Adding Explicit Cluster Shape Fields

The current edm4eic::Cluster encodes several shape-related values in a single vector member

```
edm4eic::Cluster:
  Description: "EIC hit cluster, reworked to more closely resemble EDM4hep"
  Author: "W. Armstrong, S. Joosten, C.Peng"
  Members:
    # main variables
    - int32_t           type              // Flag-word that defines the type of the cluster
    - float             energy            // Reconstructed energy of the cluster [GeV].
    - float             energyError       // Error on the cluster energy [GeV]
    - float             time              // [ns]
    - float             timeError         // Error on the cluster time
    - uint32_t          nhits             // Number of hits in the cluster.
    - edm4hep::Vector3f position          // Global position of the cluster [mm].
    - edm4eic::Cov3f    positionError     // Covariance matrix of the position (6 Parameters).
    - float             intrinsicTheta    // Intrinsic cluster propagation direction polar angle [rad]
    - float             intrinsicPhi      // Intrinsic cluster propagation direction azimuthal angle [rad]
    - edm4eic::Cov2f    intrinsicDirectionError // Error on the intrinsic cluster propagation direction
  VectorMembers:
    - float             shapeParameters   // Should be set in metadata, for now it's a list of -- radius [mm], dispersion [mm], 2 entries for
    - float             hitContributions  // Energy contributions of the hits. Runs parallel to ::hits()
    - float             subdetectorEnergies // Energies observed in each subdetector used for this cluster.
  OneToManyRelations:
    - edm4eic::Cluster        clusters    // Clusters that have been combined to form this cluster
    - edm4eic::CalorimeterHit hits        // Hits that have been combined to form this cluster
    - edm4hep::ParticleID     particleIDs // Particle IDs sorted by likelihood
```

Since 2022 we had a moratorium on adding more to the same vector – this is why we have intrinsicTheta/Phi/DirectionError members that are technically shape-related, but not present in shapeParameters.

What is the problem with shapeParameters

Here is an example of shapeParameters use in analysis (ROOT files directly without PODIO)

```
#largest_eigenvalues
for i in range(len(arrays_sim[p])):
    pars=arrays_sim[p]["_HcalFarForwardZDCClusters_shapeParameters"][i]
    index_of_max=-1
    max_val=0
    eigs=[]
    #Must make sure this doesn't get messed up if someone changes the number of shape parameters in EICrecon.
    nClust=nclusters[p][i]
    nShapePars=len(pars)//nClust
    for j in range(nClust):
        largest_eigenvalue=max(pars[nShapePars*j+4:nShapePars*j+7])
```

Determine number of elements in each shapeParameters

Within shapeParameters for cluster with index j select parameters with “magical” indices 4 to 7

Proposal

EDM4eic#171 adds the components explicitly and marks shapeParameters as deprecated

```
333  333        - uint32_t          nhits              // Number of hits in the cluster.
334  334        - edm4hep::Vector3f position           // Global position of the cluster [mm].
335  335        - edm4eic::Cov3f    positionError      // Covariance matrix of the position (6 Parameters).
     336  +     - float             radius       // Cluster radius [mm].
     337  +     - float             dispersion   // Cluster dispersion [mm].
     338  +     - float             widthTheta   // Cluster width in polar (theta) direction [rad].
     339  +     - float             widthPhi     // Cluster width in azimuthal (phi) direction [rad].
     340  +     - std::array<float, 3> principalAxesLengths // Lengths along the cluster's principal axes [mm], sorted in descending order (equivalent to sqrt of eigenvalues of
       the position covariance, descending).
336  341        - float             intrinsicTheta     // Intrinsic cluster propagation direction polar angle [rad]
337  342        - float             intrinsicPhi       // Intrinsic cluster propagation direction azimuthal angle [rad]
338  343        - edm4eic::Cov2f    intrinsicDirectionError // Error on the intrinsic cluster propagation direction
339  344      VectorMembers:
340  -     - float             shapeParameters    // Should be set in metadata, for now it's a list of -- radius [mm], dispersion [mm], 2 entries for theta-phi widths [rad], 3
       entries for x-y-z widths [mm].
     345  +     - float             shapeParameters    // [DEPRECATED] use radius, dispersion, widthTheta/Phi, and principalAxesLengths instead.
```

Other suggestions

- We could remove radius and dispersion – these quantities are not energy weighted and thus useless

- Add explicit documentation for meaning of the values of intrinsicTheta/Phi and of principalAxesLengths for planar detectors

- Move shape parameters into a PODIO component for reuse in tracking clustering