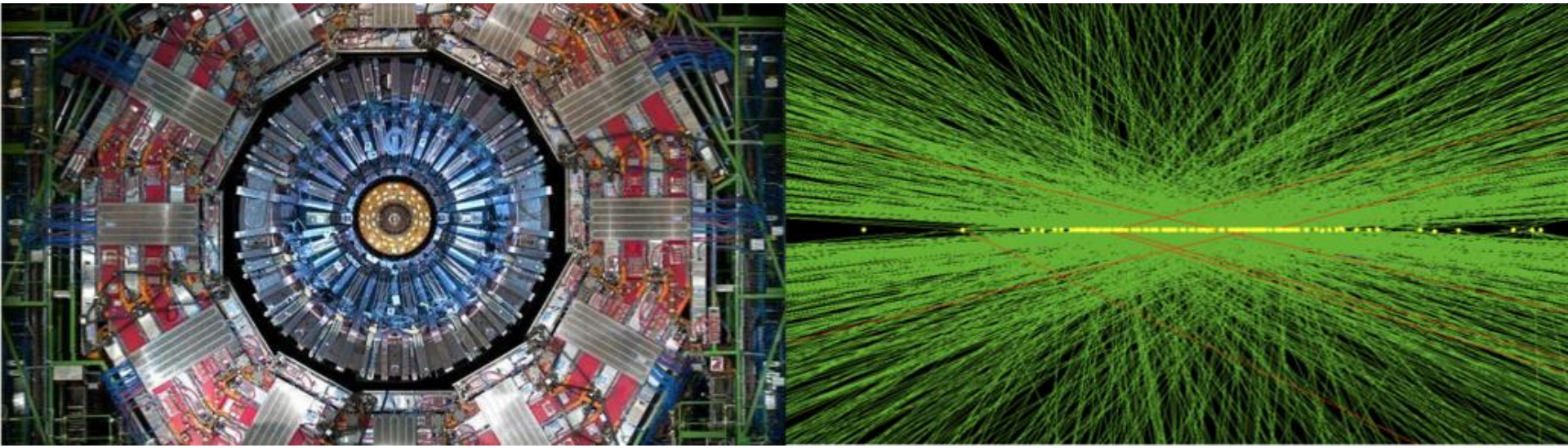
Drill Down Orientation– 402.4.5

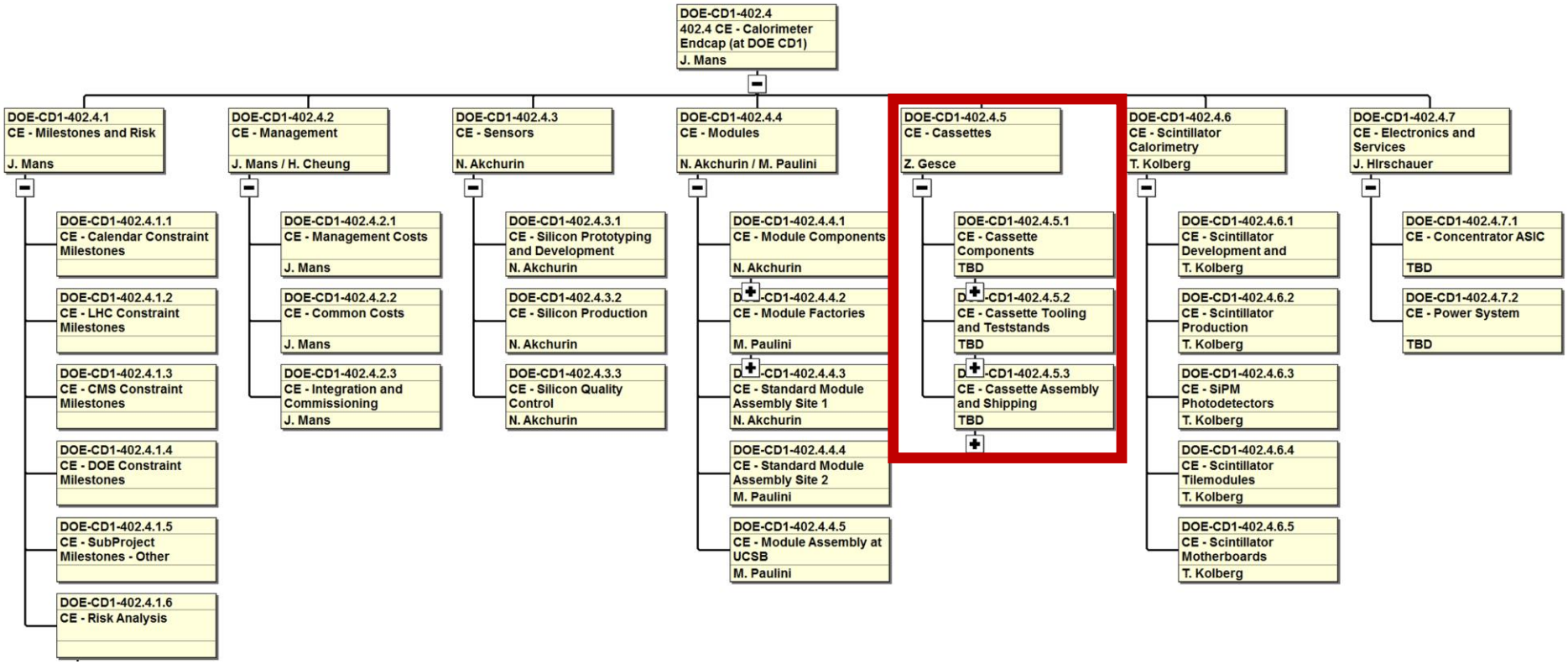
Zoltan Gecse

CD1 Review

22 October 2019



Work Breakdown Structure



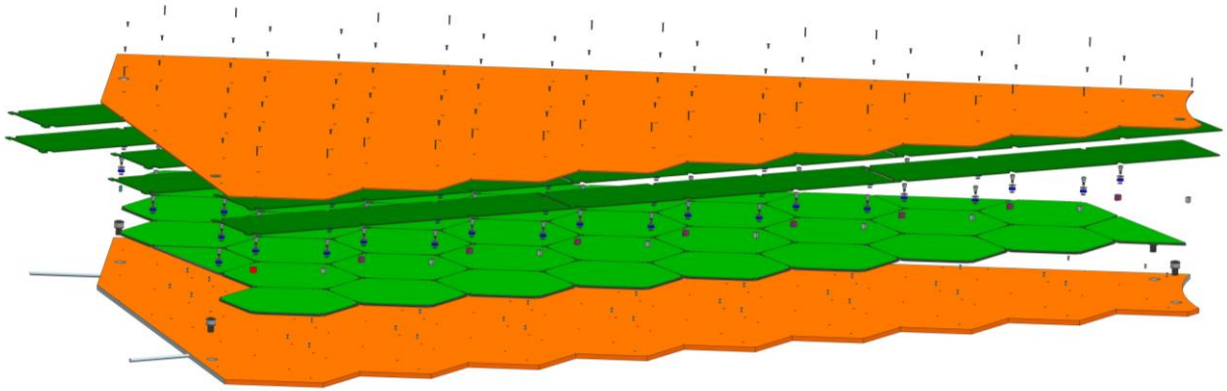
- I am responsible for the circled area

Bio

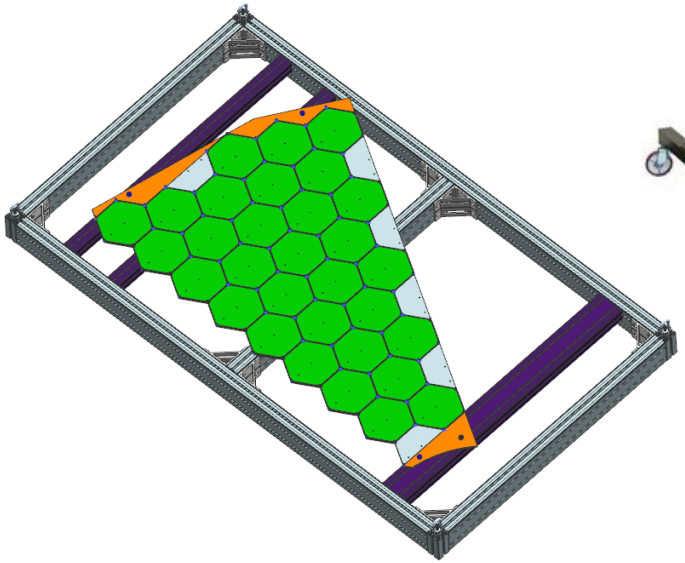
- L3 Manager: Zoltan Gecse
  - Associate Scientist at Fermilab
  - International coordinator of Cassettes L2 area
  - ~4 years of R&D experience within the HGCAL
    - Silicon sensor probing and design for HGCAL
    - Construction and operation of the first HGCAL test beam prototype and data analysis
    - Cassettes design and prototyping, built and tested a thermal and mechanical cassette mockup
  - ATLAS Transition Radiation Tracker readout firmware upgrade to 100kHz L1 rate
  - Convener of the MET based Supersymmetry Group in ATLAS
- L4 Manager for Si Motherboards: Nadja Strobbe
  - Assistant Professor of Physics at University of Minnesota
  - Detector experience: Phase 1 Upgrade of CMS HCAL
    - Led QC of production HB on-detector readout (QIE) boards (2018)
    - Coordinate HE/HB test beam at CERN (2017)
    - Characterization and QC of 45k QIE ASICs for HF, HE, HB (2016-2017)
    - Coordinate full system radiation tests for HE (2015-2016)
  - Physics: Searches for new physics
    - SUSY Analyses Combination Coordinator (2018-2019)
    - L3 Convener of CMS SUSY MC group (2015)

