

MAJOR THIRD AND THE FIFTH PARTIAL

Prelude: The motion of the vibrating string is so called *standing wave*. According to the terminology of the physicists there are immobile *nodes* at the ends of the string, and between them there is a *loop* (antinode). Playing a harmonic creates to the string several nodes and loops, the nodes dividing the string in 2, 3, 4 etc. portion of the same length. We remember, that the frequencies of the harmonics are multiples of the basic frequency and they are sounding also at the same time with the basic frequency. The most simple vibration form is called *sine wave*, and it can't be divided into more elementary components. All other regularly repeating vibrations are composed of sine-form *basic partial* and of its multiplies. The vibration of this type is called *harmonic vibration*. The sounds of the most instruments are harmonic, but the start of a tone usually contains non-harmonic noise, that is characteristic for each instrument and even essential to make the instrument sound recognizable.

Allemande: The first partials of the sixth string of the guitar are E, E, B, E, G sharp, B, D, E etc. The subject of our interest, the fifth partial G sharp, is two octaves and major third above the basic partial. But when we compare the natural harmonic on the fourth fret of the (6)-string with the G sharp on the string (1), we notice that the harmonic is very flat. The origin of our interval system is constructed of the integer relations between the partials of the harmonic series, so we could well say the opposite way that the even-tempered major third is sharp. Anyway within this article I set the even-tempered guitar as "normal" system to compare with.

Courante: The two above-mentioned G-sharps generate a strongly beating combination, and the same beating is heard, when we play together free (6)-string and G sharp on (1). Should we be contended with this situation? No! Let's remember the technique of playing harmonics: at the same time plucking the string and touching it lightly at the node point of the desired standing wave. We play the fifth partial by touching the string above the fret IV, IX, XVI or half way between the last mentioned fret and bridge. Guitarists know, that the harmonic sometimes doesn't sound though the touching point is exactly right; in this case the fault is to pluck at node. Eureka!, plucking the (6)-string e.g. above the XVI fret we produce E with strongly reduced fifth partial, and the tone is in better consonance with even-tempered G sharp. This interval, the first one in Adelita's major section is far from pleasant, if we pluck it touching the strings extremely *tasto* at the exact middle points, but a better possibility exists.

Sarabande: More common than E - G sharp conflict is the problem with D - F sharp, when the (6)-string is tuned down to D. The third of D-major chord is most often situated exactly 2 octaves and third above the bottom, in E-major chord G sharp may be played on (3)-string forming the interval of tenth. By the way, minor third is not creating this kind of conflicts, though it is as much "out of tune" but to the opposite direction in compared with the major third. The cause is outside our present discussion.

Gigue: Next we observe the opening tones of Lagrima, again G sharp above E, but the interval is only tenth. The fifth partial of E is quarrelling with the second partial of G sharp. If we want this interval to sound without beats, we pluck E above fret XVIII and G sharp above XVI. The node of the octave harmonic of G sharp is just where fret XVI, so using the technique I described we damp the conflicting partials and produce non-beating result.

Epilogue: A) The discussion above generates an observation, that moving the plucking point from middle of the string towards the bridge doesn't only induce the linear change of timbre from *tasto* to *ponticello*, but the higher partials achieve several maximums and minimums, and the sound colour is affected also by the conflicts between the partials of the tones sounding at the same time. B) The seventh partial of (6)-string, D, is even more "out of tune" than G sharp, I urge my reader to listen to the problems created by it and to discuss the possible solutions to them.

© Vesa Pölkki