Particle ID study for analysis improvement

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For analysis improvement

- All the analyses are saturated within the present framework
  - Needs new idea
- Fundamental new variables might provide improvements of analysis tools
  - dE/dx in TPC
  - Shower profiles in the calorimeters
- Those variables have already boosted lepton ID efficiency
  - ～30% improvement can be obtained
- Will those variables give improvement to other analysis components?
  - Energy correction
  - B-tagging?

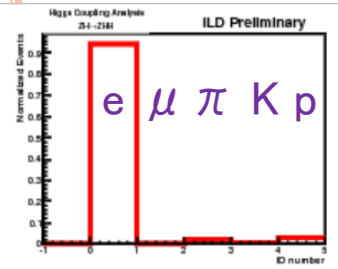
→it is necessary to study them

Particle ID

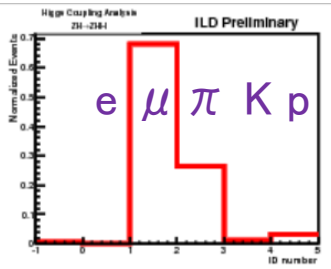
- ID efficiency for each fundamental particle type
  - How are particles identified as each particle type?

- Difference from first trial:
  - Changing MC matching method →matching eff. becomes 100%
  - So, very low momentum muon can't be distinguished from pion because such muons stop in the calorimeter

- ID efficiency:
  - Electron can be identified almost perfectly
  - Muon ID eff. reduces from 80% to ～70%
  - Hadron ID effs. are 68%～75%



e



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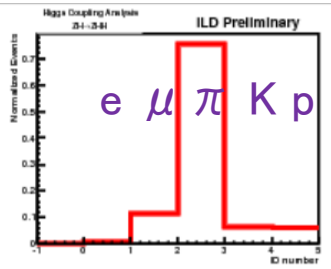

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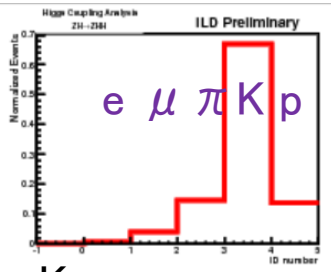

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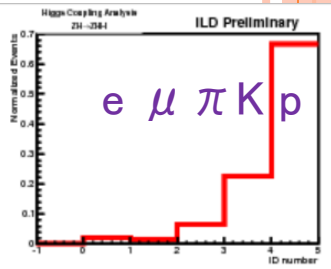

