5.4 Systematics due to the assumption of the fiducial cosmology

In this subsection, we summarize the impact of using a wrong fiducial cosmology in the BAO analysis, which were extensively studied in [51].

The choice of reference cosmology comes into play at three different stages. First, we assume a set of cosmological parameters when converting redshift measurements into distances; we term this the **grid cosmology**. The difference between the grid and true cosmologies causes a distortion of the BAO scale along and across the line of sight [10], which is quantified by the parameters $q_{\parallel} = H_{\rm grid}(z)/H_{\rm true}(z)$ and $q_{\perp} = D_{\rm true}(z)/D_{\rm grid}(z)$ respectively. Without the three-dimensional standard ruler like BAO, this effect is somewhat degenerate with the redshift-space distortions, but with a sufficiently large data set, such as we have with DESI, and with the BAO feature it is possible to distinguish between the two [145, 146]. Second, a **template cosmology** is chosen in order to compute the linear power spectrum, which is then used to create the model power spectrum for the fitting ($P_{\rm nw}$ and P_w in Eq. (4.1)). The effect of fixing the template is interpreted as an additional isotropic rescaling of the distances by a factor of $r_d^{\rm tem}/r_d^{\rm true}$. Lastly, the values for the linear bias b_1 and the growth rate $f(z)$ input into the reconstruction algorithm are cosmology dependent, affecting the estimation of the displacement field. The separate effect of both the template and the values assumed for reconstruction have been comprehensibly studied in the past [147–150], as well as the joint effect of consistently changing the reference cosmology in the whole pipeline [114], while the separate effect of the grid is less explored [151]. Potential systematic shifts of the order of a few tenths of a percent in the alpha values have been reported in the most extreme scenarios.