

# Schrödinger's mousetrap

## Part 1: The trap is primed.

Ian Stewart

Rufus Jaeger looked out from the platform at a sea of faces. Every seat was full, and dozens of people were sitting on stairs and lining the walls. It made for an electrifying atmosphere, which was just how he liked it. The audience would remember this lecture for a long time.

Jaeger was head of the Quantum Optics Group at the University of Wentbridge, and he had been selected for a unique honour: to give a plenary lecture inaugurating the World Year of Physics. He was determined to give his audience an experience that would establish him as the leading authority in quantum physics. So this would not be any ordinary lecture. Jaeger was going to carry out his latest, revolutionary, experiment — the one he called Schrödinger's mousetrap — live on stage.

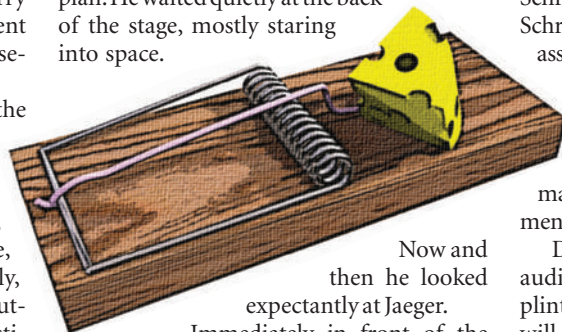
It had cost a small fortune to set the experiment up in the conference hall. Much of the stage was occupied by optical and other apparatus. Above, on a plinth, was a huge model of a mousetrap, complete with a wedge of Swiss cheese, cartoon-style with big holes. Fortunately, one of Jaeger's grants had money for 'out-reach' activities. The expenditure was justified by the presence of several journalists in the second row of the audience. Among them was Nigel Lorimer, a senior editor at *Nature*. He acknowledged Jaeger's presence with a wave, and Jaeger gave a brief nod in return.

Jaeger was an imposing figure: tall, well-built, with a flourishing beard that framed his face and sharpened his features. He could be charming when he decided that charm would get him what he wanted, and intimidating when a head-on confrontation suited his purposes better. He was sitting just left of centre stage, beside the apparatus. Next to him was his postdoc Ludmilla Shlomiuka, a strikingly attractive blonde with one of the best brains in the business. She was there to introduce Jaeger. She seemed perfectly at ease and confident, giving her boss a wry smile as the audience settled down.

Shlomiuka studiously ignored Wilfred de Bruijn, a senior member of Jaeger's group, who sat in the audience a few rows behind Lorimer, glaring at her. On the far side of Shlomiuka sat Fenton Baumgarden, a world authority in laser physics, who would chair

the session. Baumgarden was an easy-going American who had nearly got a Nobel prize. Persistent rumours had circulated for years that it was Jaeger's reference that had spoiled it for him. But their presence together at such a prestigious event would make it clear that there was no animosity between them. Which is why Baumgarden had nominated Jaeger for the job.

Almost hidden behind the apparatus was the only other person on stage: Tony Trotman, Jaeger's head technician. It was easy to overlook Trotman — if he spoke at all it was in a near whisper, and he had a chameleon-like ability to blend into his surroundings. It would be Trotman's job to make sure the demonstration went according to plan. He waited quietly at the back of the stage, mostly staring into space.



Now and then he looked expectantly at Jaeger.

Immediately in front of the journalists were various dignitaries. Jaeger was happy to see most of them, because their influence could be useful. But two he was not pleased to see: Petra Pruszczyński and Veronique Dubois. They represented his leading competitors, and they were present only because protocol demanded it.

Pruszczyński was a whizz-kid at the Gdansk Centre for Optical Computation, and a while back had given a job to one of Jaeger's former students, the brilliant but disgraced Jirong Feng. He knew Feng would be somewhere in the room ... tucked discreetly away near the back, no doubt. Dubois was an up-and-coming experimentalist with experience in secure quantum-cryptographic communications. She worked at the University of Paris 14, in direct competition with Jaeger's group. She was friendly enough — but too cool and calculating for Jaeger to feel comfortable.

The lighting in the hall dimmed. Baumgarden, silhouetted by a single dramatic spotlight, declared the conference open and invited his colleague Dr Shlomiuka to introduce their speaker. She delivered a short, witty

introduction, entirely from memory, and sat down. Jaeger rose, to enthusiastic applause.

"Distinguished guests, colleagues, and ladies and gentlemen of the press," Jaeger began, "I am humbled and honoured to inaugurate the World Year of Physics." He paused for further applause. "I have been invited to describe my research group's new results on quantum entanglement — which Einstein so memorably described as 'spooky action at a distance'. Of course, we now understand that the phenomenon is entirely rational and not at all spooky — but it does remain quite startling. Only a few months ago my team discovered just how startling."