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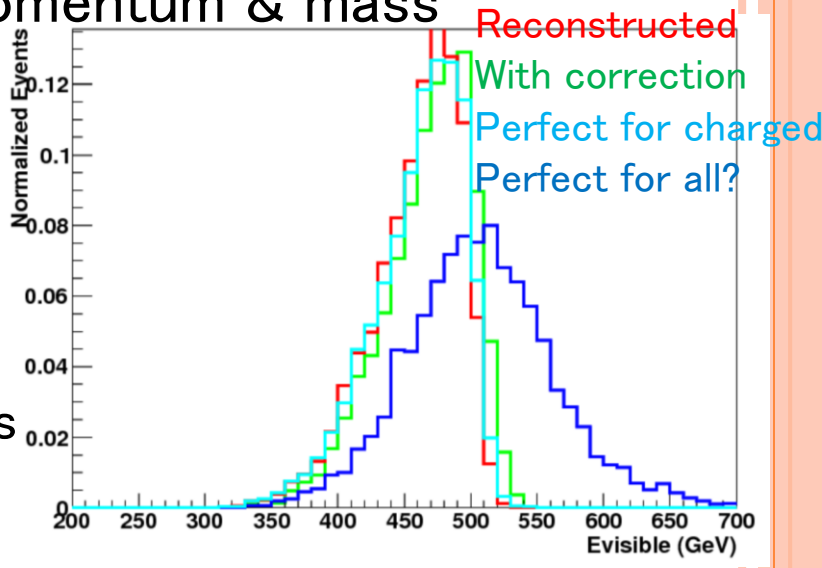
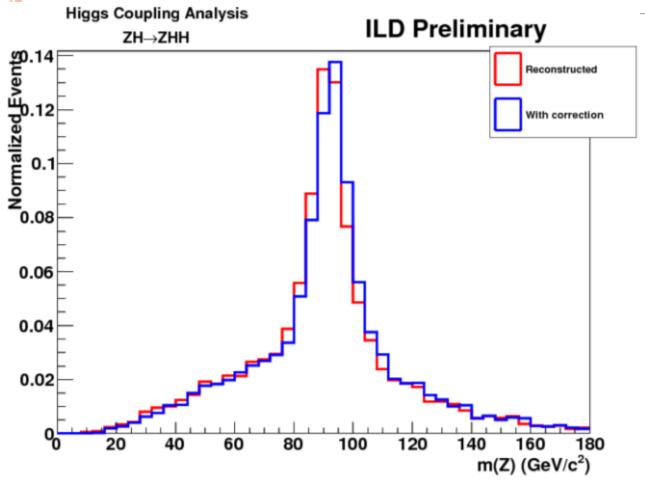
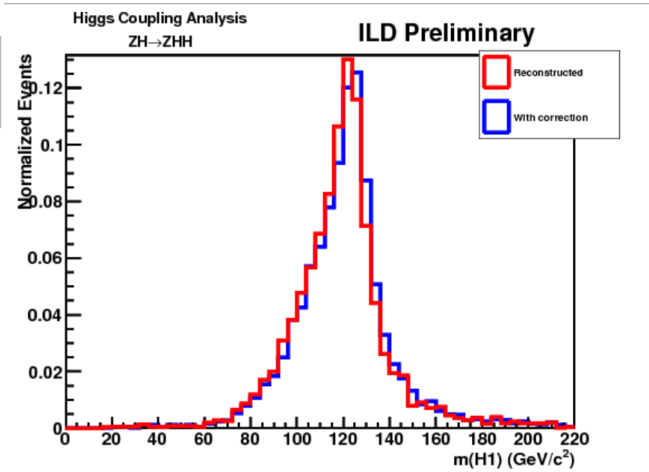
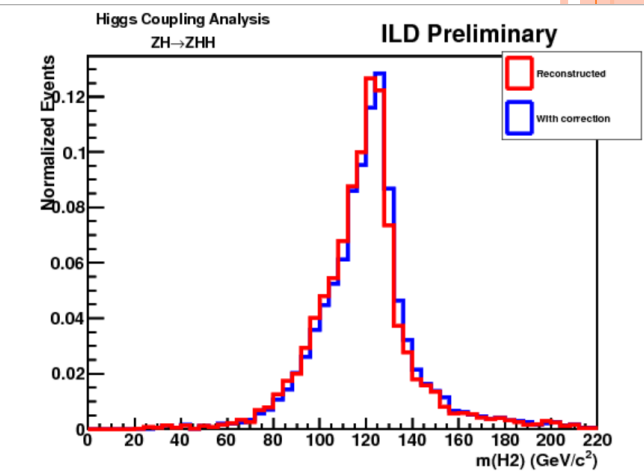
Energy correction

- Track energies are corrected using momentum & mass
  - Using particle ID to identify tracks
- Visible energy
  - Using qqHH→qq(bb)(bb)
  - So far, overestimated due to misID
  - Correction effect is small due to neutrals
- Mass distribution
  - Checking Z(Z→qq, q is light) and H(H→bb)
  - Jet matching with MC truth is applied
  - Effect is small too due to neutrals







