II

Experiments and analysis tools

5 Nuclei in collision

5.1 Heavy-ion research programs

The energy content available in the nuclear collision is the main factor in which experimental facilities differ from each other. The ultra-relativistic nuclear-collision systems we are considering are identified in table 5.1. For the maximum possible mass number up to $A_{\rm max} \simeq 200$, we show the fixed-target maximum beam energy per nucleon $E_{\rm p}^{\rm max}$ [A GeV]; for colliders, we present in this line the equivalent projectile energy. Similarly, we show the CM energy in the nucleon–nucleon system $\sqrt{s_{\rm NN}}$ [GeV], which is twice the nominal beam energy of the RHIC and LHC collider systems. We also show the total $\sqrt{s_{\rm AA}}$ [GeV] energy in the interaction region, allowing for the maximum mass number A of the beam. The final line refers to the rapidity 'gap' Δy. We will discuss these variables in the following sections.

Δy is defined as the difference between the rapidities of projectile and target. In laboratory fixed-target experiments, $y_{\rm t} = 0$, and Δy is the rapidity of the projectile $y_{\rm p}$. Using the definition of rapidity Eq. (5.4), we have

$$\cosh \Delta y = E_{\rm p}/m_{\rm p}. \tag{5.1}$$

For head-on interactions occurring at rest in the laboratory, at the collider facilities, $\Delta y/2$ is the projectile (target) rapidity of each beam, which is evaluated using, e.g., Eq. (5.1) again.

A convenient way to represent the data of table 5.1 is shown in Fig. 5.1: the solid line depicts the CM energy per pair of nucleons, $\sqrt{s_{\rm NN}}$, as a function of the rapidity y. The horizontal distance between the two branches of the solid line is the projectile–target rapidity gap Δy. The shaded areas correspond to the accessible CM energies, $\sqrt{s_{\rm NN}}$, at ex-

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