Potentiel improvement on ttH reconstrucion

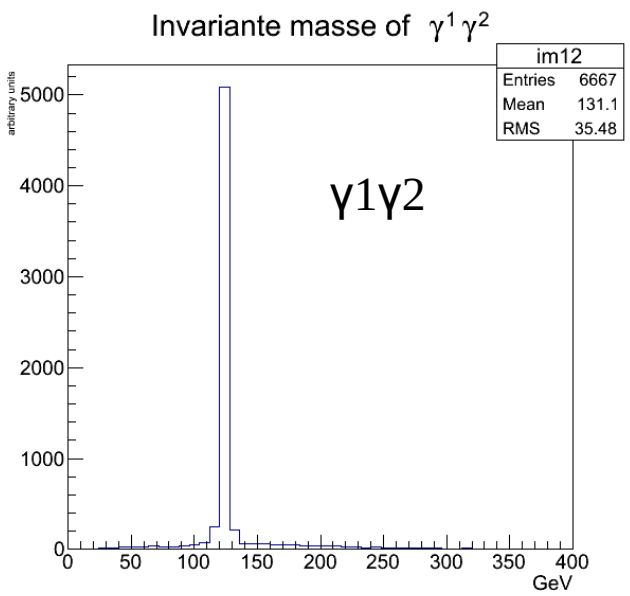
Motivation

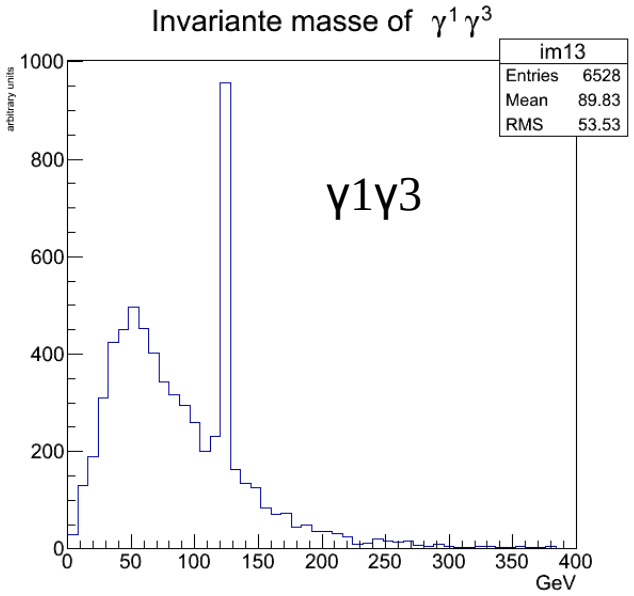
- Improvement of ttH reconstruction is importante because measurement of the ttH cross section allows to determine the Yukawa coupling constant of quark top.

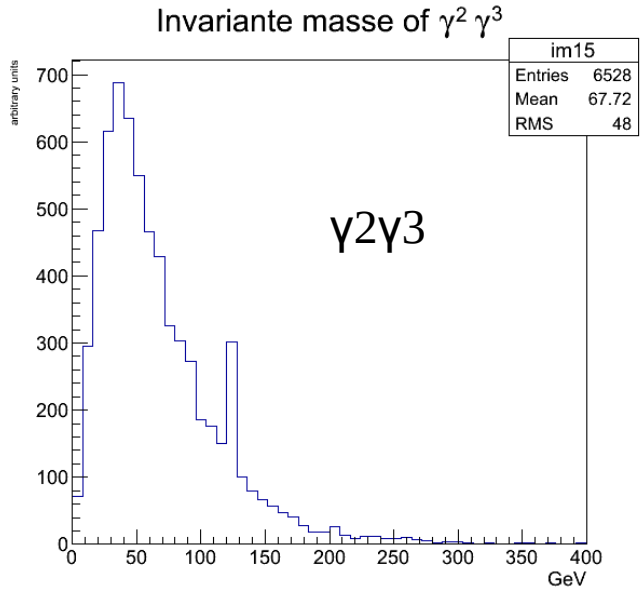
H reconstruction in ttH

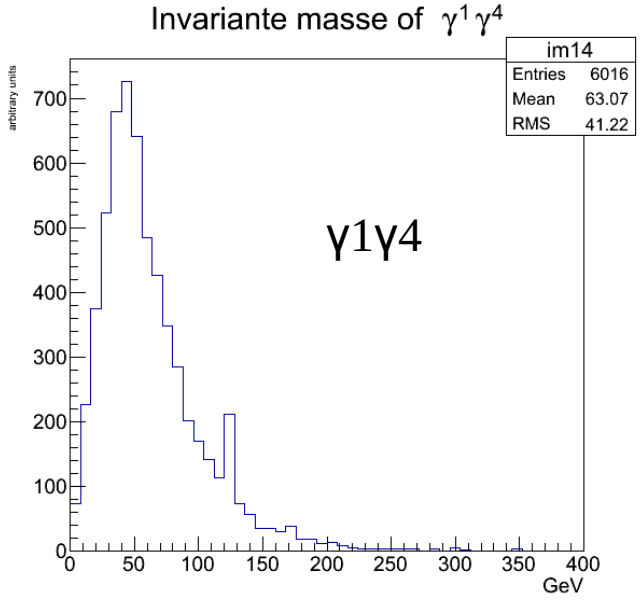
- Efficiency for different processes
  - H reconstruction with the 2 leading photons:
    - ttH : 0.79
    - ggH : 0.90
    - zH: 0.86
    - wH: 0.86
- How to explain the difference between ttH efficiency and the others ?

