

# *From Music to Mathematics: Exploring the Connections*

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## Recommended Music to Accompany Chapters 3 and 4

The first two selections offer a contrast in building music around the overtone series. The fanfare from Strauss' famous tone poem triumphantly announces the first few overtones of a low C. Hykes' music harnesses the subtle flavors inherent in the overtone series in order to generate a spiritual and contemplative sound. The other pieces feature the electronic music of composer Wendy Carlos and her creative use of non-traditional tunings. Using a synthesizer and her own mathematical scales, Carlos provides an intriguing blend of alternative harmonies and sounds.

1. Richard Strauss, Prelude to *Also sprach Zarathustra*, Op. 30, 1896. Track 1 from a Deutsche Grammophon CD of the same name (1995), performed by the Berlin Philharmonic under the direction of Herbert von Karajan. The famous opening to this tone poem is based on the overtone series (see Sections 3.4.3 and 4.1.3 in the text). Beginning with the low C in the basses and organ, the trumpet fanfare follows with the notes C', G' and C'', at which point the orchestra enters dramatically with E'' immediately followed by an Eb''. Thus, the first five notes of this important and memorable motif are aligned with the first five notes in the overtone series built on C. The piece became famous after Stanley Kubrick used it in his visionary 1968 film *2001: A Space Odyssey*. The basic and fundamental structure of the overtone series is the perfect musical metaphor for the primal, savage scene in the movie.
2. David Hykes, *Rainbow Voice*, 1983. The opening track from the CD Hearing Solar Winds Alight (special 25th anniversary remastered edition, 2008), featuring David Hykes and the Harmonic Choir. Hykes was an early Western pioneer of **overtone singing** (also called **throat singing**), where a vocalist sings the fundamental while simultaneously producing a particular overtone by changing the shape of their mouth. The result appears to be multiple pitches being sung by just one person. Hykes founded the Harmonic Choir to perform this unique type of music, a music that is believed to have originated in Mongolia. Notice how certain overtones "pop" into focus as the timbre of the pitch is varied, particularly those in higher registers. The striking appearance of the higher partials gives the music a truly ethereal and meditative quality. This piece has been used in several films, including *Blade* and *Dead Poets Society*.
3. Wendy Carlos, *Beauty in the Beast*, 1986. This is the title cut from Carlos' remarkable album Beauty in the Beast (Passport Records, 1986). Carlos composed, performed, produced, and engineered this fascinating collection of electronic music, revolutionary for its time. All the sounds and music were synthesized (digitally generated) by Carlos. In addition, many of the tracks involve non-standard tunings and special musical scales created by the composer, one of the benefits of using an electronic synthesizer. The alternative tuning systems allow for a much wider variety of notes and intervals, and thereby greater dissonance. Such an exercise could lead to jarring and aesthetically challenging music. However, Carlos impressively produces music that bridges the gap between these new, foreign tunings and the more familiar Western scales.

In this particular piece, the composer juxtaposes two different scales described as *Alpha* and *Beta*. The first scale used is Beta, where the 4:3 just perfect fourth (five half steps) is split into eight

equal parts, approximately 64 cents each (according to the composer).<sup>1</sup> The Alpha scale equally subdivides a just minor third (three half steps) into four equal parts, approximately 78–79 cents each. Try to listen for the alternative notes and intervals created by these new scales.

4. Wendy Carlos, *That's Just It*, 1986. Track 5 off the previous CD. This piece is written in a tuning system created by Carlos called the *Harmonic Scale*, a “Super-Just scale . . . which continues past the 5th harmonic (of just) all the way to the (prime) 19th!” I’m not sure what this actually means, but it sounds like an equal subdivision of the octave into many, many parts (Carlos mentions a 144-note subdivision for the previous track). This work mimics a jazz sextet with solo trumpet and tenor sax. Notice the different musical intervals used throughout the piece, some of which may sound familiar, but many are strikingly new, including some funky jazz-like power chords. The persistent tonic helps serve as a reference point from which to hear the alternative tunings.

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<sup>1</sup>This number seems a little high. Since  $8 \cdot 64 = 512$ , the perfect fourth would be 12 cents sharp of an equally-tempered P4 and 14 cents sharp of the just 4:3 P4. The actual number is likely closer to 62 cents.