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Physics and opera: a happier marriage than you might guess

I'd never expect to learn anything about physics from opera. Equally, I wouldn't expect an opera composer's work to have much to do with physics. Now two recent articles in SEED magazine have proven me to be sadly closed-minded to all that's made possible when you bring the two together.

Harvard physicist Lisa Randall talks about Hypermusic Prologue, her first opera.

Hypermusic Prologue isn't your average opera. There are no elaborate costumes or powdered wigs, and the plot is hyperreality, not high-brow romantic comedy. That's because the because the person responsible for the lyrics, Lisa Randall, is not your average opera librettist. She's a Harvard University physicist, a celebrated scientist who resides, by profession, on the fraying edges of what we know about the universe. She lives and breathes the p-branes and Anti de-Sitter space-time; her playground requires a huge stretch of imagination for even very smart people to vaguely glimpse, much less participate in.

In a way, her opera seems to be about the loneliness of the theoretical physicist, who creates in a world far removed from what we think of as reality. ("Do I believe in extra dimensions? I confess I do," Randall has written.) Or at least this is the impression I get from SEED:

When the soprano sings, "The scale of my experience is altered," this is partly a literal reference to the way physical scaling changes in Randall’s hidden dimensions. But Ellet is singing to her close-minded partner, baritone James Bobby, who keeps arguing the value of Newtonian physics until he finally has his own brief encounter with her unseen world. In this way, he becomes more open-minded and his perspective is altered.

Randall's also the author of a layman's travel guide to her extra-dimensional universe. Titled Warped Passages: Unraveling the Mysteries of the Universe's Hidden Dimensions, the book introduces readers to the idea that extra spatial dimensions "might nonetheless resolve some of the most basic mysteries of our universe"; perhaps hinting to her lyrical leanings, each chapter is prefaced by a snippet of lyrics from the Beatles, Billy Bragg, Kraftwerk, and Fleetwood Mac. The book convinced Spanish composer Hector Parra that Randall was the perfect librettist for his next opera, and provided the inspiration for the way Parra warps and twists, expands and contracts the performer's voices. Check out the slideshow at SEED for a virtual tour through the

opera's abstract stage design (I think NOVA should consider reusing it for their next string theory program) and for musical excerpts.

Our second tale from the world of physics and opera reaches right back to Wagner, who, according to recent digging by some curious physicists, certainly knew his alpha, beta, gammas. Apparently when sopranos try to deliver those really high notes clarity and power, it tends to warp their pronunciation of words. By measuring the vocal tracts of singers as they sang vowels at different frequencies, physicists at the University of New South Wales discovered that, in order to amp up their voices' power, sopranos warp their vocal tract to change its resonant frequency. Here's how it works:
...when a soprano sings at high pitches, she adjusts her vocal tract to make her voice resonate. In effect, she "tunes" the resonance frequency of her vocal tract to match the frequency of the pitch at which she is singing.

According to the abstract of the paper in the Journal of the Acoustical Society of America, the result is that vowels, "move, converge, and overlap their positions on the vocal plane...to an extent that implies loss of intelligibility."

Here's where Wagner came in.

One of the study's leaders, John Smith, was sure that a genius like Wagner would be able to find a way around this physiological physics problem, by writing a libretti such that the vowels would match the pitch at which they would be sung:
So one evening in his garden while he was recovering from surgery, Smith took up a pen and paper and went through Götterdämmerung note-by-note, lyric-by-lyric, recording which notes were paired with which vowel sounds. In the early hours of the next morning he wrote a computer program to determine with statistical certainty whether Wagner had in fact used a vowel-pitch matching technique. Looking at the program’s first results, he was amazed. There was a clear relationship.

Meanwhile, Rossini, Mozart, and Strauss's works showed no such relationship. But Wagner couldn't have grasped the "soprano problem" in the technical way the University of South Wales physicists did, which leads us to believe he solved the problem intuitively, just as the Alhambra probably wasn't built as a shrine to mathematical symmetry, despite the fact that its mosaics exemplify it beautifully.

For the last word on physics and music, some lighter fare. I've been looking for an excuse to talk about Rhythm, Rhyme, Results, a company that brings together some pretty legit-sounding lyricists and rappers to pen and perform rap songs about geometry, geoscience, and physics (equations and numerical facts included) that I wouldn't be ashamed to blast on my car stereo.

Weight, Mass, Volume, Density - Rhythm, Rhyme, Results
Posted by scappuccino at 2:40 PM
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