Between Science and Metaphor: Puppetry as a Medium for Quantum Thinking

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Abstract: *Dafa Theatre's first science puppetry performance was a new practice-based research in Quantum Physics inspired puppetry and at the same time a challenge without available methodology. The process required sustained translation across disciplines, laboratory style creation and reflection. Dafa's team initiated a creative inquiry that used the tension between real science and theatrical metaphor, as well as a script-based and devised process. The process began with probing foundational principles, followed by script writing that established characters, plot, and scientific content. During rehearsals, these were negotiated and adjusted. The result was a performance that made core quantum computing concepts, such as superposition and coherence, accessible. The initially uncertain question of whether quantum physics can be staged for children through puppetry developed into an accessible, metaphor-based method, created through making a performance that translates quantum concepts using puppetry and metaphor-based storytelling as a medium.*

Key words: *science puppetry; quantum physics; metaphor-based storytelling; interdisciplinary research; practice-based methodologyy.*

About the project

Introducing the project, its scope, and the fusion of puppetry and physics

The performance "Hyper Super Mega Max Quantum Computer", was created as part of the Please ASK! (Art-Science Kick) [1]project. The aim of this initiative is to develop original science-themed performances through creative exchange and collaboration with scientists. Dafa Puppet Theatre's production is a quantum-focused puppet performance intended for young audiences. Quantum physics is difficult to comprehend, and presenting something superficial is not acceptable; at the same time, no methodology was available to avoid didacticism or to sustain the project. The first question was whether quantum principles can be staged for children through puppetry. Through continuous artistic and scientific inquiry, this evolved into a more precise question:

How can puppetry enable children to sense quantum physics while maintaining scientific and aesthetic integrity?

[1] Creative Europe Cooperation project, No 101131281. https://pleaseask.eu/

The project had a rich timeline, but for the purposes of methodology, the key artistic-research phases included:

1. Preparation:
    - Initial script development
    - 7-day laboratory in Borovets, Bulgaria
2. Realisation phase:
    - Development with the dramaturg and scenographer
    - Residency at Libušín Atelier
    - Rehearsals
    - Opening and performances

Dafa Theatre's multinational team consisted of: Réka Deák (director), Veronika Traburová (scenographer), Jana Nunčič (dramaturg), Matěj Vejdělek (composer), Mariana Čížková and Jakub Vaverka (actors), Aurél Gábris (quantum physicist and scientific coordinator), and Radka Lím Labendz and Husam Abed (producers).

Preparation Phase

The methodology grew out of a set of practical principles defined by Réka Deák together with Aurél Gábris and Husam Abed. The question was: how to translate quantum concepts into non-didactic puppet play? One possible answer was to evoke a feeling of proximity to complex Quantum ideas - giving the audience and participants the sense that they were getting closer, but not total comprehension - to sense scientific logic experientially. Even for the artists without at least high-school-level physics, this was a challenge. They needed time to reach some level of comfort with ambiguity later in the creative process.

Choosing, and staying within, a simple narrative framework was one practical and dramaturgical principle. This was important so the audience, mainly children, could follow the storyline and engage without feeling overwhelmed. First ideas were about *Minecraft, LEGO, Ninjago,* as well as consideration of adapting *Oddsockeaters*, a well-known Czech animation. Folktales like *Little Red Riding Hood*, *Aesop's Fables*, and *The Seven Goatlings* offered various possibilities for adaptation, since they already had themes of transformation, and threat-mirroring the fragility of coherence and the inevitability of decoherence. Disheartening fact that all of the metaphors are inaccurate, because any attempt to stage will distort the quantum reality. As a final compromise *The Seven Goatlings* was the chosen narrative framework.

The next one was to choose only one quantum principle from the ones on the table: superposition, interference, or entanglement - one that can arouse children's curiosity and offer "beauty and perspective".(Demetz 2019, 402) A recurring issue during the whole process was the knowledge gap: understanding quantum scale and quantum processes. Because of this the idea of presenting real science or current quantum events

came up many times - which idea was compelling, but out of reach as it is an enormous challenge to noticeably show quantum particles on stage. Puppetry can "become the art of juxtaposing different means of expression (or 'signs'), all able to evoke metaphor" (Jurkowski 1988, 56). Metaphors do not replicate physics, but they allow audiences to grasp and visualise what cannot be directly shown. The script and rehearsal process were therefore organised around the principle that the puppet functions as a sign capable of communicating quantum ideas through metaphor.

