# Delphes task group – status report
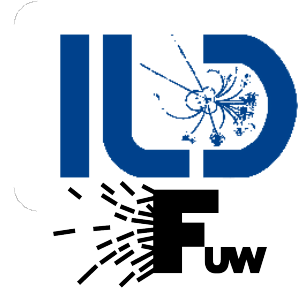
Paweł Sopicki, Aleksander Filip Żarnecki
University of Warsaw

17 June 2020

# Motivation (as presented on June 9)

**Goal: prepare the updated ILC detector model for Snowmass studies.**

**Key developments planned:**

**Include forward detector description**
    **LumiCal and LHCAL included in particle flow reconstruction**

**Verify/improve description of calorimeter segmentation**
**Verify/improve "granularity" of response description**
    **Better modeling of single-particle reconstruction**

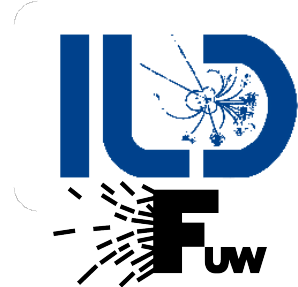**Done!**

**Improve description of b- and c- tagging**
                                            **Waiting for input**

**More options for jet clustering**
                                            **Pending!**

# Tracking performance

- **Track momentum resolution taken from IDR**
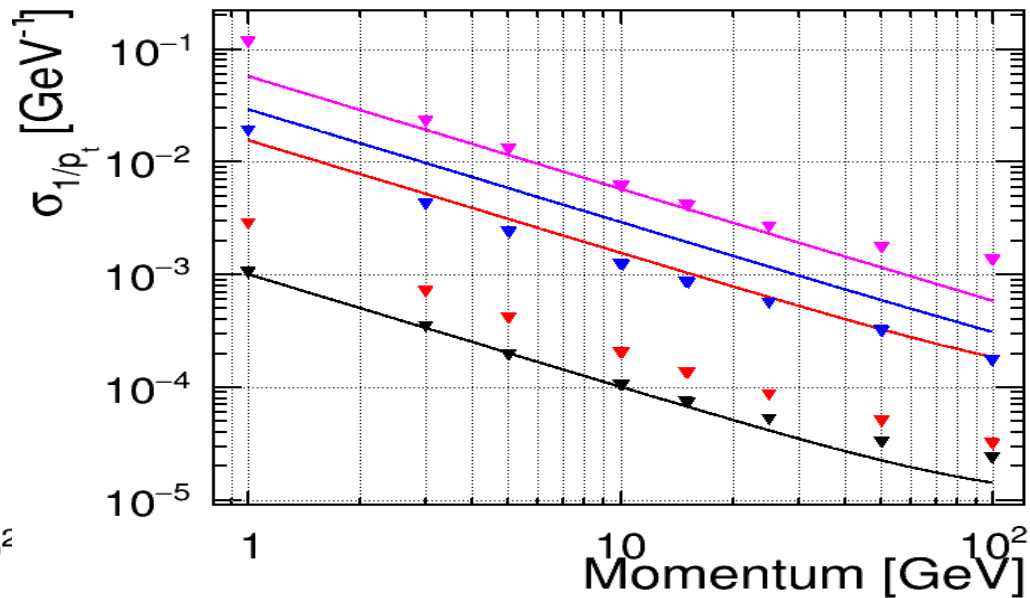
  - **Dedicated parametrisation used**

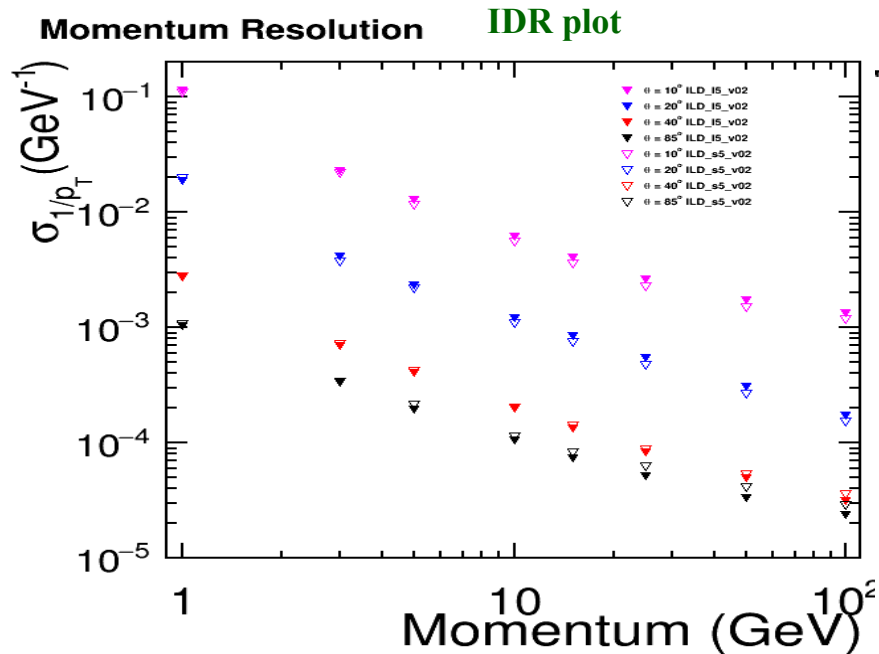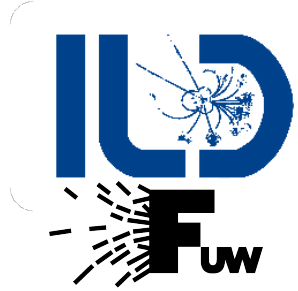# Tracking performance

