**Benchmark Performance & Analysis**

Sub Detector – level:

 // Differential: Performance as a function of object (track, jet, etc) Polar angle & Energy

**Vertex:**

 Differential Efficiency.

 Requirement: ~ 100%; dead channel number < o(0.1)%

 Intrinsic spatial & time (optional) resolution.

 Requirement: 5 micro-meter spatial resolution

Ref: CDR baseline design

Timing: shall be addressed from DAQ + Online system study

 Differential Occupancy (with beam background + MDI studies).

 Requirement: ~o(0.1)%

shall be addressed from DAQ + Online system study

**Tracker:**

 Differential Eff.

 Requirement: Pt threshold ~ o(100) MeV, |cos(theta)| < 0.99

Ref: CDR baseline design

 Differential Material Budget.

Requirement: < 10%/50% X0 in Barrel/endcap

Ref: CDR baseline design + BMR & Material Dependence

 Differential Resolution of 5 track parameters.

 Requirement: In the barrel

 delta(D0/Z0) ~ < 3 micro meter at 20 GeV

 delta(Pt)/Pt ~ o(0.1%)

 Ref: CDR baseline performance

 Differential Pid Capability: eff\*purity of Kaon id @ Z pole.

 Requirement: eff\*purity > 90% for all charged Kaon with E > 2 GeV (@ Z pole)

 ~ relative resolution of dE/dx (or dN/dx) be better than 3%

 ToF of 50 ps

 Ref: Nuclear Inst. and Methods in Physics Research, A 1047 (2023) 167835

 Sep. power: On 3 prong tau decay @ Z pole.

 Requirement: efficiency > 99% at 3-prong tau

 Ref: CDR baseline performance

**Calorimeter:**

 **Intrinsic energy resolution:** wi/wo Clustering – Hit/Energy collection efficiency.

 Requirement:

EM resolution: ~ 3%/sqrt(E) \conv 0.5%

 Ref: JHEP12(2022)135

 Had resolution: ~ 50%/sqrt(E) \conv 2%

 Ref: CDR baseline performance

 **Di-particle separation power.**

 Di photon; requirement: ~ 1.5 cm. eff. ~ 50%

 Pion + Photon; requirement: ~ 1.5 cm. eff. ~ 50%

 Pion + Neutral Hadron; ~ ? cm. (TBD)

 Ref: 2018 JINST 13 P03010

 Ref: CDR baseline performance

 Shower Profile -> Pid potential (e, mu, hadron).

 Requirement:

eff ~ 99% & mis-id ~ 1% for isolated charged particle with E > 2 GeV

 Ref: Eur. Phys. J. C (2017) 77:591

 Ref: 2021 JINST 16 P06013

 Ref: CALICE TB data analyses

 Differential Eff (long-term).

 Requirement: Energy threshold ~ o(50) MeV, |cos(theta)| < 0.995

 Ref: CDR baseline performance

**ToF: Time resolution & Efficiency.**

requirement: 50 ps @ Cluster level

 Ref: Eur. Phys. J. C (2018) 78:464

 Ref: Nuclear Inst. and Methods in Physics Research, A 1047 (2023) 167835

 Dedicated:

 LGAD,

 Multi-RPC. Ref: Nuclear Instruments and Methods in Physics Research A 1056 (2023) 168656

 Integrated with Calo (as CMS HGC). Ref: Eur. Phys. J. C (2023) 83:93

**Muon: Efficiency, Volume & Cost.**

**Global:**

 **BMR:** depends mainly on **Calo, Tracker** (Tracker Material)

 **Jet Origin id:** depends on all **sub-detector**

 **Particle identification (**optional**):** Differential Efficiency & Mis-id (Purity): depends on **Calorimeter, Tracker, ToF.**

**Physics Analysis Benchmarks.**

1, H->SS @ 240 GeV

relies on **BMR, Jet origin id**

2, Vcb from W decay @ 240 GeV and W threshold (optional)

relies on **BMR, jet origin id**

3, alpha-s from Z->Tautau @ 91.2 GeV

relies on **PFA Separation, Pid**

4, vvH, H->bb @ 360 GeV relies on **BMR, jet origin id**

5, Bs->DK @ 91.2 GeV, for CKM angle measurements (Gamma\_s, Gamma\_sb, etc)

 **relies on Jet Origin id, Pid, Tracking.**