# Study on new possible variables to control QCD

J. Pela

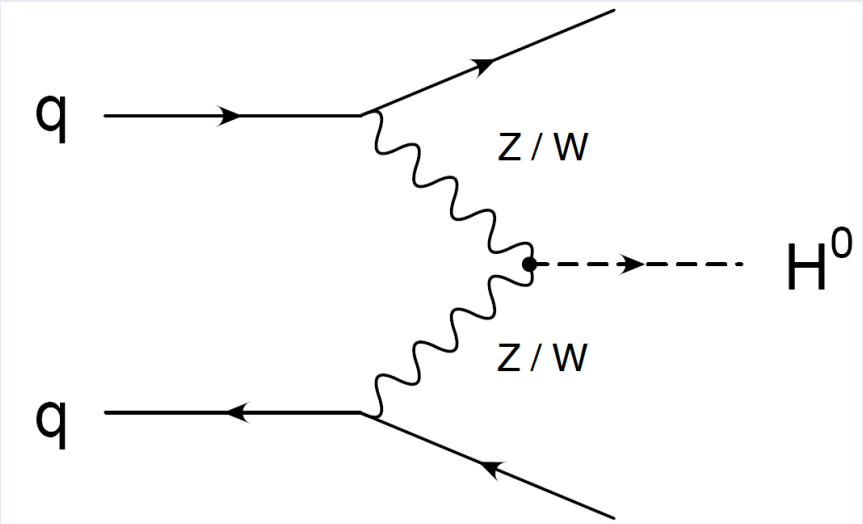
Imperial College London

2013-06-17

## Control of QCD

QCD is a major concern of our analysis, and the search for ways to control/estimate it a priority.

- The current event selection only uses variables over the dijet system of the the MET.
- Charateristics of the Dijet+MET system can be exploited to reduce the QCD background with minimal signal loss.
  - Total energy of selected objects (2 jets and MET).
  - Balance over MET and dijet system.



# Definition of variables

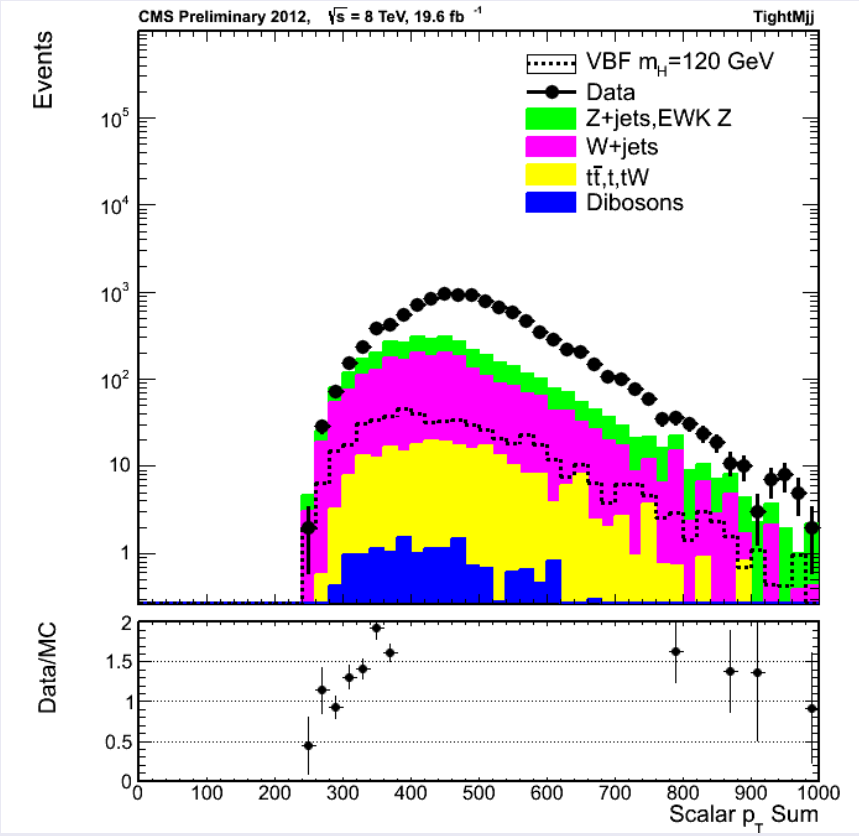
## Control of QCD

Three variable are being analyzed for possible use on this analysis

- Scalar Tri-Object Sum $= |pT(jet1)| + |pT(jet2)| + |MET|$
  - Similar to HT
  - The higher it is the better is average selected object resolution
- Dijet pT fraction $= p_T(dijet)/(p_T(dijet) + MET)$
  - Refects balance dijet+MET system
  - Signal should be highly concentrated around 0.5
- Vector Tri-Object Sum $= |VectorSum(pT(jet1) + pT(jet2) + MET)|$
  - Refects balance dijet+MET system
  - Signal should be highly concentrated around zero
  - Study underway to possibly include the jet and MET resolution in the variable