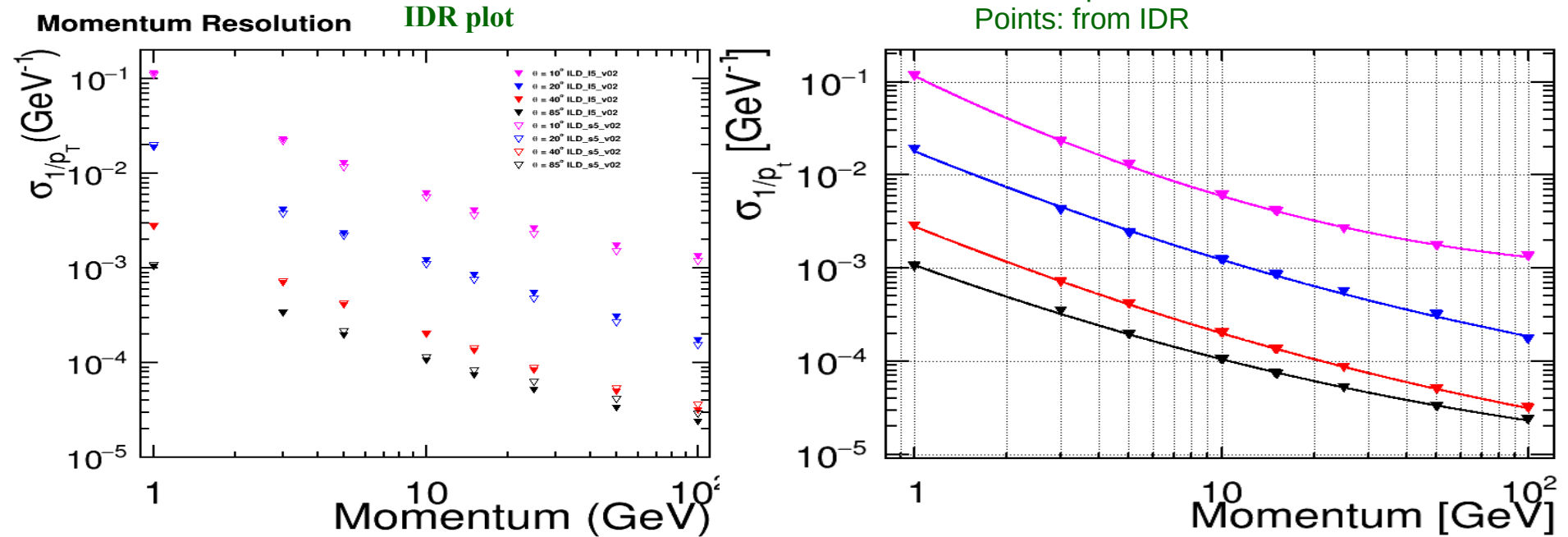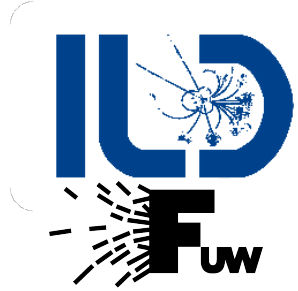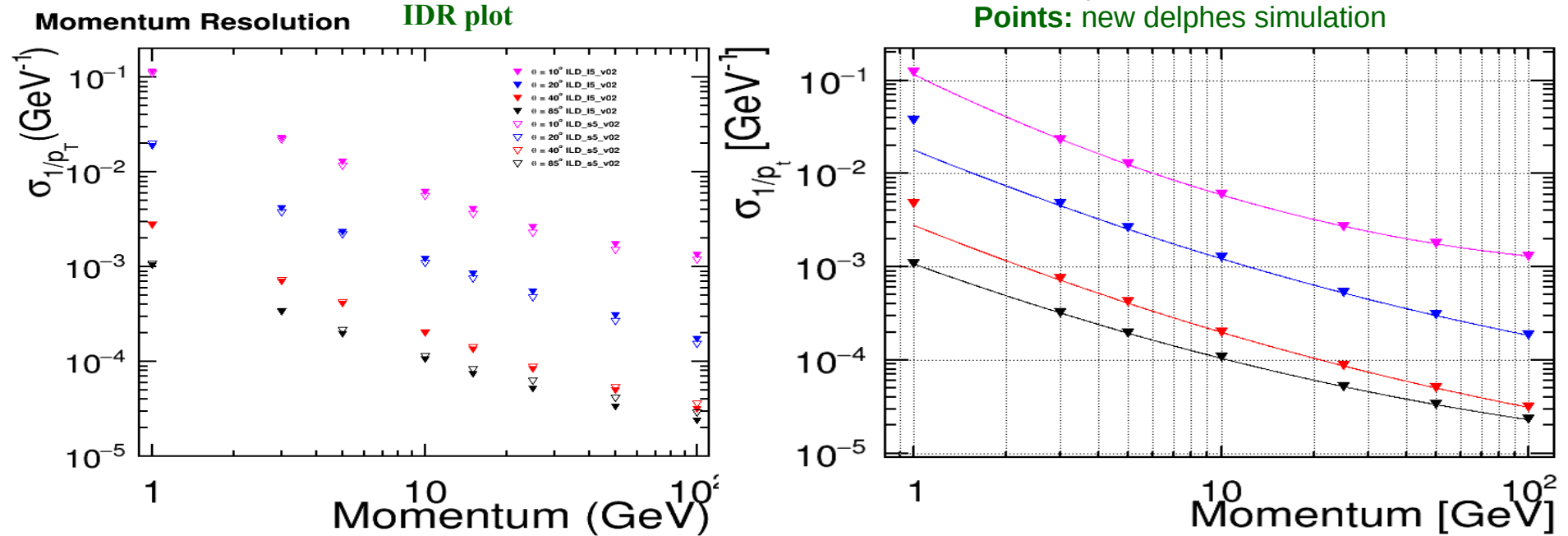- **Track momentum resolution taken from IDR**
  - Dedicated parametrisation used



