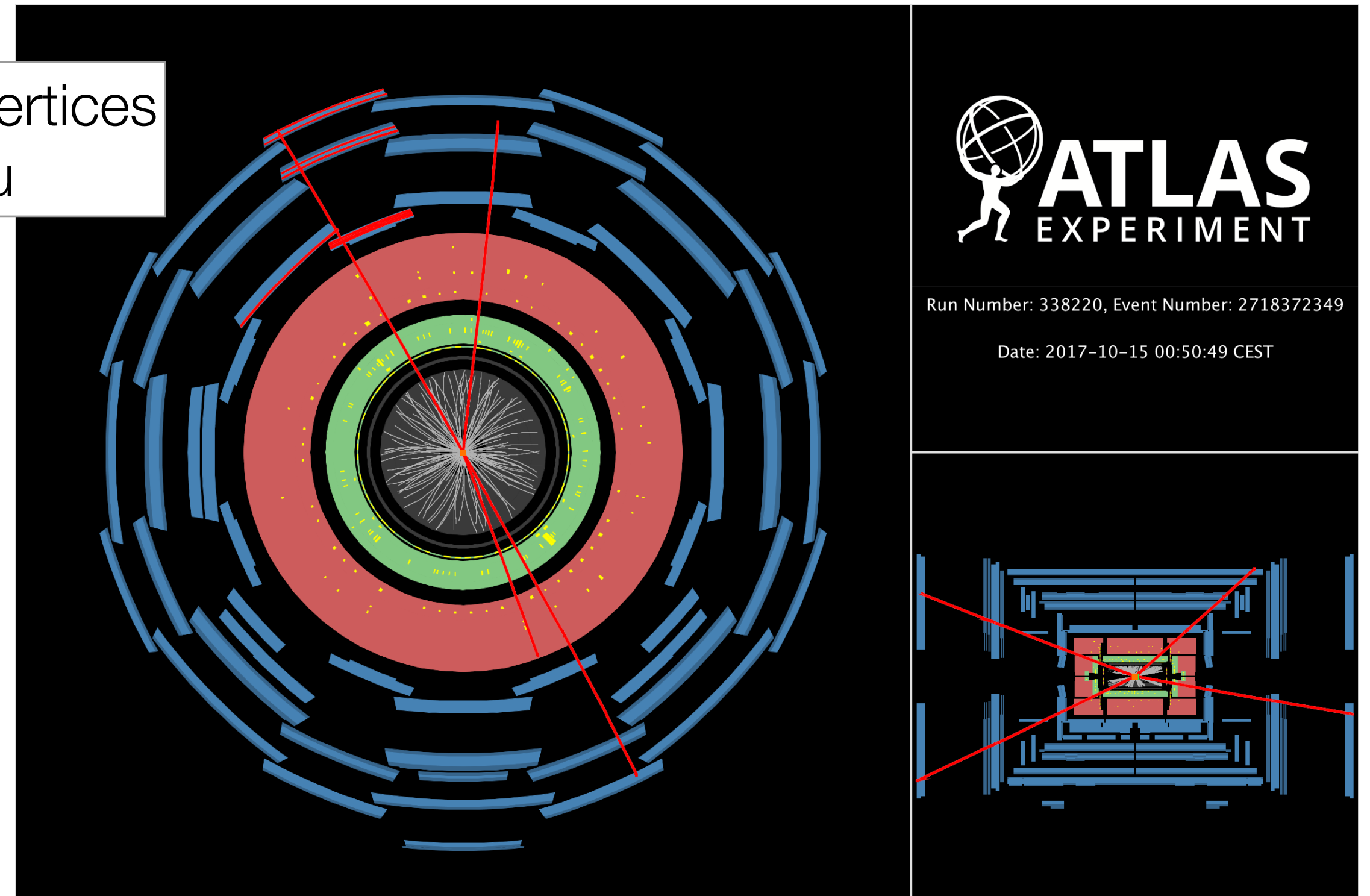


Pile-up affects physics

- For low pile-up:
 - 1 hard interaction and many minimum-bias interactions
- for high pile-up
 - possibly more than 1 hard interaction + min-bias