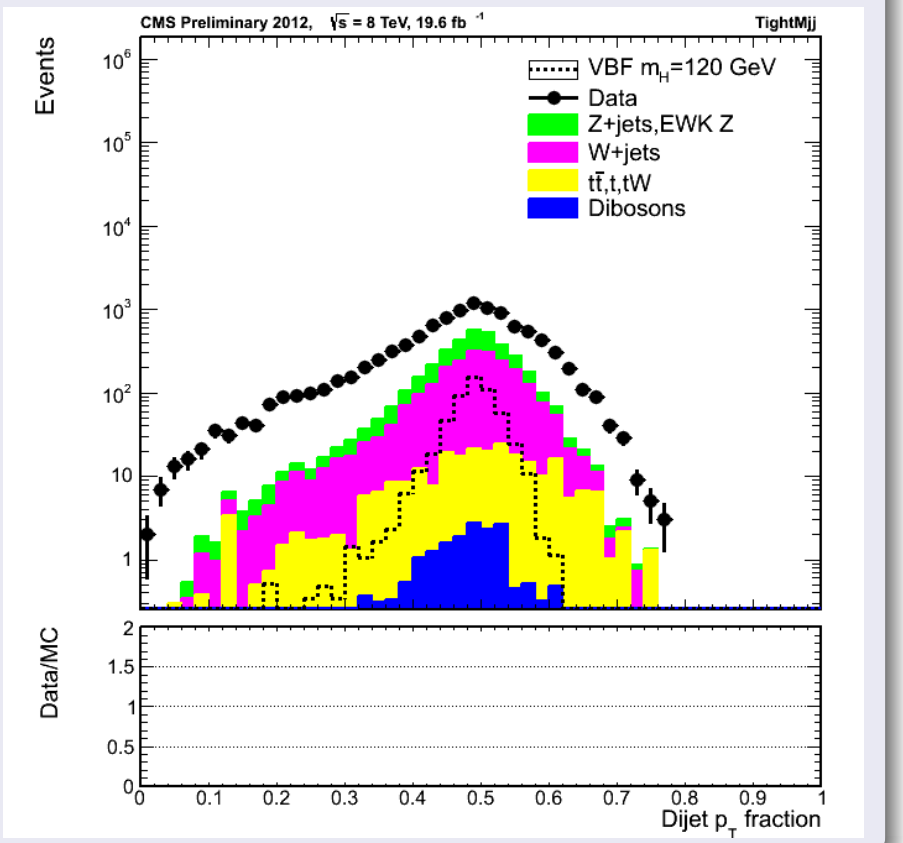
## Scalar Tri-Object Sum

- Like expected this variable by itself will not allow a big signal discrimination but conjugated with other variables it may be helpful.
- It can have the same role that HT has in conjunction with alphaT in the SUSY analysis.

