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Boosted tops and the time-structure of the hot dense-medium of heavy-ion collisions

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Summary

An active field has developed over the past years studying the differences between jets in heavy-ion collisions (HICs) and jets in proton-proton collisions. Differences arise because jets in HICs must traverse the hot-dense medium ("quark-gluon plasma") that is produced in the collisions, and the nature of modifications of the jets provides powerful insight into the properties of the plasma.

Boosted top quarks have the potential to open up a new dimension in such studies, because a top-quark's decay time is correlated with its p_t . By examining properties of jets from top-quark and W decays, as a function of the top-quark p_t , one may obtain unique insight into the time dimension of the production and evolution of the quark-gluon plasma. Significant high- p_t statistics are needed, so this is of particular interest at FCC-hh, where the top reconstruction will require the use of jet substructure techniques.

The ideas presented here may also open the door to using heavy-ion collisions one day to determine the properties of hadronically decaying new particles, providing a novel way to place constraints on their lifetime.

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