New Delphes: formula
Points: from IDR

# Tracking performance

- **Track momentum resolution taken from IDR**
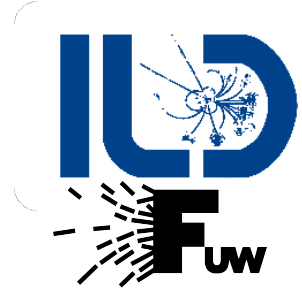
  - **Dedicated parametrisation used**
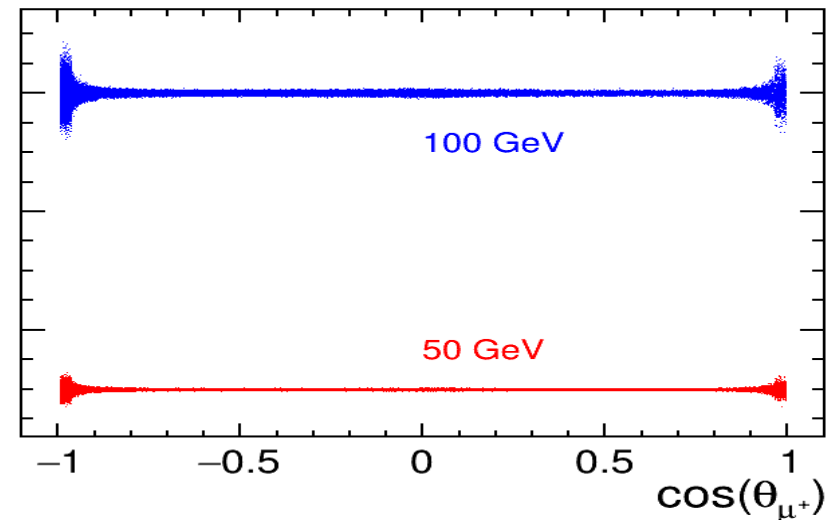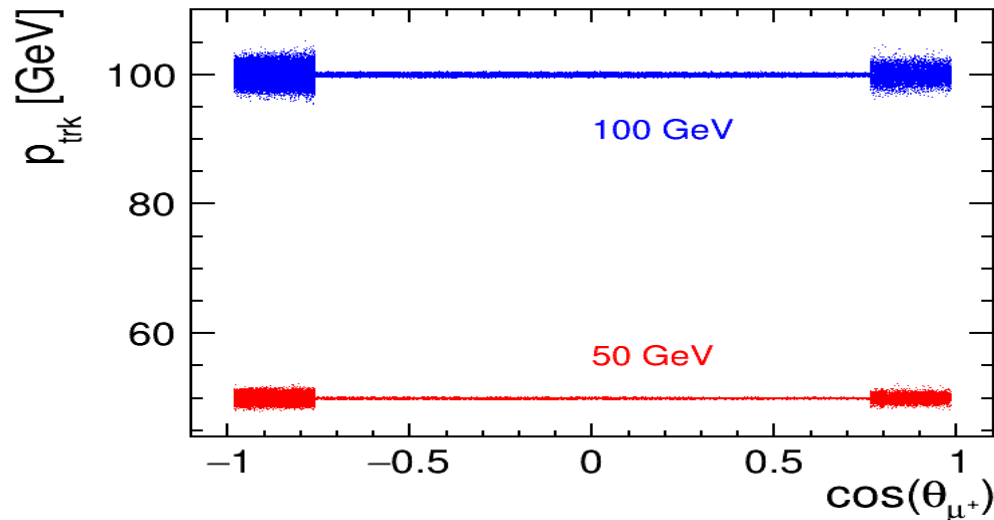


