Reference Analysis RA4 Jet+Met+Lepton

(Status report)

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Reference Analysis

Hungarian SUSY group web page:
http://grid.kfki.hu/twiki/bin/view/CMS/SusySearch
Official web pages:
SUSY RA4 Project Tables: Single Muon + MET Signature

SUSY RA4 Project Tables: Single Muon + MET Signature

Goal:
Synchronization and error pruning of analysis codes of various groups.

Take care of the Grid jobs:
- New crab version is on the lxplus (Crab 2_6_0)
  Changes:
  - New Python version
  - [EDG]--> [GRID]
- be sure to have enough free space before using „crab –getoutput”
  crab tries to download without checking for space
  and sets the „cleared” state even when the output couldn’t be saved

Muon selections

Jet+Met+Muon:

Muon selections:

These are dummy cuts, do not have physics meaning.

Quantity	PAT Object and Member Function	Cut	Comment
Mu type	pat::Muon => isGood("GlobalMuonPromptTight")	GlobalMuonPromptTight	
p_T	pat::Muon => pt()	≥ 20 GeV	
abs(eta)	pat::Muon => eta()	≤ 2.1	
Rel. Isolation	pat::Muon => hcalIso(), ecalIso(), trackIso(), pt()	< 0.1	
chi^2/dof	pat::Muon => combinedMuon()->chi2(), combinedMuon()->ndof()	< 10	
abs(d_0)	pat::Muon => track()->d0 *	< 0.2 cm	
N hits	pat::Muon => track()->numvalhits()	≥ 11	
HCal Iso Deposit E	pat::Muon => hcalIsoDeposit->candEnergy()	< 6	
ECal Iso Deposit E	pat::Muon => ecalIsoDeposit->candEnergy()	< 4	

* this is the d0 from the track. The cut should be placed on the d0 w/ respect to the beam spot. The correspondence between the two is: $d0_{beamspot} = d0_{mutrack} - beamspot_x * sin(\phi_{mutrack}) + beamspot_y * cos(\phi_{mutrack})$

Note: relative isolation is calculated as

$$Isol = \left(\sum_{\Delta R<0.3} E_T(ECAL) + \sum_{\Delta R<0.3} E_T(HCAL) + \sum_{\Delta R<0.3} p_T(tracker)\right) / p_T(\mu)$$

Electron selections

Electron selections:

These are dummy cuts, do not have physics meaning.

Quantity	PAT Object and Member Function	Cut	Comment
p_T	pat::Electron => pt()	≥ 20 GeV	
abs(eta)	pat::Electron => eta()	≤ 2.5	
Id	pat::Electron => electronID("eidRobustTight")	robustTight	
Rel. Isolation	pat::Electron => hcalIso(), ecalIso(), trackIso(), et()	< 0.1	
abs(d_0)	pat::Electron => gsfTrack()->d0	< 0.2 cm	

* this is the d0 from the track. The cut should be placed on the d0 w/ respect to the beam spot. The correspondence between the two is: $d0_{beamspot} = d0_{eltrack} - beamspot_x * sin(\phi_{eltrack}) + beamspot_y * cos(\phi_{eltrack})$

Note: relative isolation for the electron is calculated as

$$Isol = \left(\sum_{\Delta R<0.3} E_T(ECAL) + \sum_{\Delta R<0.3} E_T(HCAL) + \sum_{\Delta R<0.3} p_T(tracker)\right) / E_T()$$

Jet & Met selections

Jet selections:
These are dummy cuts, do not have physics meaning.

Quantity	PAT Object and Member Function	Cut	Comment
p_T	pat::Jet => pt()	≥ 30 GeV	
abs(eta)	pat::Jet => eta()	≤ 2.4	
Hadronic energy fraction	pat::Jet => energyFractionHadronic()	≥ 0.1	

Met selections:
These are dummy cuts, do not have physics meaning.