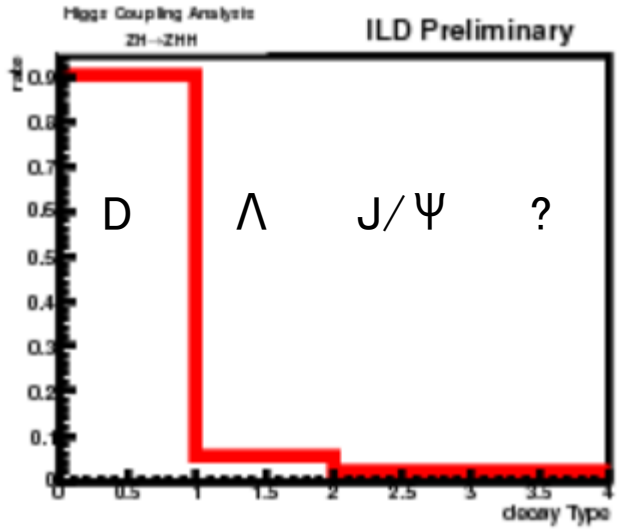


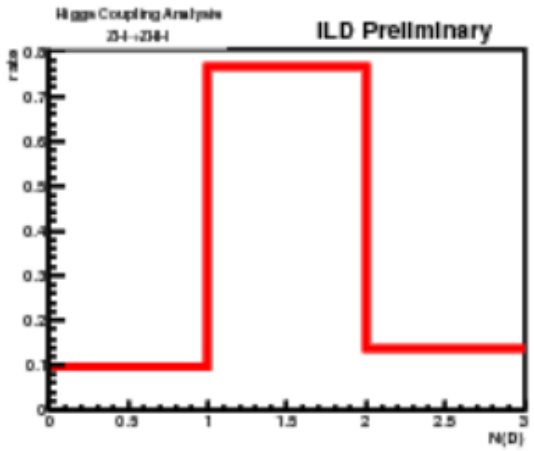
MC TRUTH STUDY FOR B-TAGGING IMPROVEMENT

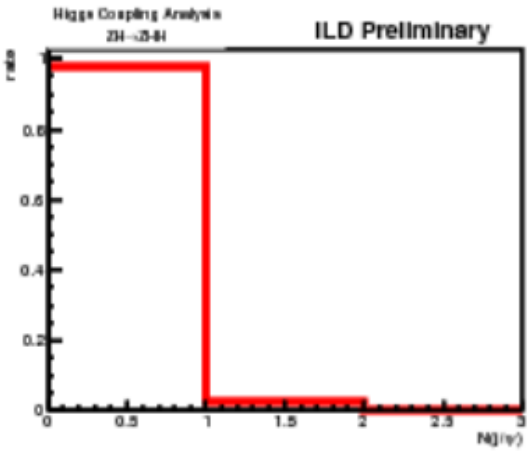
Types of B decay

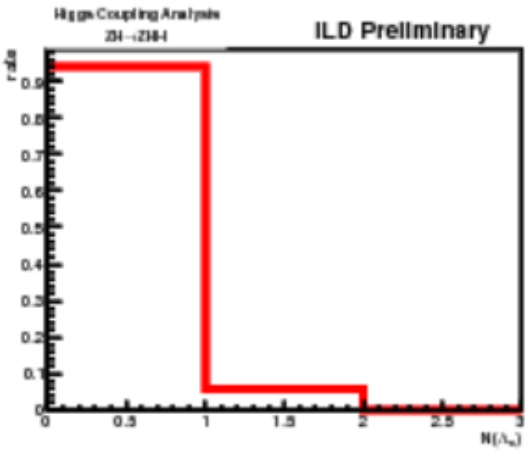
- Checking B decay types in the MC generation
  - Catching B mesons or B baryons, and looking at those daughters

- 3types of decay:
  - D meson type(includes excited state)
  - Λc type(includes excited state)
  - J/Ψ type(includes excited state)
- In D type:
  - Num. of D meson is 1 or 2







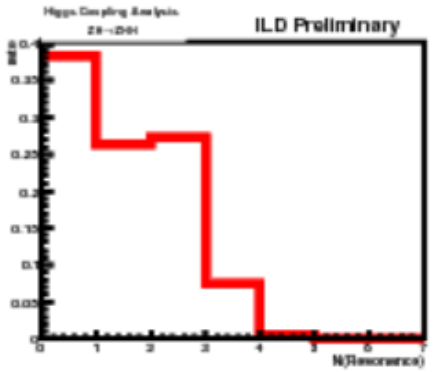


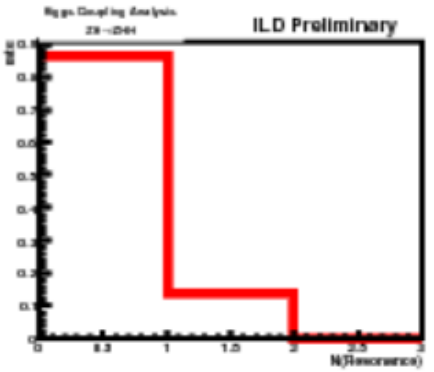
D MESON TYPE B DECAYS

- In D case, B decay is characterized as:

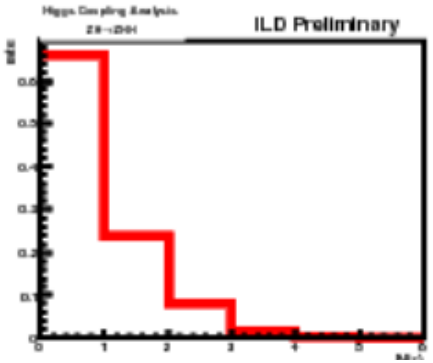
$$B \rightarrow D_1\ (+D_2) + Resonance + n\pi + nK$$

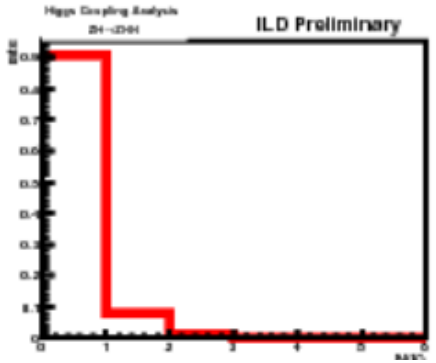
  - Num. of resonance



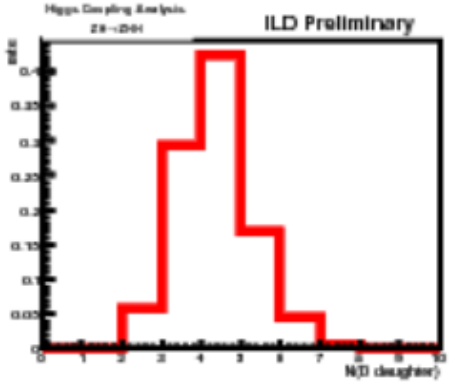


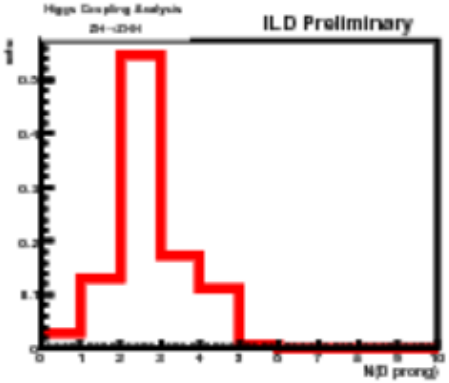
  - Num. of π s & Ks





  - Num. of particles & prongs of D decay
    - All the particles are stable



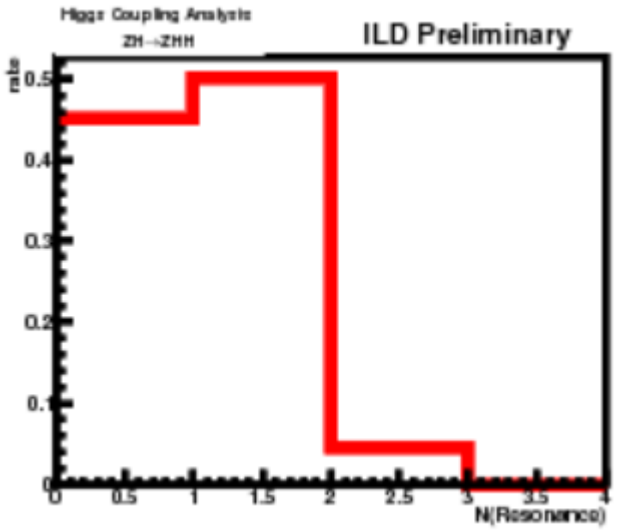


J/Ψ TYPE B DECAYS

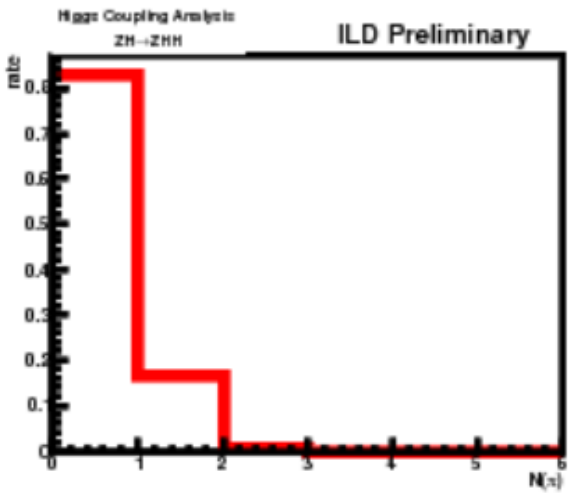
