

**ILD optimisation meeting, 30 January 2008**

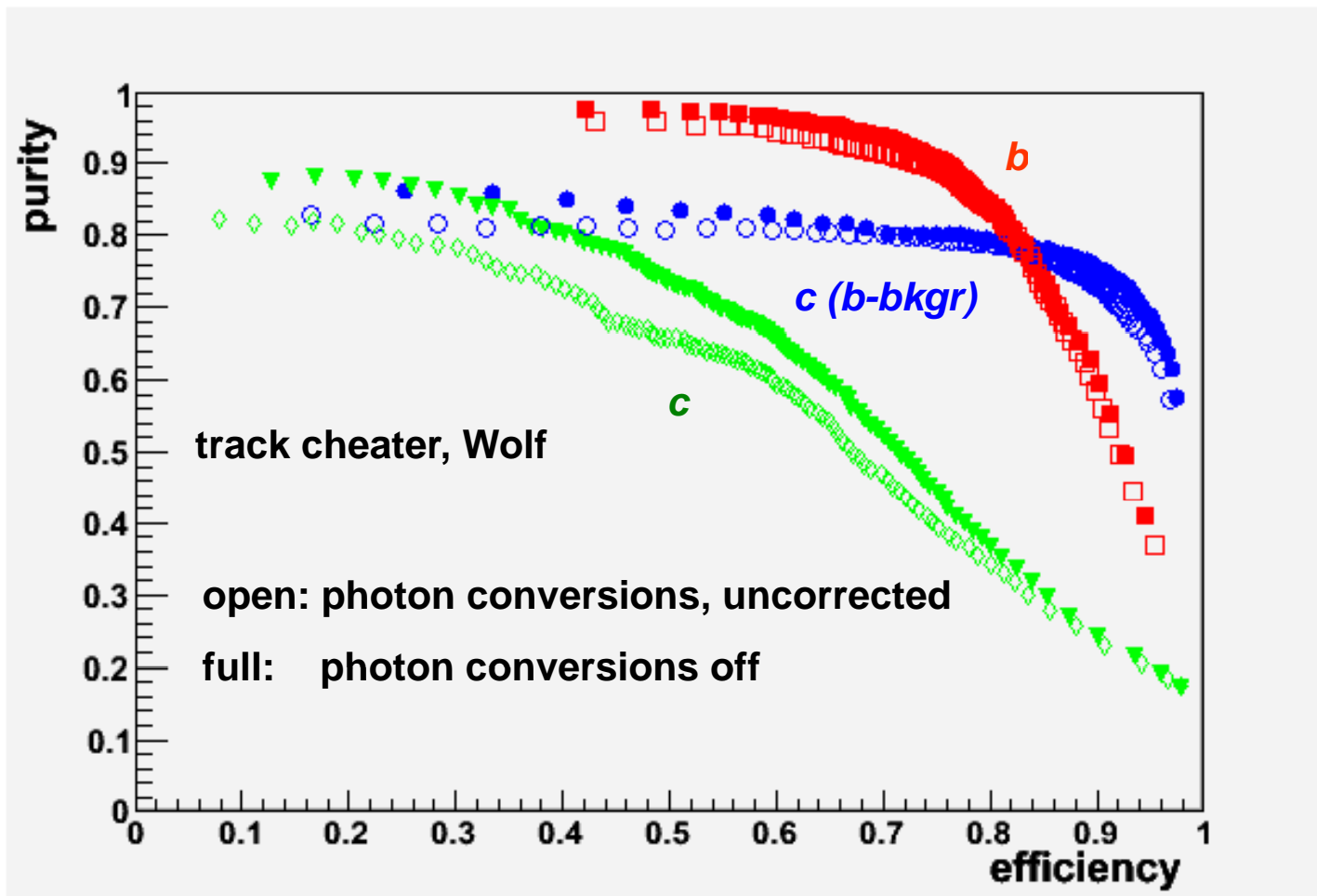
## **LCFI Vertex – ready for mass reconstruction?**

- ❖ **performance checks with new code / geometries**
- ❖ **plans for and status of “default configuration” of LCFI Vertex**
- ❖ **conclusion and questions**

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# Status of autumn 2007

- below: results obtained with track cheater, Wolf, old geometry (LDC01\_02Sc or older ?)
- during validation phase photon conversions switched off at GEANT level