Quantity	PAT Object and Member Function	Cut	Comment
MET	pat::MET => et()	> 100 GeV	

Synchronization cuts

Jet +Met+Muon:

Required in the events:

- Exactly one muon
- Zero elektron
- Three jet with p_T >=50 GeV
- E_{tmiss} >100 GeV

Chosen Correction

Our setup:

Jet selection:

- correction: RAW, OFF, REL, ABS, EMF, HAD, UE, PART, ERROR
- flavour: GLU, UDS, C, B, NONE

Jet Tags:

allLayer1JetsSC5, allLayer1Jets, selectedLayer1Jets

Met selection:

- correction:

uncorrALL (uncorrect to bare bones)
uncorrJES (uncorrect for JES (Jet Energy Scale) only)
uncorrMUON (uncorrect for MUON only)
uncorrMAXN ("none„, total uncorrected)

Met Tags:

allLayer1METsSC5, allLayer1METs, selectedLayer1METs

Results I.

Cut flow on the LM0 dataset:

Cut flow	Number of Events (% Efficiency)					
	UCSB*	Imperial	Vienna	Aachen	KIT	Debrecen
1-muon	1078.2 (9.80)	1120.8 (10.19)	1079(9.81)	1080.4 (9.82)	1079(9.8)	1079.38(9.81)
0-electrons	1017.0 (9.25)	1056.7 (9.61)	1018(9.26)	1019.2 (9.27)	995(9.0)	1018.21(9.26)
Jet cuts	579.0 (5.26)	599.1 (5.45)	597(5.43)	580.8 (5.28)	565(5.1)	579.88(5.27)
MET>100	381.3 (3.47)	395.5 (3.60)	395.3(3.60)	383.0 (3.48)	373(3.4)	382.22(3.47)

* UCSB only ran on 198686 out of the 202686 events in the LM0 Pattuple

Cut efficiency on the LM0, LM1 and Ttbar+jet datasets :

Cut flow	LM0						LM1						TT+jets					
	KIT	UCSB	Imperial	Vienna	Aachen	Debrecen	KIT	UCSB	Imperial	Vienna	Aachen	Debrecen	KIT	UCSB	Imperial	Vienna	Aachen	Debrecen
	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1-muon	9.8	9.82	10.15	9.80	9.82	9.81	7.8	7.80	7.95	7.76	7.80	7.77	13.2	13.30	13.58	13.27	13.32	13.27
0-electrons	9.0	9.39	9.58	9.36	9.39	9.26	7.3	7.56	7.58	7.47	7.51	7.41	12.4	12.77	12.83	12.69	12.78	12.53
Jet cuts	5.1	5.46	5.47	5.51	5.50	5.27	3.7	3.93	3.91	3.91	3.93	3.76	3.9	4.09	3.83	4.10	4.17	3.9
MET>100	3.4	3.62	3.11	3.65	3.64	3.47	3.3	3.51	3.31	3.53	3.51	3.38	0.75	0.84	0.72	0.83	0.85	0.76

Results II.

Process	Num evts in 100/pb						Efficiency (%)						Comments
	UCSB	Imperial	Vienna	Aachen	KIT	Debrecen	UCSB	Imperial	Vienna	Aachen	KIT	Debrecen	
LM0	398.1	347.1	393.25	400.4	373	382.22	3.62	3.15	3.575	3.64	3.4	3.47	05-10-2009
LM1	56.3	53.9	55.96	56.4	53.9	54.31	3.51	3.36	3.485	3.51	3.33	3.38	05-10-2009
LM2	9.4	9.2	9.22	9.3	8.8	9.05	3.88	3.80	3.809	3.86	3.66	3.73	05-10-2009
LM3	65.1	63.1	64.03	65.1	61.5	63.17	5.52	5.35	5.43	5.52	5.21	5.35	05-10-2009
LM4	31.0	31.1	30.46	31.0	29.6	30.28	4.62	4.64	4.54	4.63	4.42	4.52	05-10-2009
LM5	9.7	9.9	9.6	9.8	9.2	9.43	5.02	5.10	4.95	5.05	4.76	4.86	05-10-2009
LM6	9.5	9.5	9.1	9.5	8.8	9.02	7.41	7.42	7.1	7.44	6.9	7.07	06-05-09
LM7	8.3	8.1	8.01	8.3	7.8	8.03	2.87	2.79	2.76	2.87	2.68	2.77	05-10-2009
LM8	26.3	25.3	25.65	26.2	24.3	25.4	9.19	8.85	8.97	9.17	8.50	8.9	04-29-2009
LM9	28.1		27.5	28.1	26.3	27.13	2.43		2.37	2.43	2.27	2.3	04-29-2009
LM10						15.21						2.3	04-29-2009
LM11						18.99						5.9	04-29-2009
W + jets	106.8	146.0	104.3	113.2			0.0027	0.0036	0.0026	0.0028			04-29-2009
Z + jets	5.1	11.4		5.1	4	4.39	0.0014	0.0031		0.0014	0.001	0.0012	4-29-2009
ttbar	265.8	234.7	255.96	268.9	237	239.75	0.84	0.74	0.807	0.85	0.75	0.76	4-29-2009

