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Taking aim at the wino-higgsino plane with the LHC

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In this work we explore multiple search strategies for higgsinos and mixed higgsino-wino states in the MSSM and project the results onto the (μ, M_2) plane. Assuming associated production of higgsino-like pairs with a W/Z boson, we develop a search in a channel characterized by a hadronically tagged vector boson accompanied by missing energy. We use as our template an ATLAS search for dark matter produced in association with a hadronically decaying vector boson, but upgrade the search by implementing a joint likelihood analysis, binning the missing transverse energy distribution, which greatly improves the search sensitivity. For higgsino-like states (more than 96% admixture) we find sensitivity to masses up to 550 GeV. For well-mixed higgsino-wino states (70-30% higgsino) we still find sensitivities above 300 GeV. Using this newly proposed search, we draw a phenomenological map of the wino-higgsino parameter space, recasting several complementary searches for disappearing tracks, soft leptons, trileptons, and hadronic diboson events in order to predict LHC coverage of the (μ, M_2) mass plane at integrated luminosities of up to $3\,\mathrm{ab}^{-1}$. Altogether, the full run of the HL-LHC can exclude much of the "natural" ($\mu, M_2 < 500$ GeV) wino-higgsino parameter space.

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