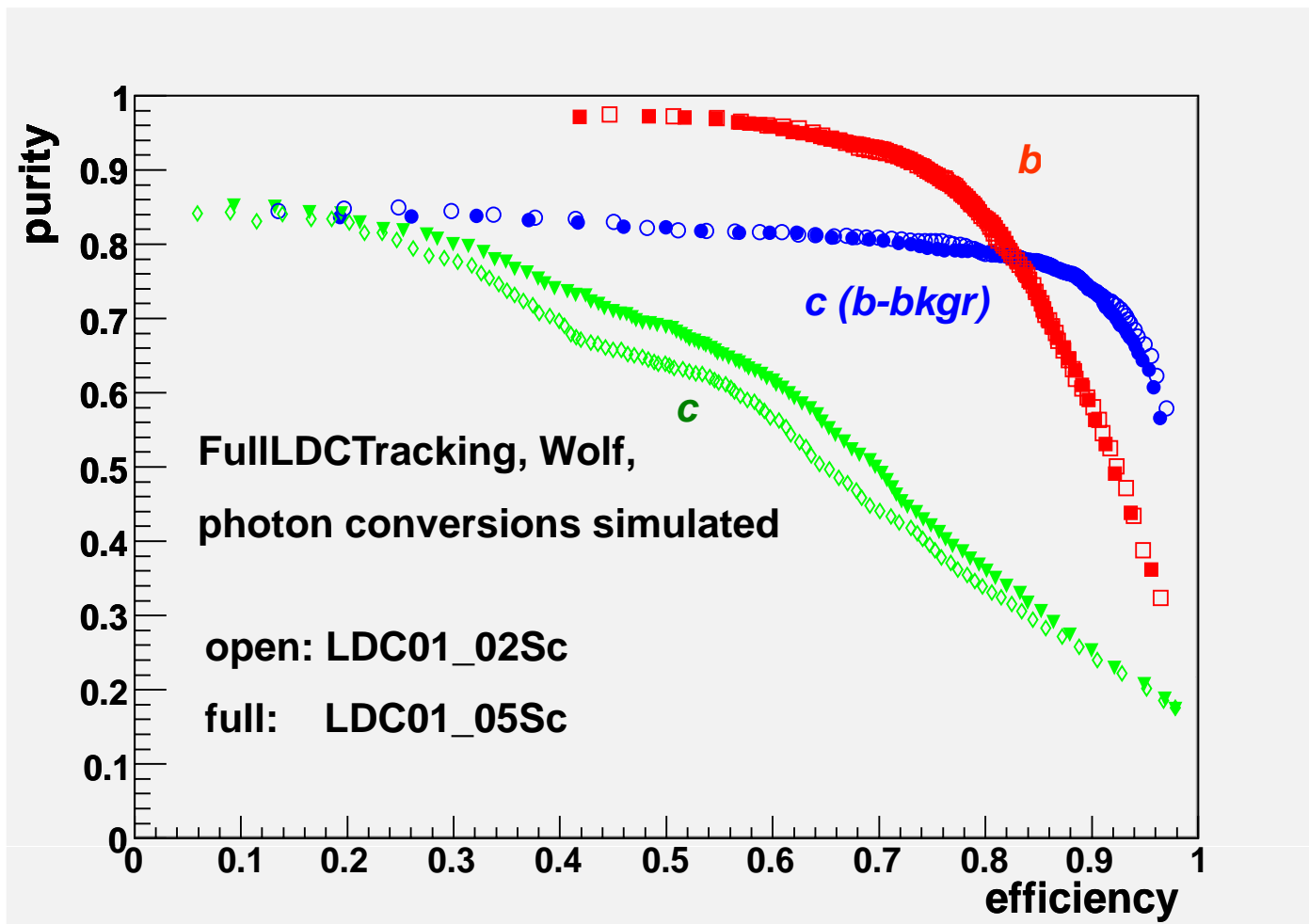


Note: this switch also affects CAL showers  
→ DON'T WANT TO DO THIS FOR ANY "REAL" STUDY

- **c-tag degrades when photon conversions simulated;**
- **this difference is less pronounced for FullLDCTracking**

# Current Status: detector comparison

- in the meantime, have moved to FullLDCTracking: consistent performance
- ... and to detector version LDC01\_05Sc: improvement over LDC01\_02Sc

