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Search for pair production of top squarks at LHC Run 2 with the ATLAS detector

L. LONGO(1)(2)

(1) *INFN, Sezione di Lecce - Lecce, Italy*
(2) *Dipartimento di Matematica e Fisica, Università del Salento - Lecce, Italy*

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Summary. — Despite the lack of experimental evidence from LHC Run 1, supersymmetry (SUSY) remains one of the most promising and motivated Standard Model (SM) extensions. Supersymmetry models with light partners of the top quark (top squarks or stops) are well motivated since they limit the dominant correction to the Higgs boson mass and thus preserve naturalness. The latest results in searching for stop-pair production are presented, exploiting the proton-proton collision data collected by the ATLAS experiment during 2015 and 2016 at the center-of-mass energy of 13 TeV.

1. – Stop pair production results

In the context of a supersymmetric SM extension, several models can be considered assuming different hypotheses on the mass spectrum of the supersymmetric particles or imposing additional symmetries to the theory. A large number of models assumes, for example, the conservation of the multiplicative quantum number R-parity(1) and, as a consequence, that the lightest supersymmetic particle (LSP) is stable; in these cases the lightest neutralino, $\tilde{\chi}_1^0$, is often considered as the LSP. However, there are also models where R-parity is not conserved and the LSP is supposed to be the lightest squark top, $\tilde{t}_1$, decaying into two down-type quarks, through baryon-number-violating couplings. In particular, the latest ATLAS results of the stop-pair production search regard the following signals:

- $\tilde{t}_1 \to t^{(*)} + \tilde{\chi}_1^0$,
- $\tilde{t}_1 \to t + \tilde{\chi}_2^0$ with $\tilde{\chi}_2^0$ decaying into $Z + \tilde{\chi}_1^0$ (BR = 0.5) or $h + \tilde{\chi}_1^0$ (BR = 0.5) with $m(\tilde{\chi}_1^0) = 0$,

(1) R-parity is defined as $R = (-1)^{3(B-L)+2S}$ with B, baryon number, and L, lepton number.

- $\tilde{t}_2 \to \tilde{t}_1 + Z(h)$ with $\tilde{t}_1$ decaying into $t + \tilde{\chi}_1^0$ and assuming $\Delta m(\tilde{t}_1, \tilde{\chi}_1^0) = 180\,\text{GeV}$,
- $\tilde{t}_1 \to s + d(b + s)$.

While the first three signals belong to the R-parity–conserving scenario and they are characterized by large missing transverse momentum, $E_{\text{T}}^{\text{miss}}$, in the final state due to the presence of the neutalinos, the latter model is related to the R-parity–violating scenario and its final state consists of four jets forming two pairs, originating from a pair of equal mass resonance.

All the data, collected by the ATLAS experiment during 2015 and 2016 at the center-of-mass energy of 13 TeV, have been considered but no significant excess has been observed in any of the analyses targeting the models previously described. Limits on the SUSY particles masses have been thus set at 95% CL as shown in fig. 1.

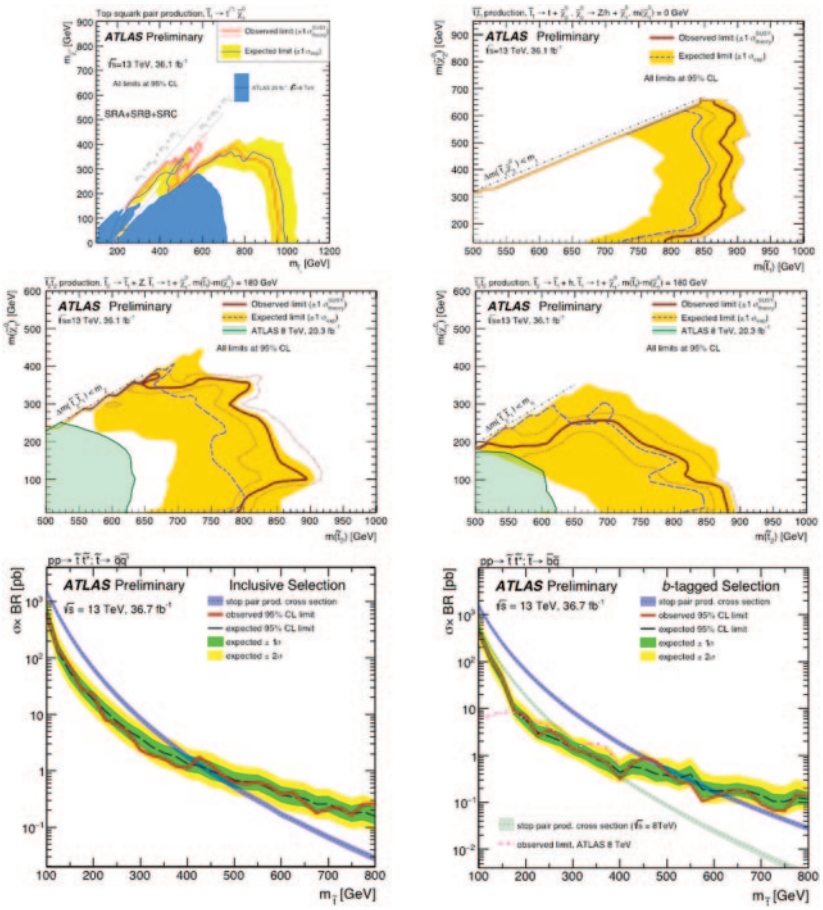

Fig. 1. – Exclusion limits for the signal models $\tilde{t}_1 \to t^{(*)} + \tilde{\chi}_1^0$ (top left) [1], $\tilde{t}_1 \to t + \tilde{\chi}_2^0$ (top right) [2], $\tilde{t}_2 \to \tilde{t}_1 + Z(h)$ (middle) [2] and $\tilde{t}_1 \to s + d(b + s)$ (bottom) [3] are shown. For the R-parity–violating model, an improvement in the exclusion is observed after requiring at least two b-tagged jets (bottom right) in the final state.

REFERENCES

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