Homeworks

❑ Exercise 1: can we discover the chargino at LHC ?

- Download the new version of the macro from http://www.cern.ch/pralavop/SUSYAnalyzer.tar.gz
  - ✓ *Dated from 07-Nov 2013*
- When downloaded: tar -xzvf SUSYAnalyzer.tar.gz; cd SUSYAnalyzer and follow README
- Originally setup for ROOT 5.34.05. Works for 5.28/00 onwards.
- Next slide shows a reminder of what we found during the exercise (for emu channel).
- **Two homeworks are detailed in the following 2 slides**

❑ Exercise 2: can we exclude m(gluino)<1 TeV?

- **One homework is detailed in the last slide**

❑ Send answers by End of November.

- In case of questions, don't hesitate to contact me (pascal.pralavorio@cern.ch)

Exercise 1: Reminder

❑ Results found in the emu channel

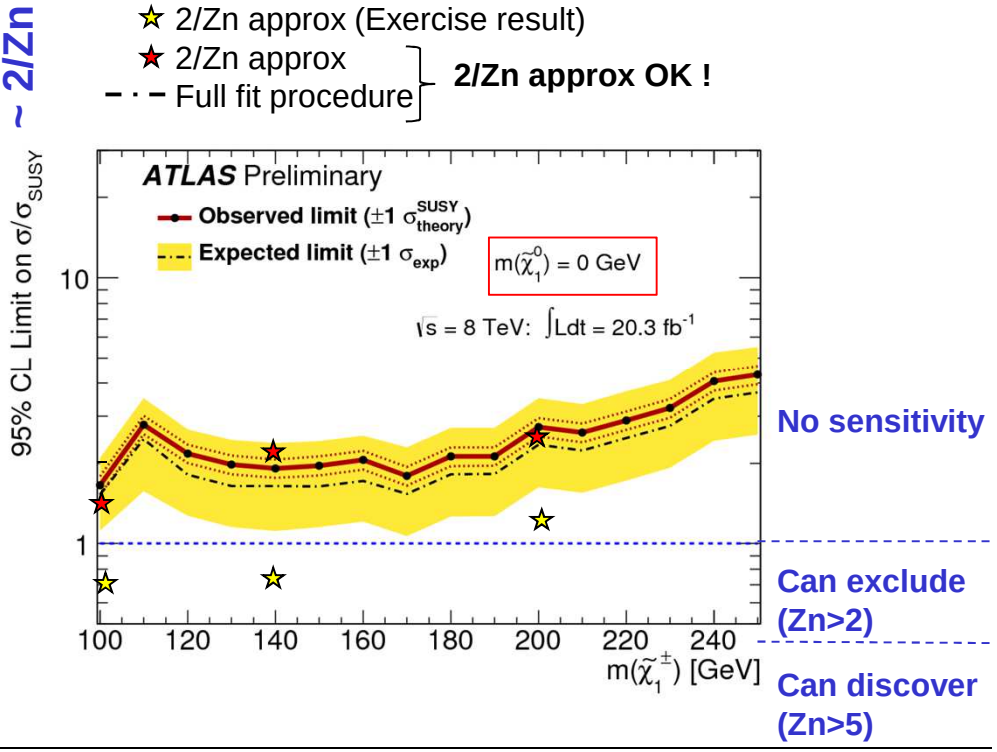
- Results from ATLAS-CONF-2012-049 and from the exercise (yellow)

	SR-*WW*a	SR-*WW*b	SR-*WW*c
lepton flavour	$e^{\pm}\mu^{\mp}$		
$p_{\mathrm{T}}^{\ell 1}$	> 35 GeV		
$p_{\mathrm{T}}^{\ell 2}$	> 20 GeV		
$m_{\ell\ell}$	< 80 GeV	< 130 GeV	—
$p_{\mathrm{T},\ell\ell}$	> 70 GeV	< 170 GeV	< 190 GeV
$\Delta\phi_{\ell\ell}$	< 1.8 rad		
$E_{\mathrm{T}}^{\mathrm{miss,rel}}$	> 70 GeV	—	
m_{T2}	—	> 90 GeV	> 100 GeV