2 separate vertices
 $Z \rightarrow \mu\mu$

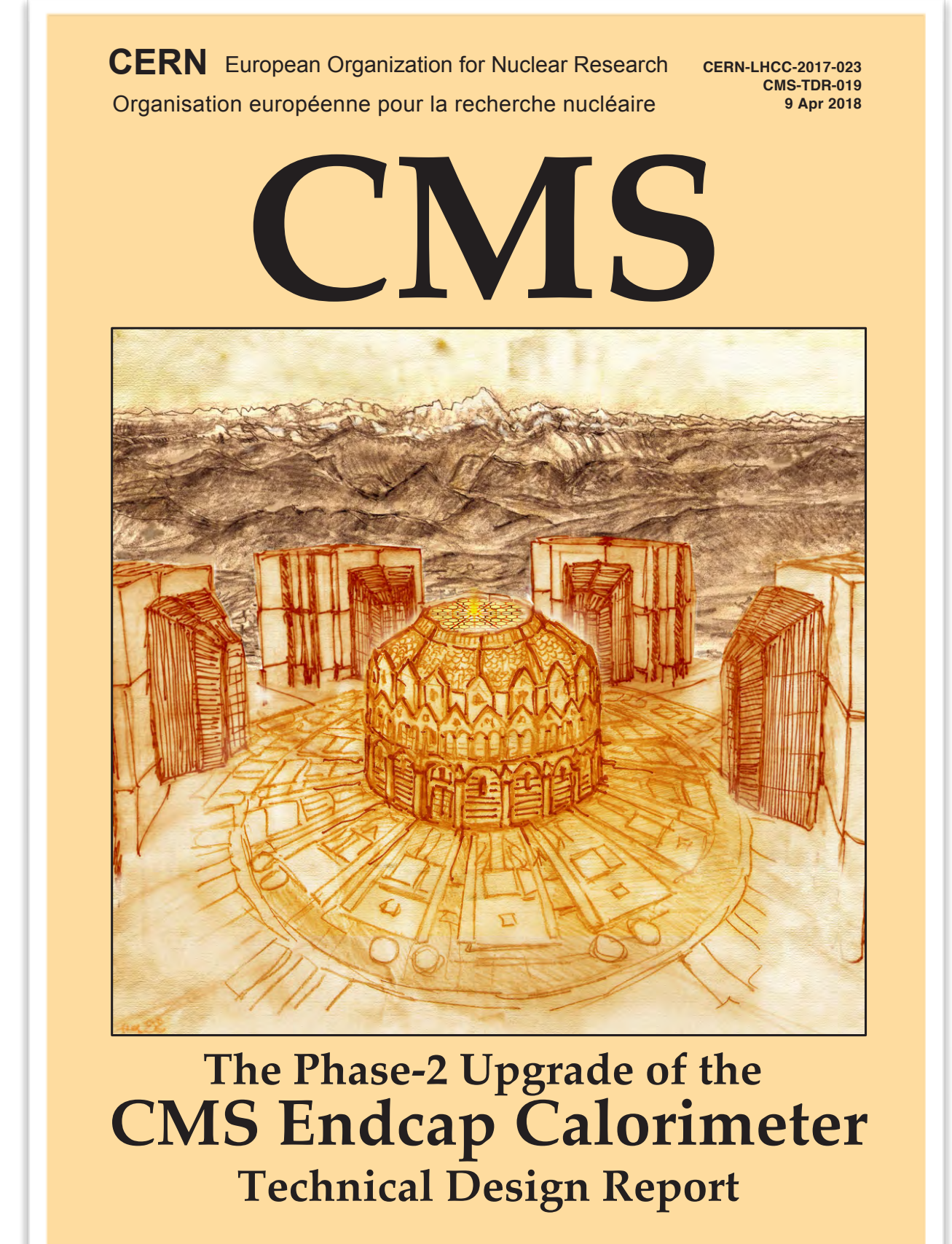
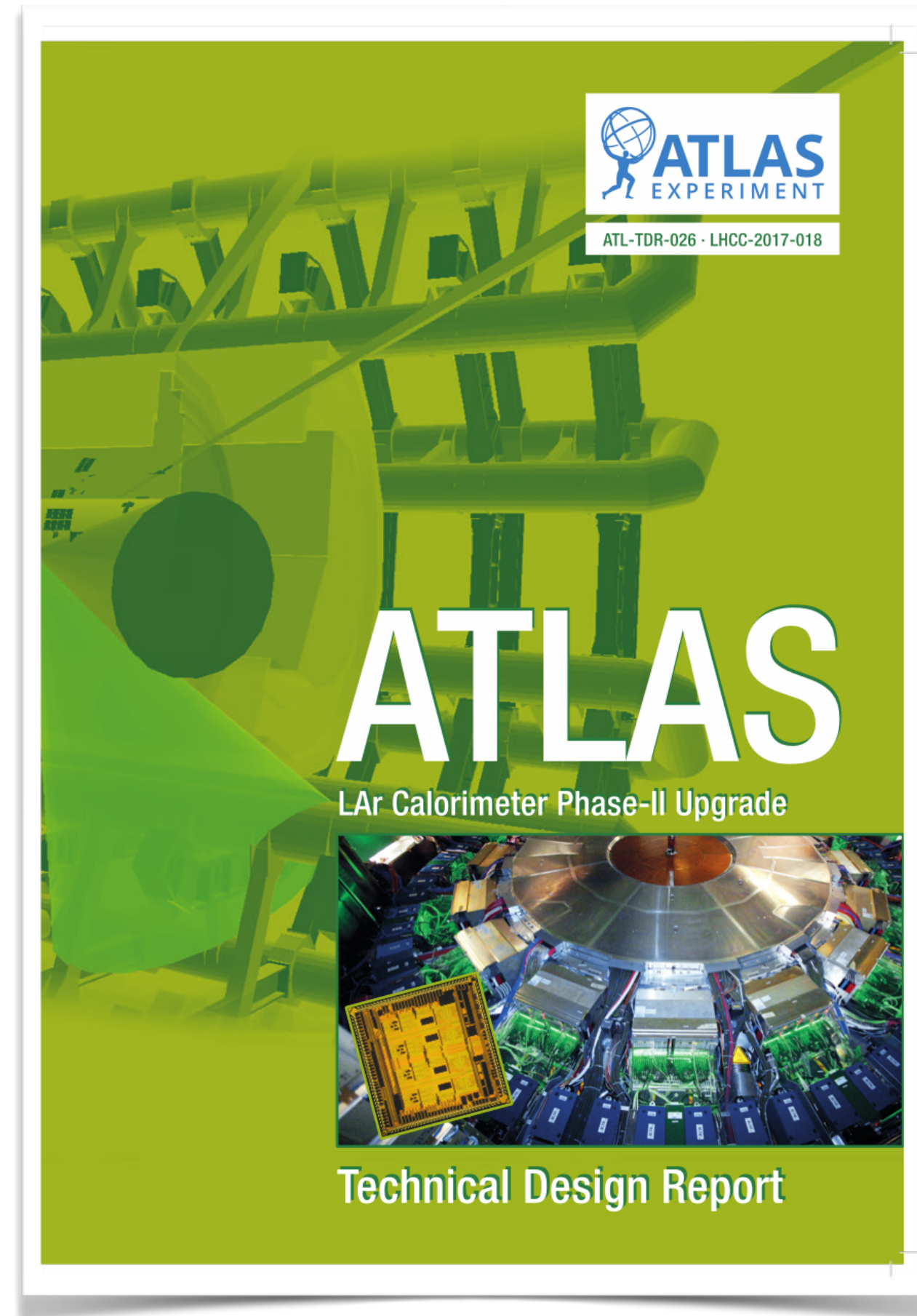
*2 independent
hard-scale
events*