Invariant mass of γ pair





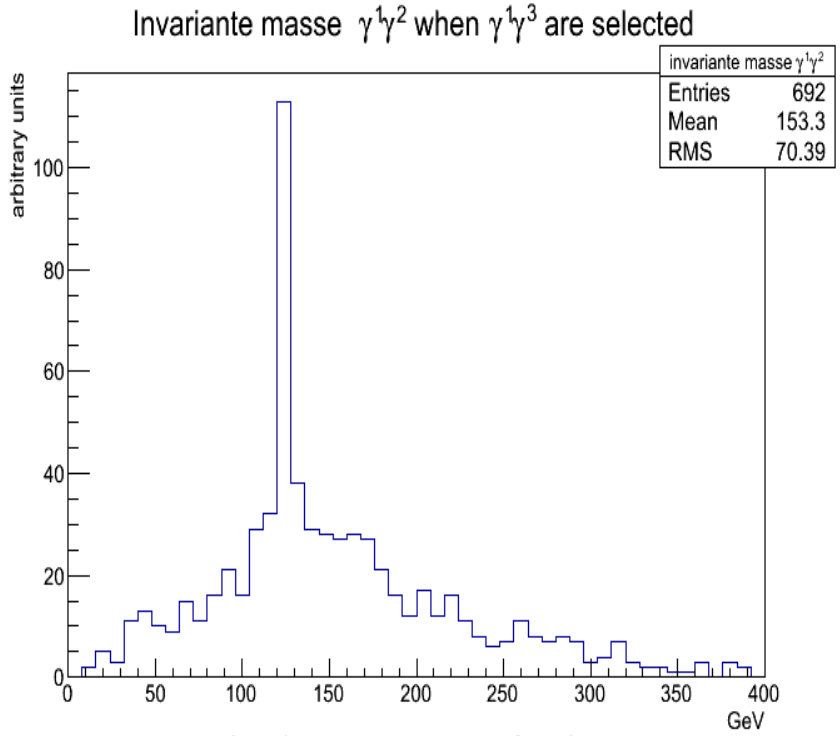


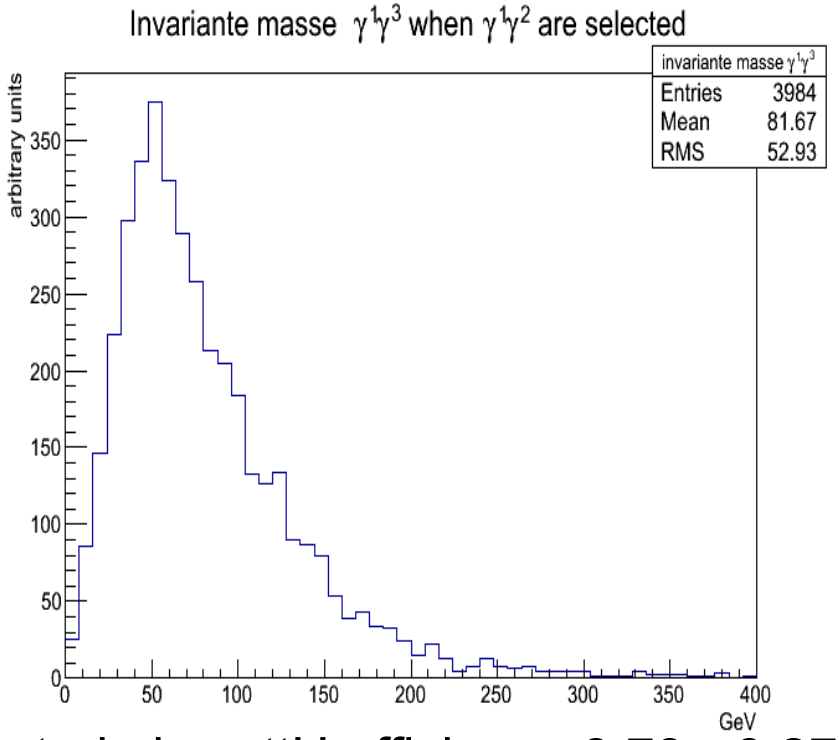


- Non negligible signal for γ1γ3 invariant mass
- Negligible for other combination

Invariant mass of γ pair

- Pair of γ is selected for :
-
  - It seems that some time photon, with higher pT than second photon comming from the Higgs, appears.

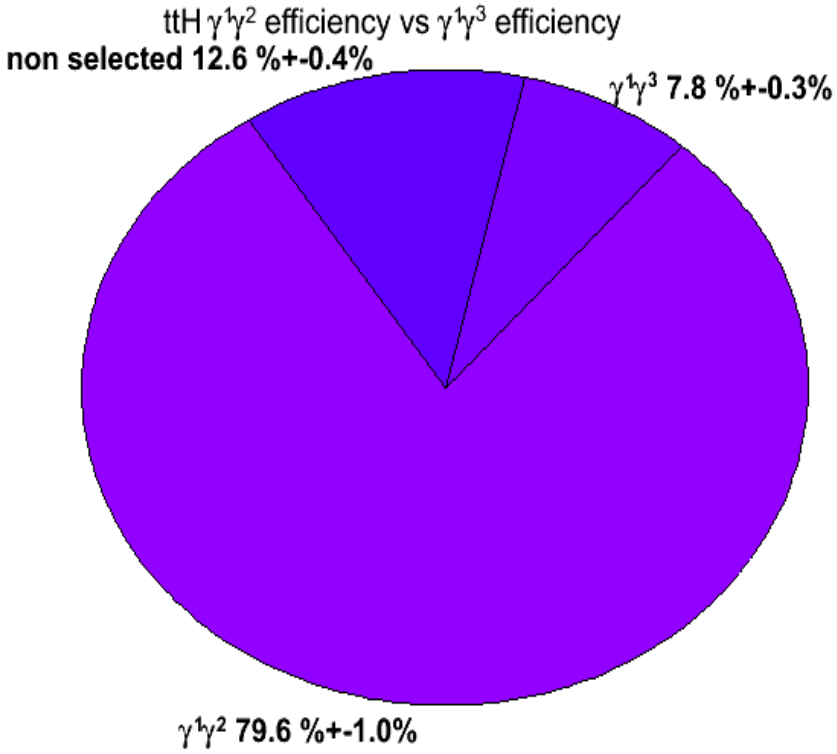




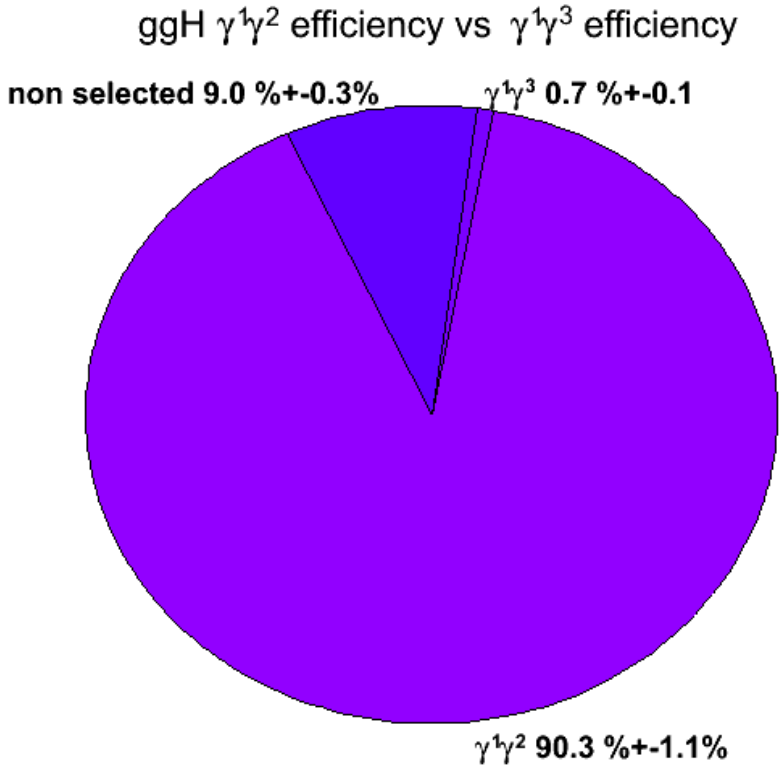
- By taking γ1γ3 when γ1γ2 are not selected gives ttH efficiency 0.79->0.87

