

考核报告

(2022年8月 - 2022年12月)

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■ ATLAS实验物理分析

1. $\tilde{\chi}_1^\pm \tilde{\chi}_1^\mp$ 与 $\tilde{\chi}_1^\pm \tilde{\chi}_2^0 \rightarrow \tilde{\tau} \rightarrow \geq 2\tau + MET$ 过程
2. $\tilde{\chi}_1^\pm \tilde{\chi}_2^0 \rightarrow Wh \rightarrow 2\tau + 1l + MET$ 过程
3. *pMSSM* Reinterpretation
4. *EWK 2-Tau* 分析的 RPC-to-RPV Reinterpretation

■ ATLAS实验，tau子的in-situ能量刻度

■ 未来计划

ATLAS实验 $\tilde{\chi}_1^\pm$ 与 $\tilde{\chi}_2^0$ 的寻找

ICHEP 2022: [ATLAS-CONF-2022-042](https://atlas.conf-2022-042)

1. $\tilde{\chi}_1^\pm \tilde{\chi}_1^\mp$ 与 $\tilde{\chi}_1^\pm \tilde{\chi}_2^0 \rightarrow \tilde{\tau} \rightarrow \geq 2\tau + MET$ 过程
2. $\tilde{\chi}_1^\pm \tilde{\chi}_2^0 \rightarrow Wh \rightarrow 2\tau + 1l + MET$ 过程: **ATLAS首次研究**

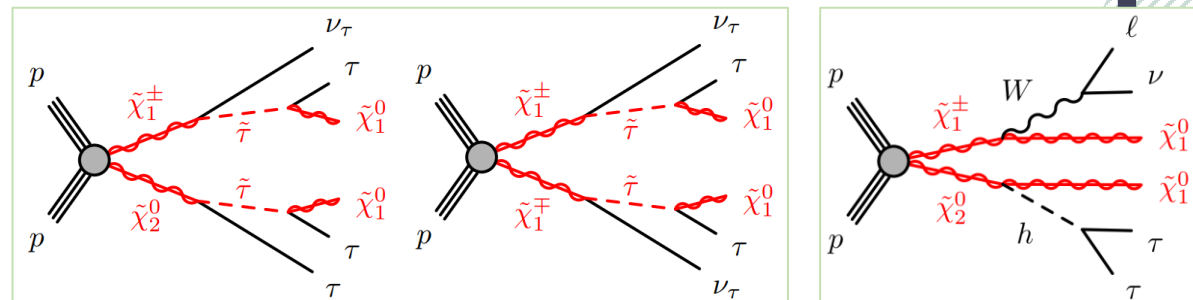
■ 工作: 全组样本产生工作、分析(1)的理论误差计算与最终结果, 分析(2)的全部分析工作。担任Support note editor, 课题组SUSY3 derivation联系人、课题组EWK combination联系人, 做了ATLAS Approval Talk。

■ 进展:

- 帮助 Direct stau channel 产生新的 ntuple.
- 准备过程1 与2 的HEPData: <https://www.hepdata.net/record/sandbox/1672820798>

■ 计划:

- 完成文章所需的收尾工作。



HEPData Sandbox

Upload New Files

Download All

Filter 27 data tables

Overview

Overview of HEPData Record

Exclusion contours:

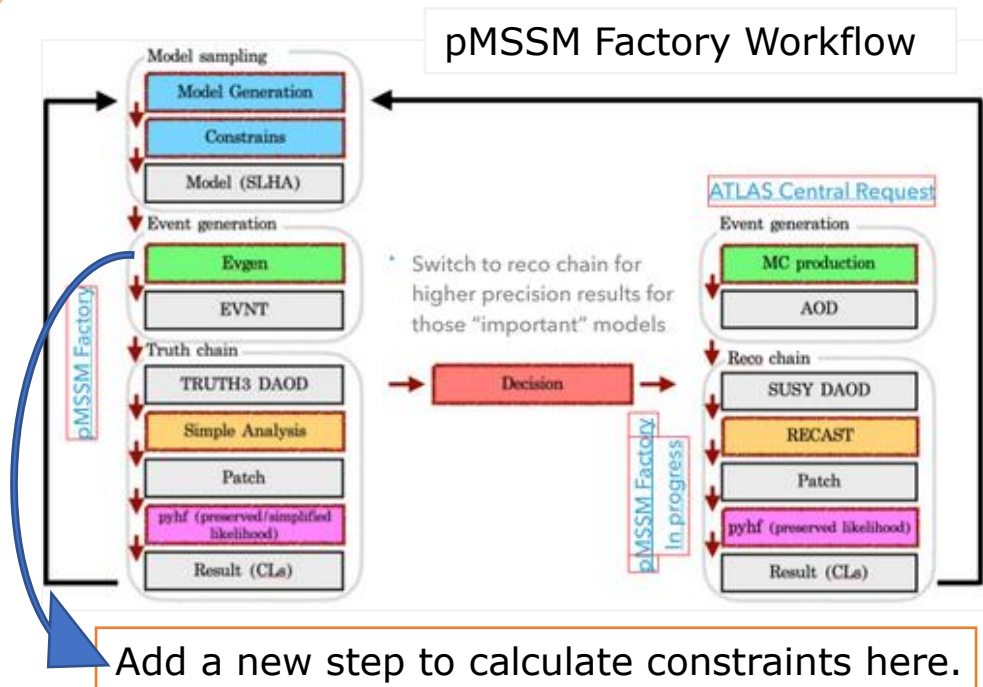
- C1C1 exclusion contour (Obs.)
- C1C1 exclusion contour (Obs. Down)
- C1C1 exclusion contour (Obs. Up)
- C1C1 exclusion contour (Exp.)
- C1C1 exclusion contour (Exp. Down)
- C1C1 exclusion contour (Exp. Up)
- C1C1+C1N2(OS) exclusion contour (Obs.)
- C1C1+C1N2(OS) exclusion contour (Obs. Down)
- C1C1+C1N2(OS) exclusion contour (Obs. Up)
- C1C1+C1N2(OS) exclusion contour (Exp.)
- C1C1+C1N2(OS) exclusion contour (Exp. Down)
- C1C1+C1N2(OS) exclusion contour (Exp. Up)
- With exclusion contour (Obs.)

Papers

- ☒ **observed upper limit** on the signal cross section overlaid for each grid point ("the little grey numbers"). In a table in the aux material. Optionally, the expected upper limit on the cross-section can be provided
- ☒ the observed and expected exclusion **contour lines** in **Tgraph**, a list of (x,y)
- ☒ **plot** showing which signal region is used for which grid point (expected CLs).
- ☐ **acceptance (A) & efficiency (Eps)**.
- ☐ the **truth code**, and XML for MVA analysis.
- ☐ **SR Plots**.
 - N-1 plots,
 - as presented in publication (no additional plots), We do **not** upload plots in the control regions to HEPdata
 - SR plots: **eg**, the effective mass or missing transverse momentum distributions
 - **table (one per plot)**, where the rows correspond to the plot bins
 - all backgrounds should be lumped together.
 - statistical and total systematic uncertainties are given separately for the background.
 - data counts given along with the statistical uncertainties,
 - signal benchmark point(s), ideally the same that is (are) used for the cut-flow table,
- ☒ **Analysis likelihood** public <https://twiki.cern.ch/twiki/bin/view/AtlasProtected/LikelihoodValidation>.
- ☒ SLHA

pMSSM Reinterpretation

pMSSM Factory Workflow



- 目的：目前ATLAS SUSY组主要使用SUSY简化模型的作为信号模型，并没有考虑超对称粒子间的关联，所以我们计划使用所有Run-2的分析定义的信号区限制pMSSM模型的参数，得到更真实的排除限。