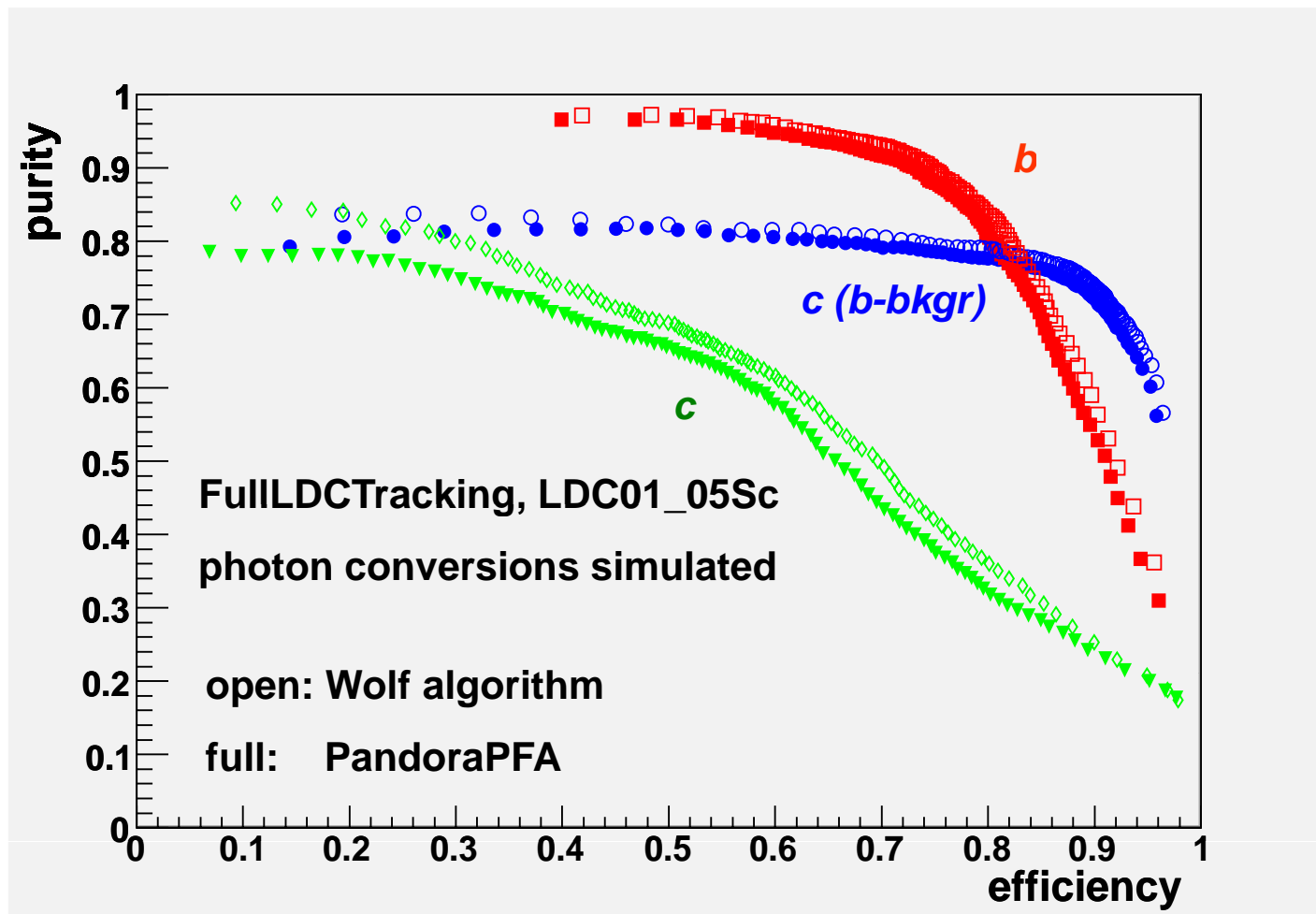


- new detector gives better result also for PandoraPFA

(note: for Pandora and LDC01\_02Sc have not been using correct calibration; but expect that at least part of the improvement truly is due to the detector)

# Current Status: PFA comparison

- comparing Wolf + LCFIVertex to PandoraPFA (new version, calib consts) + LCFIVertex
- the combination with Wolf gives better flavour tag – looking into possible reasons



- track selection is known to have potentially a large effect:
- does Pandora remove tracks that pass Wolf?
- if so, would it be possible to include them without impairing PFA performance?