Comparaison with others processes

- Comparaison with others processes shows the mis-combination of photons seems to be specific at ttH
  - One takes γ1γ3 when γ1γ2 are not selected :



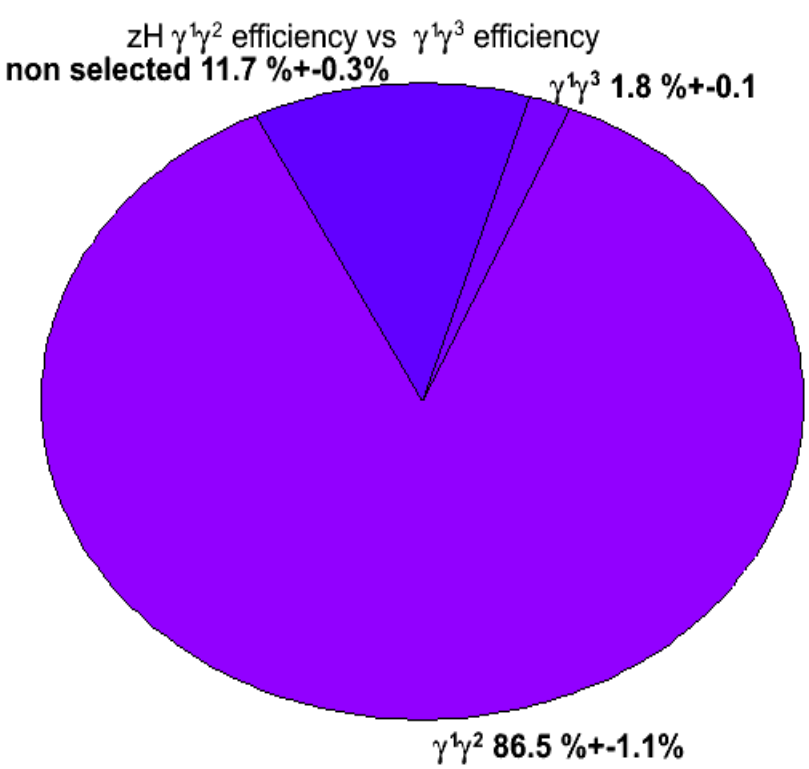
ttH



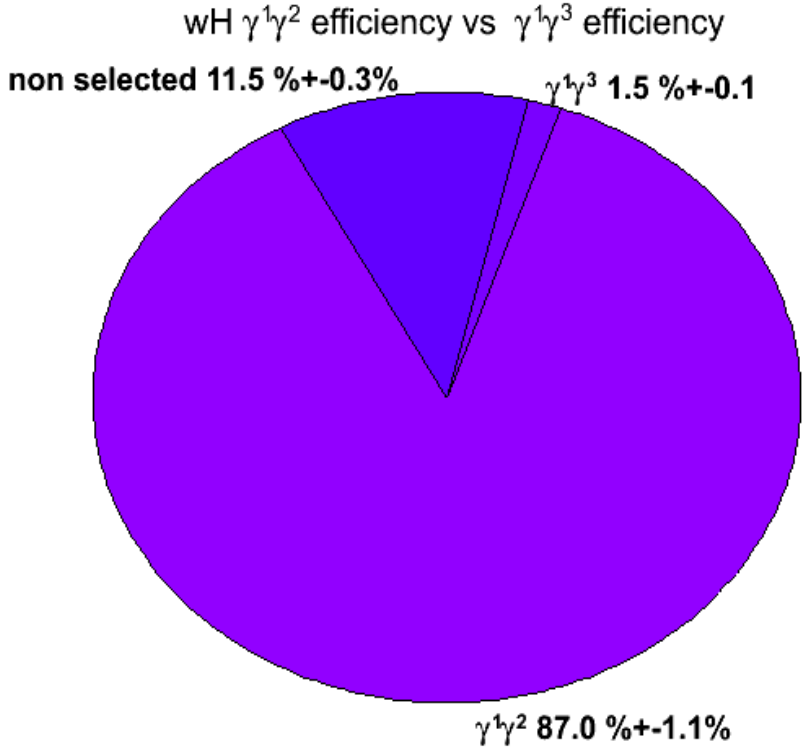
ggH

Comparaison with others processes

- Comparaison with others processes shows the mis-combination of photons seems to be specific at ttH
  - One takes γ1γ3 when γ1γ2 are not selected :



zH



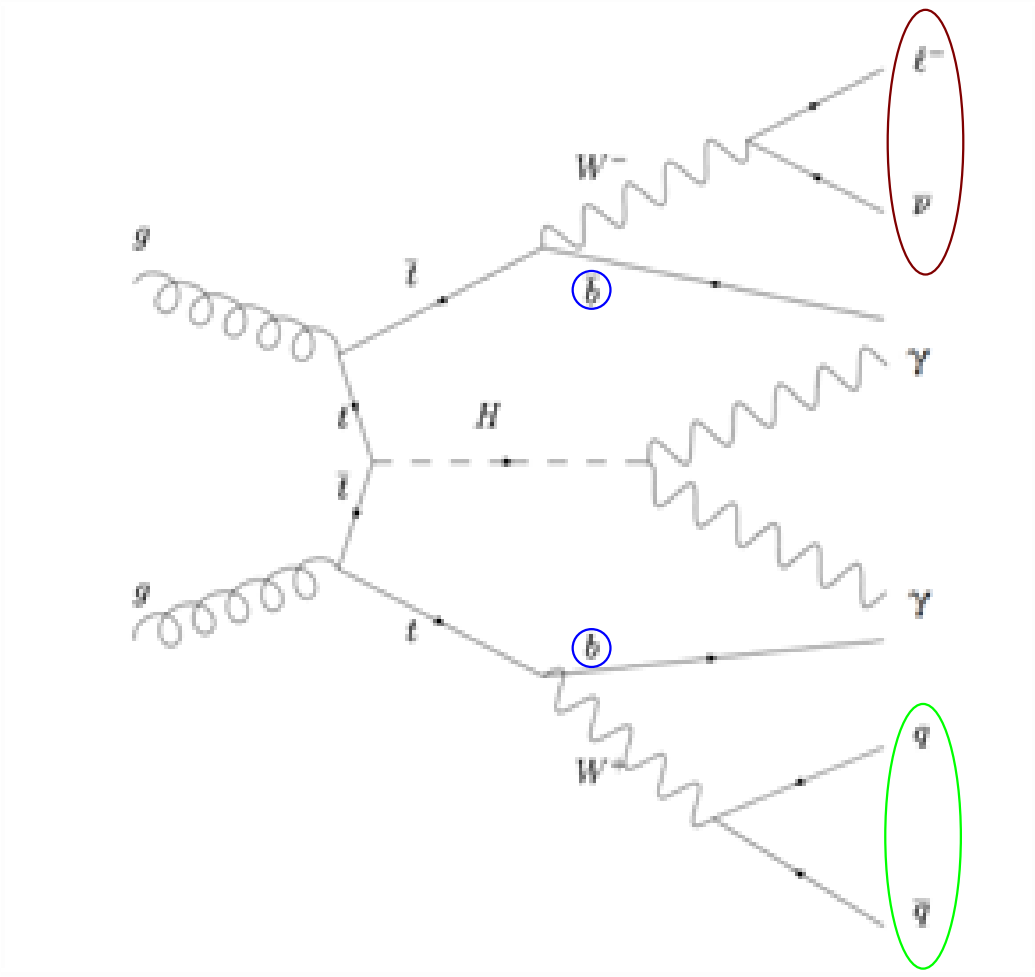
wH

Check on «unknown EM Object »