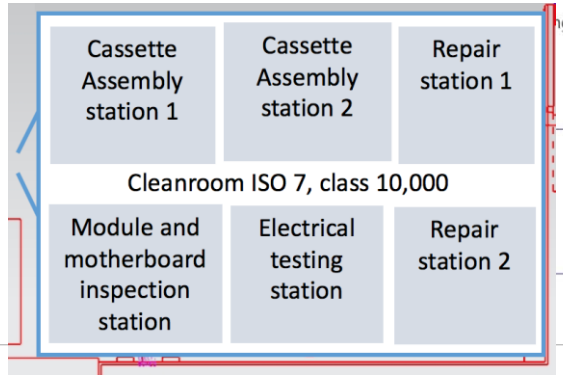
WBS Overview

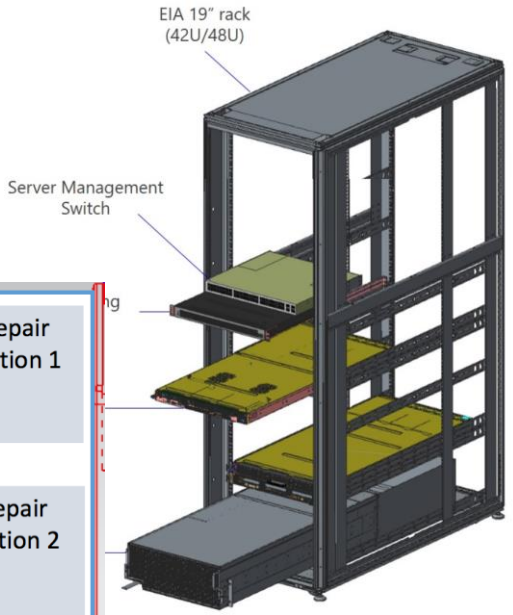
- Cassette Components (550 cassettes)



- Cassette Tooling







Costbook to L4

WBS	Direct M&S ($)	Labor (Hours)	FTE	Direct + Indirect + Esc. ($)	Estimate Uncertainty ($)	Total Cost ($)
DOE-CD1-402.4 402.4 CE - Calorimeter Endcap (at DOE CD1)	21,051,786	332579	188.11	40,672,474	10,143,585	50,816,059
DOE-CD1-402.4.2 CE - Management	1,934,243	82022	46.39	3,807,266	622,019	4,429,285
DOE-CD1-402.4.3 CE - Sensors	7,501,635	14846	8.40	8,393,032	1,722,630	10,115,663
DOE-CD1-402.4.4 CE - Modules	2,932,730	96412	54.53	8,405,886	1,435,046	9,840,932
DOE-CD1-402.4.5 CE - Cassettes	3,677,813	47416	26.82	9,422,794	3,065,143	12,487,937
DOE-CD1-402.4.5.1 CE - Cassette Components	2,671,722	17168	9.71	5,226,651	1,933,964	7,160,616
DOE-CD1-402.4.5.1.1 CE - Cassette Cooling Plates	59,600	6440	3.64	866,898	287,956	1,154,853
DOE-CD1-402.4.5.1.2 CE - Silicon Motherboards	2,245,755	7688	4.35	3,600,258	1,296,667	4,896,926
DOE-CD1-402.4.5.1.3 CE - Cassette Interface and Cables	366,367	3040	1.72	759,496	349,341	1,108,836
DOE-CD1-402.4.5.2 CE - Cassette Tooling and Teststands	754,300	2923	1.65	1,316,290	403,513	1,719,803
DOE-CD1-402.4.5.2.1 CE - Cassette Frames	239,000	475	0.27	330,776	61,287	392,063
DOE-CD1-402.4.5.2.2 CE - Cassette Assembly Tooling	247,000	928	0.52	440,832	135,507	576,339
DOE-CD1-402.4.5.2.3 CE - Cassette Electrical Test Stands	75,100	400	0.23	155,185	21,568	176,753
DOE-CD1-402.4.5.2.4 CE - Cassette Thermal Test Stands	193,200	1120	0.63	389,497	185,152	574,649
DOE-CD1-402.4.5.3 CE - Cassette Assembly and Shipping	251,791	27325	15.46	2,879,852	727,666	3,607,518
DOE-CD1-402.4.5.3.1 CE - Assembled Cassettes	41,278	22117	12.51	2,155,092	451,206	2,606,298
DOE-CD1-402.4.5.3.2 CE - Tested Cassettes	19,203	2921	1.65	264,659	98,417	363,076
DOE-CD1-402.4.5.3.3 CE - Delivered Cassettes	191,310	2287	1.29	460,101	178,043	638,144
DOE-CD1-402.4.6 CE - Scintillator Calorimetry	2,084,047	60875	34.43	4,196,710	1,244,785	5,441,494
DOE-CD1-402.4.7 CE - Electronics and Services	2,921,318	31008	17.54	6,446,786	2,053,962	8,500,748