ATLAS and CMS Phase II Upgrades

- Original plans had been outlined in Lol and Technical Proposal
- Scoping Documents have been provided in addition end 2015
- All* TDRs have been received; good understanding of the technical needs and scope

Two of the later TDRs



* CMS TDAQ scheduled to come later to profit from technology development

Experiments

- Each major detector component provided its own TDR; 10 TDRs have been received in total
 - TDRs were scheduled not to arrive at the same time
 - TDRs have been examined by LHCC for physics need and technical soundness
 - Cost matrix and risks monitored by UCG
- Try to optimise and profit from synergies in technical development
- April RRB had been scheduled to close the loop for the first time

Status April RRB

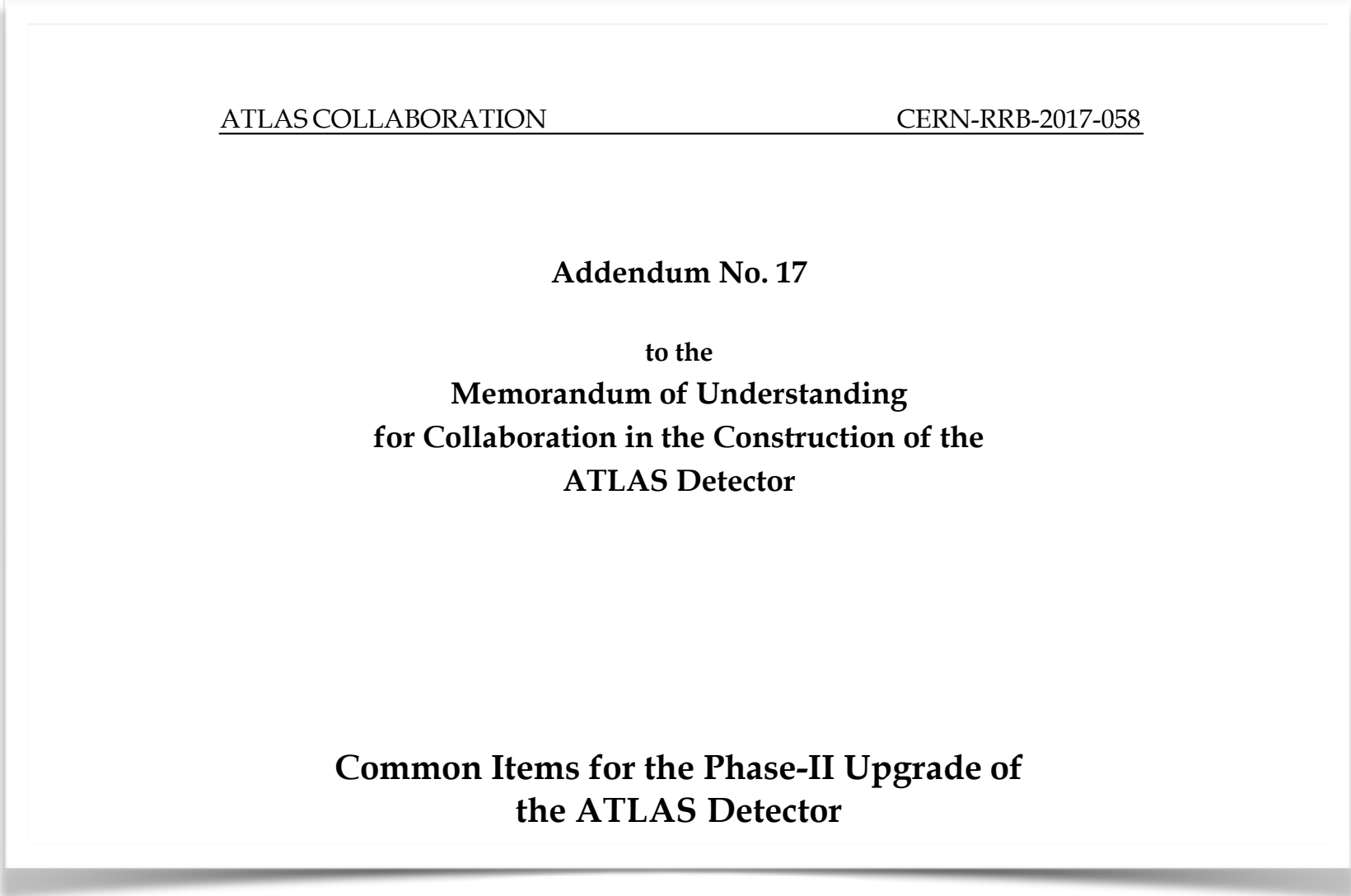
- LHCC assumptions on LHC luminosity are realistic; pile-up of 60 in 2017 was just an appetiser of what is to come at the HL-LHC
 - Experiments have to safeguard themselves (Timing detectors)
- First time all TDRs have been scrutinised – thanks to tremendous LHCC/UCG effort
 - A smaller version of the upgrade will not exploit the investments in HL-LHC in full
 - Cost has been optimised; a little more to be gained with additional R&D
- Loop has been closed: Scoping Document → 10+1 TDRs → Cost Overview

Money Matrix

- Continuously updated and maintained by experiments during the process
 - original cost frame maintained
 - timing detectors have been examined for physics need in November LHCC and are now included in the phase II upgrade
 - encouraging involvement of funding agencies
 - have reached good closure so far
- October 2018 RRB will settle the final sharing

