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## Top quark pair property measurements and $t\bar{t} + X$ using the ATLAS detector at the LHC

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Precise measurements of the properties of the top quark test the Standard Model (SM) and can be used to constrain new physics models. As it may be significantly enhanced by the presence of new physics, the  $t\bar{t}$  production charge asymmetry is measured inclusively and differentially using the 8 TeV ATLAS dataset using both the lepton+jets and dilepton channels, including a dedicated measurement for highly boosted top-quarks. The top-quark is predicted in the SM to decay almost exclusively into a  $W$  boson and a  $b$ -quark. We present a wide range of searches for non-SM top quark decays using the 8 TeV and 13 TeV ATLAS datasets, including  $t \rightarrow qH$ ,  $t \rightarrow q\gamma$  and  $t \rightarrow qZ$ . In addition, measurements of the  $W$ -helicity and spin correlations in  $t\bar{t}$  production are presented as well as new measurements of  $CP$  asymmetries in  $b$ -hadron decays using top-quark events.

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