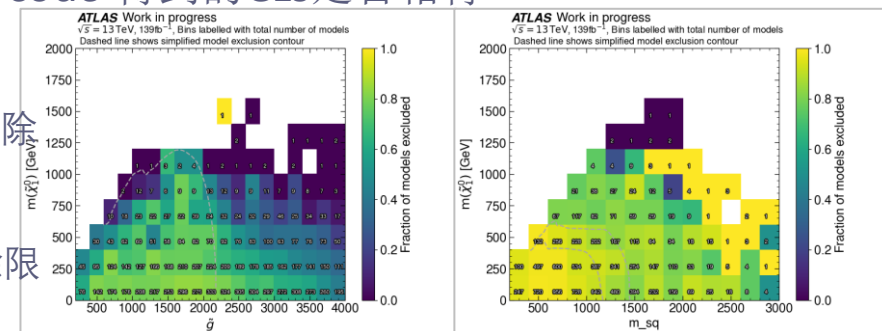
- 帮助搭建pMSSM workflow
- 计算非直接寻找SUSY的实验对pMSSM参数的约束
- SUSY Strong production 的扫描工作 (General pMSSM scan)

进展

- 通过随机产生的10万个信号模型，得到了gluino与squark的初步的排除限。
- 检查了pMSSM信号点与simplified模型的信号点通过 SUSY Strong analyses 的 truth code 得到的CLs是否相符

例：

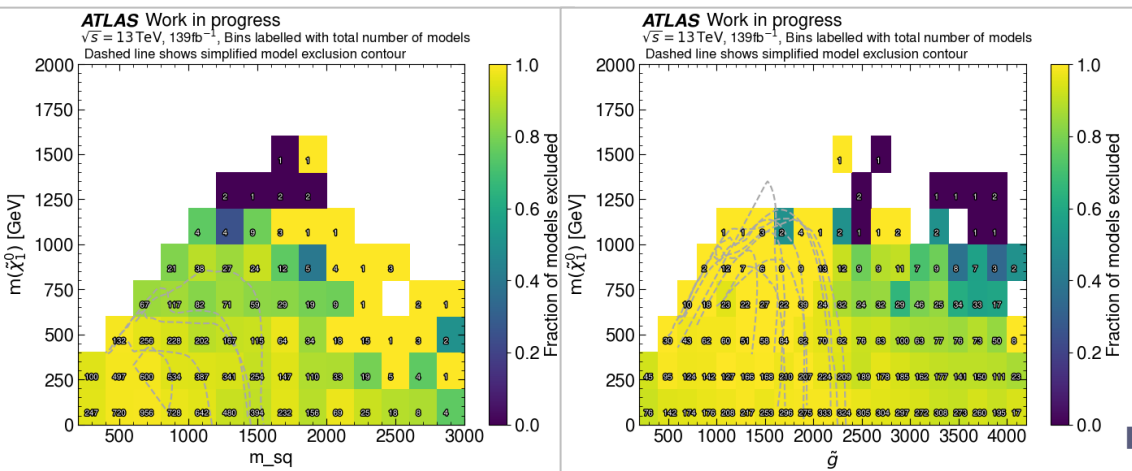
1L的gluino-LSP排除限和
0L multi bin的
squark-LSP的排除限



- 挑选了276个 CLs 处于 $[0, 0.1]$ 之间的具有代表性的信号点，申请 Full Reco 样本 [\[jira\]](#)

