Material map update

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ePIC tracking++ meeting

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Known Issues:

- Material map script broken since ACTS 39.3 update, and later ACTS44.4
  - Propagation error ([fixed](#) by Dmitry)
  - Validation script not writing out materials ([fixed](#) by Dmitry)

- Inconsistent tracking performance with official/local map
  - Pull distribution (see Shyam's [talk](#))
  - # of outliers on OB (see Athavan's [talk](#))

Test Detector Configurations

- Material map generation:
  - eic-shell 26.01.0-stable
  - epic PR1014 (updated MPGD)
  - craterlake_materal_map.yml
    i. NO solenoid/field
    ii. BIC and FF were not included until epic PR1008)

- Simulation:
  - 1000 single pi+ events
  - -0.8<eta<0.8, p=0.5GeV
  - craterlake_tracking_only.yml

- Reconstruction:
  - The same local map with the following detector config file:
    i. epic.xml:
      - full geometry, trackers seen by ACTS:
        = SVT+MPGD+TOF+BIC+FF+FB ← Athavan used this
    ii. Full - FF - FB
    iii. Full - BIC ← many tracking studies used this
    iv. Full - BIC - FF - FB ← the test map was generated with this

Full

Pull distribution = (mc - rec)/ error, where error includes material effects and propagation uncertainties.
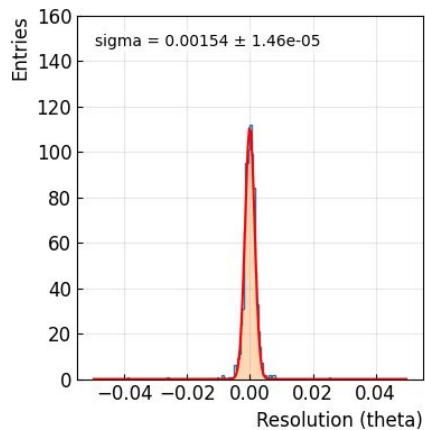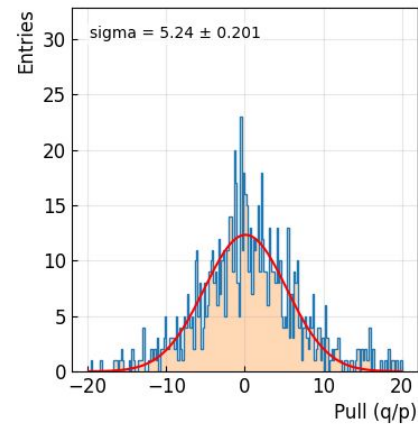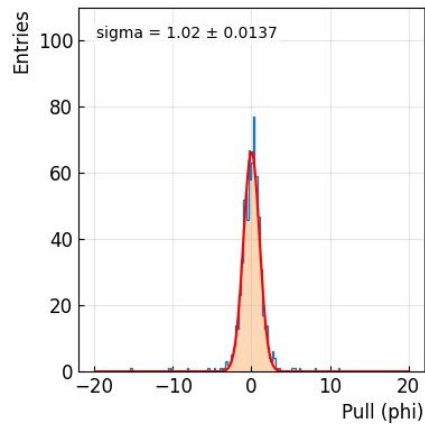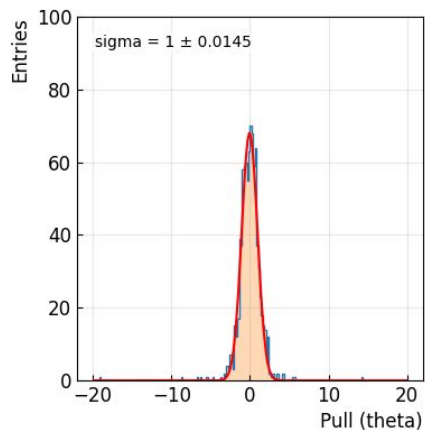