- In J/Ψ case, B decay is characterized as:

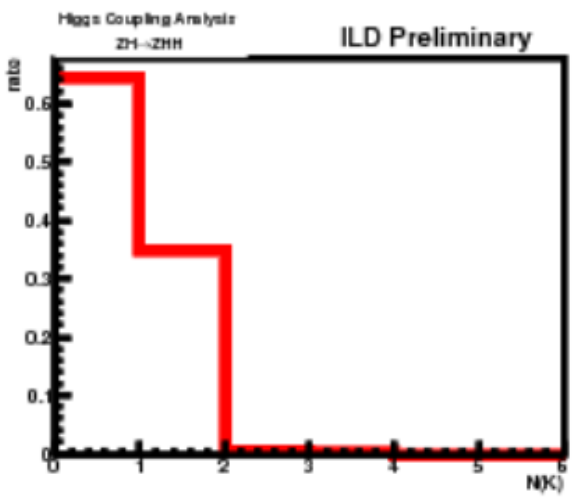
$$B \rightarrow \mathrm{J}/\Psi + Resonance + n\pi + nK$$

- Num. of resonance



- Num. of π & K



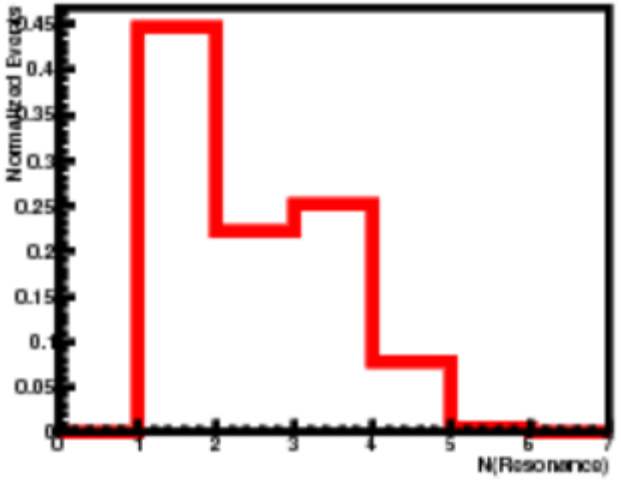


Λc TYPE B DECAYS

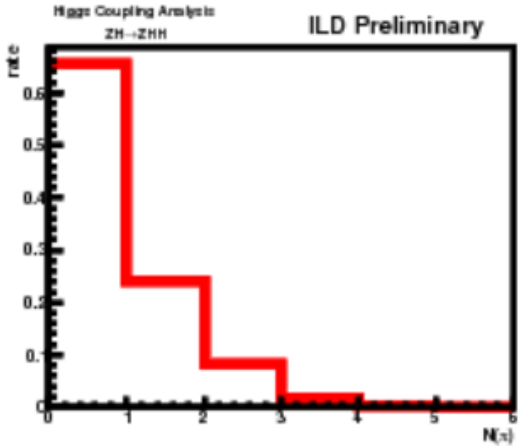
- In Λc case, B decay is characterized as:

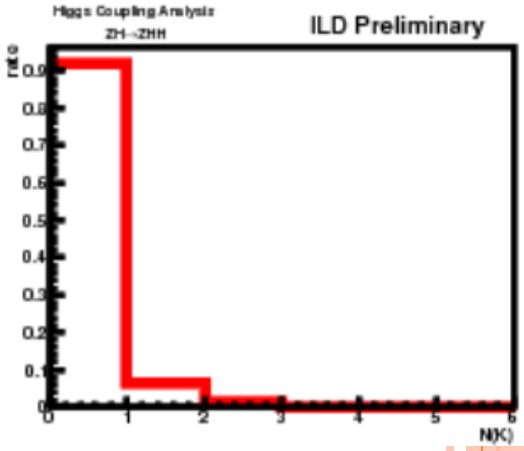
$$B \rightarrow \Lambda c + Resonance + n\pi + nK$$