**IDR plot**

New Delphes: **test results**
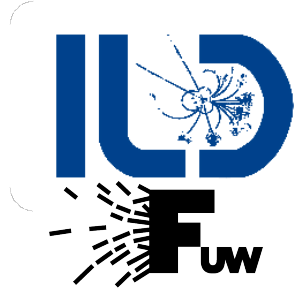**Points:** new delphes simulation

# Tracking performance

- **Track momentum resolution taken from IDR**
  - **Smooth description of angular dependance**
  - **Tracking acceptance extended to $|\eta| = 3$ (95% efficiency assumed for high $\eta$ and high pT)**

Old Delphes: **2-bins**                                    New Delphes: **formula**

# Forward calorimetry

- **LumiCal+LHCAL+BeamCal**
  - **Only LumiCal and LHCAL included in Particle Flow**

**Number of reconstructed objects for**
**$Z \to e^+e^-$ samples**
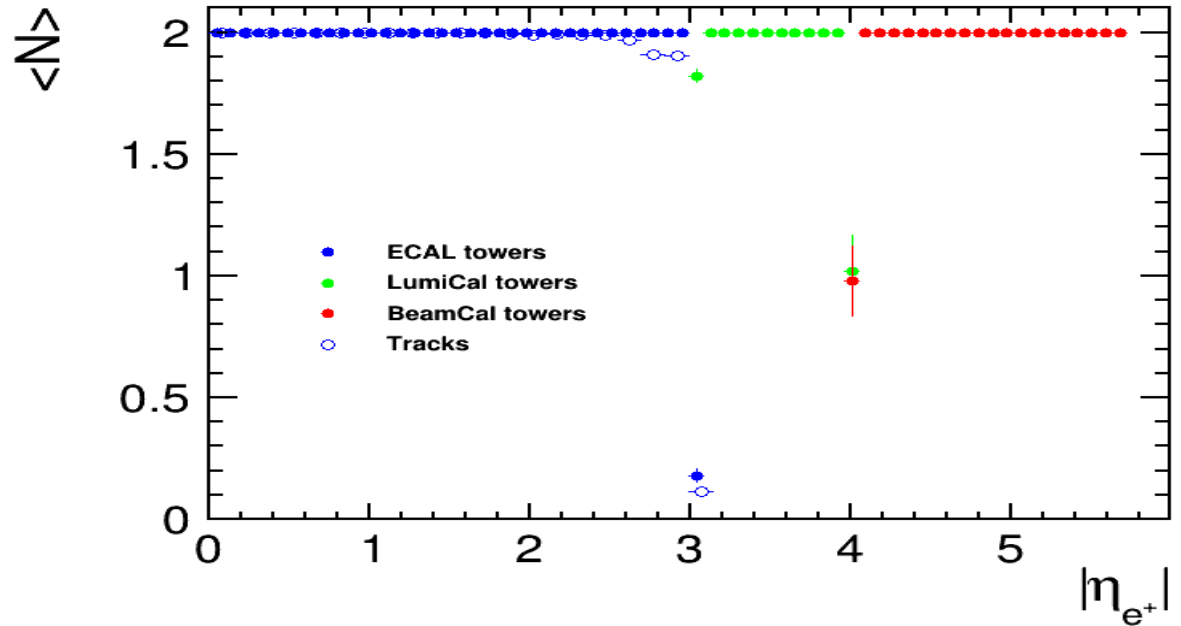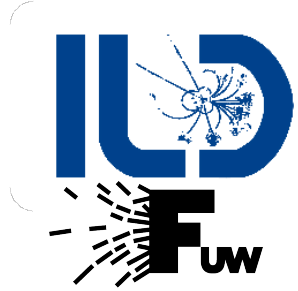
(electron energy of 25, 50 and 100 GeV
mixed)

