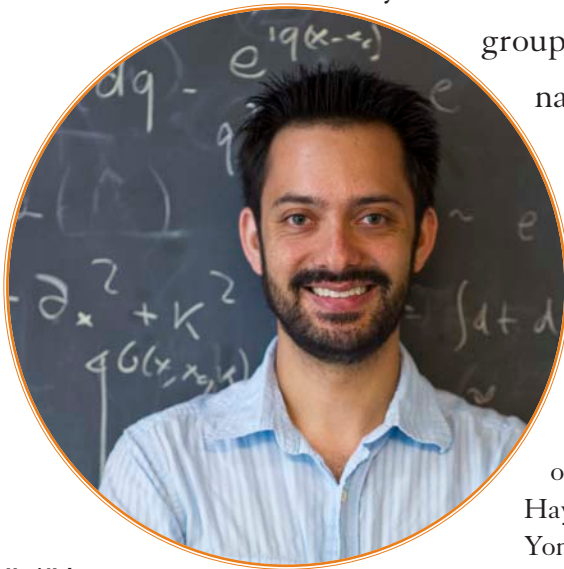


Student Profile

Yonatan (Yoni) Kahn, PhD Candidate, High-Energy Theoretical Physics

In a communal graduate student office in the Center for Theoretical Physics, you can find French horn cases with Ligeti horn trio scores taped onto poster board parked alongside a corner desk stacked with quantum field theory equations, physics tomes and an iMac. Meet **Yoni Kahn**, second-year PhD student in phenomenologist Professor Jesse Thaler's group, professional player of both the French horn and natural, or "period," horn.



Yoni Kahn

It's not unusual to discover an MIT physics professor (or three) with a love for twanging electric guitar chords or driving a drum beat at the Society of Physics Students' annual rock concert. Nor is it unknown for postdoctoral fellows to seek refuge from data analysis in the music department's piano practice rooms. What is uncommon, though, is to come across signs of a genuine, dual-career physicist *and* classical musician, one who averages two to four performances per month, and is on the sub lists for the Boston Philharmonic and the Handel & Haydn Society, no less.

Yoni arrived at MIT Physics last fall by way of dual degrees, both *summa cum laude* (B.A., physics and mathematics; B.Mus., horn performance), from Northwestern University in 2009; a 2009-2010 Churchill Scholarship for graduate studies (completed with Distinction) in applied mathematics and theoretical physics at the University of Cambridge; and a 2010-2011 MIT Emerson Fellowship to study with renowned horn soloist and ensemble coach Jean Rife. With his dual background in physics and music, starting PhD studies in high-energy theoretical physics soon afterward was, for Yoni, part of a natural progression.

physics@mit: Yoni, many members of the MIT physics community avidly pursue creative interests alongside their work in physics, running the gamut from rebuilding car engines and oil painting to surfing and writing mystery novels. However, you've brought your own parallel passions—physics and music—to a professional level. What motivates you? Does it have anything to do with physics and music being intrinsically complementary?

Yoni Kahn: Yes, music and physics do motivate me for different, yet complementary, reasons. With physics, it's the challenge of understanding the deepest unsolved mysteries of the universe, such as the identity of dark energy and dark matter. Right now, I'm helping to

Photo: Justin Knight Photography

design an experiment to look for a very weak “fifth force” (besides gravity, electromagnetism, and the strong and weak forces), which could mediate dark matter interactions. To understand the solutions to these puzzles you have to be fluent in the language in which they’re written. I certainly want to understand the solution when someone does solve them, and that’s what keeps me motivated when working on smaller problems.

“Both physics and music are challenging, and require constant practice to stay at the top of my game.”

With music, my motivation is simply to have fun playing the horn. But the horn is such a fickle instrument that, to have fun, you have to play at an extremely high level or else get frustrated rather quickly. Plus, the feeling of conquering a difficult ensemble piece, with anywhere from three to thirty musicians playing and thinking furiously alongside you, is just amazing.