# Flavour tag: parameters for joint probability

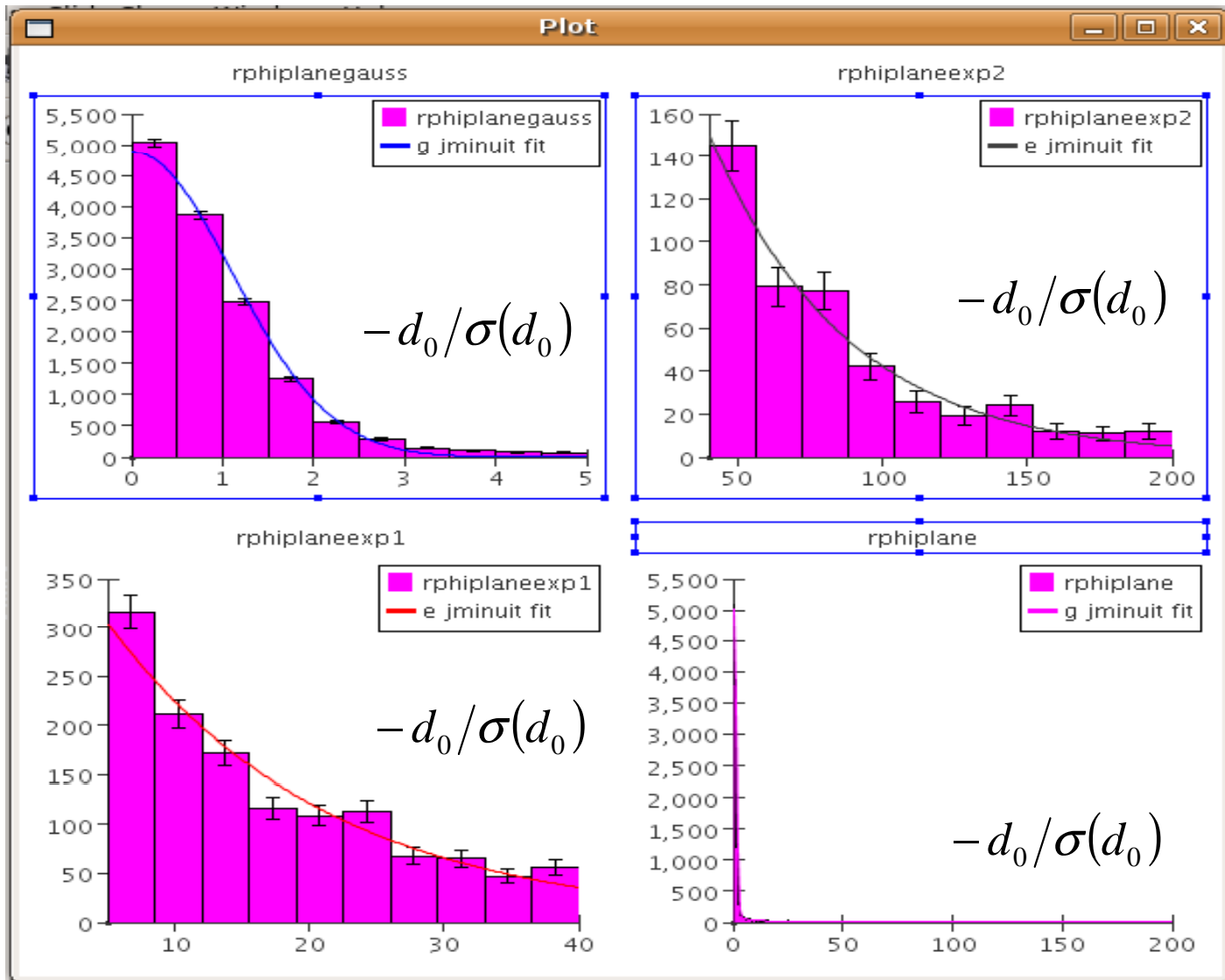
- improvement to calculation of one of the inputs for the flavour tag-NN:
- probability that a track from primary vertex has impact parameter significance  $> b/\sigma_b$  is

$$P_i = \frac{\int_{b/\sigma_b}^{\infty} f(x) dx}{\int_0^{\infty} f(x) dx}$$

- the **symmetric function  $f(x)$**  needs to be obtained from a fit of the negative side of the impact parameter distribution (done separately for R- $\phi$  and z);
- first release of the Vertex Package uses hard coded parameterisation obtained from fast MC
- **Erik Devetak is working on a module to obtain parameters properly from a fit**
- **joint probability** (flavour tag input) for ensemble of tracks to come from primary vertex is

$$P_J = y \sum_{m=0}^{N-1} \frac{(-\ln y)^m}{m!}$$

# Parameters for joint probability: status



- fit macro written, and tested;
- low-statistics run yields parameters that differ up to 20% from current values
- effect on flavour tag purity vs efficiency under study

# Plans for default configuration as of autumn 07

- **in autumn, aimed at to complete the following by January:**
  - correction procedure for **photon conversions** based on reconstructed information
  - correction procedure for **K-shorts and Lambdas** using reconstructed information
  - proper correction for **hadronic interactions**
  - ensure **compatibility of LDCtracking, PandoraPFA, LCFIVertex (MOKKA / GEAR issues)**
  - **parameter tuning with full MC and reconstruction:**
    - optimise track selection for **ZVRES** and **IP-fit** based on distributions of cut variables
    - tune **ZVRES** parameters, using **ZVRES** diagnostic plots & table
    - optimise track selection for **flavour tag**
    - tune **flavour tag** parameters, in particular: parameters for joint probability calculation
  - **training of new neural nets** using full MC, reconstruction and optimised code parameters
  