The production was planned as intimate: designed for two actors, with small groups of children. This setup allowed direct communication and check-interactions to ensure that children from the audience perceived the intended quantum concepts.

The script was designed to avoid the trap of turning science into fiction - Quantum physics challenges everyday human intuition and classical physics.[2] The strangeness of quantum logic must not be presented as science fiction but instead normalized within the internal rules of the script. The director and the scientist started to explore and script performative metaphors for quantum computing such as characters assembling parts of a "quantum computer," or contrasts between chaotic decoherence and synchronized behavior as superposition - creating possibility for children to sense, rather than be taught, how quantum systems behave.

The further development of the script was guided by a consideration that sought to balance scientific accuracy, theatrical experimentation, and accessibility for young audiences. At its core was the conviction that puppetry and object theatre could translate complicated quantum concepts into material metaphors-allowing children not to understand quantum physics in the didactic sense, but to feel its strangeness and beauty through play, rhythm, and interaction. The silliness of puppets added an extra layer of joy.

Capacity building took part in the lab in Borovets. Selected people from Arte Urbana Collectif (Bg), Dafa Puppet Theatre (Cz), Pro Progressione (Hu) tried out different innovative cross-disciplinary approaches, taught each other their methodology in creating performing arts and science productions. The selected artists and scientists from the three production teams took part in this summer school in order to both train them and learn from them. to try out different innovative cross-disciplinary approaches between performing arts and science.

One of the most important takeaways is the story would collapse without science - principle learned from Andrea Brunello. To expand: it means that science, scientific premise should be the axis mundi of the dramaturgy. It meant for Dafa that even with a recognizable tale, a clear narrative base, the performance should be meaningless, cause and effect are not connected, puppetry is random objects moving on a stage. Coherence is missing…

[2] https://www.scientificamerican.com/article/quantum-physics-isnt-as-weird-as-you-think-its-weirder/

Realisation - From Story to Superposition

Rehearsal process, dramaturgy, scenography, presentation of quantum concepts

A December 2024 residency helped solidify the central storyline and finalized the scenographic concept. The scenographer's role was central: design was not only visual but also choreographic, defining how fast puppets and objects moved and how scenes pulsed. For example, hand puppets can move quickly, while string marionettes have a slow, solemn motion.Veronika Traburová, through her design, defined the rhythm of the performance: wooden tabletop puppets with magnetic-detachable heads and bodies can move quickly, while a wire-built wolf with replaceable limbs moves more slowly; however, the wire structure created a surprising visual effect for a shadow appearance. Two multifunctional tables structured the stage space.

By January 2025, a text-based structure had emerged that balanced accurate scientific content about decoherence with playful theatricality. The script is based on *The Seven Goatlings* fairytale. Considering the age target audience (8+), the goats were replaced by children:

At the same time, the pressure of creating something unprecedented sometimes led the creators to overlook that they could draw on applied theatre literature, where theatre is in dialogue with the social sciences and other disciplines. Joe Winston's observation helped address rigorosity: "the real enjoyment, and the real learning, lay in the tensions along the journey rather than in the moral stability of the final resolution."(Winston 2009, 45) This perspective helped to make puppetry in which artists and audiences can encounter quantum decoherence through joyful, human and affective contexts is already a meaningful outcome.

From this standpoint, quantum decoherence does not need to be presented as a complicated concept requiring extensive study to grasp. Instead, it can be staged through puppetry in an relatable, joyful way. As a puppet, it takes the form of a cold, metallic animal figure-a wolf with a realistic and threatening presence. Audience verbal feedback confirmed that this approach first engaged viewers emotionally and then conceptually. On a conceptual level, the Decoherence Wolf collapses superposition-one reason why real-world quantum computers are unstable. But this metaphor emerged gradually through the process. As computers are already part of children's everyday experience, and as quantum computers are expected to become increasingly accessible and highly performant in the near future (as confirmed by Aurel Gábris), creating the narrative with familiar technological references was a logical step. The wolf, as a metaphor, translates a quantum process into something noticeable, affective, and narratively meaningful.

