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No Pain, no Gain? Hard Probes of Quark-Gluon Plasma Coming of Age

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Hard QCD and QED probes hold the promise of providing controlled, rigorously calculable means of interrogating hot and dense QCD Matter, measuring its properties and determining its structure. While the RHIC has opened hard probes to experimental investigation, the LHC has extended the range of hard probe measurements by an order of magnitude. Data on jets, high-pT hadrons, quarkonia, photons, and lepton pairs over a wide kinematic range are now putting the challenge back into the theorists' court: Can we use these hard probes as hoped to characterize the quark-gluon plasma created in heavy ion collisions model independently and determine its structure? Related questions concern the investigation of the low-x parton structure on large nuclei and of the thermalization mechanism by means of hard probes. In my lecture I will review the status of experimental results and of theoretical efforts to understand and interpret them prior to Hard Probes 2012. I will also identify issues that need to be clarified before the full promise of hard probes for hot QCD matter can be realized.

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