News & Updates
ATHENA Costing Group

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On behalf of the ATHENA Costing Group

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Outline

- Brief overview of overall status
- 1-slide status updates:
  - Calorimetry: Oleg Tsai
  - DAQ: Jeff Landgraf
  - FarBackward: Mariusz Przybycien
  - FarForward: Alex Jentsch
  - PID: Roberto Preghenella
  - Tracking: GEM (Matt Posik) / MM (Francesco Bossu) / Silicon (Laura Gonella)
- Overview of costing charts / tables - Proposal
- ATHENA timeline
- Summary and Next Steps

Brief overview of overall status

- Weekly ZOOM meetings: Thursday at 02:00PM
- Preliminary cost estimates / studies were presented for all sub-systems:
  - Calorimetry: Oleg Tsai
  - DAQ: Jeff Landgraf
  - FarBackward: Mariusz Przybycien
  - FarForward: Alex Jentsch
  - PID: Roberto Preghenella
  - Tracking: GEM (Matt Posik) / MM (Francesco Bossu) / Silicon (Laura Gonella)
- Completion of EIC costing templates has started, incl. preparation of charts / tables, discussed later in this presentation!
- Goal is to release preliminary costing to ATHENA as early as next week!

Calorimetry

ATHENA Calorimetry Cost Estimates Status, 9/29/21 O.Tsai

Subsystem	Materials	Labor	Missing Items	Open Questions	R&D Costing	Reviewed	Converted to official templates	Majority of Basis of estimate
pECAl	v2 done	v2 done	?	Integration items	done	No	No	Scaled FCS
pHCal	v2 done	v2 done	?	Integration items	done	No	No	Scaled FCS
bHCal	v1 done	v1 done	?	Integration items	N/A	No	No	Expert Op.
nHCal	v1 done	v1 done	?	Integration items	N/A	No	No	Expert Op., Scaled
bECal WScFI	v1 done	v1 done	?	Integration items	No	No	No	Expert Op.
bECal Imaging	V1 done	V1 done	?	?	done	No	Yes	Expert Op., Scaled
nECal	V1 done	V1	?	Integration items	done	No	No	Expert Op.

DAQ

DAQ costing status

Jeff Landgraf

- Status of material / labor costing
  Global Timing Material: $100k (Very preliminary)
  Felix Material: $3.1M (Could be ½ depending upon aggregation done by Tracker MAPS/Micromegas)
  DAQ computing: $550k (Could be ½ depending upon whether we want a full reconstruction online)
  Labor Estimate: 60 total FTE (5 Engineer, 5 tech, 50 Physicist/Software/Student)
- Missing items
  - We need to be involved in the FELIX board development. The project will discuss the handling of this R&D item.
  - The current aggregation cost (listed in Felix Material) is higher than it should be. This is dominated by assumptions that the aggregation of the MAPS detector is similar to CERN detectors, despite our much lower data volumes per sensor. Cheaper aggregation would reduce the cost a lot and still needs to be incorporated in the costing properly.
- Open Questions
  - We don't have final readout technologies for some detectors. In particular single photon sensitive SiPM readout (dRICH) causes challenges. If mRICH or DIRC use SiPM it will increase costs.
- Time Frame for conversion to official spreadsheets
  - We will start this week, and hope to have something close to complete by mid October
- R&D costing
  - There will need to be R&D for software data reduction, in particular for the dRICH. This may include machine learning algorithms for identifying hits originating from particle tracks. It will also include software triggering ideas.
  - The FELIX board will need to be tailored to some degree to the Athena Detectors (and vice-versa). Athena would need to be involved in the ongoing development of this board. The details of this are to be discussed by the project as it equally applies to all proto-collaborations.

FarBackward

Status of costing for Far Backward detectors

Mariusz Przybycien

- The FB detection system consists of:
  - four small electron (tungsten/Sci spaghetti) calorimeters,
  - two small movable photon (tungsten/Sci/fused silica spaghetti) calorimeters,
  - three electron spectrometers (scintilator strips),
  - two movable tungsten/graphite filters with fused silica SR monitors,
  - small dipol.
- Cost of materials: $2M (does not include the dipol price).
- Readout electronics (with ASICs at 100 MHz signal sampling & preprocessing - in two 4- and 10-bit versions for 1600 and 1200 channels): $500k
- Summary of manpower:

Scientist - 13 FTE,	PhD Student - 8 FTE,
Mechanical Engineer - 5 FTE,	Mechanical Designer - 1.5 FTE,
Mechanical Tech - 7 FTE,	Electrical Engineer - 4 FTE,
Electrical Tech - 5 FTE,	Software Expert - 2 FTE