This approach is supported by Deldime and Pigeon, who found that children's theatrical memory is often shaped most strongly by visual elements that are surprising or unexpected.(Winston 2009, 45) In the performance the wolf appears as a mysterious shadow, then in a realistic, recognisable form, and by then in the end disintegrates into

powder. This transformation triggers tension in both children and adults, functioning as a visual metaphor for the inevitability and irreversibility of decoherence.

During first rehearsals actors, Mariana Čížková and Jakub Vaverka created joyful scenes with the seven children making it relatable to the young audience. Less time was available to experiment with magnets, and metallic powder - the final shape of the wolf. This is a loss in visuality, because during the residency in Libušín, the actors invisibly manipulate these elements (using magnets) to create shifting, almost organic patterns, making them a perfect sensorial metaphor for the constantly infiltrating decoherence.

Incorporating technology in a science theatre performance can be self-explanatory, but does it enhance - rather than substitutes - narrative meaning? Visits to CVUT[3], observing advanced technology such as the Tokamak GOLEM[4], revealed the temptation of integrating real quantum technology, but also revealed its incompatibility with the goals of accessible performance for local audiences. Not to mention the financial dimensions. Instead, the project turned to frameworks like Liz Corb's *Triple E Framework,*[5] which emphasise purposeful technological tool selection (originally in education, though the parallel to theatre practice is applicable). No technological spectacle. Puppet theatre became the chosen medium precisely because it could embody science while leaving room for imagination, participation, and fun. The main virtue of Triple E is its reminder that technology should extend learning, not replace it. In our context, high-tech tools would merely substitute traditional puppetry rather than *Extend, Enhance, or Engage.* (Kolb, 2017) Another risk would be to channel creative energy into operating machinery instead of collective creation or building a rich world for the puppets.

The scientific foundation was rigorously maintained thanks to the presence of Aurél Gábris during rehearsals. He gently supervised and clarified the scientific content. A scientist should participate in rehearsal and creation to ensure fidelity (no incorrect scientific content) and conceptual coherence (no metaphor should replace factual accuracy). At the same time, the insistence on accuracy created tension during the rehearsals. On one side stood the playful creativity of the puppeteers, eager to explore seven children puppets and object animation. On the other side stood Aurél Gábris's demand that "quantum-wise it must make sense." When science is translated into theatre, it should be accurate, otherwise it risks staging misconceptions. This negotiation became part of the methodology itself: a constant balancing act between playful creation and scientific accuracy. Interestingly, a dramaturgical dilemma arose during the rehearsals that mirrored a real challenge in quantum physics: it was difficult for two puppeteers to manipulate eight puppets (a parent and seven children), and

[3] Czech Czech Technical University; Aurél Gábris serves as Deputy Head of the Department of Physics.. https://www.cvut.cz/en

[4] Tokamak GOLEM http://golem.fjfi.cvut.cz/

[5] Triple E Framework https://www.tripleeframework.com/

debates emerged over whether to use three or seven puppets. Aurél Gábris noted that seven-qubit systems in quantum physics present a difficult problem as well.

The story of *The Seven Goatlings* was adapted, using its storyline as a guiding thread to lead the audience through the main challenge of creating a quantum computer, more exactly the decoherence. The young audience is already familiar with its basic plot: a wolf repeatedly tries to devour the goatlings, succeeds on the third attempt, while one small goatling escapes and the goatlings are later saved by the returning parent.

In the adaptation children puppets represent qubits. When the children cooperate (make ice cream) they embody coherence. The wolf becomes the metaphor of decoherence. The adaptation does not follow the original fairy tale chronologically but instead develops as a narrative escalation, repeating the core storyline three times as an applied dramaturgical strategy.

The first one introduces the concept of a "normal" computer and bits, which are familiar to the audience. To demonstrate the limitations of classical computation, scenes were created in which children, representing bits, could only respond with "yes" or "no," reflecting the binary nature of bits (0 or 1). On stage, bits were represented as puppets without heads.

The second story introduces the qubits in the quantum computer, which is more powerful than the classical one. Qubits appear as children with heads, allowing for more complex forms of communication.

The third story focuses on decoherence - the cost of the complex quantum computer. It is an ongoing and real challenge for scientists, embodied in the figure of the shape-shifting wolf. Since the audience already knows the story, they can focus less on the plot, allowing space for complex quantum ideas.