Resolution = mc - rec
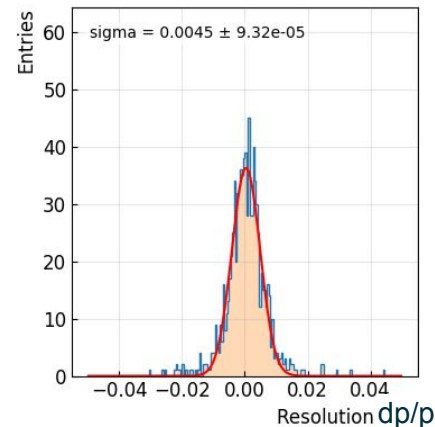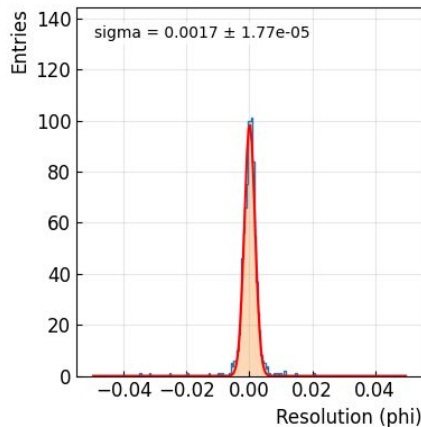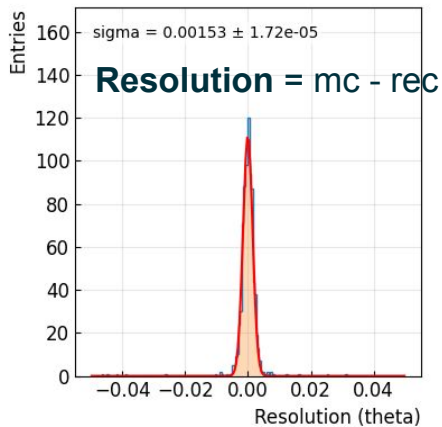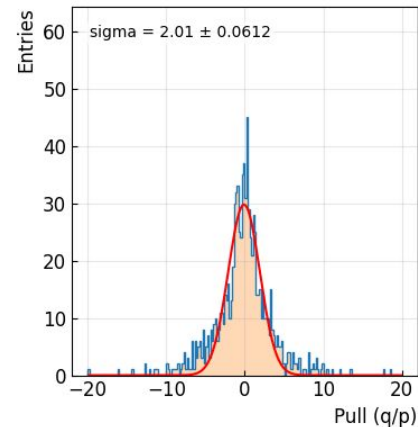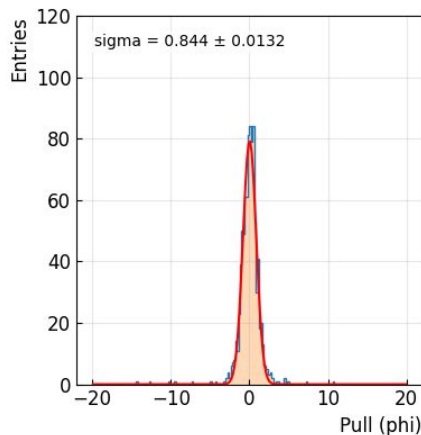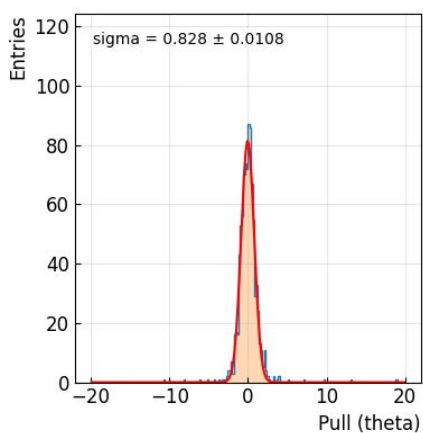
