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From microscopic interactions to the dynamics of the fireball

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Incorporating the dynamic nature of the quark-gluon plasma into models is crucial to the theoretical interpretation of experimental results from heavy ion collisions at RHIC and LHC. We have developed a transport framework, BAMPS (Boltzmann Approach to Multi-Parton Scatterings), that based on perturbative QCD matrix elements describes the partonic stage of such heavy ion collisions. The Monte Carlo approach allows for the investigation of various observables and assumptions within one single framework. It uniquely features the consistent inclusion of partonic radiation and annihilation processes, obeying the principle of detailed balance. We show that the inelastic processes drive the system into thermal equilibrium on time scales on the order of 1 fm/c, well in accordance with experimental observations of the elliptic flow. Accordingly the viscosity of the medium is found to be small, close to the conjectured lower bound. The dynamic origin of quarkonia production, flow and suppression is successfully studied within the model as well as their open heavy flavor equivalents. Also the investigation of light flavor phenomena at large transverse momenta - both on the level of single inclusive and of jet observables - is possible, allowing for a comparative study of medium versus high-pt predictions. Based on analytical and numerical studies we demonstrate that the commonly used Gunion-Bertsch approximation to the radiative matrix element needs to be modified when being applied in rate-based approaches. We discuss possible implications on the dynamic description of the medium.