Risks

RI-ID	Title	Probability	Cost Impact	Schedule Impact	P * Impact (k$)	P * Impact (months)
WBS / Ops Lab Activity : 402.4 CE - Calorimeter Endcap (16)						
Risk Rank : 3 (High) (2)						
RT-402-4-18-D	CE - Additional concentrator ASIC engineering (MPW) run is required	50 %	164 -- 241 -- 385 k$	6 -- 7.5 -- 9 months	132	3.8
RT-402-4-01-D	CE - Additional FE ASIC engineering run required	25 %	336 k$	8 months	84	2.0
Risk Rank : 2 (Medium) (6)						
RT-402-4-22-D	CE - Additional production acceleration required	20 %	564 -- 564 -- 777 k$	1 months	127	0.2
RT-402-4-91-D	CE - Shortfall in Calorimeter Endcap scientific labor	30 %	0 -- 0 -- 982 k$	0 months	98	0.0
RT-402-4-04-D	CE - Concentrator does not meet specifications	10 %	907 -- 971 -- 1035 k$	6 -- 7.5 -- 9 months	97	0.8
RT-402-4-90-D	CE - Key Calorimeter Endcap personnel need to be replaced	25 %	75 -- 225 -- 555 k$	0 -- 0 -- 3 months	71	0.3
RT-402-4-02-D	CE - Infrastructure failure at module assembly facility	30 %	100 -- 336 k$	1 -- 4 months	65	0.8
RT-402-4-13-D	CE - HGCROC front end chip is delayed	20 %	21 -- 126 -- 252 k$	1 -- 6 -- 12 months	27	1.3
Risk Rank : 1 (Low) (8)						
RT-402-4-23-D	CE - Si Motherboard complexity is much higher than expected	5 %	383 -- 575 -- 767 k$	0 months	29	0.0
RT-402-4-16-D	CE - Cassettes damaged or lost in assembly, testing or shipping	5 %	100 -- 1000 k$	3 months	28	0.2
RT-402-4-15-D	CE - Motherboard and interface board fabrication failure	10 %	73 -- 193 k$	3 months	13	0.3
RT-402-4-20-D	CE - Boundary between Si and scintillator sections is moved	5 %	252 k$	0 months	13	0.0
RT-402-4-17-D	CE - Cassette assembly site failure	10 %	73 -- 163 k$	3 months	12	0.3
RT-402-4-09-D	CE - Module PCB batch failure	5 %	144 -- 186 k$	2 -- 4 months	8	0.2
RT-402-4-14-D	CE - Cassette cooling plate fabrication failure	10 %	73 -- 83 k$	3 months	8	0.3
RT-402-4-10-D	CE - Silicon sensor has low yield	1 %	542 -- 784 k$	2 -- 4 months	7	0.0

- For each failure take the value of the affected area
- Estimate the time it would take to replace the lost items
- Probabilities are based on prior experience