Full - FF - FB
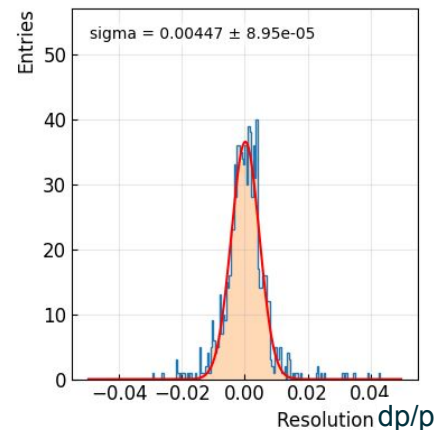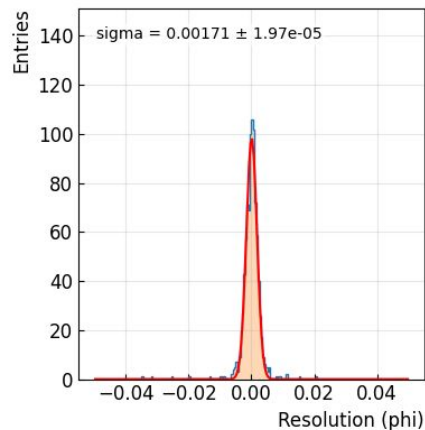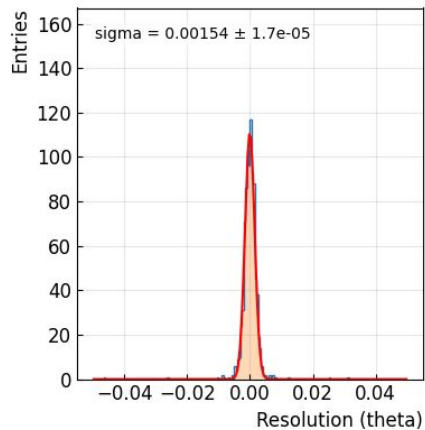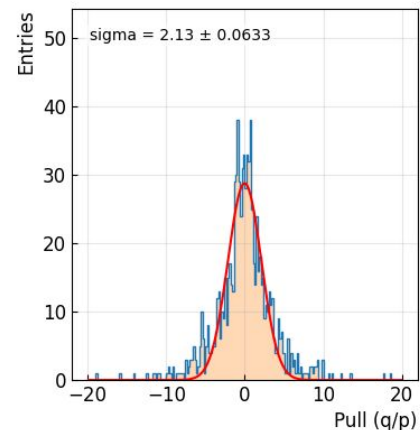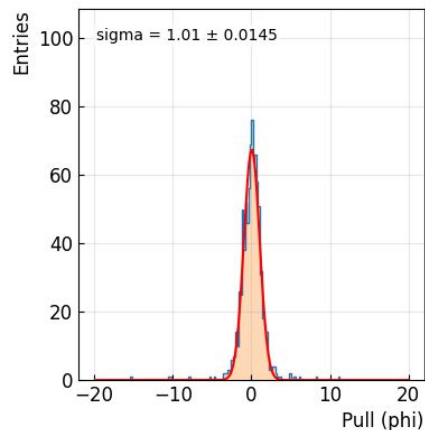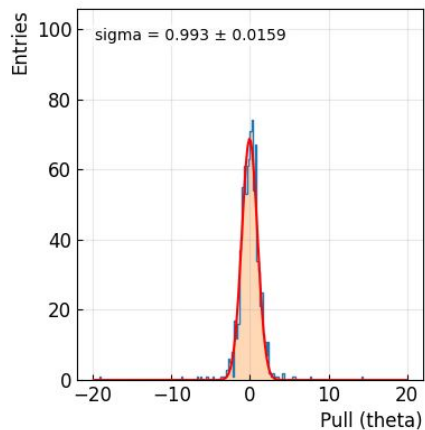