So, for me, both physics and music are challenging, and require constant practice to stay at the top of my game. And while music is “in the moment,” where all that matters is what happens in the concert, physics is more gradual, where a solution to a tough problem comes after some dedicated effort and doesn’t necessarily require instant inspiration. If I get stuck on a physics problem, I can go practice for half an hour, and clear my mind while working on the musical side of things. And, if I’m having a bad day on the horn or need a day off to recover some strength, those are often my most productive physics days. What’s best of all is that neither one feels like work.

physics@mit: Yoni, you began your musical training at age seven on the piano, but then switched to the horn at twelve. From grammar school to high school, mathematics was your favorite subject; in college, however, your B.A. was in physics. Why the two shifts, and is there any correlation between them?

Yoni Kahn: These were more shifts of emphasis, rather than interest. The first shift was pretty straightforward: I had always been interested in physics, but my high school didn’t offer a particularly good AP physics course, and middle school science didn’t really touch physics. So like most nerdy kids, I joined the math contest teams, and focused on math until I hit a wall at the Olympiad-style exams. Once I had the chance to take physics at the local state university, I was hooked, since physics was a way to apply the math I’d been learning to “real world” problems. Actually, a childhood influence was family friend and MIT physicist Professor Allan Adams, then a Stanford graduate student, who shared his newfound excitement for string theory at our Bay Area family dinners.

The shift toward physics as a full-time career made sense once I got to college, where I quickly discovered it would be impossible to do theoretical physics as a part-time career; you really have to be at a university or a government lab to have your research taken seriously. Although Einstein lived at a time when it was possible to think up something as profound as special relativity while working in a patent office, the field has advanced so far since then that

Student Honors & Awards



*Yoni at his desk
in the MIT Center for
Theoretical Physics.*

you must be immersed in physics on a daily basis to keep up with how fast the field is moving. Luckily, though, a part-time career in music is totally feasible, especially on the horn, where you're limited to three or four hours of practice a day because the instrument is so physically demanding. So, a full-time career in physics accompanied by a part-time career in music seemed like the perfect fit, and I've been lucky to continue on that path as far as I have. An enjoyable bonus is including the MIT physics community in my musical life: when I played Bach's Brandenburg Concerto #1 last November, professors Jesse Thaler, Krishna Rajagopal, and Frank Wilczek, as well as several of my fellow students, all came and had a great time.

physics@mit: One technical question, for your musician half: what, exactly, is the difference between a modern horn and a natural horn? How different are they musically?

Yoni Kahn: The most obvious difference is that the natural horn has no valves: it's just a long tube, so the sounds you produce are limited to the harmonic series, *i.e.*, the modes of a vibrating cavity. By moving your hand around in the bell, you can produce sounds between these notes: some are muffled, some are brassier. So, on the natural horn you have most of the

Photo: Justin Knight Photography

notes you can play on the modern horn, but they all sound different—and composers such as Mozart and Brahms exploited this to great effect. Valves were invented c. 1815, and by the beginning of the 20th century everyone had stopped writing for the natural horn, and both big Romantic composers like Mahler and modern composers like Bartok took full advantage of the valve technique. Musically, the difference between the two horns is that notes are expected to have different sound qualities on the natural horn, but these differences are purposely smoothed out on the modern horn. [Editor's note: for more detailed descriptions of both horns, including audio samples, visit Yoni's web page at grandharmonie.com/the-natural-horn.html.]

MIT is the reason I became interested in the natural horn, through Jean Rife and the Emerson Fellowship program, so I wanted to share my interest in early music with the rest of the MIT community. Last April was the inaugural concert of the MIT Grand Canonical Ensemble (a Baroque period-instrument group that I founded), directed by Adam Boyles, the MIT Symphony Orchestra conductor. We played some Bach cantatas in the MIT Chapel and plan to apply for a Council for the Arts at MIT (CAMIT) grant to give two more performances next year, and hope to include several members from the MIT community in both the orchestra and the chorus. If you're interested in seeing us perform, email me at ykahn@mit.edu and I'll be happy to add you to our events email list.

—*Carol Breen, Communications &
Pappalardo Fellowships Program Administrator,
MIT Physics*