- **Not as much progress made, as we hoped – we knew these plans were ambitious**

# Current Vertex Package track selection

✓ : cut enabled

X : cut disabled

Description	xml parameter names	Code default	ipfit.xml	zvres.xml	fti.xml
Cut on $\chi^2/ndf$ of track fit	a1_Chi2OverDOFEnable a2_Chi2OverDOFCutLowerThan a3_Chi2OverDOFCutValue	10	10 X	10 X	10 X
Cut on d0 (R $\phi$ impact parameter)	b1_D0Enable b2_D0CutLowerThan b3_D0CutValue	20	50 ✓ (mm)	10 ✓ (mm)	20 ✓ (mm)
Cut on d0 error	c1_D0ErrEnable c2_D0ErrCutLowerThan c3_D0ErrCutValue	0.25	0.025 X (mm)	0.25 ✓ (mm)	0.025 X (mm)
Cut on z impact parameter	d1_Z0Enable d2_Z0CutLowerThan d3_Z0CutValue	20	50 ✓ (mm)	20 ✓ (mm)	20 ✓ (mm)
Cut on error on z imp param	e1_Z0ErrEnable e2_Z0ErrCutLowerThan e3_Z0ErrCutValue	0.25	0.025 X (mm)	0.025 X (mm)	0.025 X (mm)
Cut on pT of track	f1_PTEnable f2_PTCutLowerThan f3_PTCutValue	0.1	0.1 X (GeV/c)	0.1 ✓ (GeV/c)	0.1 ✓ (GeV/c)
cut on Ks, $\Lambda$ decay tracks	h1_MCPIDEnable h2_CutPIDS h3_MonteCarloLCRelationCollection	0	X	✓ +- 310 +- 3122	✓ +- 310 +- 3122

plus additional cuts on the number of hits in the vertex detector used in zvres.xml, fti.xml

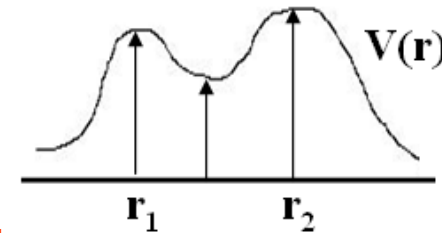


## ZVTOP algorithm

- Find all maxima for  $f_i(\mathbf{r})f_j(\mathbf{r})$  with  $i, j = 0 \dots N$  and collect spatial points  $\mathbf{r}_{ij}$  for cases of good vertex fit,  $\chi^2_{ij} < X_0$  **TwoTrackCut**
- Search in 3D for maxima in  $V(\mathbf{r})$  near each such  $\mathbf{r}_{ij}$

- If two such maxima fail ‘resolubility criterion’

$$\frac{\min\{V(\mathbf{r}) : \mathbf{r} \in \mathbf{r}_1 + \alpha(\mathbf{r}_2 - \mathbf{r}_1), 0 \leq \alpha \leq 1\}}{\min\{V(\mathbf{r}_1), V(\mathbf{r}_2)\}} < R_0$$



**ResolverCut**

they are merged together

- Spatially resolved clusters of  $V(\mathbf{r})$  maxima form candidate vertices
- Track to vertex association ambiguities are decided according to largest  $V(\mathbf{r})$  after  $\chi^2_i < X_0$  trimming **TrackTrimCut**
- Vertex that includes the IP ellipsoid is called the Primary

# What's realistically possible in time for mass rec<sup>n</sup>?

- **We have checked that LCFIVertex runs with full tracking, both PFAs, LDC01\_05Sc**
  - **We have the fit macro for joint prob' optimisation and the diagnostic tools in place**
  - **We do not yet have a set of Vertex Package parameters optimised for MOKKA/LDC**
  - **We are currently investigating, if updating the joint probability parameters only already gives an improvement in performance – will know this in a week from now**
  - **It does no longer seem realistic to aim for completion of this optimisation before the start of mass reconstruction, so would like to ask:**
    - **What the currently envisaged start date for mass reconstruction is**
    - **If there could be 2 iterations of centrally running LCFIVertex: the first at the same time as for the other packages, the second at a later stage when parameters tuning is complete**
    - **which detector model will initially be used for mass production / reconstruction**
- (NOTE: since Vertex Package parameter optimisation quite involved, will need to run with the same configuration for different detector models)**