Common Fund for HL-LHC – Status of Signatures

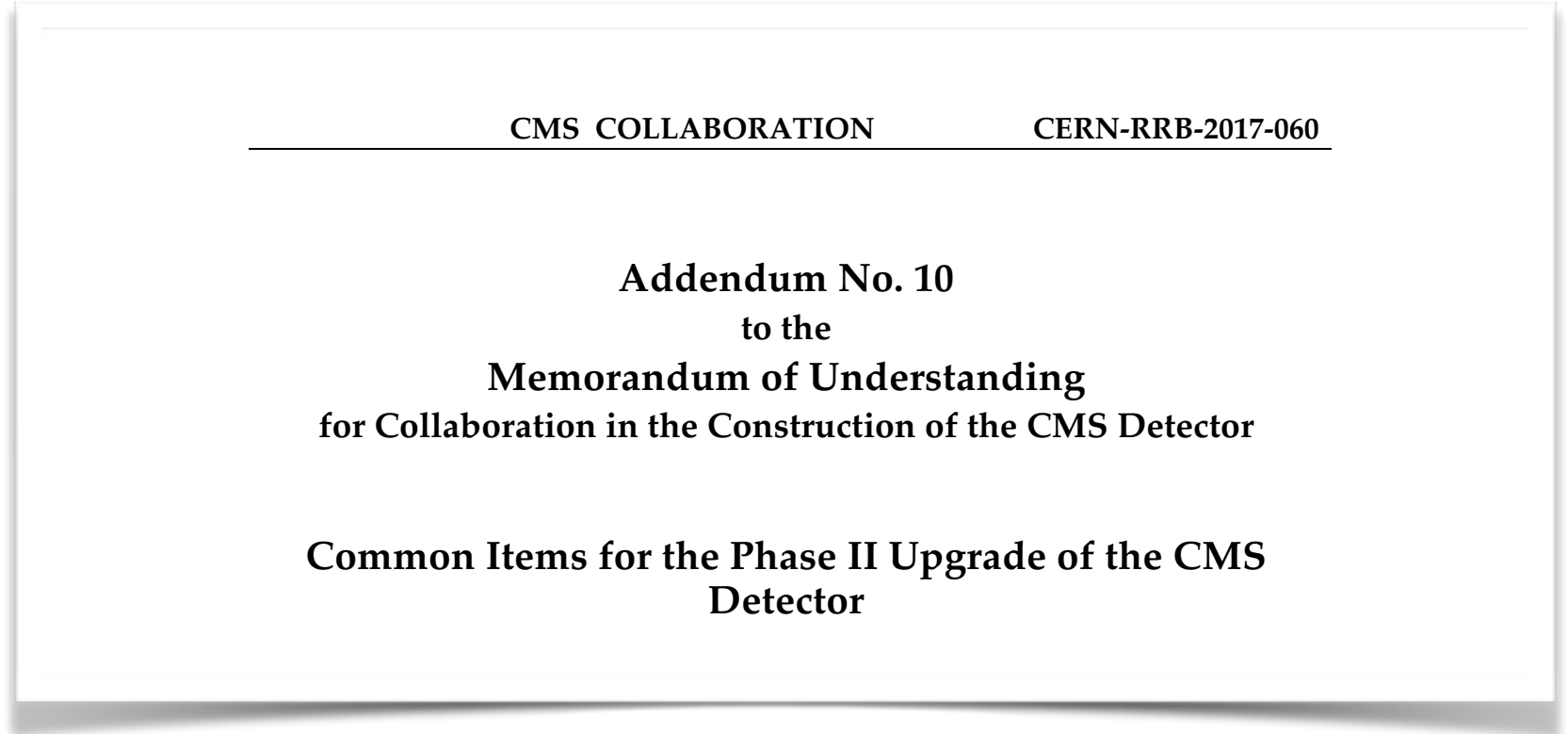
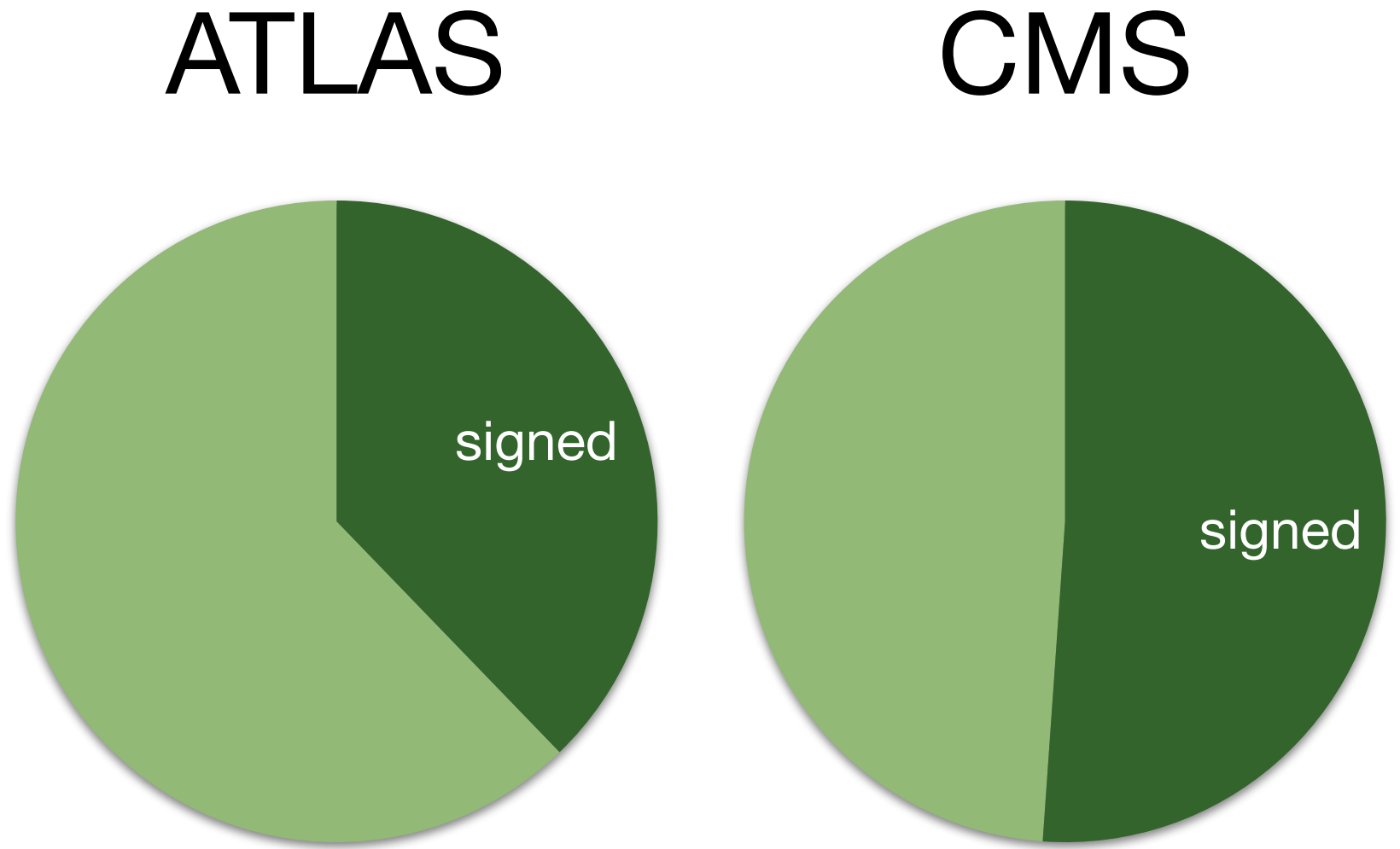
- Single MoU to describe Common Fund capped at a fraction $O(10\%) \sim 25$ MCHF
 - spread evenly over construction period
- Sharing according to PhD or equivalent
- Separate budgeting from M&O but similar accounting methods