- Not clear about manpower related to:
  - EIC integration and dipol magnet installation (assumed 1P+1E+1T),
  - DAQ/SC and ATHENA integration (assumed 1P+1E).
- Converting to official templete file has started.
- Cost of R&D: (four calorimeter and two spectrometer prototypes including beam tests)
  - Materials: $230k, Manpower (total): 6.5 years FTE, Tests/travel/transport: $120k

FarForward

Full Summary

Alex Jentsch

- Materials
  - All four detector subsystems have a final design concept in place, and all materials costed with available numbers for technology, # of sensors and crystals, cables, etc.
  - Caveat: Some materials costing (namely support structure) is “best-guess” as certain aspects of the integration are still under consideration.
- Labor
  - Labor estimates available for two of the four subsystems. The other 2 subsystems will have numbers soon.
- What is missing?
  - Some detailed aspects of engineering costs (e.g. support structure and integration with vacuum system).
  - In-kind contributions: We have some collaborators who have expressed interest in contributing to procurement and labor FTEs. Need to get firmer numbers from them in the next few days.

PID

Costing PID detectors

Roberto Preghenella

- **costing sheets being collected on PID INDICO website**
  - https://indico.bnl.gov/event/12866/
  - if multiple sheets, look at date in the filename for the latest version
- **pretty advanced estimates from all systems**
  - DIRC
    - status ok
  - dRICH
    - estimate still preliminary
    - to be cross-checked / updated
  - mRICH
    - layout under discussion
    - will be a slightly different detector: not modular, no lens
    - likely most of costs will stay similar
  - LGAD TOF
    - two versions available
    - with hadron-side wall “before” or “after” forward RICH
    - “before” is currently the most-likely setup
  - GridPIX TPC
    - status ok

Tracking - GEM

GEM Costing

Matt Posik

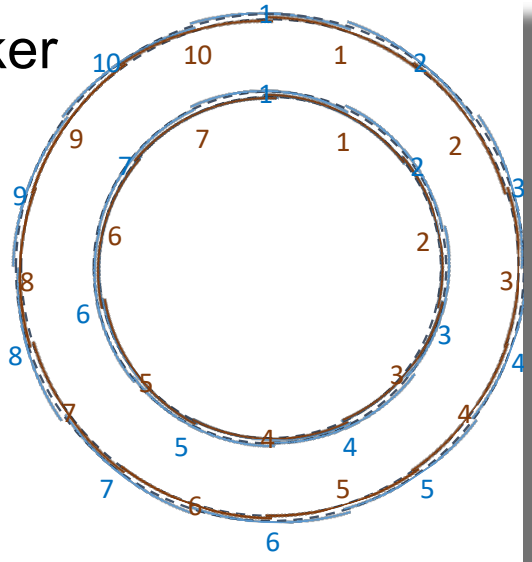
- Done
  - GEM material: GEM, HV, readout foils, frames – based on eRD6 1m long GEM
  - Electronic and DAQ material – based on STAR FGT
  - HV and gas systems material – based on STAR FGT
  - Labor costs associated with engineering design of components
- To Do
  - Cross check DAQ cost with micromegas DREAM system
  - Estimate of mechanical support structure
  - Estimate labor costs for GEM detector construction
  - Calculate time line for installation
  - R&D costs – input from eRD6 and eRD108
- Time Line
  - Remaining costing need known GEM configuration, e.g. fixed tracking configuration. This is expected within one week

Tracking - MM

Francesco Bossu

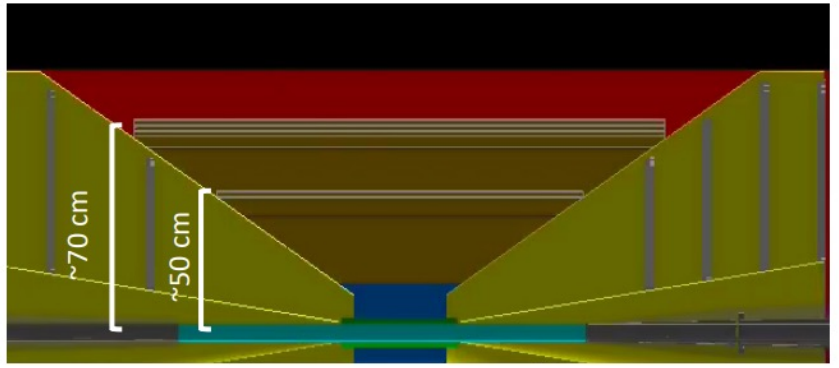
Cylndrical Barrel Micromegas Tracker

- Two pairs of Micomegas layers at radii ~50cm and ~75cm
- Module dimension: ~50x70cm^2
- Outer layers: 3X10 modules
- Inner layers: 2x7 modules
- **Total (with spares): 96 detectors, 66k channels**



