\[ \sigma \text{ and } R \text{ in } e^+e^- \text{ Collisions} \]

![Graph showing \( \sigma \) and \( R \) in \( e^+e^- \) Collisions](image)

**Figure 40.6:** World data on the total cross section of \( e^+e^- \rightarrow \text{hadrons} \) and the ratio \( R(s) = \sigma(e^+e^- \rightarrow \text{hadrons}, s)/\sigma(e^+e^- \rightarrow \mu^+\mu^-, s) \). \( \sigma(e^+e^- \rightarrow \text{hadrons}, s) \) is the experimental cross section corrected for initial state radiation and electron-positron vertex loops, \( \sigma(e^+e^- \rightarrow \mu^+\mu^-, s) = 4\alpha^2(s)/3s \). Data errors are total below 2 GeV and statistical above 2 GeV. The curves are an educative guide: the broken one is a naive quark-parton model prediction and the solid one is 3-loop pQCD prediction (see “Quantum chromodynamics” section of this Review, Eq. (9.12) or, for more details, K. G. Chetyrkin et al., Nucl. Phys. B 586 (2000) 56 (Erratum ibid. B 634 (2002) 413). Breit-Wigner parameterizations of \( J/\psi, \psi(2S) \), and \( \Upsilon(nS), n = 1, 2, 3, 4 \) are also shown. The full list of references to the original data and the details of the \( R \) ratio extraction from them can be found in hep-ph/0312114. Corresponding computer-readable data files are available at [http://pdg.lbl.gov/xsect/contents.html](http://pdg.lbl.gov/xsect/contents.html). (Courtesy of the COMPAS[Protvino] and HEPDATA[Durham] Groups, August 2005. Corrections by P. Janot (CERN) and M. Schmitt (Northwestern U.).)