	SR-*WW*a	SR-*WW*b	SR-*WW*c
Observed	123	16	9
Background total	117.9 ± 14.6	13.6 ± 2.3	7.4 ± 1.5
Top	15.2 ± 6.6	2.7 ± 1.1	1.0 ± 0.7
WW	98.6 ± 14	10.2 ± 2.1	5.9 ± 1.3
ZV (*V* = *W* or *Z*)	3.4 ± 0.8	$0.26^{+0.31}_{-0.26}$	0.29 ± 0.14
Higgs	0.76 ± 0.14	0.21 ± 0.06	0.10 ± 0.04
fake	$0.02^{+0.33}_{-0.02}$	$0.26^{+0.30}_{-0.26}$	$0.12^{+0.17}_{-0.12}$
Signal expectation			
$(m_{\tilde{\chi}_1^\pm}, m_{\tilde{\chi}_1^0})$ = (100, 0) GeV	31	N/A	N/A
$(m_{\tilde{\chi}_1^\pm}, m_{\tilde{\chi}_1^0})$ = (140, 0) GeV	N/A	5.1	N/A
$(m_{\tilde{\chi}_1^\pm}, m_{\tilde{\chi}_1^0})$ = (200, 0) GeV	N/A	N/A	3.3
$(m_{\tilde{\chi}_1^\pm}, m_{\tilde{\chi}_1^0})$ = (110, 113) GeV	18	4.3	N/A

Eff=0.3% 0.7% 78 | 12% 151 | 17% Eff=0.2% 0.5% 13.1 | 20% 9.4 | Eff=0.4% 7.7 | 3.3 6.6 | 0 | 0 | 0

Zn (σ/σSUSY at 95%CL~ 2/Zn) 1.5 (1.3) 3(0.7) 1.0 (2.1) 2.9(0.7) 0.8 (2.4) 1.7(1.2)



Comments: **truth level optimistic wrt published results**

1- No smearing in high tails (will affect S and B differently)
i) S(reco)=S(true)/2 and ii)B(reco)=B(true)/1.5 [1] for SRWWa [b,c]

2- Other background not completely negligible (Counts for 20-30%)

3- Scale factors not 1 in Control Region (1.2 for WW)

Exercise 1: Homework (1)

1. Redo sensitivity studies for ee *(channel=0)* **and mumu** *(channel=2)***. What do we gain ?**

- Assume WW still dominant since Z+X background can be killed by a Zveto
- Design signal regions for SUSY signal and compute Zn(**ee**) and Zn(**mumu**)
- Compute the new sensitivity for each SUSY signals as $Zn(tot)=\sqrt{Zn(ee)^2+Zn(mumu)^2+Zn(emu)^2}$

→ **Prepare a 3 page summary report (latex format):**

i) to motivate the cut chosen for ee and mumu signal region (show 1 typical distribution, Nb of WW&SUSY after all cuts),

ii) to present the combination result in the form 2/Zn vs M(C1) for ee, emu, mumu and tot

Exercise 1: Homework (2)

2. Can you discover the Higgs boson (H→WW) ?

- Focus on the **emu** channel
- Assume same preselection as for SUSY and **WW**=dominant background
- Design a signal region to find the H→WW. Compute the corresponding Zn. Can we discover the Higgs boson in this channel at $\sqrt{s}$=8TeV and L=20 fb-1 ?

→ **Prepare a 3 page summary to explain your result (latex format)**

Exercise 2: Homework (3)

3. Extract relevant information from a ATLAS/CMS paper

- Choose one ATLAS/CMS paper searching for gluinos (Could be the one you look at during the exercise session)

https://twiki.cern.ch/twiki/bin/view/AtlasPublic/SupersymmetryPublicResults
https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsSUS
https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsEXO

- Extract from the paper the following information

1- Which Experiment ? Which Hypothesis on R-parity ? Which LSP (N1 or Gravitino) ?
2- Which gluino decay ? (if several concentrate on one)
3- Main information from the analysis: main discriminating variable, main background
4- In this case, extract the plot showing the limit on the gluino. Quote the number for m(LSP)=0 and 500 GeV (if limit exists !)
5- Find the corresponding analysis from the other experiment and compare in few lines the two results

→ **Prepare a 3-page report (latex format) with all these information.**