# Forward calorimetry

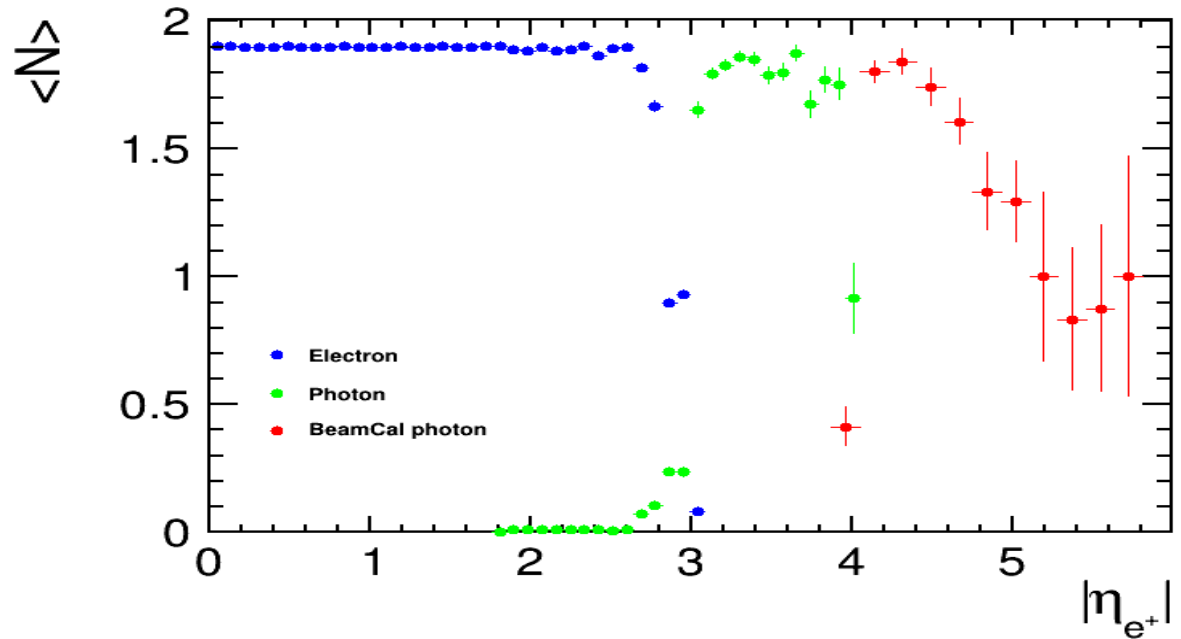- **LumiCal+LHCAL+BeamCal**
    - **Only LumiCal and LHCAL included in Particle Flow**

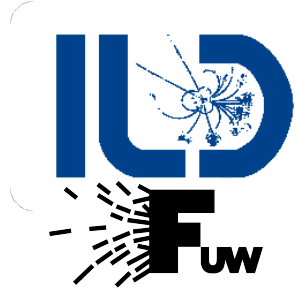**Number of reconstructed objects for Z→ e⁺e⁻ samples**

(electron energy of 25, 50 and 100 GeV mixed)

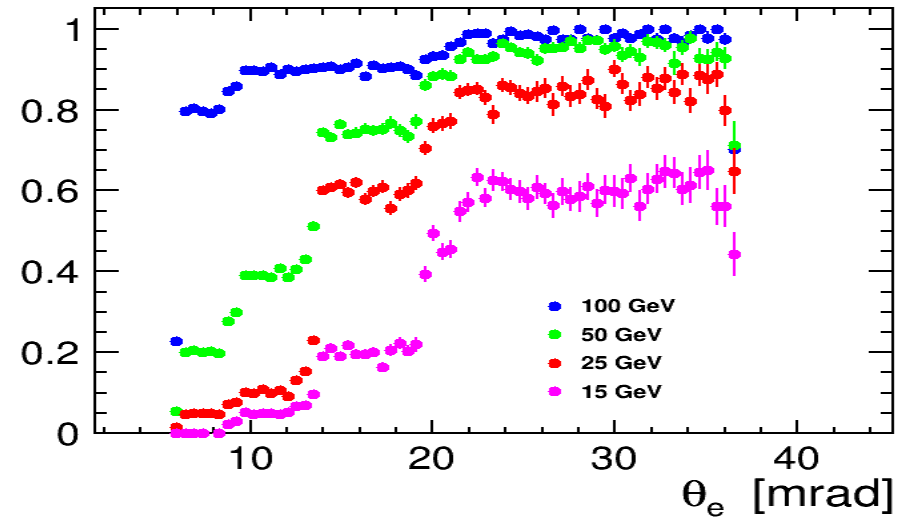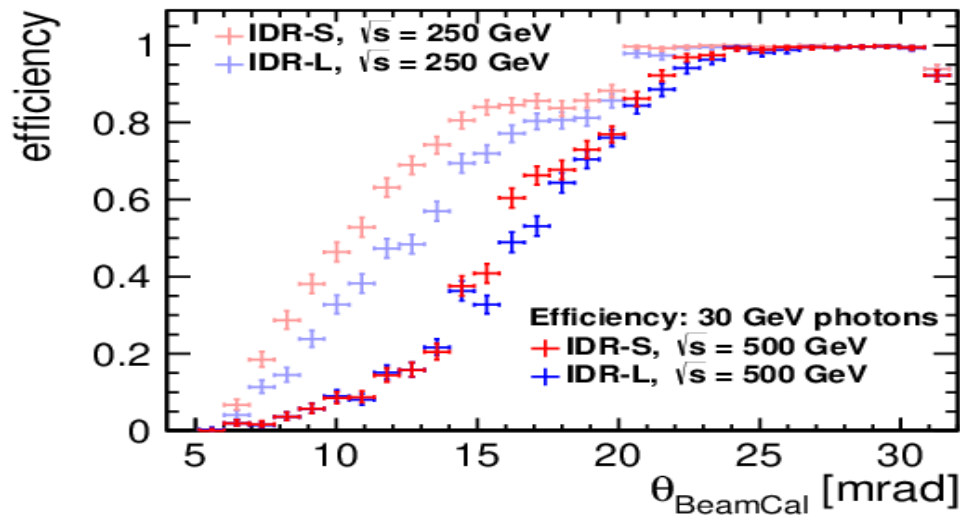**High level: including efficiency and isolation cuts**
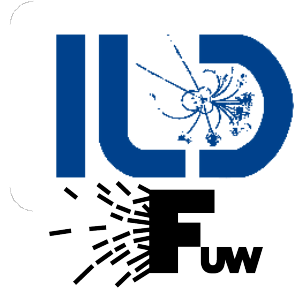
# Forward calorimetry