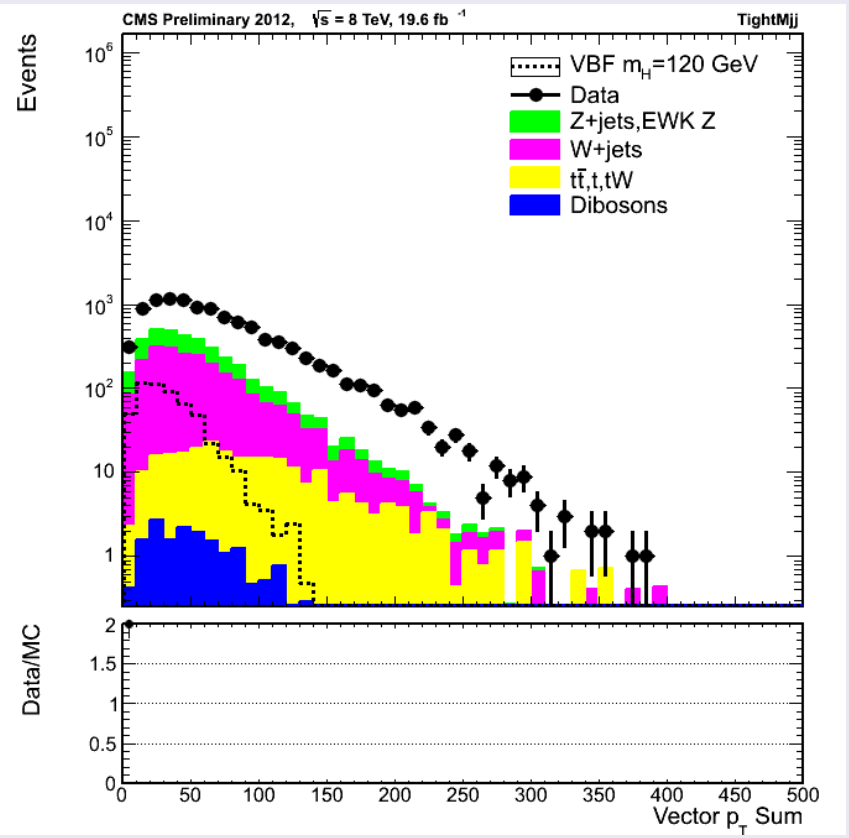


# Individual Variables after TightMjj

## After TightMjj cut

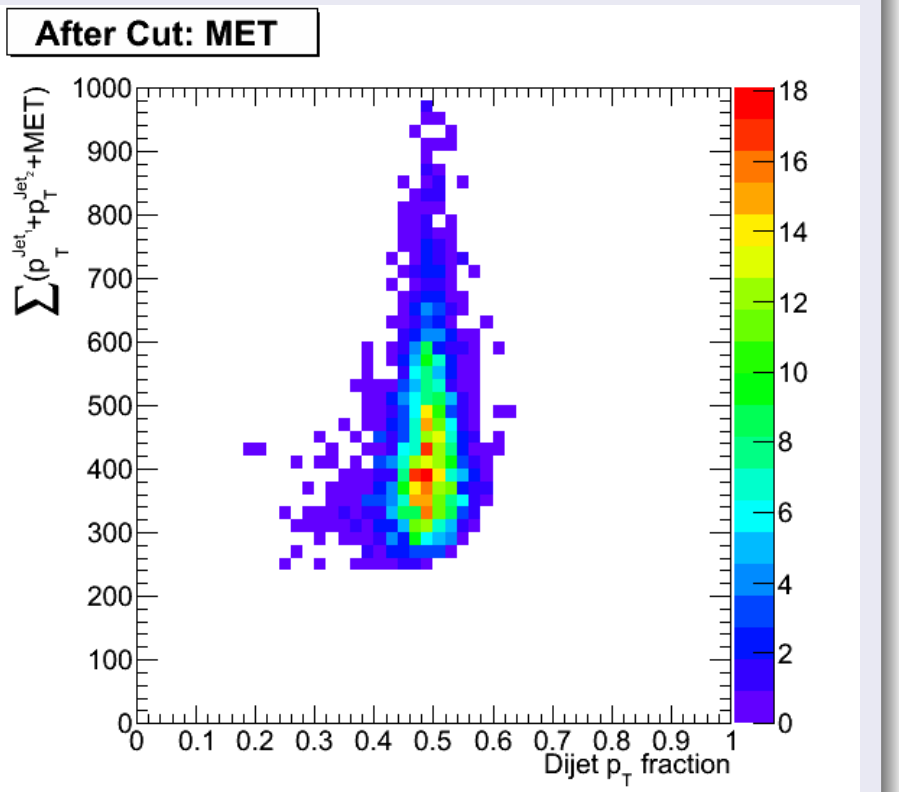



## After DijetFraction cut

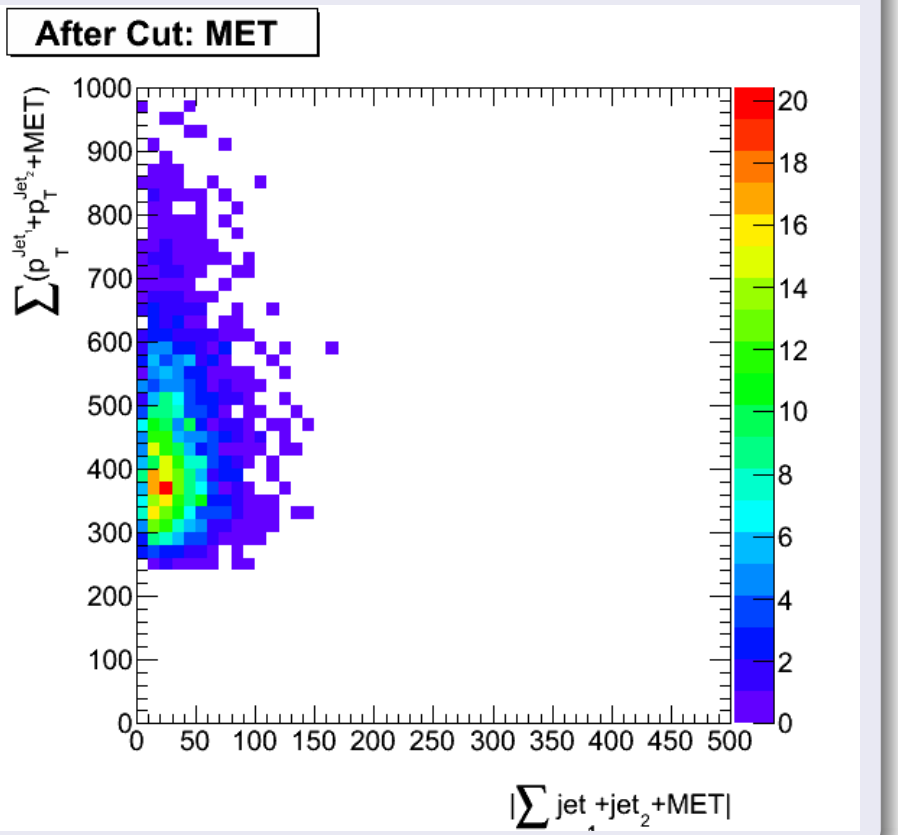


# 2D plots of variables on MC and Data at MET cut level

## After MET cut