Material cost breakdown

Prototypes	$30k
Preseries	$70k
Production	$430k
Test facility	$130k
Mechanics, gas, HV	$330k
Electronics ~$8/ch	$500k
Total	**$1.5M**



Materials and labor estimates being translated into the official spreadsheet

Tracking - Silicon

Silicon vertex and tracking costing

Laura Gonella

- The EIC Silicon Consortium is about to release a costing model based on the YR all-silicon detector
  - Meeting between EIC SC, proto-collaborations steering committees and project to discuss this on Monday 27 September
    - Main messages from EICSC found clear and well received, any further feedback from proto-collaborations and project expected shortly
  - This includes a detailed bottom-up approach for detector development from CD3 to installation
    - It provides estimated personpower and schedule for tasks
    - Only item missing is sensor cost
  - A similar estimate for the R&D phase up to CD 3 will be released next

- What we will need to do once we get the costing model
  - Adjust for number and size of layers and disks for our configuration
  - Adjust for number of testing and assembly sites (need some discussion with the ATHENA silicon tracking groups)
  - Insert into ATHENA spreadsheet,
  - Timescale 2 weeks (from when the costing model is released)

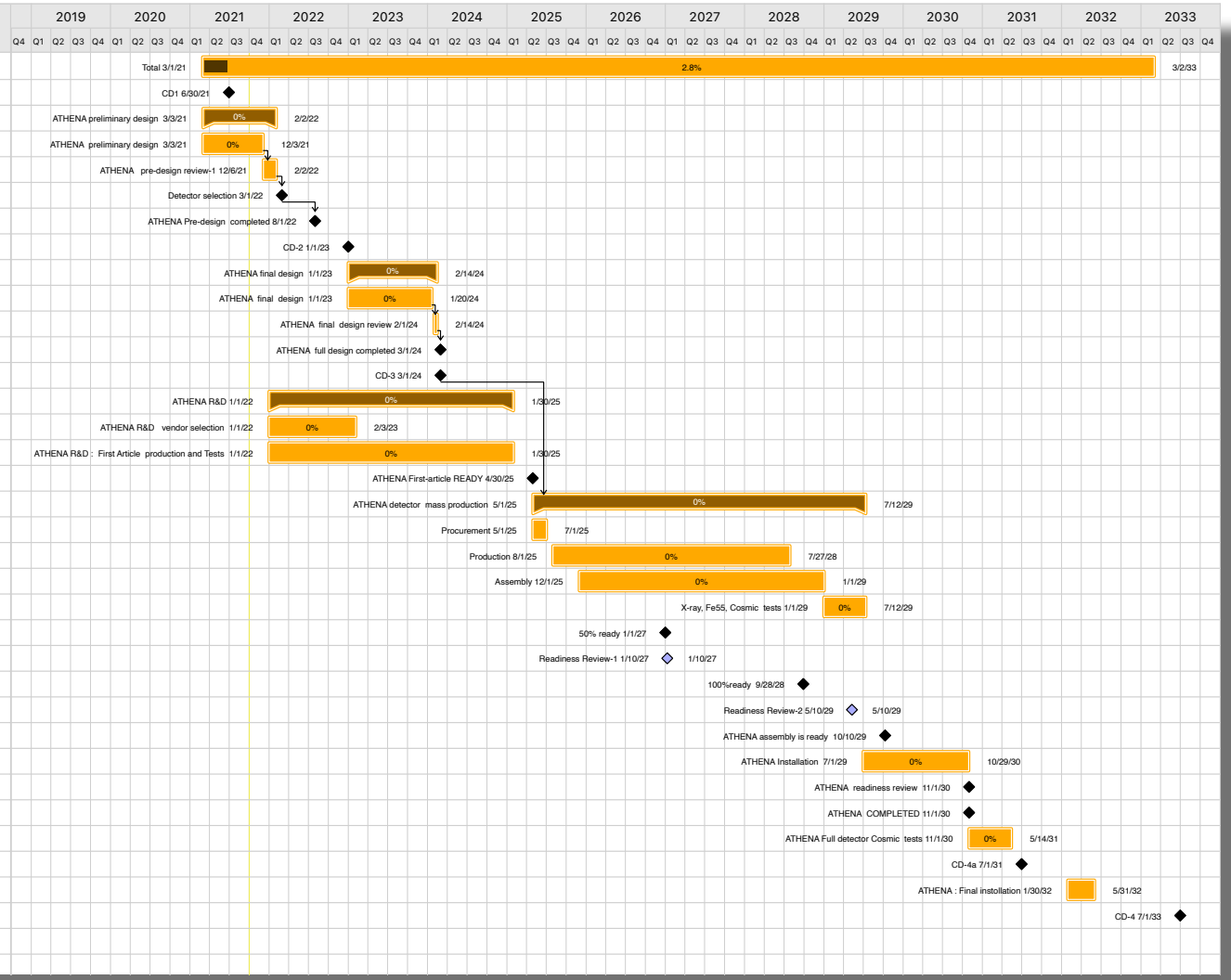
Overview of costing charts / tables - Proposal