- Missing efficiency comes from this photon
  - To improve ttH we have to identify this photon
- Where does this photon come from ?
  - Identification with true photon from MC using $\Delta R<0.5$ and $\Delta pT/pT<0.1$
    - No true photon from MC match with this photon
    - It's a fake photon

Candidates of the fake photon origin

- Where does this fake photon come from?



Possible cantidates:

- W->eν ?
- W->μν ?
- W->τν ?
- W->qq ?
- b from t ?

In the code

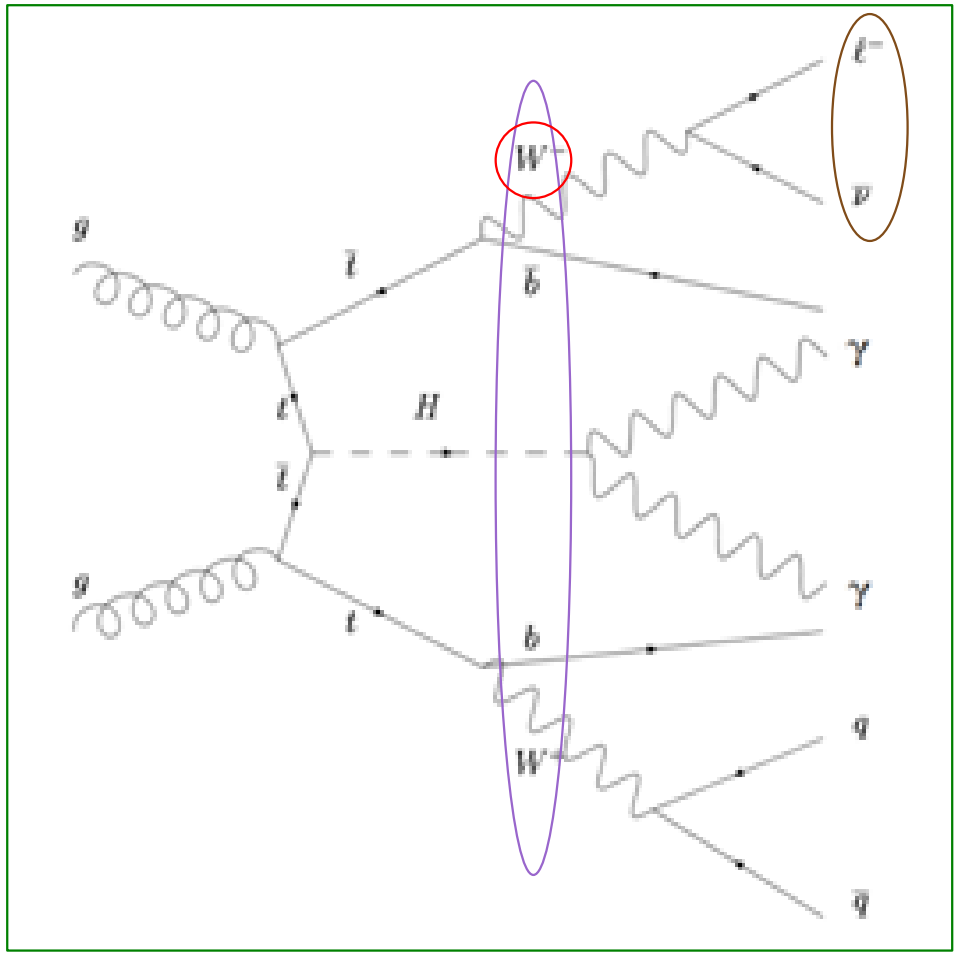
- How to count the origins:

- Processes the MC samples in order to get only tree level informations :
- Using mc_status, with selection mc_status=3
- Informations for one particule are stored in an structure named element

```
typedef struct element element;
struct element
{
  vector<element> children;
  vector<int> parentId;
  float pt;
  float eta;
  float phi;
  int pdgId;
  int order;
  int index;
};
```

In the code

- All data process are stored in : `vector<vector<vector<element > > > data;`
- data[event][order][element].children