same principle applied for both experiments

- Status of signatures:

Fraction of signatures



CERN involvement in Phase II upgrade

- Host laboratory responsibilities
 - Have been well defined up and including LS2
Considerable amount of Phase II Civil Engineering will take place in LS2
 - Remainder can now be settled on the basis of the installation work required for the detectors as described in the TDRs
- CERN is also actively contributing 55 MCHF (starting 2016) to the upgrade of ATLAS and CMS each
- Overall resource demands have to be sorted out by October 2018 RRB

ATLAS

ATLAS Phase-II Upgrades – envisaged CORE Contributions by Funding Agency [kCHF]

267 MCHF

	TDAQ	ITk	LAr	Tile	Muons	HGTD ³⁾	Total	Common Fund	TOTAL (incl. CF)	LUCID ⁴⁾	FWD ⁵⁾	μ-Tagger ⁶⁾
CORE Costs¹⁾ [kCHF]	44'880	121'966	27'882	11'129	28'172	8'533	242'561	24'420	266'981	500	800	3'500
Funding Agency	CORE Commitments²⁾											
Argentina												
Armenia												
Australia												
Austria												
Azerbaijan												
Belarus												
Brazil												
Canada												
Chile												
China NSFC+MSTC												
Colombia												
Czech Republic												
Denmark												
France IN2P3												
France CEA												
Georgia												
Germany BMBF												
Germany DESY												
Germany MPI												
Greece												
Hong Kong												
Israel												
Italy												
Japan												
Morocco												
Netherlands												
Norway												
Poland												
Portugal												
Romania												
Russia												
JINR												
Serbia												
Slovak Republic												
Slovenia												
South Africa												
Spain												
Sweden												
Switzerland												
Taipei												
Turkey												
United Kingdom												
USA DOE												
USA NSF												
CERN												
TOTAL (kCHF)												
Uncertainty Low												
Medium												
High												
% of CORE Costs												

← passed LHC/UCG →

Notes

- 1) CORE costs as defined in the TDRs and reviewed in detail by the Upgrade Cost Group (UCG) for TDAQ, ITk, LAr, Tile, Muons. For HGTD, FWD, μ-Tagger see notes 3-6).
- 2) Bars are normalised to the maximum in each column.
- 3) The High Granularity Timing Detector (HGTD) has not yet been reviewed, the TDR will follow in 2019.
- 4) A new LUCID detector was originally proposed in the Scoping Document under "Forward Detectors". It is now planned as a "Small Project" with details to be worked out in the coming months.
- 5) The remaining Forward Detector projects (ALFA,AFP,ZDC) are not being formally proposed at this stage.
- 6) The μ-Tagger project is not included in the present Phase-II scope, but remains an option as a further upgrade project for installation at a later stage (>2025)

Bars normalised to maximum in column

CMS Phase-II Money Matrix [kCHF]											
	EC-CALO	ECAL Barrel	HCAL Barrel	Muons	Tracker	MIP-TD	BRIL	Trigger	DAQ/HLT	Common Fund	Total (incl. CF)
CORE Costs (kCHF)	67'127	12'675	580	25'187	111'900	15'796	2'600	5'900	12'600	25'000	279'365
Funding Agency	CORE Commitments										
Austria											
Belgium FNRS											
Belgium FWO											
Brasil/FAPESP											
Brasil/UERJ											
Bulgaria											
CERN											
China											
Colombia											
Croatia											
Cyprus											
Egypt											
Estonia											
Finland											
France-CEA											
France-IN2P3											
Germany BMBF											
Germany Helmholtz											
Greece											
Hungary											
India											
Iran											
Ireland											
Italy											
Korea											
Lithuania											
Malaysia											
Mexico											
New Zealand											
Pakistan											
Poland											
Portugal											
RDMS-DMS-Russia											
Serbia											
Spain											
Switzerland											
Taipei											
Thailand											
Turkey											
United Kingdom											
USA-DOE											
USA-DOE-NP											
USA-NSF											
Ecuador											
Montenegro											
Qatar											
Sri Lanka											
Latvia											
TOTAL (kCHF)											
Uncertainty Low											
Medium											
High											
% of CORE Costs											
Δ (TOTAL-CORE Costs)											