During the early rehearsals, the influence of scientific correctness fluctuated, at times becoming the primary dramaturgical force, until the final scene was developed, which was a tough challenge. The folk tale has a fixed ending: the wolf is punished, eliminated and harmony is restored. But quantum-wise, that was not the right answer: decoherence cannot be eliminated. It is always present. Scientific accuracy and dramaturgical logic clashed.

This tension shifted the process away from purely rational analysis toward an emotionally accessible narrative adaptation - one that provided a character the audience could empathise with. The youngest child became the key. She faces the most dangerous enemy and initiates a dialogue. The wolf is ultimately defeated through dialogue and discovery, but the focus shifts to the girl. The ending is not about the wolf's defeat as in the original story plot, but about a young girl's quest to save her family. Her journey also represents another quantum concept: error correction.

Aurél Gábris pointed out: "To defeat the wolf, a concrete way should be applied. But science does not always have concrete ways - only questions, many questions…"

And so it is with puppetry: Can puppetry function without emotion? How can theatre makers access intuitive or emotional dimensions when they feel bound by scientific accuracy? Where is the boundary between rehearsal and research? Is interpreting science the main role of science theatre?

Finally, the process was shaped by dialogue and plurality. Different theatrical traditions - Romanian, Slovenian, and Czech - brought distinct assumptions about roles, authorship, and collaboration. The spirit of play and experimentation was repeatedly tested by the need to remain faithful to scientific fact. Negotiating these tensions became as revealing as the artistic product itself.Demetz concludes that "science and theatre seek the same goals, in the same way, using the same language. That is, they both seek to understand the natural world through intelligence and insight. Scientists speak of finding 'truth', while theatre artists work to present verisimilitude, or similarity to life on stage."(Demetz 2019, 402) So the performance "Hyper Super Mega Max Quantum Computer" can be understood as producing an experiential and perceptual form of truth through puppetry.

The methodology can be solidified with more reflective practice in another project. For now can be summarised as an interplay of scientific accuracy and theatrical metaphor. The performance deliberately avoided oversimplification while resisting the temptation of mathematical abstraction - inviting children to experience coherence and decoherence as dynamic puppetry. Puppets acted as signs translating scientific processes into embodied stage metaphors.

The premiere was held on 14 April, 2025 in Prague, on *International Quantum Day*. Feedback praised the production's educational potential. One attending physics teacher, for example, described the materials as "totally age-appropriate," noting that it provided a strong foundation for voluntary engagement. She suggested that additional support materials would help ensure children take away the key parallels to quantum computing even if they do not articulate them directly.

Conclusion

This academic report contributes to artistic research by demonstrating how puppetry can function as a method for translating complex scientific knowledge into embodied and experiential forms. In the absence of an established methodology for quantum-physics-based puppetry for audiences aged 8 and above, the process necessarily remained experimental. The resulting performance language is grounded in scientific principles while simultaneously engaging with imaginative play.

The project shows that puppetry, as a non-realistic art form whose natural language is metaphor, enables audiences not only to imagine life, but also to actively interpret signs. A key finding is that metaphor, when treated as a carefully constructed dramaturgical device, can bridge scientific accuracy and sensory accessibility. The Decoherence Wolf emerged as such a device: an experiential metaphor for a quantum

process. Rather than offering a didactic explanation, it enabled audiences - adults, children, and scientists - to engage first emotionally and then conceptually. This is reflected in expert feedback. Dr Mariana Filipova described coherence (coordinated movement of children) as a state of unity and synchronisation associated with positive and harmonious experiences, while the wolf "creates a feeling of destruction and decoherence," confirming the metaphor's capacity to communicate scientific phenomena through experience.

Methodologically, the project proposes a practice-based approach that combines scientific accuracy with theatrical strategies, including puppetry, storytelling, repetition, material transformation, and play. By using a familiar folktale framework, the performance reduces the cognitive load of following the plot, thereby opening space for encountering concepts such as qubits, superposition, and decoherence. This demonstrates that understanding in science theatre can emerge through sensing, participation, and affect, rather than through explanation alone. Puppetry thus engages with science not as illustration, but as a mode of inquiry that produces alternative, often fragile ways of knowing through aesthetic and sensory experience.

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