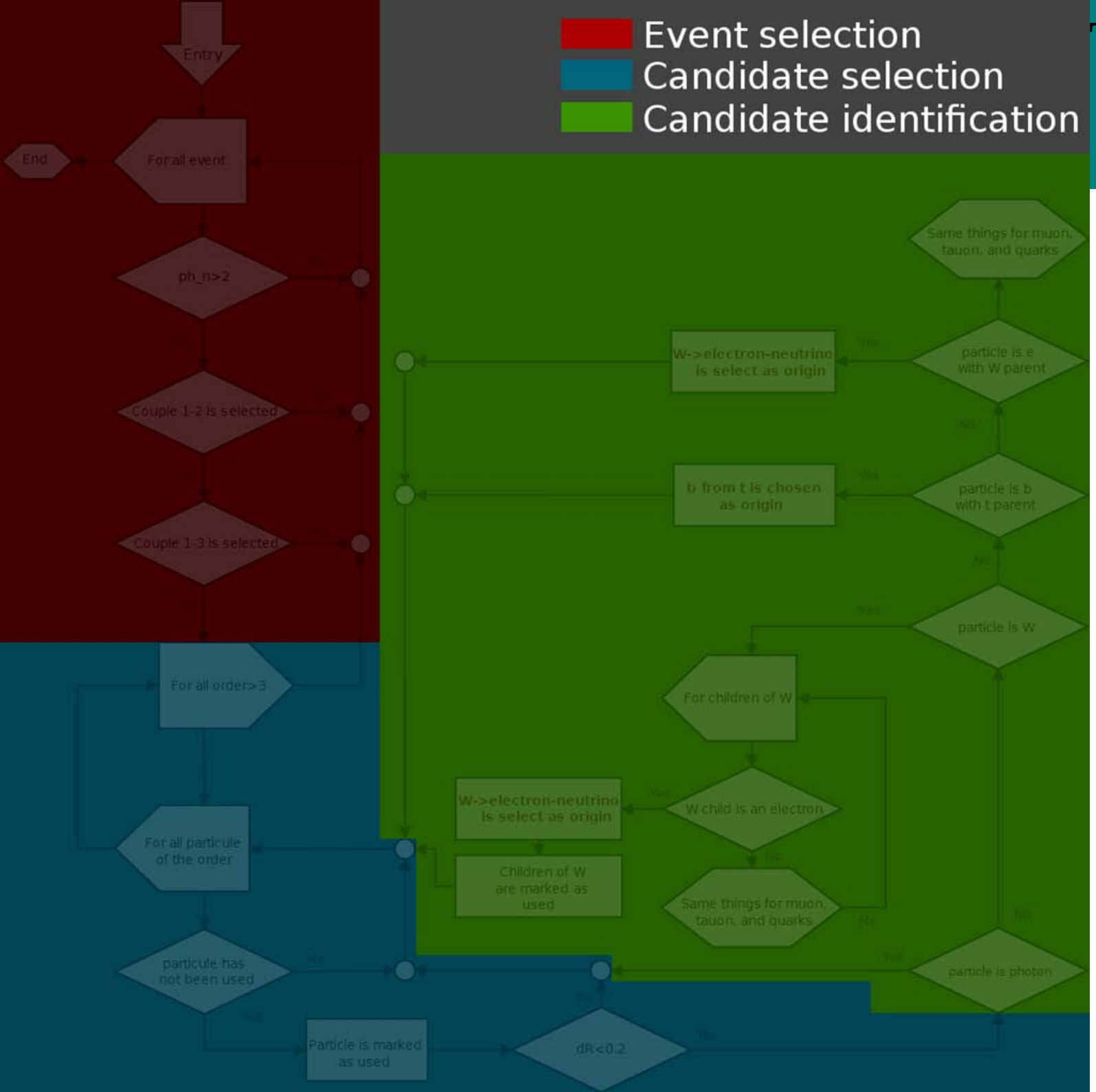


- To check this process one can print tree level :
- First number
- is the pdgId of
- the particules
- Second number
- is the index of the
- particule

```
21 0
---21 2
-------6 4
----------24 7
------------1 13
-------------2 14
----------5 8
------6 5
---------24 9
-------------3 15
------------4 16
---------5 10
------25 6
---------22 11
---------22 12
21 1
---21 3
-------6 4
----------24 7
------------1 13
-------------2 14
----------5 8
------6 5
---------24 9
-------------3 15
------------4 16
```