He glanced down at the assembled journalists. "You all know the fable of Schrödinger's cat, but it is often forgotten that Schrödinger's primary purpose was not to assert the existence of superposed quantum states, but to examine their paradoxical consequences for a macroscopic entity." He paused. "In the interests of animal welfare, I will employ a simple machine instead of a cat. I call the experiment 'Schrödinger's mousetrap.'"

Dutiful laughter rippled through the audience. So that's what the model on the plinth was for. "First," Jaeger explained, "I will set up my mousetrap." He gestured towards the model. "A laser-operated optical trap. But I do not bait my mousetrap with cheese, because it has already caught a mouse. Which in this instance is a hollow dielectric sphere.

"Now, although I know there is a mouse in the trap, I do not know its quantum state." He paused. "What does that mean? It means that my spherical mouse can resonate in two distinct modes. Following the precedent set by Herr Professor Doktor Schrödinger, I shall refer to these modes as 'dead' and 'alive'.

"So have I trapped a live mouse, or a dead mouse? That, my friends, is the great mystery!"

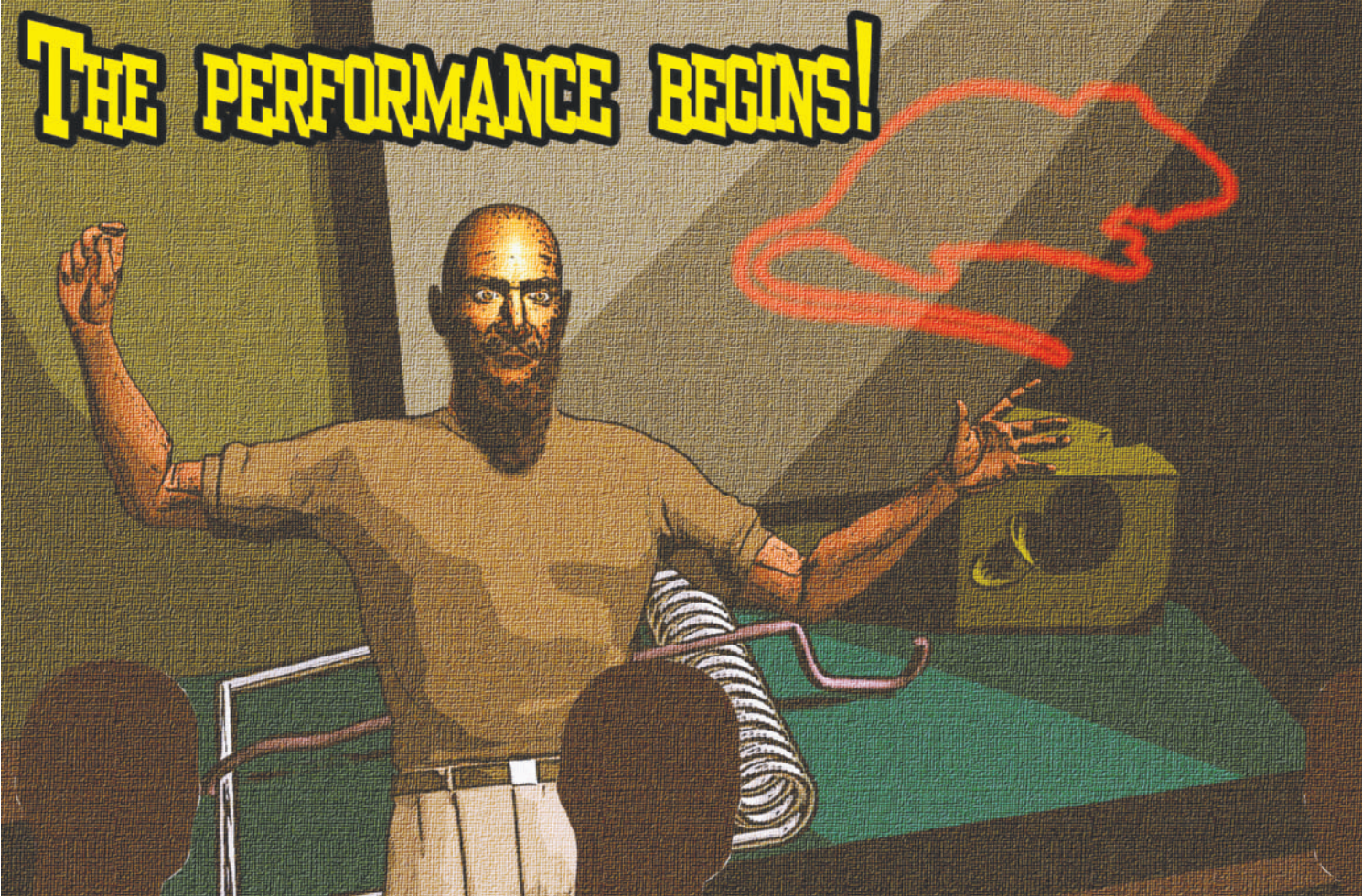
Pruszczyński turned to Dubois, and said, in a stage-whisper, "Juz' like Rufus. He iz real showman."