计划

- 完成General pMSSM scan的后续工作

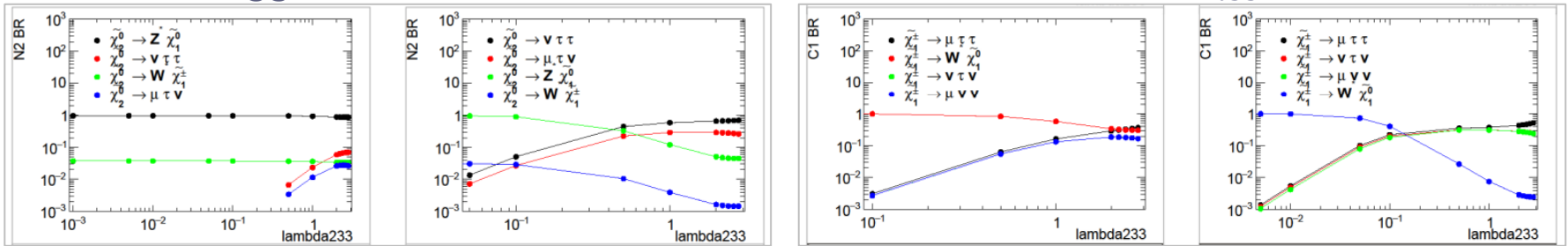


RPC-to-RPV reinterpretation

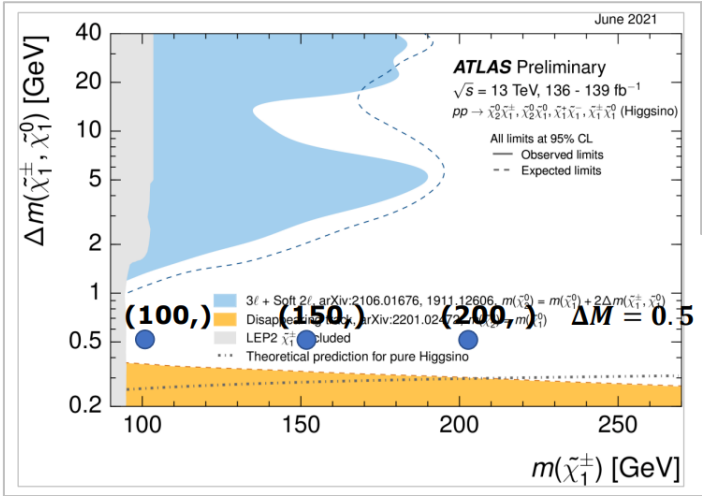
- 目的: SUSY模型中可以存在破坏重子数或轻子数守恒的项, 通过人为引入R宇称并要求R宇称守恒 (RPC) 可以使重子数与轻子数的守恒。此研究的目的是使用RPC $\tilde{\chi}_1^\pm \tilde{\chi}_1^\mp / \tilde{\chi}_1^\pm \tilde{\chi}_2^0 \rightarrow \tilde{t}/Wh \rightarrow \geq 2\tau(+1l) + MET$ 过程的信号区对RPV过程进行约束, 这是首次对Higgsino λ_{i33} 衰变进行研究。

- 进展:

- 目前我们主要关注higgsino-like C1/N2/N1过程, 得到了 SUSY粒子的衰变与 λ_{i33} 的关系



- 在SUSY Run 2 Summaries组报告并申请了54个信号点, 目前正在产生: [jira]



	Signal Mass	MC16a	MC16d	MC16e	10 ¹ ,10 ⁰ ,10 ⁻¹	10 ⁻² ,10 ⁻³ ,10 ⁻⁴	Processes
For each higgsino process	(100,99.5)	200k	200k	200k	× 2	× 1	+3
	(150,149.5)	200k	200k	200k			
	(200,199.5)	200k	200k	200k			

- 计划:

- 申请的信号点里有6个过程有较高的优先级, 利用他们进行后续的研究。

ATLAS实验中tau子的in-situ能量刻度 (in-situ TES)

