

# REFERENCE FRAME

## Memoirs of Schrödinger's Cat

as told to Daniel Kleppner

*Recently, a cat materialized in my study, a Cinnamon Tabby, who sat eyeing me with the cool look of a superior being. The situation was unnerving, and I finally said in jest, "Are you by any chance Schrödinger's cat?" To my astonishment, the cat replied.*

Schrödinger's cat? *Ganz absurd!* Ridiculous! Please to understand that I never belonged to Schrödinger. Schrödinger belonged to me. It was I—Beatrix Ottoline Sophia von Schnurr—who made Schrödinger immortal. Schrödinger, however, did not return my favor. In fact, as you will appreciate, he made bizarre efforts to ensure my mortality.

So, let me set aside false modesty. I was to Schrödinger as Landau was to Lifschitz. Perhaps it is better to say that I was to Schrödinger as Socrates was to Plato. Did Plato thank Socrates? Of course. But Schrödinger... not a single coauthorship, not one word of acknowledgment. The man was totally incapable of gratitude.

You do not believe that cats can do physics? But why not? Cats are not dogs. Only one thing there is between a cat and magnificence and that is motivation. Let me explain that Beatrix Ottoline Sophia von Schnurr is extremely highly motivated.

So, you wish to know about me and the Herr Professor Dr. Erwin Schrödinger? Well, the year 1925 I was passing in Vienna. Why Vienna? First is the opera. What opera! Next are the wonderfully delicious Viennese mice. There are no mice like Viennese mice. Finally, Vienna is not terrible for doing physics.

This was my life: Opera every night, nap every morning, and in the afternoons to amuse myself with physics. But in Vienna, one does not work on really serious problems. So, I was working on such things as the viscosity of cream and canine acoustics and so on. Problems that are useful but not deep.

Then one day comes a message from

*We have not been able to obtain biographical details on B. O. S. VON SCHNURR from any of the standard references. DANIEL KLEPPNER is the Lester Wolfe Professor of Physics and associate director of the Research Laboratory of Electronics at the Massachusetts Institute of Technology.*



a friend at the Château de Broglie. The young de Broglie has proposed that a particle has a wavelength and it is inversely proportional to the momentum, and the proportionality constant is that of Professor Planck.

On the instant, bells in my mind start to chime. You do not believe that bells start to chime? Then maybe you should know that I am thinking deeply on such problems ever since the first Solvay conference. Thinking, thinking, thinking. You will permit me to boast a little? Even though I was a mere kitten, at the Solvay conference I was already the second deputy mouser! That left much time and I kept my ears open. When I think of those wonderful days and the great laps of Europe! Planck, Einstein, Rutherford, Madame Curie. Lap after lap, so close one could creep from one to the next. They were all great scientists, and they knew well how to stroke a cat.

So, from thinking about fundamental problems ever since Solvay, I know at once that de Broglie has found a priceless key. But what is the door? I must find the door.

Vienna is no place for such work. Too much opera. Too many mice. I need peace. I must be surrounded by nature. I know a little villa in the mountains near Arosa. But I am not a cat who thinks with a pen or blackboard. I am a cat who thinks by talking. So I must have someone to talk with. And I must have an excellent lap. On an excellent lap, nobody but nobody can compute like von Schnurr. If you allow a little joke, I am without question the world's greatest laptop computer.

So, I need the best possible combination of intelligence and lap. It is not easy to find excellence in both—except

for Einstein, whose lap is heavenly, but he is busy thinking about gravity.

Finally I choose Erwin Schrödinger. Schrödinger is highly intelligent and in those days he is an excellent listener. Also, his lap is famous. So, I telegraph him to meet me in Munich, and together we will go to Arosa. Naturally, he comes at once.