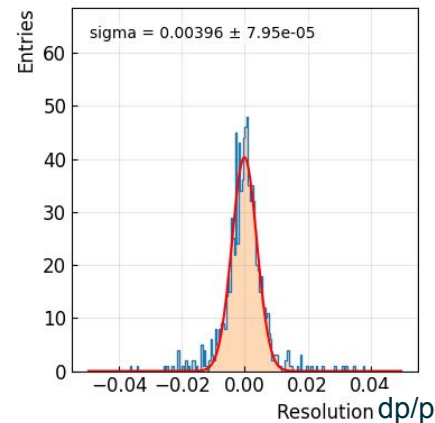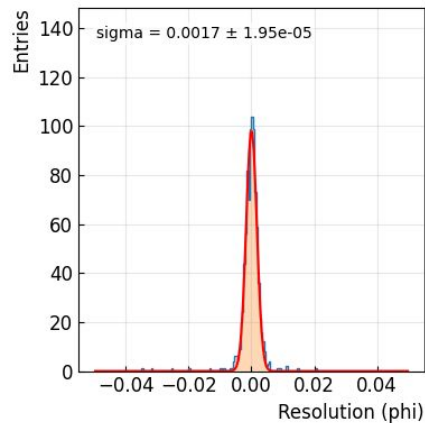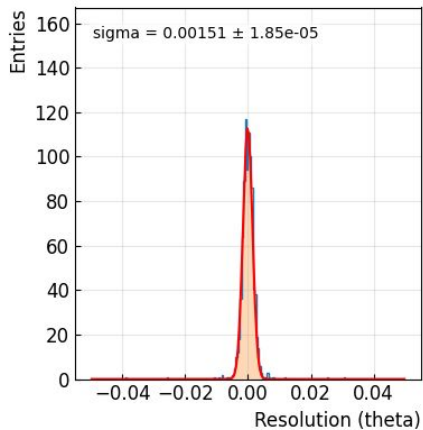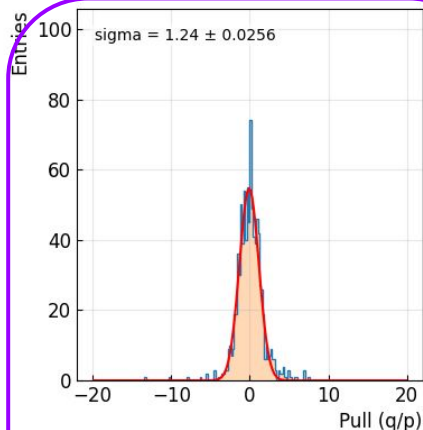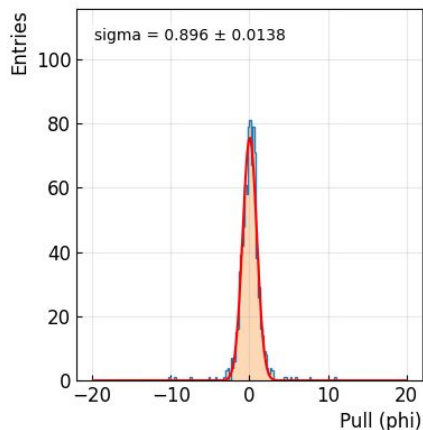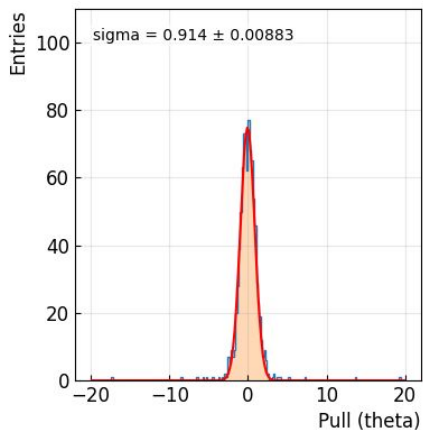
Full - BIC

