7.7.6 Ageing of the strings

The decay diagrams shown to this point in Chapter 7.7 have all been measured using fresh strings – a condition that never lasts long. Three processes predominantly change the mechanical properties of a string: the surface corrodes, the cross-section changes, and deposits of grease and skin-particles appear on the string. Solid strings (usually G_3, H_3, E_4) are always made of spring steel; the magnetic and mechanical requirements leave little room to maneuver for manufacturers here. The core of wound strings (E_2, A_2, D_3) also consists of spring steel, with the wrap spinning made of nickel wire or steel wire. Brass or bronze wound strings are only found on the acoustic guitar, since these materials are of a non-magnetic nature and generate too weak a voltage in the magnetic pickup.

When playing, the string is pressed against the frets, and moved back and forth with (possibly virtuoso) finger vibrato. Even if the string is made of hard steel: over time, **small grooves** are ground into its lower side, and these affect the propagation of the waves generated during plucking. Each groove is a discontinuity (a local change in the wave impedance) that leads to unwanted reflections, detuning of partials, and vibration-damping. The most serious cause of the change in the string parameters, however, is the **accumulation** of skin-, grease- and dust-residue, especially if this gets into and between the layers of the wrapping. These deposits are efficient absorbers that can extract much more vibration energy from the string than all previously presented absorption processes. In **Fig. 7.83**, the left-hand picture shows the decay time of partials of the A-string of a Les Paul Classic. This was a "not entirely fresh anymore" A-string the history of which could not be determined more precisely. Compared to a fresh A-string, the decay time has decreased by 50 – 80%; in particular the treble fades away much faster. Compared to this very efficient damping mechanism, only two vibration absorbers can compete: a neck resonance at 220 Hz, and the known bridge resonance around 2 kHz. After just a few minutes of typical guitar playing, grease and skin deposits already can lead to measurable effects – therefore comparisons must only and always be done with completely new strings!

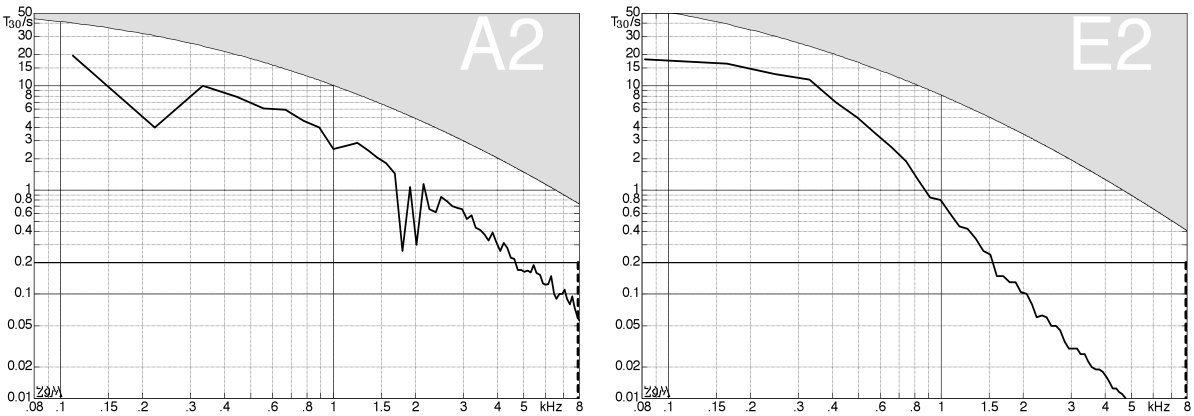

Fig. 7.83: Decay times of partials, on a Les Paul Classic (left), and on a stone table (right). Note the extended ordinate range!

The graph on the right shows the decay times of the partials for a very old E2-string stretched across a stone table. The high-frequency signal components (that are still present at the moment of plucking) lose their energy instantly; the T_{30} treble-dropoff occurs with a slope of f to the power of 3. Nevertheless, such a string is not completely useless: bring in a distortion device, and the string rises to new heights … well, the treble is kind of revitalized, anyway.