- **BeamCal efficiency**
  - Based on IDR figure 8.8a and Moritz Hebermehl PhD Thesis Figure 4.10: 4 energy*4η bins

**IDR 8.8a**

# Forward calorimetry

- **BeamCal efficiency**
  - **Based on IDR figure 8.8a and Moritz Hebermehl PhD Thesis Figure 4.10: 4 energy*4η bins**

M. Hebermehl Fig 4.10

# Jets
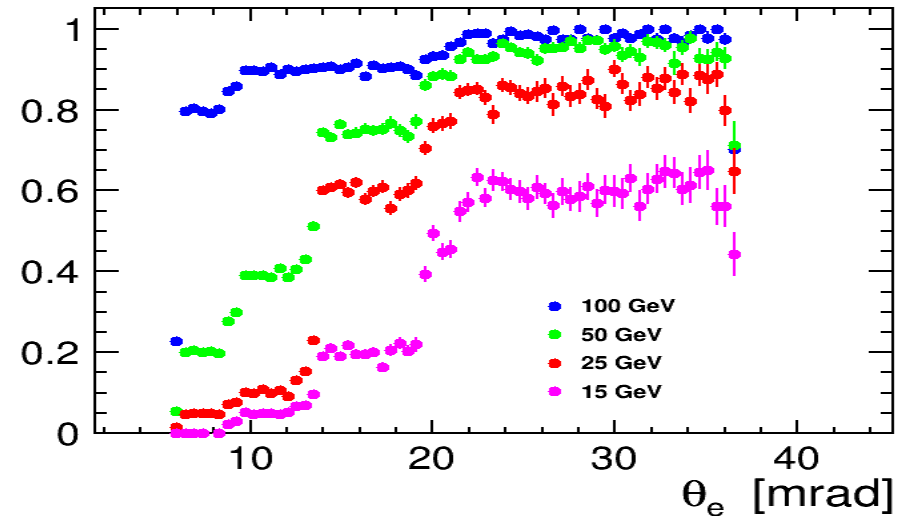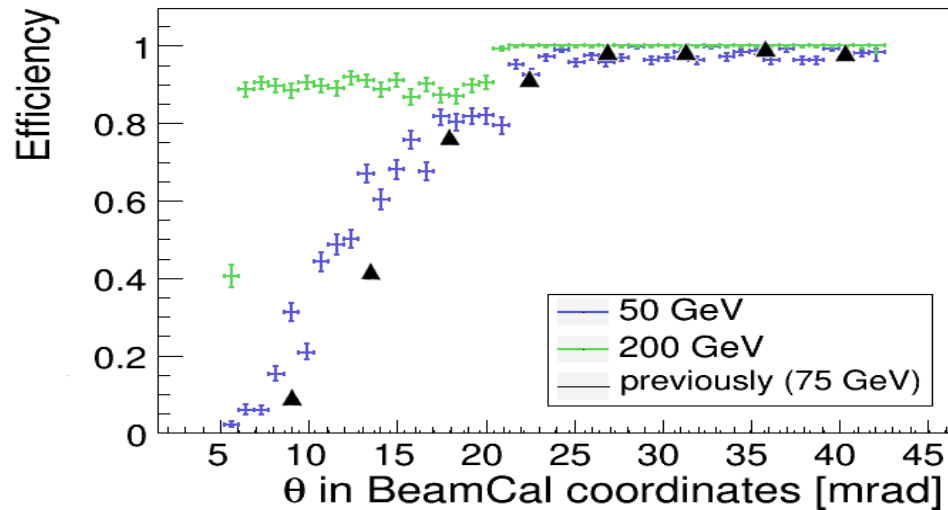
## So far only basic jet definition
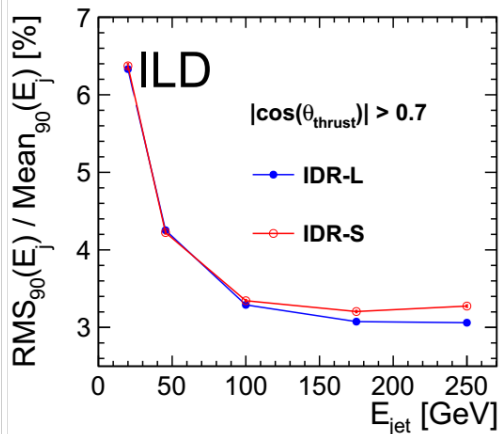
**IDR 8.3 (a,b) – uds only**
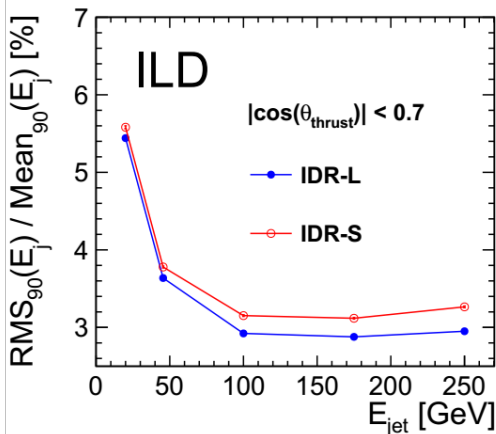