Full - BIC - FF - FB

Best performance when detector config in EICrecon matches detector config material map production
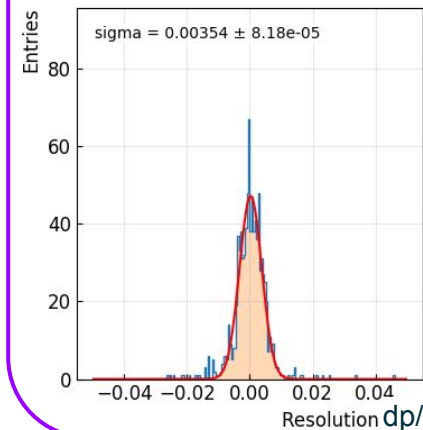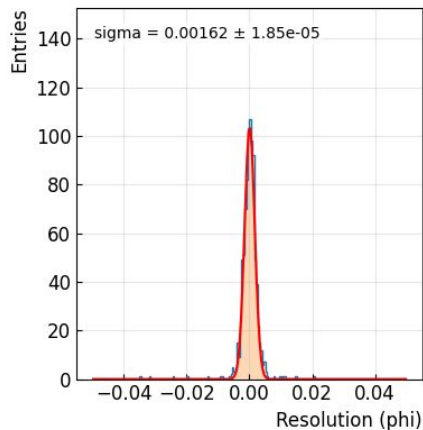
Example of mis-matched ACTS volume ID (auto-generated)

full:

| Volume ID	Name	Approaches
2	acts_beampipe_central::Barrel	1, 2
2	acts_beampipe_central::Barrel	X
17	EndcapMPGDSubAssembly::NegativeEndcap	1, 2
19	OuterSiEndcapSubAssembly::NegativeEndcap	1, 2
21	MiddleSiEndcapSubAssembly::NegativeEndcap	1, 2
29	InnerSiTrackerSubAssembly::NegativeEndcap	1, 2
32	VertexBarrelSubAssembly::Barrel	1, 2
34	InnerSiTrackerSubAssembly::PositiveEndcap	1, 2
36	MiddleSiBarrelSubAssembly::Barrel	1, 2
38	OuterSiBarrelSubAssembly::Barrel	1, 2
39	MiddleSiEndcapSubAssembly::PositiveEndcap	1, 2
40	OuterSiEndcapSubAssembly::PositiveEndcap	1, 2
41	EndcapMPGDSubAssembly::PositiveEndcap	1, 2
42	InnerMPGDBarrelSubAssembly::Barrel	1, 2
44	EndcapTOFSubAssembly::PositiveEndcap	1, 2
45	BarrelTOFSubAssembly::Barrel	1, 2
46	OuterBarrelMPGDSubAssembly::Barrel	1, 2
47	EcalBarrelTrackerSubAssembly::Barrel	1, 2
48	B0TrackerSubAssembly::PositiveEndcap	1, 2

NO BIC:

Volume ID	Name	Approaches
2	acts_beampipe_central::Barrel	1, 2
2	acts_beampipe_central::Barrel	X
14	EndcapMPGDSubAssembly::NegativeEndcap	1, 2
16	OuterSiEndcapSubAssembly::NegativeEndcap	1, 2
18	MiddleSiEndcapSubAssembly::NegativeEndcap	1, 2
26	InnerSiTrackerSubAssembly::NegativeEndcap	1, 2
29	VertexBarrelSubAssembly::Barrel	1, 2
31	InnerSiTrackerSubAssembly::PositiveEndcap	1, 2
33	MiddleSiBarrelSubAssembly::Barrel	1, 2
35	OuterSiBarrelSubAssembly::Barrel	1, 2
36	MiddleSiEndcapSubAssembly::PositiveEndcap	1, 2
37	OuterSiEndcapSubAssembly::PositiveEndcap	1, 2
38	EndcapMPGDSubAssembly::PositiveEndcap	1, 2
39	InnerMPGDBarrelSubAssembly::Barrel	1, 2
41	EndcapTOFSubAssembly::PositiveEndcap	1, 2
42	BarrelTOFSubAssembly::Barrel	1, 2
43	OuterBarrelMPGDSubAssembly::Barrel	1, 2
44	B0TrackerSubAssembly::PositiveEndcap	1, 2

Adding a new tracker (BIC) introduced index changes almost everywhere:
Mismatch vol ID (comparing to the material map) → **EICrecon** loaded the material info incorrectly

The Fix:

- A new map is created with all trackers (SVT+MPGD+TOF+BIC+FF/FB) and any materials sit in that envelope (PR1038, under review)
- The craterlake_tracking_only.yml is updated to include BIC i.e. now it has all trackers