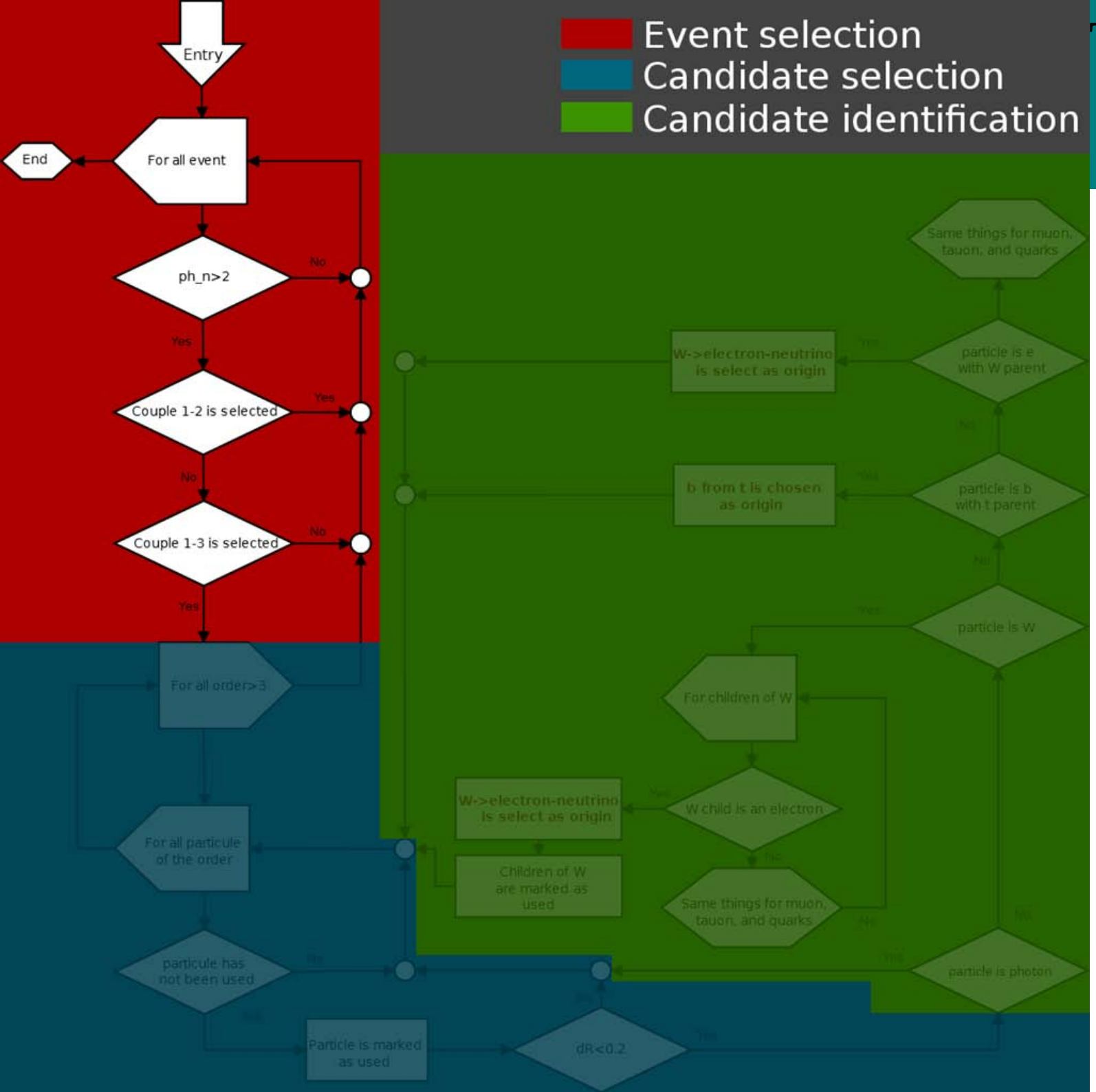
The algorithm

- The algorithm is composed of 3 part



The algorithm

- The algorithm is composed of 3 part



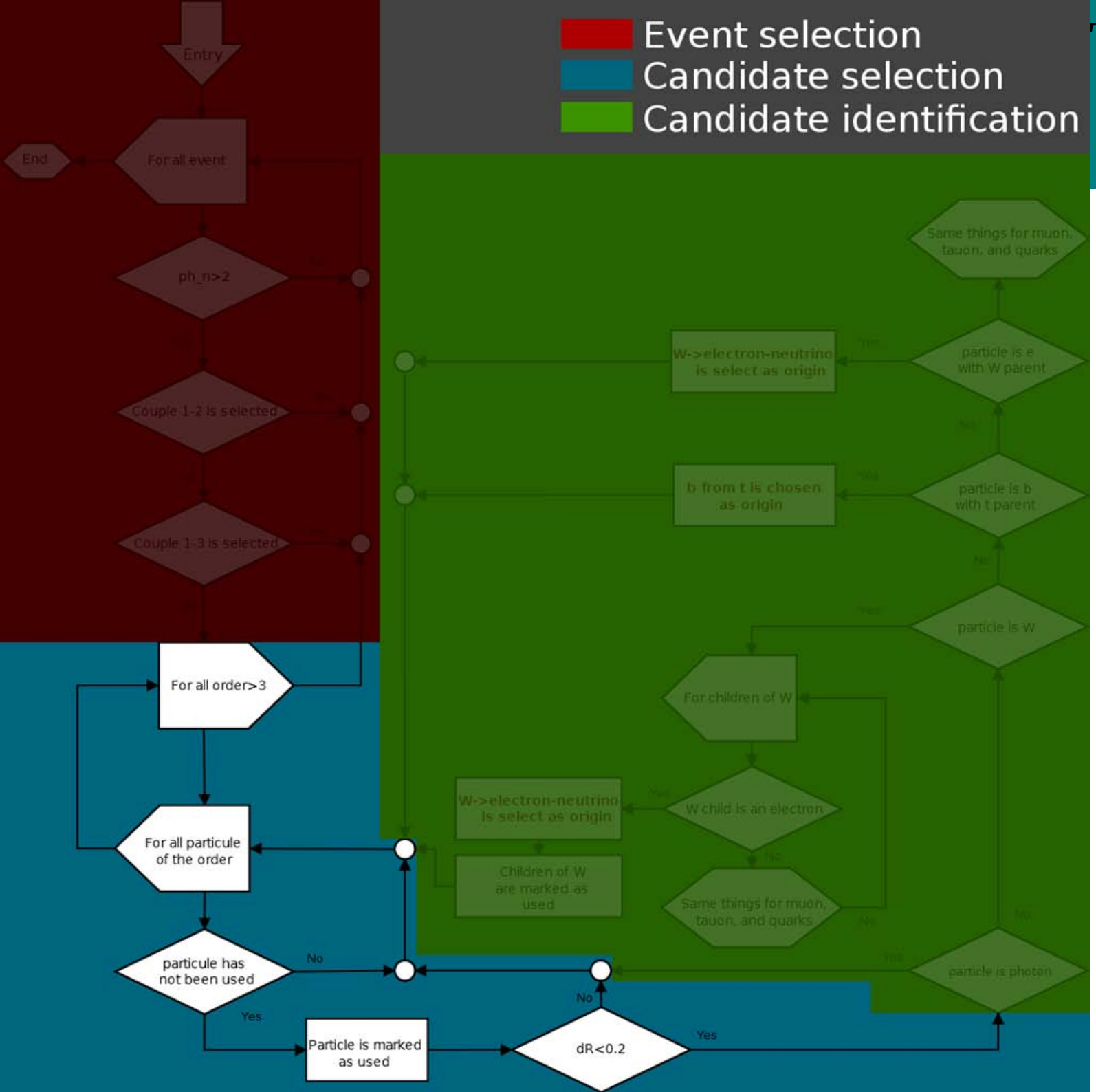
- Event selection :

- For number of detected photon is higher than 2

- And γ1γ2 is not selected, and γ1γ3 is .

The algorithm

- The algorithm is composed of 3 part



- Candidate selection :

- When particule has not been used

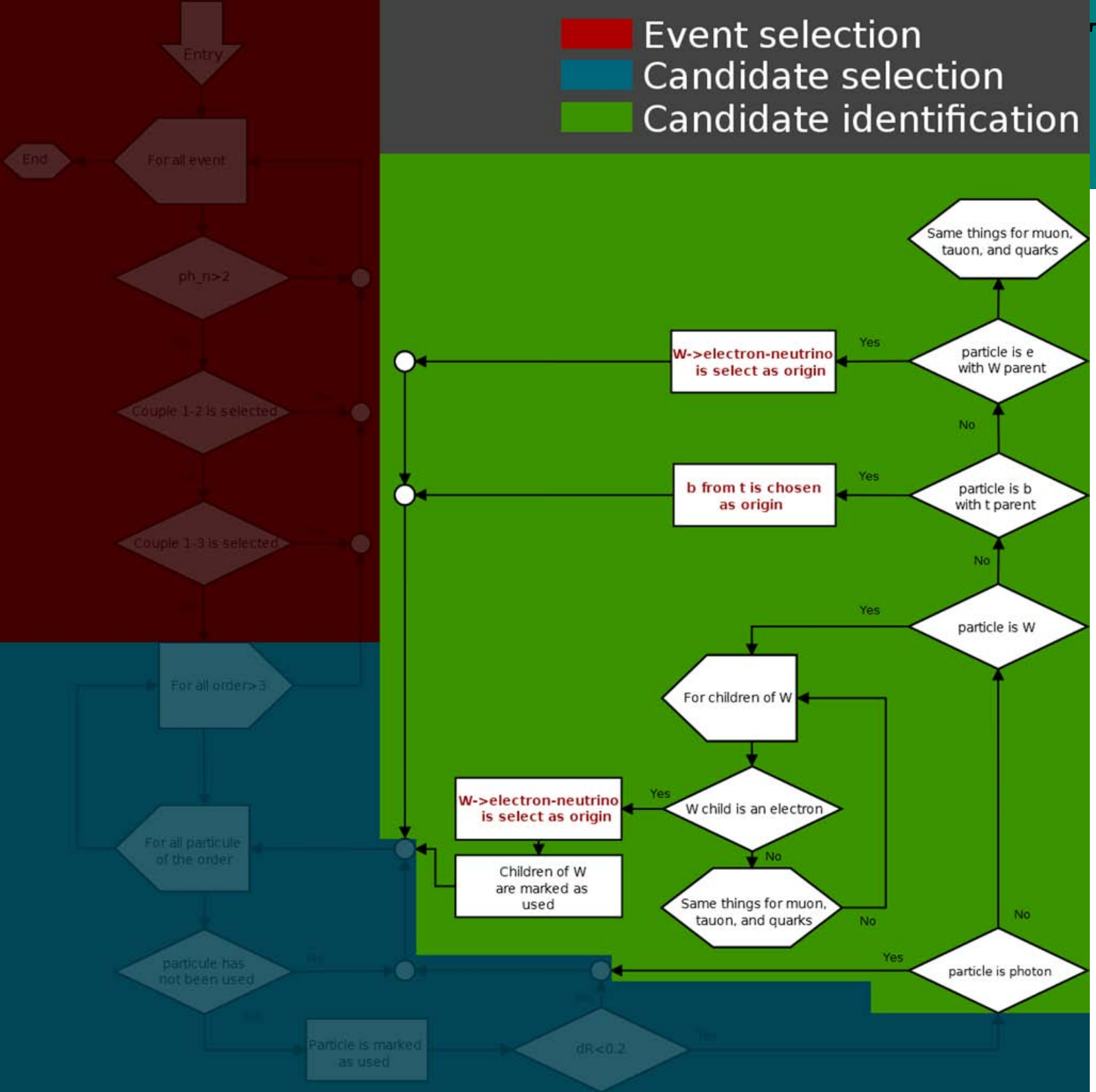
- When it match with second leading photon, dR<0.2