JER (rms90/mean90) [jetE / %] :

| | |
|---|---|
| 45 GeV | 10.0% |
| 100 GeV | 8.3% |
| 175 GeV | 5.3% |
| 250 GeV | 4.6% |

$|cos(theta)|<0.7$

**Sample: uds**
**Jet def:**
antikt
R=0.5
pT Min = 20 GeV
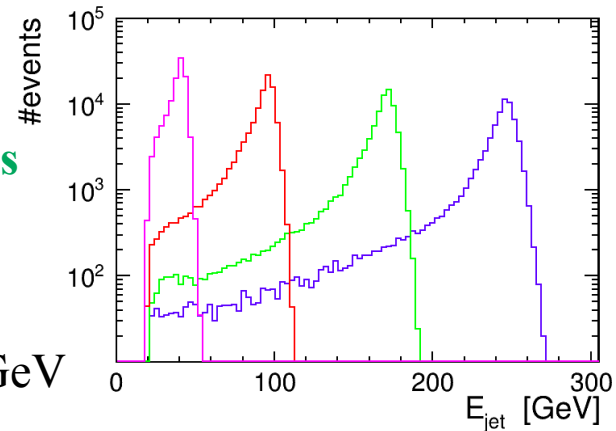
# DELPHES checklist

- **Partickle tracking conditions**
  - Assumed: ILD magnetics field and tracking volume size
- **Tracking coverage and efficiency for charged particles**
  - Tracking efficiency as given in the ILD IDR (Figure 8.2)
  - Tracking extended up to eta = 3: can point to LHCAL, educated guess
- **Tracking resolution (momentum smearing)**
  - Parametrisation of ILD IDR results (Figure 8.1a)

# DELPHES checklist

- **Calorimeter acceptance and tower structure**

  ECAL     up to  3.0

  LumiCal   3.0  - 4.0

  BeamCal   4.0  - 5.8

  HCAL     up to  2.8

  LHCAL    2.8 - 3.8

  **Two separte flows prepared:**

  **- main calorimeters only: ECAL+HCAL**
  **- all calorimeters**

  ECAL  subranges: 0.0-1.1-2.0-2.5-3.0

  HCAL  subranges: 0.0-1.1-2.0-2.5-2.8

  **Response thresholds for forward calorimeter towers currently set to 1 GeV**

# DELPHES checklist

- **Calorimeter resolution for single particles**

    Resolution formula from Daniel

    ECAL/LumiCal:  sqrt(energy^2*0.01^2 + energy*0.17^2)

    HCAL/LHCAL:    sqrt(energy^2*0.017^2 + energy*0.45^2)


**Assumed BeamCal resolution (taken from FCAL simulation):**


(abs(eta) > 4.0 && abs(eta) <= 4.8) * sqrt(energy^2*0.02^2 + energy*0.30^2) +

(abs(eta) > 4.8 && abs(eta) <= 5.8) * sqrt(energy^2*0.03^2 + energy*0.45^2)