- Improved performance (dp, # of outliers) at central region, 0.5 GeV:
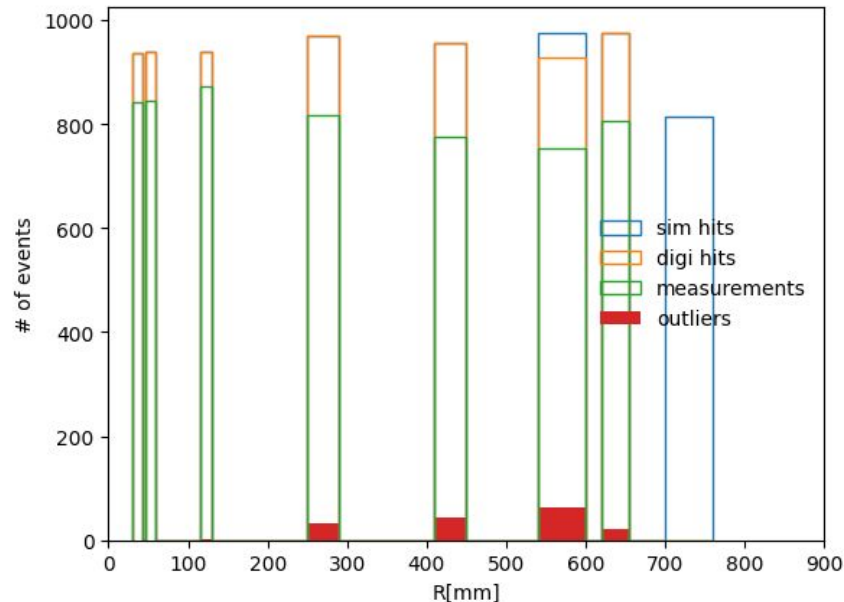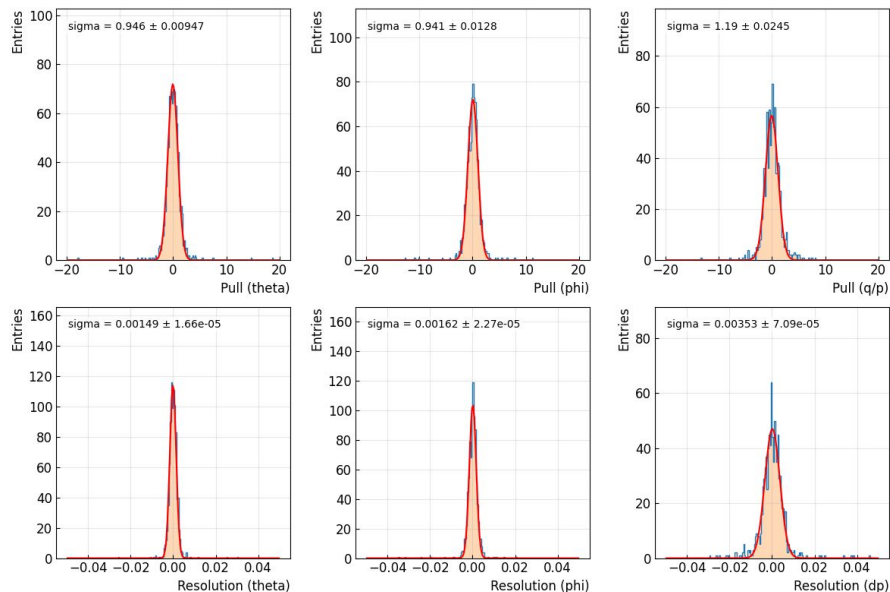
Lesson Learned

When running simulations, make sure
- the detector configuration contains EXACTLY THE SAME materials/detectors within the craterlake_material_map.yml envelope
- Don't add tracking detectors outside of the above envelope without consulting the experts
- It's in generally OK to add non-tracking detectors and materials outside of the envelope

Next step:
- Enable index checks when loading map in EICrecon
- Make volume IDs stable (??)