Cuts update

Quantity	PAT Object and Member Function	Cut
Mu type	pat::Muon => isGood("GlobalMuonPromptTight")	GlobalMuonPromptTight
p_T	pat::Muon => pt()	≥ **10 GeV**
abs(eta)	pat::Muon => eta()	≤ 2.1
chi^2/dof	pat::Muon => combinedMuon()->chi2(), combinedMuon() ->ndof()	< 10
abs(d_0)	pat::Muon => track()->d0 *	< 0.2 cm
N hits	pat::Muon => track()->numvalhits()	≥ 11
Trk. Isolation	pat::Muon => trackIso()	< **6 GeV**
ECal Isolation	pat::Muon => ecalIso()	< **6 GeV**
HCal Isolation	pat::Muon => hcalIso()	< **6 GeV**

This was not run yet.

Selections

Jet+Met+Electron:

These are dummy cuts, do not have physics meaning.

Electron Selection

Quantity	PAT Object and Member Function	Cut	Comment
Id	electronID(eidRobustLoose)	eidRobustLoose	
p_T		≥ 20 GeV	
abs(η)		≤ 2.5	
Rel. Isolation		< 0.1	

Note:

- Electron should not be in the ECAL gap: 1.47 < abs(eta) < 1.567
- Relative isolation is calculated as:

$$Isol = \left(\sum_{\Delta R<0.3} E_T(ECAL) + \sum_{\Delta R<0.3} E_T(HCAL)\right) / p_T(e)$$

Jet Selection

Quantity	PAT Object and Member Function	Cut	Comment
p_T		≥ 25 GeV	
abs(η)		≤ 3.0	
EMFraction	emEnergyFraction()	≤ 0.9	

Synchronization cuts

Jet +Met+Electron:

Required in the events:

- passes single electron trigger (HLT_Ele15_LW_L1R)
- Exactly one electron
- Three jet with:

  p_T >= 50 GeV

  Abs(η)<3.0

  EMFraction<0.9
- E_{tmiss} >100 GeV

Results

LM0 dataset:

Weight: $\sigma = N/L$, σ - cross section
N - total event number
L - luminosity

$L = 202686/110\ pb^{-1} = 1842,6\ pb^{-1}$

$w = 100\ pb^{-1}/1842,6\ pb^{-1} = 0,05427$

	N	w*N	Efficiency
total event number:	202686	10999,77	
After hlt cut:	202686	10999,77	100
After number of electron cut:	17144	930,4	8,5
After jet cut:	9741	528,64	4,8
After met cut:	6370	345,7	3,1

Conclusion:
There is a bug in the trigger selection code.

Background synchronization

SUSY RA4 Single Lepton + MET Signature: Data driven background methods

Muon, electron, jet, met selection cuts are the same as in the Jet+Met+Muon code.

Backgroud estimation algorithms:

- Chi2
- MET, MET/sumEt
- ABCD
- 8 fields
- Rubik's Cube
- Topbox

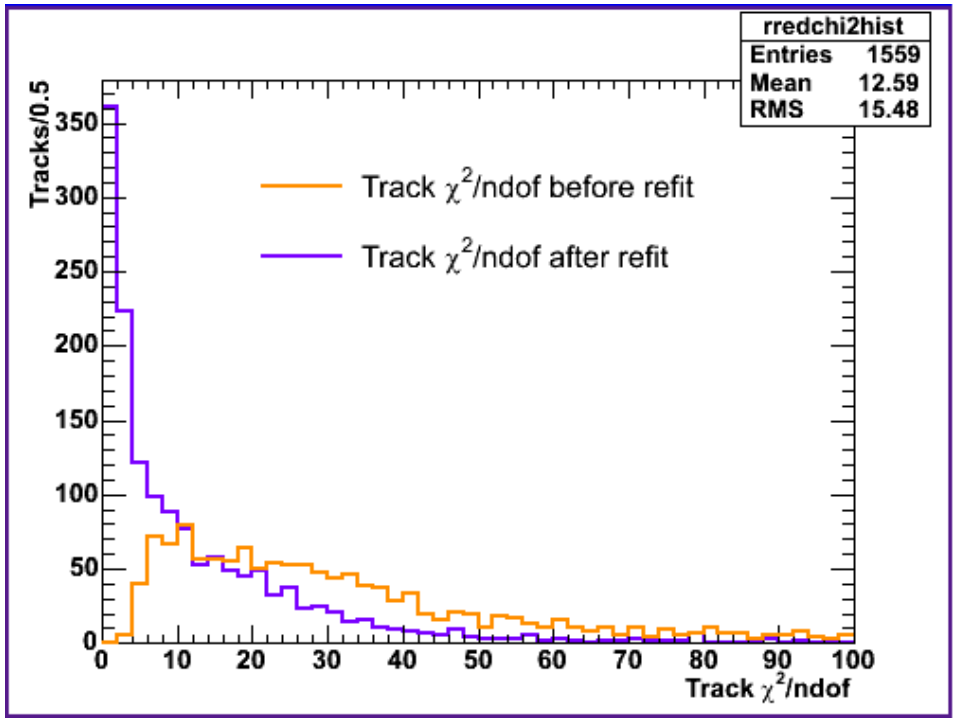
We would like to find a good method to separate the signal from the background .

Gregor Kasieczka:
Extension of ABCD Method to more than two variables

Chi2 & MET, MET/sumEt

$$\chi^2 = (M_{j_1 j_2} - M_W)^2/{\sigma_{jj}}^2 + (M_{j_1 j_2 j_3} - M_t)^2/{\sigma_{jjj}}^2 + (M_{W_l j_4} - M_t)^2/{\sigma_{\mu\nu j}}^2$$

Ttbar: smaller values
Signal: bigger values
For example:



Met: It would look like as this plot.

ABCD

HEPHY Institute of High Energy Physics

OAW Austrian Academy of Sciences

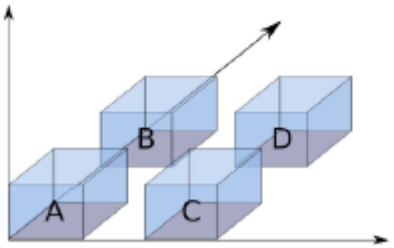
ABCD Method

Data driven BG estimation in two independent variables

➔D=B*C/A

Problems:

- correlation
- signal contamination



- New methods try to address these problems
- BUT not everything is possible for early data
- Don‘t want MC dependence
- Accept only weak dependence on SUSY scenario
- Method MUST work on BG only

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8 fields

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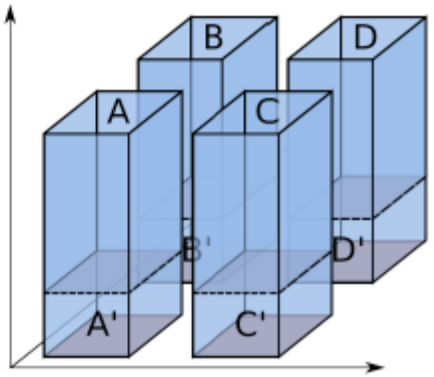
8 Fields / Estimate Correlation

- We want to **estimate correlation** from **data**
- Measure correlation in signal depleted subregion A‘B‘C‘D‘
- Transport it into full ABCD regions to correct measurement

- Desired Method for extension of ABCD:
  D = k‘ * B * C / A

- Measure k‘ in signal depleted subregion as:
  k‘ = (A‘/B‘)/(C‘/D‘)



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Rubik's Cube

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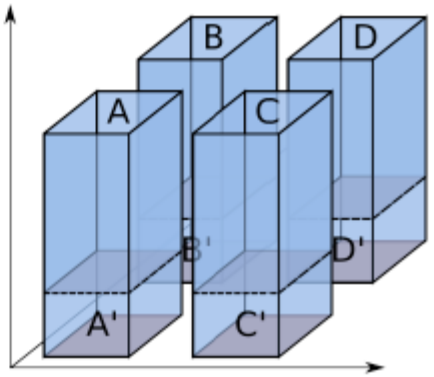
Rubiks Method

- Attempt to improve 8 Fields by avoiding contamination
- Strong signal contamination in regions B and C
- If variables allow estimate on the SIDES of the cube:

  B = B‘*A/A‘

  C = C‘*A/A‘
- Combine with estimation for k from 8 fields
- Result:

  D = D‘*A/A‘
- Trade-Off between effect of correlation and signal contamination!