That is in early December 1925. My work, of course, goes well. So simple it is once I see the way! If there is a wave, there is a wave equation. It takes me practically no time to find it. To tease Erwin a little, I do not tell him at once but give him a few clues each day until he finds it also. It takes him almost two weeks, and he is so happy when I give in and tell him his answer is correct. You will permit me to mention that Schrödinger has finally found von Schnurr's equation. That, of course, is what we called it, even though today one calls it Schrödinger's equation.

Erwin pleads to rush back to Zurich to publish about von Schnurr's equation, but I say no. Before telling it to the world, I must understand for myself what one can do with it. Why let others skim the cream? So, Erwin spends the week rocking in our chair while I lie curled on his lap thinking and computing. I work out the hydrogen atom and then I find a good variational solution for the helium atom and then I work out perturbation theory to all orders. I work out Hartree-Fock theory and then alpha decay and then I invent the Dirac theory. I cannot give Erwin any details because I think so much faster than he can write, but he knows more or less what I am up to.

One morning Erwin says, "Trixie (that is what he called me in those days), what is life? Is your equation good enough to describe life? Could you, for instance, solve the von Schnurr equation for Beatrix Ottoline Sophia von Schnurr?" It is a wonderful question, for I have no idea how far one can push my new theory. Of course, it is also a provocative question. I do not fail to detect a hint of mockery.

So, I must think a little. One cannot solve a truly deep problem curled on a lap, and I order Erwin from the room. He goes to the basement and keeps busy in rustic pursuits, sawing and cutting and banging away.

In a few days I have the answer. The problem breaks up into two parts. The first thing is to find my Hamiltonian function. Here is what I do. I find the Hamiltonian of a dog. That is not difficult because dogs are simple. A dog's Hamiltonian takes less than one page! From this, I find my own Hamiltonian. No, I will not tell you how except to say my use of transformation theory is absolutely brilliant.

Next, I find my eigenstates. It takes a few days to find them all and I finish on 31 December 1925, late in the afternoon. I call in Erwin and show him the results.

Erwin is delighted. "Incredible, Trixie, simply incredible," is what he says. He is, of course, correct. "Come, it is New Year's Eve and we must celebrate." Then commences a night of celebration. Never have I drunk such cream or eaten such catnip. Never have I danced with such abandon. At midnight Erwin says, "Little Trixie, I, too, have done something amazing. Let me show you," and he takes me to the basement. I am none too steady on my paws, and he has to carry me. He takes me to a little room—evidently this is what he has been building all week—and puts me on a cushion. The room has a desk, and in a corner is some sort of contraption. Erwin sits at the desk and squints at me past his thumb, as if he is going to draw me. But he does not draw. He writes equations. "What is happening?" I ask, but he keeps writing, writing, writing, glancing at me now and then.

I try to stand but my legs do not work. Erwin has drugged the cream! "Erwin, Erwin, what are you doing?" I cry, but he works on in silence. Finally, he says, "Von Schnurr, you have been kind enough to provide me with a complete set of your basis states. I have now projected your present state onto them. I have written the wavefunction of Beatrix Ottoline Sophia von Schnurr!"

I feel suddenly delocalized. My world becomes jittery. I can sense bits of me here, there and everywhere. Evidently, my state functions are a little imprecise. What a humiliation!

Schrödinger goes on. "Now let me explain this little apparatus in the corner. Here we have a small sample of radioactive material. Not very radioactive, just a little radioactive, maybe a particle every hour or so. And here we have a Geiger counter. And here we have a little hammer and spring and a little electrical latch. When I close the switch to the Geiger counter, it will sooner or later detect a particle. Then it will let go the hammer and the hammer will come down like so," he makes a sweeping gesture and breaks this little vial. "And then?"

I ask. "Oh, then you are a dead von Schnurr. The vial contains cyanide."

Even if I have the strength to plead with my former friend and colleague, I do not have the heart. The inhumanity, the monstrosity of his machine! As Schrödinger continues to calculate, I feel my basis set expanding until it includes not only every eigenfunction for von Schnurr alive but every eigenfunction for von Schnurr dead. Eventually Erwin says, "Now, my little Trixie, your wavefunction is really complete. So, you are mostly alive, but already a little bit dead. Isn't this curious? Isn't this a paradox? You are my very own little *gedanken* experiment! Farewell Trixie!" He closes the switch and with a smile and a wave he walks out, locking the door.