- Charts and costing tables will be prepared for each principal sub-system and total
  - ECAL / HCAL / Tracking / PID in Backward, Barrel, and Forward direction
  - Backward: 2 (Lumi / Low-Q^2 tagger)
  - FarForward: 4 sub-systems (ZDC / 2 Roman pot stations / 2 Off-mom. detectors / B0 detector)
- Basic charts —> Dashboard prepared based on excel template files: Proposal/Review
  - 1 Vert. stacked bar chart vs. Fiscal Year: Labor (Project/In-kind) / Material (Project/In-kind)
  - 1 Vert. stacked bar chart vs. Fiscal Year: FTE type (Project/In-kind)
  - 1 pie chart: Labor (Project/In-kind) / Material (Project/In-kind)
  - 1 pie chart: Basis for estimate (Labor/Material)
- EXCEL Tables with costing information by sub-system and total
- Presentation of global ATHENA timeline in Gantt chart for Proposal/Review and separately by sub-system for review!

ATHENA Timeline

Draft of ATHENA Global timeline

#	Name	Start	End
1	Total	3/1/21	3/2/33
2	CD1	6/30/21	6/30/21
3	**ATHENA preliminary design**	3/3/21	2/2/22
4	ATHENA preliminary design	3/3/21	12/3/21
5	ATHENA pre-design review-1	12/6/21	2/2/22
6	Detector selection	3/1/22	3/1/22
7	ATHENA Pre-design completed	8/1/22	8/1/22
8	CD-2	1/1/23	1/1/23
9	**ATHENA final design**	1/1/23	2/14/24
10	ATHENA final design	1/1/23	1/20/24
11	ATHENA final design review	2/1/24	2/14/24
12	ATHENA full design completed	3/1/24	3/1/24
13	CD-3	3/1/24	3/1/24
14	**ATHENA R&D**	1/1/22	1/30/25
15	ATHENA R&D vendor selection	1/1/22	2/3/23
16	ATHENA R&D : First Article productio	1/1/22	1/30/25
17	ATHENA First-article READY	4/30/25	4/30/25
18	**ATHENA detector mass production**	5/1/25	7/12/29
19	Procurement	5/1/25	7/1/25
20	Production	8/1/25	7/27/28
21	Assembly	12/1/25	1/1/29
22	X-ray, Fe55, Cosmic tests	1/1/29	7/12/29
23	50% ready	1/1/27	1/1/27
24	Readiness Review-1	1/10/27	1/10/27
25	100%ready	9/28/28	9/28/28
26	Readiness Review-2	5/10/29	5/10/29
27	ATHENA assembly is ready	10/10/29	10/10/29
28	ATHENA Installation	7/1/29	10/29/30
29	ATHENA readiness review	11/1/30	11/1/30
30	ATHENA COMPLETED	11/1/30	11/1/30
31	ATHENA Full detector Cosmic tests	11/1/30	5/14/31
32	CD-4a	7/1/31	7/1/31
33	ATHENA : Final instollation	1/30/32	5/31/32
34	CD-4	7/1/33	7/1/33



Summary and Next Steps

- Anticipated timeline: Agenda costing meeting highlights
  - September: Review of labor/material costing
    - 30: Review of labor/material costing --> Transfer to template
  - October: Review of labor/material on template
    - 7: Review of labor/material costing on template
    - 14: Review of labor/material costing on template
    - 21: Preparation of proposal costing section
    - 28: Preparation of proposal costing section
  - November: Final reading and editing
    - 4: Final reading and editing costing team
    - 11: Circulation for comments / final edits
    - 18: Final proposal costing section!
    - 25: No meeting - Thanksgiving!

Summary and Next Steps

- Anticipate a rough overall cost release as early as next week
- Preparation of charts has started
- Gantt chart: Access to non-excel software / EXCEL Gantt chart template available (Conversion to Quarterly layout needed!)
- Meeting needed with EIC project team (Elke) about various costing questions such as contingency, magnet, detector infrastructure, detector management, and detector pre-ops & commissioning!