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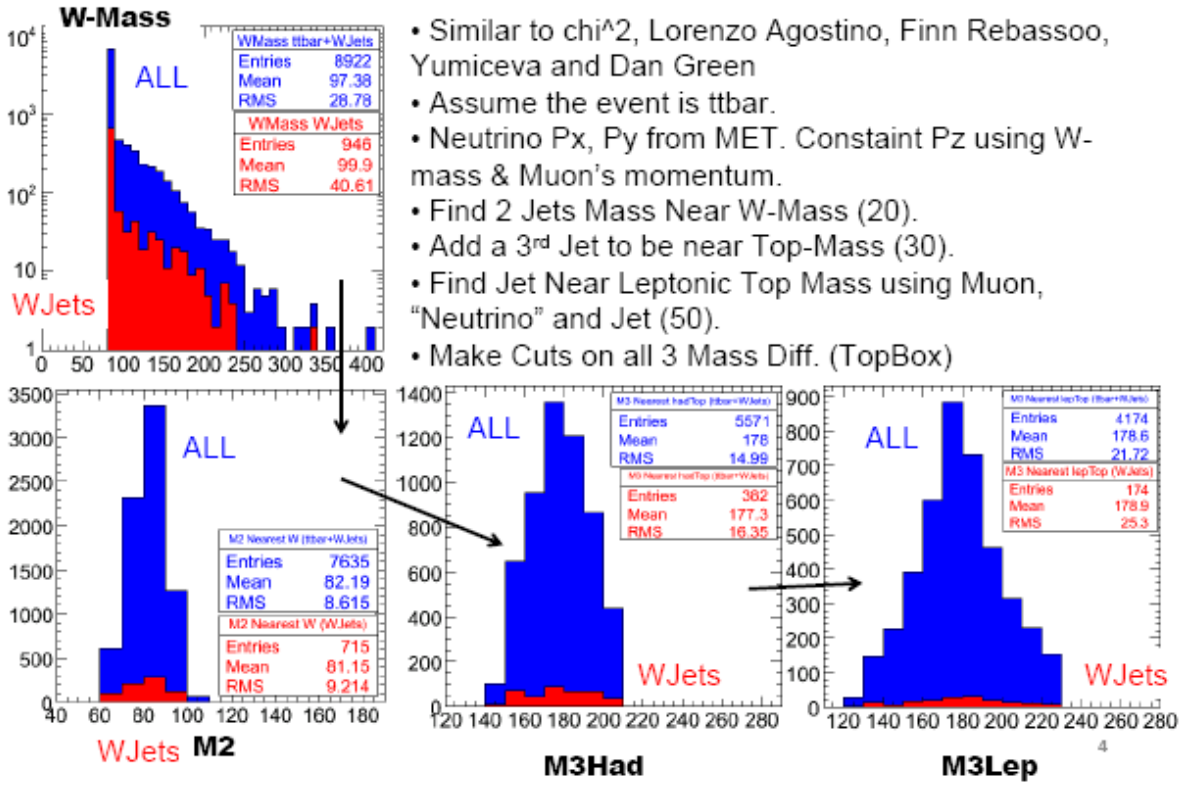
Topbox

Wing To: [Studying jet charge for top reconstruction]

Review of the TopBox



- Similar to chi^2, Lorenzo Agostino, Finn Rebassoo, Yumiceva and Dan Green
- Assume the event is ttbar.
- Neutrino Px, Py from MET. Constaint Pz using W-mass & Muon's momentum.
- Find 2 Jets Mass Near W-Mass (20).
- Add a 3rd Jet to be near Top-Mass (30).
- Find Jet Near Leptonic Top Mass using Muon, "Neutrino" and Jet (50).
- Make Cuts on all 3 Mass Diff. (TopBox)

To do list

Jet+Met+Muon selection:
- Preparing more physical cuts together with the other groups

Jet+Met+Electron selection:
- Found the bug in the trigger selection
- Run the code to all dataset

Background synchronization:
- Understand better the algorithms
- Look for a new, better algorithm
- Do the cuts

Thank you for your attention!

Questions?