- Num. of resonance



- Num. of π s and Ks





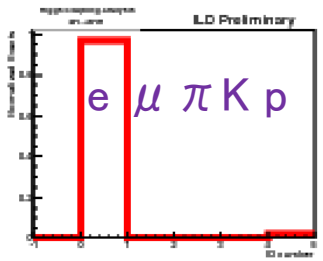
Summary and Todo

- Studying particle ID:
  - Hadron ID eff. is 68%～75%
  - Energy correction effect is small, but going to good direction
- Studying B decay using MC truth
  - Most of Bs are going to D mason(1 or 2)
  - B decay produces some resonances →going to cascades
  - Most of D meson decays have more than 1 prong
  - π^0 is importatnt?
- Todo:
  - Particle ID optimization
  - More study of B decay
  - Need to study D meson decay
  - Catch some hints of b-tagging improvement

Backups

Particle ID

- ID efficiency of first trial



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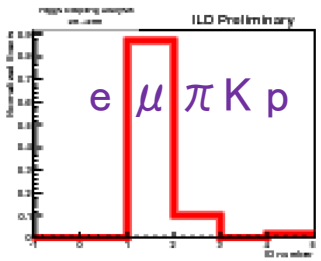
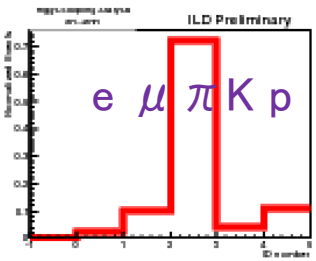
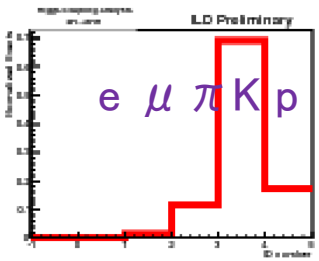


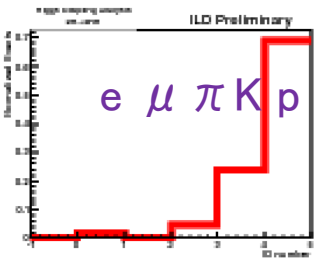
μ



π



K



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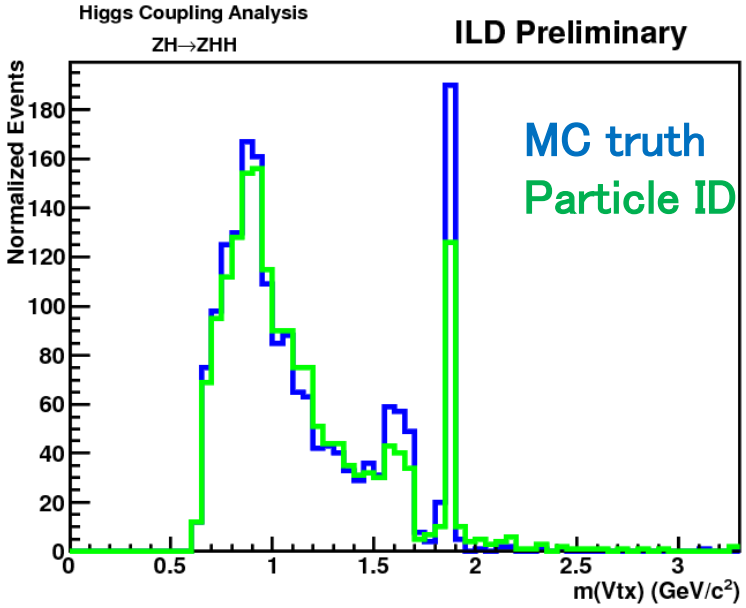
- Vertex mass in 2prong vertex with K+ π



Particle ID strategy