- **BeamCal response to hadrons: should it be included ?**

# DELPHES checklist
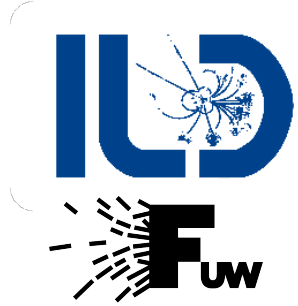
- **Efficiency for particle reconstruction (on particle flow level)**
  - **Conservative estimate from Daniel**

    For photons:

    (energy > 0.5 ) * (abs(eta) <= 3.0)         * (0.95) +

    (energy > 1.0 ) * (abs(eta) > 3.0 && abs(eta) <= 4.0) * (0.90)

    For electrons:

    (abs(eta) <= 3.0)         * (0.95) +

    (abs(eta) > 3.0 && abs(eta) <= 4.0) * (0.90)

    For muons:   0.95 (fixed)

  - **BeamCal reconstruction efficiency taken from plots**

    IDR Figure 8.8a and Moritz Hebermehl PhD Thesis Figure 4.10 in  4 x 4 energy x eta bins

# DELPHES checklist
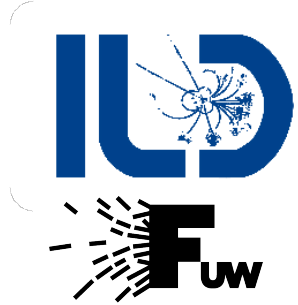
- **Isolation requirements**
  - Analysis dependent. Old settings used so far...
- **Clustering algorithm**
  - Analysis dependent. Old settings kept for now. More options should be added
  - Jet pT threshold at 20 GeV: too high?
- **Falvour tagging efficiencies and mistagging probabilities**
  - Waiting for input from Ryo and Tomohiko
  - Q: bit configuration? Add a bit for 'true' tag?
- **Tau-jet tagging**
  - Not a priority. Postponed
    - Some estimates can be pesented by Shin-Ichi
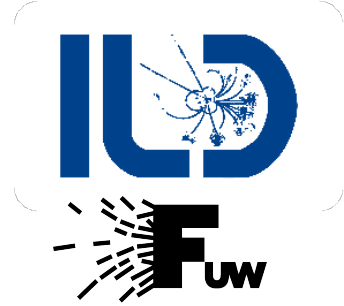
# Summary & Outlook
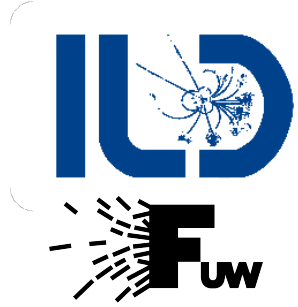
**Dedicated repository created:** https://github.com/ILDAnaSoft/ILDDelphes

**Still in need of some inputs – b/c-tagging**

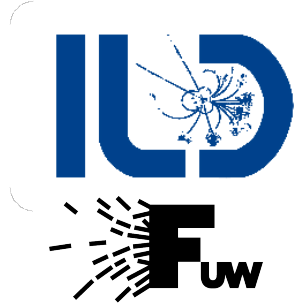**Decision needed: number and definitions of jets clustering**

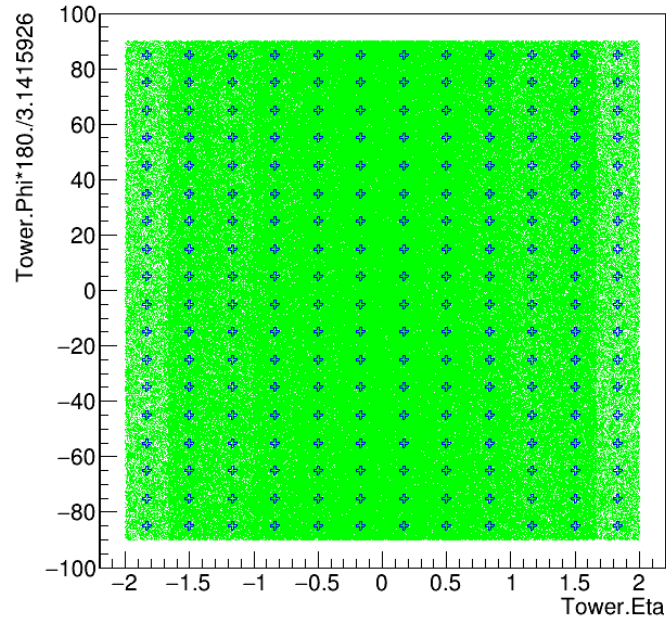**Main code structure ready for more detailed tests and improvements**

# Some plots

backups

# Energy deposits in ECAL towers



18 bins in $\phi$, 12 bins in $\eta$

- Sample: electrons only
- Tower center smearing
  - Off: crosses
  - On: dots