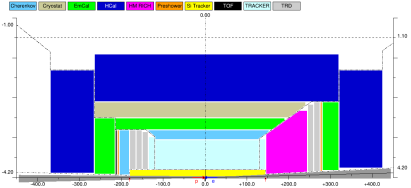
YR DWG Calorimetry: Complimentarity Questions

Geometrical Constraints Dominate the Selection of Options



Light-collecting calorimeters
Implementation is challenging
Charged collecting (LAr) not considered

Within the constaints, assume SiPM sensor

- HCAL both arms: ΔZ=87 cm - (too?) short - Fe/Sc sandwich
- HCAL barrel: no practical constraint ?
- ECAL electron arm: ΔZ=50 cm - OK for: crystals, W/ScFi, W-Shashlyk, Pb-Shashlyk
- ECAL hadron arm: ΔZ=38 cm - OK for: W/ScFi, W-Shashlyk
- ECAL barrel: ΔR=30 cm ?: - OK for: W/ScFi, W-Shashlyk

If more space available, assume SiPM sensor

- ECAL: ΔZ=65 cm - ScGlass 16 RL

Challenges

- Photosensors: SiPM - rad.damage, crystal resolution
- Engineering - very tight space

Table.5 **Calorimetry for EIC**

η	ECAL								HCAL				
	Total depth, cm	**Depth, RL**	**Energy resolution σE/E, %**	**Spacial resolution σX, mm**	**Granularity, mm²**	**Min. photon energy, MeV**	**PID e/π, π suppression**	**Technology examples***	**total depth, cm**	**Energy resolution σE/E, %**	**Spacial resolution σX, mm**	**Granularity, mm²**	**Technology examples**
-3.5:-2.0	38	22	$2.2/\sqrt{E}\oplus1.0$	$3/\sqrt{E}\oplus1$	20×20	20	100	$PbWO_4$ crystals	105	$50/\sqrt{E}\oplus10$	$50/\sqrt{E}\oplus30$	100×100	Fe/Sc
-2.0:-1.0	38 38 50 50 (65)**	20 20 22 13* 16*	$8.0/\sqrt{E}\oplus1.5$ $12/\sqrt{E}\oplus2$ $(7\text{-}8)/\sqrt{E}\oplus1.5$? $5.0/\sqrt{E}\oplus1.5$	$3/\sqrt{E}\oplus1$ $3/\sqrt{E}\oplus1$ $6/\sqrt{E}\oplus1$ $6/\sqrt{E}\oplus1$ $6/\sqrt{E}\oplus1$	25×25 25×25 40×40 40×40 40×40	50 50 50 30 30	100	W/Sc Shashlyk W powder/ScFi Pb/Sc Shashlyk SciGlass SciGlass	105	$50/\sqrt{E}\oplus10$	$50/\sqrt{E}\oplus30$	100×100	Fe/Sc
-1.0:1.0	30	18 18 6	$12/\sqrt{E}\oplus2$ $14/\sqrt{E}\oplus3$?	$3/\sqrt{E}\oplus1$ $3/\sqrt{E}\oplus1$ $6/\sqrt{E}\oplus1$	25×25 25×25 40×40	100	100	W/Sc Shashlyk W powder/ScFi SciGlass	110	$100/\sqrt{E}\oplus10$	$50/\sqrt{E}\oplus30$	100×100	Fe/Sc
1.0:3.5	38 38 (50)** (65)**	20 20 22 16*	$8.0/\sqrt{E}\oplus1.5$ $12/\sqrt{E}\oplus2$ $10.0/\sqrt{E}\oplus1.5$ $5.0/\sqrt{E}\oplus1.5$	$3/\sqrt{E}\oplus1$ $3/\sqrt{E}\oplus1$ $6/\sqrt{E}\oplus1$ $6/\sqrt{E}\oplus1$	25×25 25×25 40×40 40×40	100 100 100 30	100	W/Sc Shashlyk W powder/ScFi Pb/Sc Shashlyk SciGlass	105	$50/\sqrt{E}\oplus10$	$50/\sqrt{E}\oplus30$	100×100	Fe/Sc

* A non-PMT readout is assumed, occupying <15cm longitudinally
** If more space than in the current layout is allocated
*** Additional technologies may be considered

Questions

- Would the complementary designs naturally be associated with different choices of solenoid field, centre of mass energy, luminosity or beam polarisation?

  Not directly. Lower energy may allow slightly shorter calorimeters. A considerably smaller size of the spectrometer may lead to a different choice of technologies.

- How might a second detector differ in technology choices and what (dis)advantages might that bring in terms of kinematic coverage, resolution on reconstructed variables, radiation hardness, dominating systematics etc?

  More space would improve the performance (HCAL in hadron arm) and reduce risks

- Are there wider implications for other parts of the detector - eg due to material budgets?

  Material in front of ECAL degrades the resolution and e/π

- Are there any limitations in the performance of your sub detector technologies for very small bunch spacing < 9ns?
  Are there any rate limitations?

  Likely no, but depends on the readout electronics

Questions

- Is +/- 4.5 m enough longitudinal space to fit the detector

  Depends on the physics goals: luminosity vs detector performance
- Are there any issues we should be aware of in terms of cost, technology readiness, or time required to construct the detector?

  Crystals delivery, performance with SiPM, engineering issues. For well established technologies $\sim$ 1y R&D is required. Other technologies may take 2-3y for R&D
- Might it be possible to combine more than one function into your detector(s)?

  Nothing special
- Do your detector technologies have any impact on the design of the interaction region?

  No
- What studies need to be done (or have been done already) to make fully quantitative statements?

  A full simulation is needed.