Risk of Damaging or Losing Cassettes

RT-402-4-16-D CE - Cassettes damaged or lost in assembly, testing or shipping

Risk Rank:	1 (Low) **Scores:** Probability : 1 (VL) ; Cost: 2 (M) Schedule: 1 (L))	**Risk Status:**	Open
Summary:	If a cassette gets damaged during assembly or a batch of 15 cassettes get damaged during cold testing or a batch of 15 cassettes get lost during shipping, then the lost cassettes need to be fabricated and assembled again, which may jeopardize the delivery of cassettes to CMS on time.		
Risk Type:	Threat	**Owner:**	Zoltan Gecse
WBS:	402.4 CE - Calorimeter Endcap	**Risk Area:**	Management Risk / Experience or Capability
Probability (P):	5%	**Technical Impact:**	0 (N) - negligible technical impact
Cost Impact:	PDF = 2-point - flat range Minimum = 100 k$ Most likely = N/A Maximum = 1,000 k$ Mean = 550.0 k$ P * <Impact> = 28.0 k$	**Schedule Impact:**	PDF = 1-point - single value Minimum = N/A Most likely = 3.0 months Maximum = N/A Mean = 3 months P * <Impact> = 0.15 months
Basis of Estimate:	The cost estimate is based on the cost of losing up to 15 cassettes. We will be assemblying and testing in batches of 15, and shipping them to CERN in batches of 15. We calculate the cost by simply rolling up the cost of producing 375 cassettes, and taking (15/375) of this cost for the maximum cost impact. The cost of producing and testing all components, including silicon modules and scintillator tile-modules, and the cost of cassette assembly, testing, and shipping, are included. We do not include the cost of HGCROC and ECON ASIC as enough spares are expected to be purchased so we do not need an addition production run of these chips. The delays is based on the time needed to replace the lost cassettes.		
Cause or Trigger:		**Impacted Activities:**	Linked to Ship cassettes 331 - 360
Start date:	1-Jan-2021	**End date:**	12-Dec-2023
Risk Mitigations:	Set in place carefully designed tooling and safe handling procedures. Do not handle many cassettes at the same time; limit number of cassettes in a shipment to 15 and no more than one of each type per shipment. Planned production includes 1 spare cassette of each type (for the test beam wedge). Ensure adequate quantity of spare parts to allow rapid assembly of replacement cassettes. Ensure that all shipments are adequately insured. Contracts to include options for later delivery of additional components.		
Risk Responses:	Response depends on the exact lost, if losing an entire batch of 15 cassettes in shipping, or damaging some cassettes in a batch(es) during handling in the assembly, testing, or shipping. In the worst case of losing all 15 cassettes in a batch, we will order additional parts as needed and make the additional 15 cassettes. The 15 test beam wedge cassettes may be used in the detector if this is needed tgo avoid significant delays. As needed we will accelerate the cassette assembly and testing. The cost of accelerating the cassette production is included in a separate risk entry.		
More details:			

Risk of Cassette Assembly Site Failure

RT-402-4-17-D CE - Cassette assembly site failure

Risk Rank:	1 (Low) **Scores:** Probability : 2 (L) ; Cost: 1 (L) Schedule: 1 (L))	**Risk Status:**	Open
Summary:	If the cleanroom area of the cassette assembly site gets damaged or if the CO2 cooling plant fails then the assembly and testing procedure will stop until the problems are fixed and it may jeopardize the delivery of cassettes to CMS on time.		
Risk Type:	Threat	**Owner:**	Zoltan Gecse
WBS:	402.4 CE - Calorimeter Endcap	**Risk Area:**	External Risk / Facilities
Probability (P):	10%	**Technical Impact:**	0 (N) - negligible technical impact
Cost Impact:	PDF = 2-point - flat range Minimum = 73 k$ Most likely = N/A Maximum = 163 k$ Mean = 118.0 k$ P * <Impact> = 12.0 k$	**Schedule Impact:**	PDF = 1-point - single value Minimum = N/A Most likely = 3.0 months Maximum = N/A Mean = 3 months P * <Impact> = 0.3 months
Basis of Estimate:	The estimate is based on the range of costs needed to replace the damaged equipment = 10 - 100k$. The 3 month delay is estimated based on the time it may take to fix the problems. The L3 burn rate due to the delay of downstream activities is $21k/month (CMS-doc-13481). Min cost = $10k + 3 months * $21k burn rate = $73k. Max cost = $100k + 3 months * $21k burn rate = $163k.		
Cause or Trigger:		**Impacted Activities:**	JM: Inserted into assembly between 150 and 151
Start date:	1-Jan-2021	**End date:**	12-Dec-2023
Risk Mitigations:	To mitigate the impact on the schedule, the capacity of the assembly and testing facility is planned to twice larger than required for normal operations.		
Risk Responses:			
More details:	CMS-doc-13481		

Critical Path