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LHC Signatures of a Vector-Like Top Partner and Charged Higgs in the 2HDM-II

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I will present the collider phenomenology of a vector-like top partner (VLT) in the Type-II Two-Higgs-Doublet Model (2HDM-II) extended by a vector-like quark doublet, with emphasis on final states involving a charged Higgs boson. The analysis is performed in the alignment limit, where the light CP-even Higgs boson exhibits Standard Model-like properties. In this framework, the VLT predominantly decays via the exotic channel $T \to H^+ b$, yielding signatures with high b-jet multiplicity and leptonic components. Results are based on Monte Carlo simulations of VLT pair production at the 14 TeV LHC, covering both fully hadronic and semi-leptonic final states. The projected discovery sensitivity reaches up to $m_T \sim 1.6$ TeV, depending on the charged Higgs mass, integrated luminosity, and systematic uncertainties.

Primary authors: BENBRIK, Rachid (Cadi Ayyad University, Marrakech); Dr BOUKIDI, Mohammed (IFJ PAN); Prof. MORETTI, Stefano (Department of Physics & Astronomy, Uppsala University, Box 516, SE-751 20 Uppsala, Sweden.)

Presenter: Dr BOUKIDI, Mohammed (IFJ PAN)

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