- dR<0.2 has been chosen in order to limit times where 2 candidates are selected for one event.(9 for 485 event select)

The algorithm

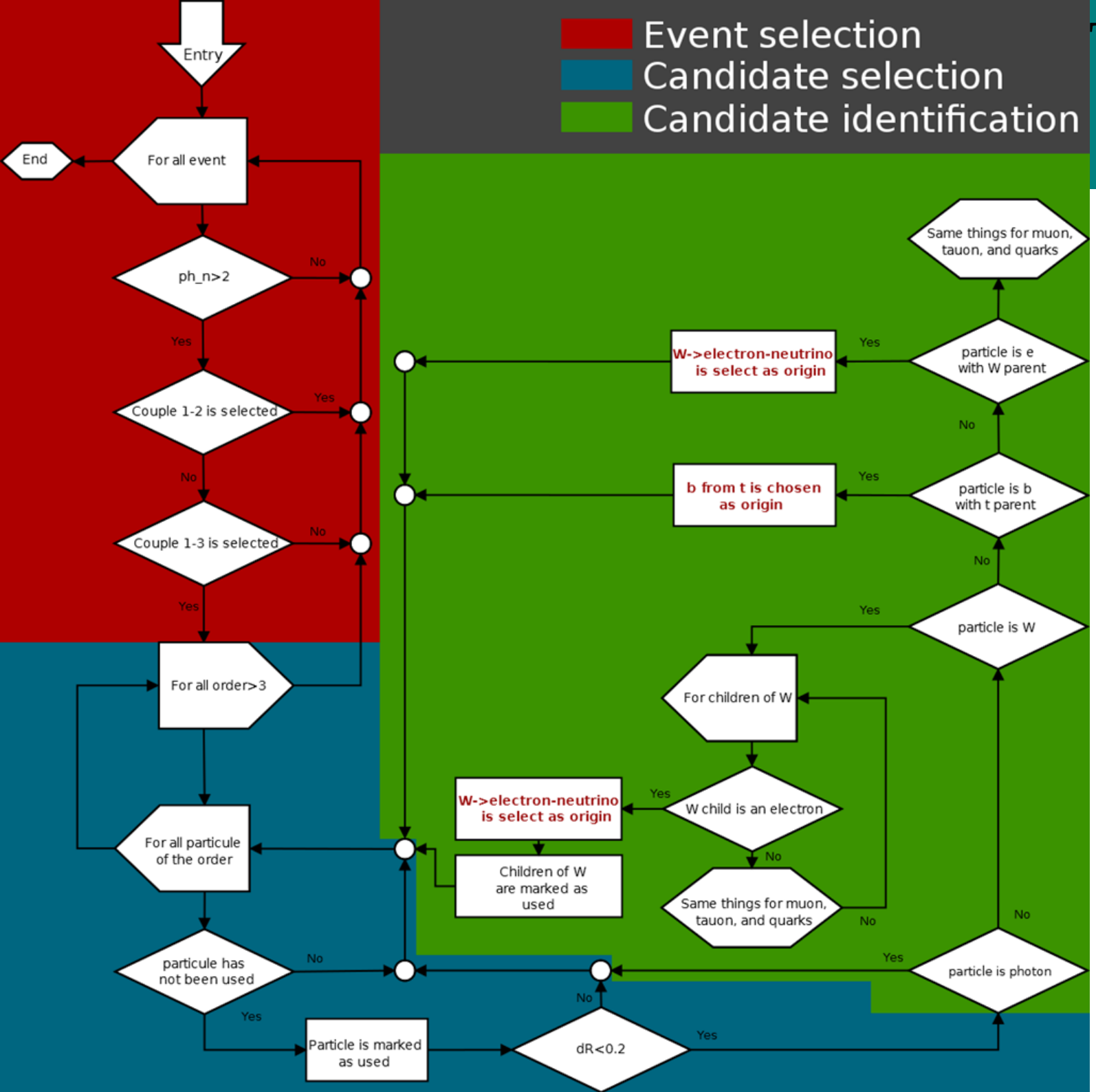
- The algorithm is composed of 3 part

- Candidate identification



The algorithm

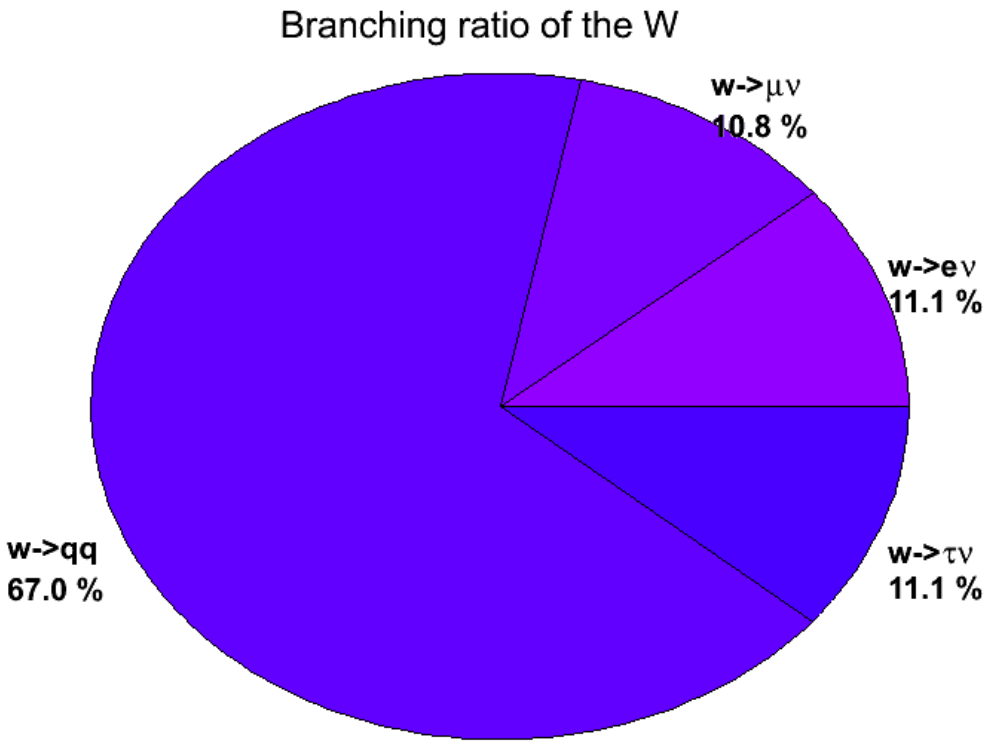
- The algorithm is composed of 3 part

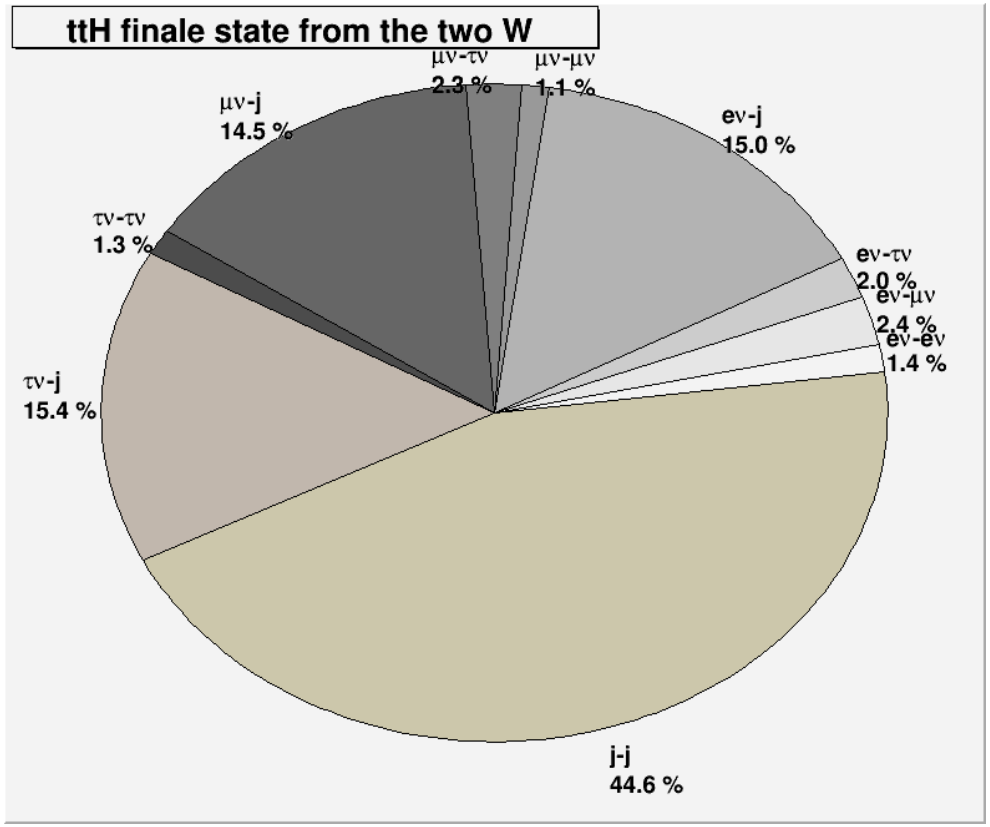


- The loops on the orders and on the particules are not broken when candidate is identified in order to not make an imbalance because of the double selection.

Validation of the algorithm

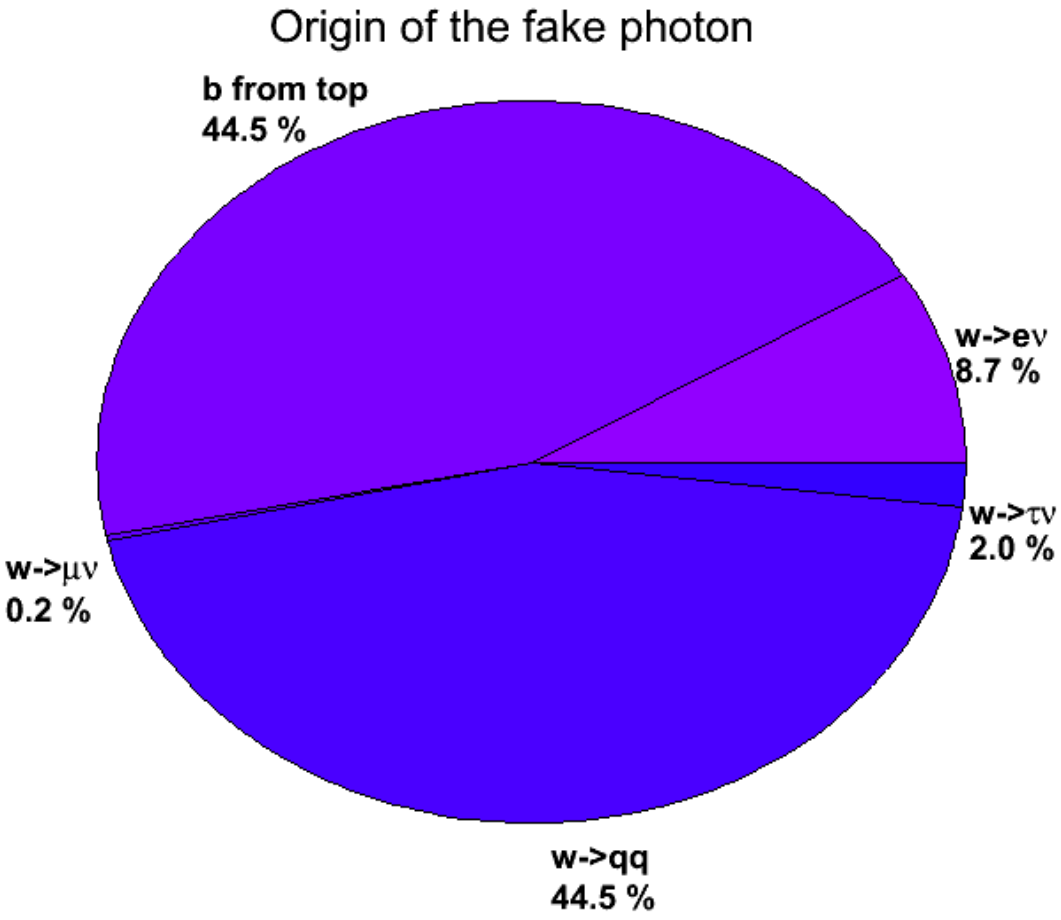
- Some branching ratio in order to validate the code :
  - Distribution in agreement with PDG data





Results

- Where does this fake photon come from?



- This fake photon seems come mainly from b and jet

Conclusion

- We have studied H reconstruction for ttH production process with H to γγ
- We found a lower H reconstruction efficiency on ttH compare to others processes.
- The efficiency loss in ttH can be explain by a fake photon mainly due to the b from top and W->qq.
- The identification of the fake photon could improve the efficiency from 0.79 to 0.87 by including third photon in H reconstruction.
- I will check a way of reconstruction on tt pair.