← passed LHC/UCG →

← Bars normalised to maximum in column

ATLAS Phase-II Upgrades – envisaged CORE Contributions by Funding Agency [kCHF]

	TDAQ	ITk	LAr	Tile	Muons	HGTD ³⁾	Total	Common Fund	TOTAL (incl. CF)	LUCID ⁴⁾	FWD ⁵⁾	μ-Tagger ⁶⁾
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South Africa												
Spain												
Sweden												
Switzerland												
Taipei												
Turkey												
United Kingdom												
USA DOE												
USA NSF												
CERN												
TOTAL (kCHF)												
Uncertainty Low												
Medium												
High												
% of CORE Costs												

Notes

- 1) CORE costs as defined in the TDRs and reviewed in detail by the Upgrade Cost Group (UCG) for TDAQ, ITk, LAr, Tile, Muons. For HGTD, FWD, μ-Tagger see notes 3-6).
- 2) Bar scale: 0 ... 10'000 kCHF; bars for larger CORE contributions are cut off at 10'000 kCHF.
- 3) The High Granularity Timing Detector (HGTD) has not yet been reviewed, the TDR will follow in 2019.
- 4) A new LUCID detector was originally proposed in the Scoping Document under "Forward Detectors". It is now planned as a "Small Project" with details to be worked out in the coming months.
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- 6) The μ-Tagger project is not included in the present Phase-II scope, but remains an option as a further upgrade project for installation at a later stage (>2025)

Bars capped at 10 MCHF

CMS Phase-II Money Matrix [kCHF]											
	EC-CALO	ECAL Barrel	HCAL Barrel	Muons	Tracker	MIP-TD	BRIL	Trigger	DAQ/HLT	Common Fund	Total (incl. CF)
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Funding Agency	CORE Commitments										
Austria	█				█						█
Belgium FNRS					█						█
Belgium FWO					█						█
Brasil/FAPESP					█						█
Brasil/UERJ					█						█
Bulgaria				█							█
CERN	█	█		█	█		█	█	█	█	█
China	█			█				█			█
Colombia											
Croatia	█										█
Cyprus											
Egypt				█							█
Estonia								█			█
Finland					█						█
France-CEA	█	█		█	█						█
France-IN2P3	█	█		█	█						█
Germany BMBF				█	█						█
Germany Helmholtz				█	█				█		█
Greece	█				█			█			█
Hungary				█	█			█			█
India	█		█	█	█						█
Iran				█							█
Ireland				█							█
Italy		█		█	█	█				█	█
Korea				█							█
Lithuania									█		█
Malaysia	█										█
Mexico				█							█
New Zealand											
Pakistan				█	█						█
Poland				█							█
Portugal	█	█				█					█
RDMS-DMS-Russia	█			█							█
Serbia				█							█
Spain				█	█						█
Switzerland		█			█	█					█
Taipei	█				█						█
Thailand	█										█
Turkey	█										█
United Kingdom	█	█		█	█			█			█
USA-DOE	█	█		█	█	█		█	█	█	█
USA-NSF	█	█	█	█	█			█			█
USA-DOE-NP									█		█
Ecuador									█		█
Montenegro									█		█
Qatar				█							█
Sri Lanka											█
Latvia											█
TOTAL (kCHF)											
Uncertainty Low	█	█		█	█	█	█	█	█	█	█
Medium	█	█	█	█	█	█	█	█	█	█	█
High	█			█		█		█	█		█
% of CORE Costs											
Δ (TOTAL-CORE Costs)											