## After MET cut



# Definition of test cut zones

## Dijet PT Fraction + scalar pT Sum

We can define a rectangle cut:

- Dijet PT Fraction := [0.46,0.54]
- Scalar pT Sum := [250,600]

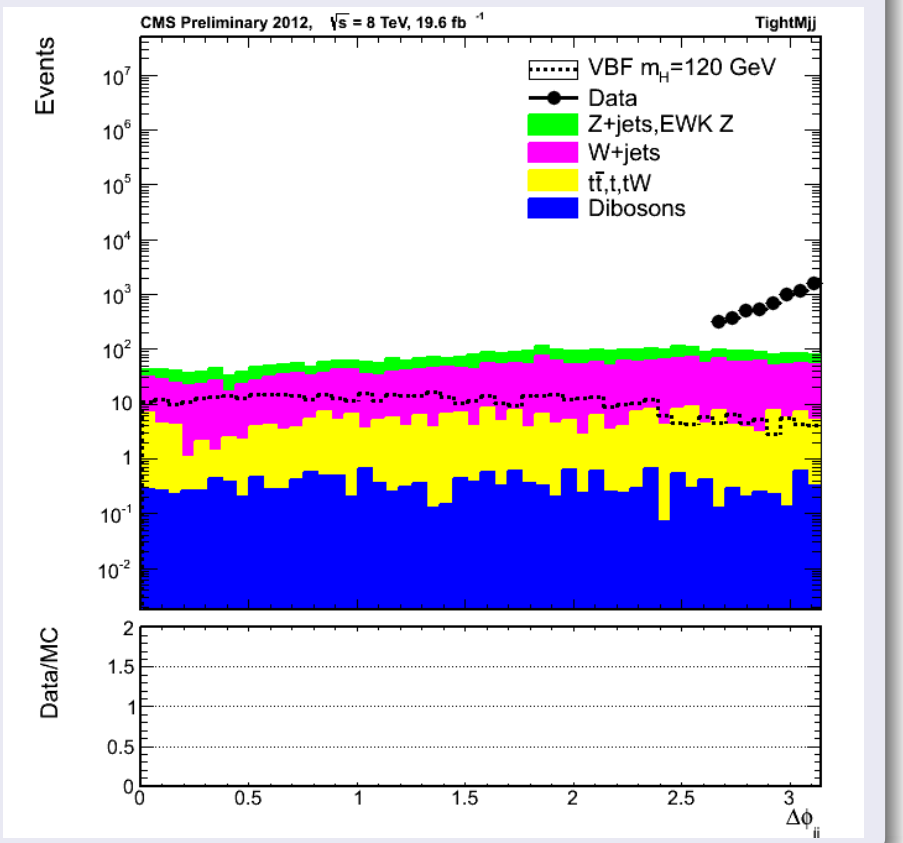
## Vector pT sum + scalar pT Sum

We can define a rectangle cut:

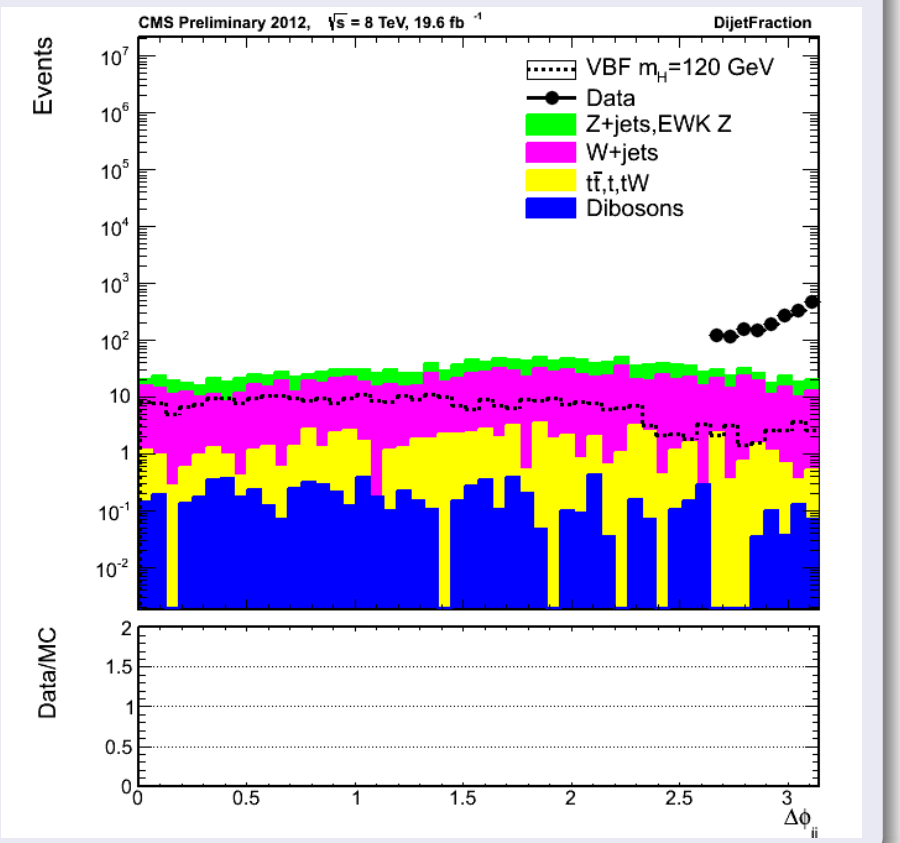
- Dijet PT Fraction := [0,40]
- Scalar pT Sum := [250,550]

# Plots before and after cut on *dphi* $> 2.6$ for DijetFrac

## After TightMjj cut




## After DijetFraction cut



# Event Yields DijetFraction

## After TightMjj cut

| Step | QCD | W+jets | Z+jets | SumMC | Data | Signal 120 |
|---|---|---|---|---|---|---|
| JetPair | 1529141 ± 103399 | 23443 ± 107 | 10769 ± 51 | 1571309 ± 103619 | 1435063 | 1440 ± 21 |
| AN | 23162 ± 2055 | 5192 ± 60 | 3534 ± 32 | 33018 ± 2179 | 32324 | 856 ± 18 |
| DEta | 605071 ± 46654 | 11333 ± 83 | 5123 ± 41 | 623389 ± 46813 | 576792 | 1171 ± 19 |
| MET | 8540 ± 1778 | 4250 ± 54 | 2795 ± 30 | 16186 ± 1885 | 16282 | 881 ± 17 |
| TightMjj | 6560 ± 1445 | 2032 ± 39 | 1357 ± 21 | 10256 ± 1521 | 10481 | 543 ± 14 |
| DijetFraction | 3035 ± 1163 | 895 ± 27 | 584 ± 14 | 4606 ± 1213 | *XXX* | 344 ± 11 |
| DPhiSIGNAL | 688 ± 688 | 217 ± 14 | 130 ± 7 | 1057 ± 714 | XXX | 137 ± 7 |
| DPhiQCD | 2206 ± 927 | 129 ± 10 | 73 ± 4 | 2421 ± 945 | 1873 | 22 ± 3 |

## Conclusions

- Variable that use the dijet+MET show signal discrimination potencial for our analysis.
- With first attempt of 2D cut, we have a factor of 3 reduction on QCD and keep 60% of signal.
- Vector $p_T$ sum, not presented today but similar discrimination is expectable.

## Next

- Finish Vector $p_T$ sum first study
- Optimize variables
- Include resolution effects (possible gains)