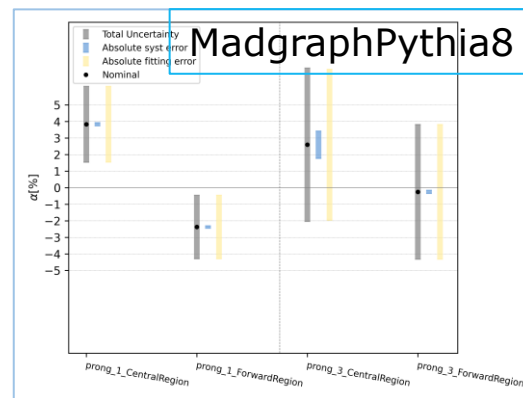
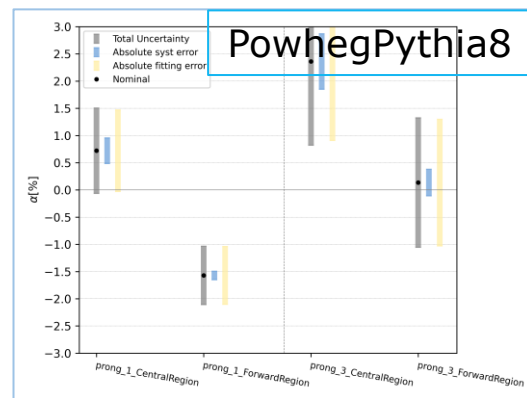
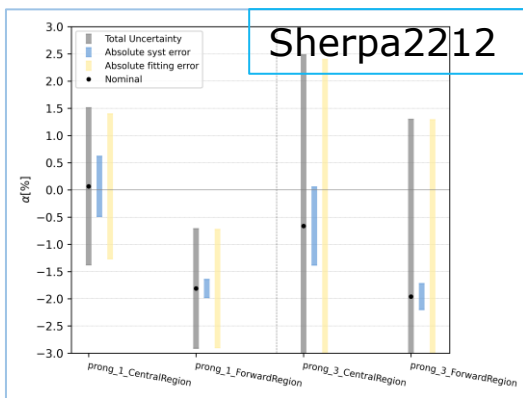
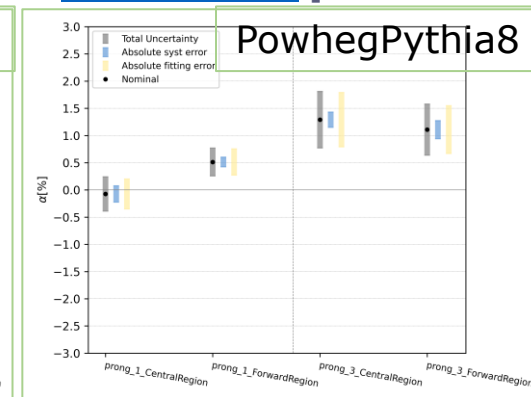
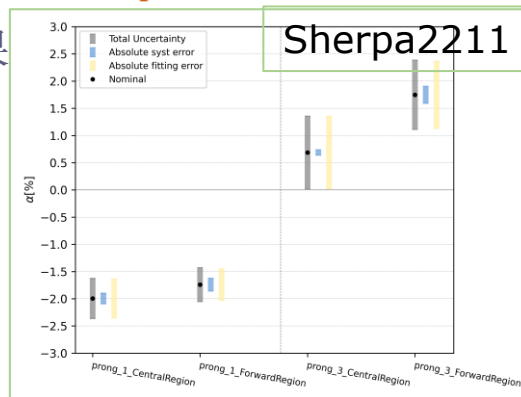
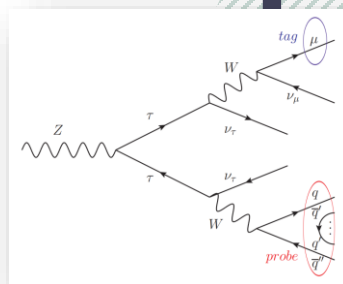
■ 目的: 使用tag-and-probe方法对 τ 子四动量修正以使蒙卡模拟更接近真实的实验数据, 作为R22的tau recommendation

■ 进展:

● 在CLHCP2022上报告了in-situ TES与tau ID SFs的pre-recommendation [contribution]

● 完成了Run-2 reprocessing (MC20) 的结果

● 得到了Run-3 (MC21) 的初步结果



■ 计划:

● 尝试解决Run-3阶段MC的统计量过低而导致误差过大的问题。

● 目前Run-2 reprocessing的结果还没有在组内报告, 计划假期结束后进行组内讨论, 确定Recommendation。

● 准备Note所需的材料。

未来计划

- Di-tau末态的electroweakino与stau的寻找：
 - 完成收尾工作，计划上半年发表一篇文章
- Tau performance
 - 尽早给出MC20与MC21的recommendation，计划今年完成note。
- pMSSM reinterpretation:
 - 继续研究，得到General pMSSM scan的结果，计划年中发表一篇文章。
- RPC to RPV reinterpretation:
 - 尽快进行后续的研究，计划今年发表一篇文章。
- 参加ITK相关的工作，了解硬件。

报告链接

- CLHCP: <https://indico.ihep.ac.cn/event/16608/contributions/121346/>
- SUSY EWK-2tau Working group
 - <https://indico.cern.ch/event/1222380/#36-compressed-stau>
- General pMSSM meeting
 - <https://indico.cern.ch/event/1201417/#1-roundtable>
 - <https://indico.cern.ch/event/1206452/#1-roundtable>
 - <https://indico.cern.ch/event/1213552/#1-roundtable>
 - <https://indico.cern.ch/event/1218813/#1-roundtable>
 - <https://indico.cern.ch/event/1225552/#1-roundtable>
 - <https://indico.cern.ch/event/1225552/#1-roundtable>
 - <https://indico.cern.ch/event/1230250/#1-roundtable>
- RPV-meets-RPC
 - <https://indico.cern.ch/event/1213195/#6-round-table>
 - <https://indico.cern.ch/event/1215585/#7-direct-stau-signal-sample-ge>
 - <https://indico.cern.ch/event/1217771/#8-di-tau-reinterpretation-upda>
- SUSY Run 2 Summaries
 - <https://indico.cern.ch/event/1218668/#3-di-tau-interpretation>

谢谢！

Parameter	Min value	Max value	Note
$m_{\tilde{L}_1} (= m_{\tilde{L}_2})$	90 GeV	4 TeV	Left-handed slepton (first two gens.) mass
$m_{\tilde{e}_1} (= m_{\tilde{e}_2})$	90 GeV	4 TeV	Right-handed slepton (first two gens.) mass
$m_{\tilde{L}_3}$	90 GeV	4 TeV	Left-handed stau doublet mass
$m_{\tilde{e}_3}$	90 GeV	4 TeV	Right-handed stau mass
$m_{\tilde{Q}_1} (= m_{\tilde{Q}_2})$	200 GeV	4 TeV	Left-handed squark (first two gens.) mass
$m_{\tilde{u}_1} (= m_{\tilde{u}_2})$	200 GeV	4 TeV	Right-handed up-type squark (first two gens.) mass
$m_{\tilde{d}_1} (= m_{\tilde{d}_2})$	200 GeV	4 TeV	Right-handed down-type squark (first two gens.) mass
$m_{\tilde{Q}_3}$	100 GeV	4 TeV	Left-handed squark (third gen.) mass
$m_{\tilde{u}_3}$	100 GeV	4 TeV	Right-handed top squark mass
$m_{\tilde{d}_3}$	100 GeV	4 TeV	Right-handed bottom squark mass
$ M_1 $	0 GeV	4 TeV	Bino mass parameter
$ M_2 $	70 GeV	4 TeV	Wino mass parameter
$ \mu $	80 GeV	4 TeV	Bilinear Higgs mass parameter
M_3	200 GeV	4 TeV	Gluino mass parameter
$ A_t $	0 GeV	8 TeV	Trilinear top coupling
$ A_b $	0 GeV	4 TeV	Trilinear bottom coupling
$ A_\tau $	0 GeV	4 TeV	Trilinear τ lepton coupling
M_A	100 GeV	4 TeV	Pseudoscalar Higgs boson mass
$\tan\beta$	1	60	Ratio of the Higgs vacuum expectation values