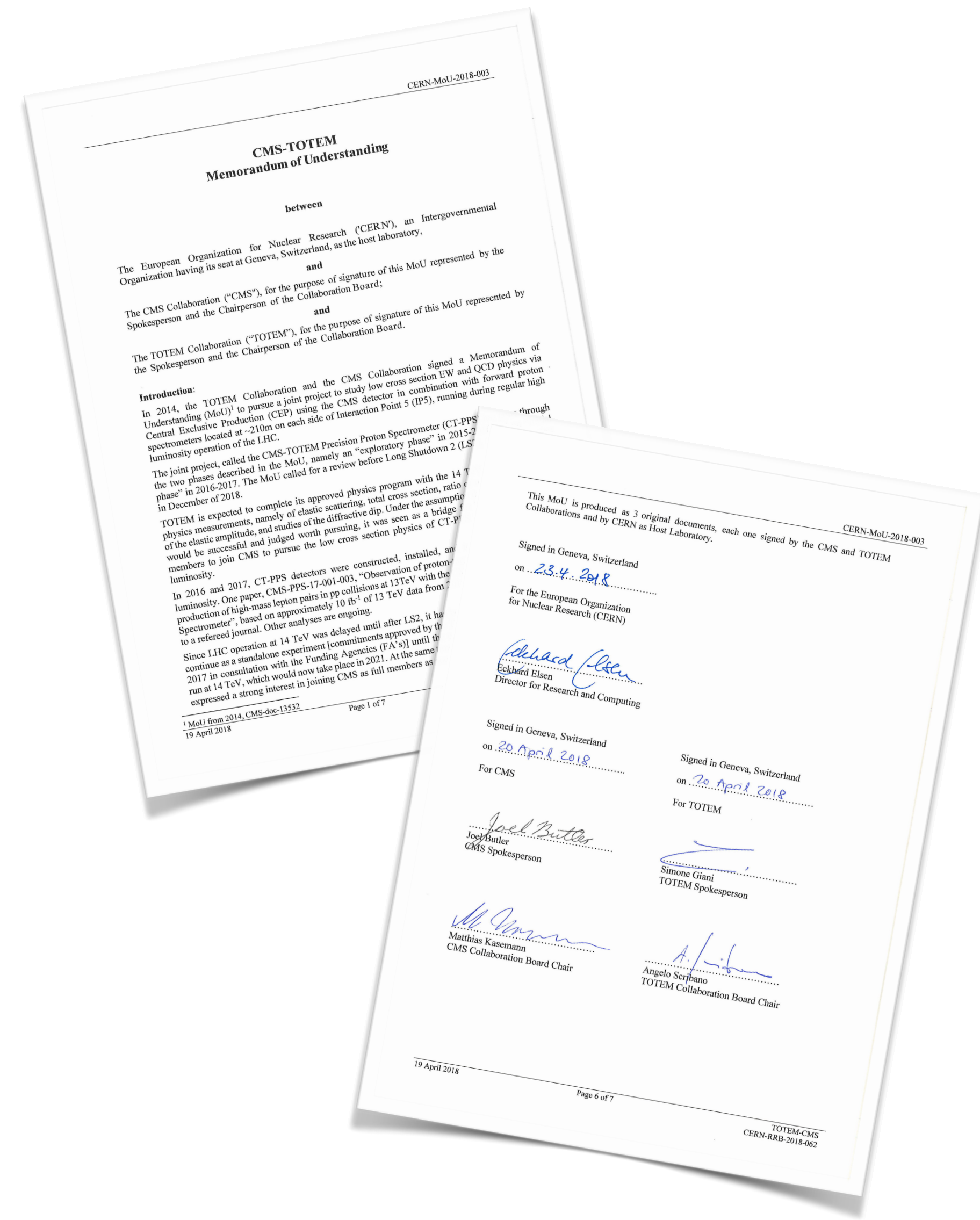
Bars capped at 10 MCHF

Towards MoUs – Ownership of upgraded Detector components

- as we proceed to MoU for TDRs
 - will assume that ownership is transferred to CERN
 - this is relevant for decommissioning and disposal in particular after exposure to radiation
 - allows for coherent and consistent policy (environmental aspects, central planning and logistics)
- will try to incorporate this also in phase 1 components that will be extracted from the experiment

MoU between CMS and TOTEM – Full Integration of CT-PPS

- TOTEM and CMS have successfully negotiated a merging of the two collaborations
- Starting in 2018 (most) TOTEM institutes will join CMS
- TOTEM will continue to exist to carry out the 14 TeV high-cross section programme in Run 3
- New head of PPS system will be Simone Giani
- More details in closed session



Composition of Scrutiny Group 2018

- SIMON, Frank (MPI Munich, DE) (Chair)
- *HAHN, Ferdinand † (Scientific Secretary)*
- VASSEUR, Georges (CEA/IRFU, FR)
- SANDAKER, Heidi (University of Oslo)
- GOLDSTEIN, Joel (Bristol, UK)
- DANIELSSON, Hans (CERN, EP)
- CHRISTIE, William B. (BNL, US)
- MOLL, Michael (CERN EP)
- PÖSCHL, Roman (Orsay, FR)
- CAMPBELL, Michael (CERN EP)
- CONVERY, Mary (Fermilab, US)
- LUBBRANO, Pasquale (Perugia, IT)
- PRODON, Sylvie (CERN, FAP)

Conclusion

- TDRs have been received as scheduled
 - Tremendous effort has been made by LHCC and UCG
 - LHCC / UCG work is very well supported (including cross-refereeing)
 - Upgrade Progress will be monitored by two standing sub-committees of the LHCC (see following presentations)
- Cost containment fulfilled
Optimisation/savings in some detector components; need of Timing detector