

# Probing photons-enriched signatures for Semi-visible jets at the LHC

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The Hidden Valley scenario consists of a set of models where the Standard Model is accompanied by a Hidden Sector and connected with it via a heavy mediator or a weak coupling. If realised in nature, the Hidden Valley scenario may result in unusual and little-studied phenomena at the LHC. Under the assumption of a QCD-like confining dark sector, novel experimental signatures emerge, characterized by sprays of particles resembling hadronic jets containing stable invisible dark matter bound states. The resulting signature is characterised by missing momentum aligned with one of the jets, defining an orthogonal phase-space compared to traditional WIMPs searches. These semi-visible jets have been studied theoretically and experimentally in the fully hadronic signature, and more recently including also leptonic final states. We present new simplified models allowing the decays of the unstable dark bound states to photons via a pseudo-scalar portal, such as an axion-like particle. The new resulting signatures are semi-visible jets characterised by an enhanced presence of non-isolated photons, coming directly from dark bound states decays. We show that these exotic jets evade the phase space probed by current LHC searches exploiting jets or photons due to the expected high jet neutral electromagnetic fraction and photons candidates non-isolation, respectively. Moreover, we show that by leveraging the distinguishing features of the substructure of the final state BSM jets compared to SM ones, it is possible to develop identification criteria that can be used in real analyses at the LHC to enhance the sensitivity to these novel signatures.

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Yes

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