"Yes," Dubois whispered back. "Effective, isn't it?"

Pruszczyński glared at her, then sighed and nodded. "I am sorry to say, you are right."

"To resolve the mystery," Jaeger continued, "I shall appeal to quantum entanglement. I will arrange for the mouse's fate to be

# THE PERFORMANCE BEGINS!



CHRISTIAN DARKIN

entangled with that of another sphere: the 'cat'. This sphere also resonates in two modes. The entanglement procedure will ensure that the two spheres have different states: if the cat is alive, then the mouse is dead, and vice versa. My assistant will now use a brief laser pulse to prepare the entangled states." As Trotman laboured in the darkness of the stage, the screen showed a schematic animation of the entanglement procedure.

"At the climax of the experiment," Jaeger explained, "I will observe the state of the cat, and infer the state of the mouse. If I observe the cat to be alive, then the mouse's wave function will immediately collapse to 'dead', and the mouse will stay in the trap. However, if the cat is observed to be dead, then the mouse's wave function will collapse to 'alive', and in this higher resonant mode the sphere will escape from the trap."

"How will we know if the mouse escapes or not, Professor?" one of the reporters called out.

"Ah, my impatient questioner from the press, I am coming to that. To make the results visible to everyone in this room, I have arranged the apparatus so that the laser beam will project a three-dimensional hologram of the mouse. You will see either a dead mouse caught in my trap, or a live one running across the stage above my head as it escapes."

At this point Shlomiuka noticed that Pruszczyński was grumbling, and asked her to stand up and clarify her concerns. It would be better then letting her simmer, and eventually explode.

"Iz stupid experiment! Iz dangerous! Laser must be unnecessarily powerful, juz to make silly hologram..."

"My dear woman," said Jaeger unwisely, "there are adequate safeguards..."

"Am not your dear woman! Experiment iz totally meaningless! One trial proves nothing: iz all about correlations. Must do experiment hundreds of times!"

"Which we have done, in the laboratory, as our forthcoming paper will establish," said Jaeger smoothly. "But we don't have enough time to do that today. This is just a demonstration, Professor Pruszczyński."

Pruszczyński was unconvinced. "Seen preprint. Prove nothing! Extraor'nary claim require extraor'nary evidence, which you don't got!"

With ill-concealed anger, Jaeger suggested that Pruszczyński should learn the basics of quantum entanglement. Before she could react, Baumgarden, in his role as chair, politely tried to end the discussion. But it was Shlomiuka, who always wanted to keep everyone happy, who proposed that the demonstration should be performed several times to obtain some statistical evidence. Pruszczyński, still grumbling, sat down, while Jaeger, red-faced, dabbed at his forehead and looked a little unwell. He took his place beside the demonstration apparatus.

The lights dimmed for a ten-minute multimedia presentation of the background to the experiment and its theoretical basis. The hall and platform were now in almost total darkness, save for tiny individual read-

ing lights. The presentation ended, and Trotman readied the apparatus. The slide projector showed the cat's state: it was alive. While the audience waited for the hologram of a dead mouse to appear, a strange sizzle and a dull thud could be heard. Trotman was about to reset the apparatus for a second trial, when a terrible scream came from the stage. It was Shlomiuka.

After a few moments, someone had the presence of mind to turn the main lights on in the hall. Jaeger had collapsed, and was lying awkwardly on the stage, not moving. A faint smell of burning drifted on the air. Shlomiuka was kneeling beside Jaeger. She lifted his head and started sobbing.

Baumgarden bent down, stared at Jaeger's face, and pulled her away. "He's dead," he said blankly. "There's a hole in his head." He reached for a microphone. "Ladies and gentlemen: it seems that there has been a terrible accident."

Lorimer, who had a reputation for being calm in a crisis, rose to his feet. "Sorry to contradict you, Fenton, but has it occurred to you that what you call an 'accident' might have been deliberate?"

Baumgarden went pale. It was unlikely, but Lorimer had a point. There was only one thing to do. He instructed Security to lock the doors to the conference centre, to make sure no one could leave, and call the police.

**To be continued...**

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