Do I lie there for one hour? Two hours? A day? I do not know. By and by, I hear a click from the Geiger counter and the sound of breaking glass. I feel my wavefunction collapsing, settling on me like a cold, damp tent.

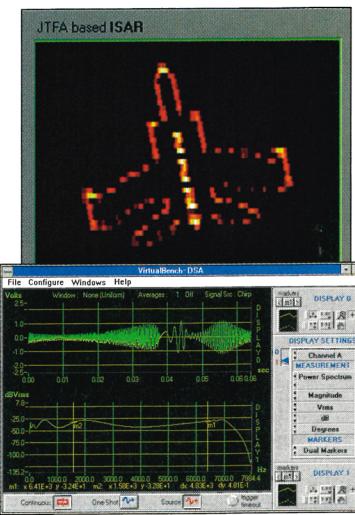
"What a horrible story," I said. "You must have been terrified lying there, waiting for death."

Not at all. On the contrary, I am feeling quite exhilarated. You see, Schrödinger had only a superficial understanding of the von Schnurr equation. He knew about wavefunction collapse but not about quantum mechanical revivals. So, every now and then, when enough of my basis functions get back in phase, up I pop. But not for too long. When they go once again out of phase, they become incoherent and I unpop. Oh, oh, just a little moment . . . I feel myself unpopping now. *Von Schnurr looked jittery for an instant—and then vanished.*

*Frankly, I do not believe von Schnurr's story. Most probably, von Schnurr is simply a pathological liar. However, I am not sure. While reading Walter Moore's Schrödinger, Life and Thought (Cambridge University Press, 1989), I came across the following passage (page 194) in which Moore describes the creation of the Schrödinger equation:*

Towards the end of 1925 Erwin wrote to 'an old girlfriend in Vienna' to join him in Arosa, while Anny remained in Zurich. Efforts to establish the identity of this woman have so far been unsuccessful. . . . Like the dark lady who inspired Shakespeare's sonnets, the lady of Arosa may remain forever mysterious. . . . Whoever may have been his inspiration, the increase in Erwin's powers was dramatic, and he began a twelve-month period of sustained creative activity that is without a parallel in the history of science. ■

# Signal Processing Suite



Interactive stand-alone applications plus add-in tools for LabVIEW®, LabWindows®/CVI, Visual Basic, C, and DLL users.

## Joint Time-Frequency Analysis Toolkit

- Gabor Spectrogram and short-time Fourier transforms
- Data acquisition capabilities

## Digital Filter Design Toolkit

- IIR and FIR filter design
- Pole-zero and magnitude response design

## Third-Octave Analysis Toolkit

- Data acquisition and third-octave analysis
- Adheres to ANSI Standard S1.11-1986

## Dynamic Signal Analyzer

- Dynamic signal acquisition and analysis
- Power Spectrum, frequency response, THD, and much more

Call today for your FREE  
Signal Processing Suite  
demo at (800) 433-3488

E-mail: [info@natinst.com](mailto:info@natinst.com)

WWW: <http://www.natinst.com/catalog/swcat>



**NATIONAL INSTRUMENTS®**  
The Software is the Instrument®

Corporate Headquarters  
6504 Bridge Point Parkway  
Austin, TX 78730-5039 USA  
Tel: (512) 794-0100 • Fax: (512) 794-8411  
E-mail: [info@natinst.com](mailto:info@natinst.com)

© Copyright 1996 National Instruments Corporation. All rights reserved.  
Product and company names listed are trademarks or trade names of  
their respective companies.

Courtesy of Airborne Branch U.S. Naval Research Laboratory.

Circle number 11 on Reader Service Card