# From quantum picturalism to quantum AI

Bob Coecke

*Quantinuum Ltd., Compositional Intelligence team, Oxford, UK.*

**Our Oxford-based CQ-team first performed Quantum Natural Language Processing (QNLP) on an IBM quantum computer [1, 2], and more recently also did so our own trapped ion hardware. Key to having been able to achieve what is conceived as a heavily data-driven task, is the observation that quantum theory and natural language are governed by much of the same compositional structure -- a.k.a.~tensor structure.**

**Hence our language model is in a sense quantum-native, and we provide an analogy with simulation of quantum systems in terms of algorithmic speed-up [forthcoming]. Meanwhile we have made all our software available open-source, and with support [github.com/CQCL/lambeq].**

**We will also introduce the notion of compositional intelligence, exploiting the fact that the compositional match between natural language and quantum extends to other, such as patio-temporal perception and embodiment [3, 4], we will argue that a new generation of AI can emerge when fully pushing this analogy, while exploiting the completeness of categorical quantum mechanics / ZX-calculus [5, 6, 7] for novel reasoning purposes that go hand-in-hand with modern machine learning.**

[1] B. Coecke, G. De Felice, K. Meichanetzidis and A. Toumi (2020) Foundations for Near-Term Quantum Natural Language Processing. https://arxiv.org/abs/2012.03755

[2] R. Lorenz, A. Pearson, K. Meichanetzidis, D. Kartsaklis and B. Coecke (2020) QNLP in Practice: Running Compositional Models of Meaning on a Quantum Computer. https://arxiv.org/abs/2102.12846

[3] V. Wang and B. Coecke (2021) Talking Space: inference from spatial linguistic meanings. https://arxiv.org/abs/2109.06554

[4] B. Coecke (2021) Compositionality as we see it, everywhere around us. https://arxiv.org/abs/2110.05327

[5] B. Coecke and A. Kissinger (2017) Picturing Quantum Processes. A first course on quantum theory and diagrammatic reasoning. Cambridge University Press.

[6] B. Coecke, D. Horsman, A. Kissinger and Q. Wang (2021) Kindergarden quantum mechanics graduates (...or how I learned to stop gluing LEGO together and love the ZX-calculus). https://arxiv.org/abs/2102.10984

[7] B. Coecke and S. Gogioso (2022) Quantum in pictures. Quantinuum publications.