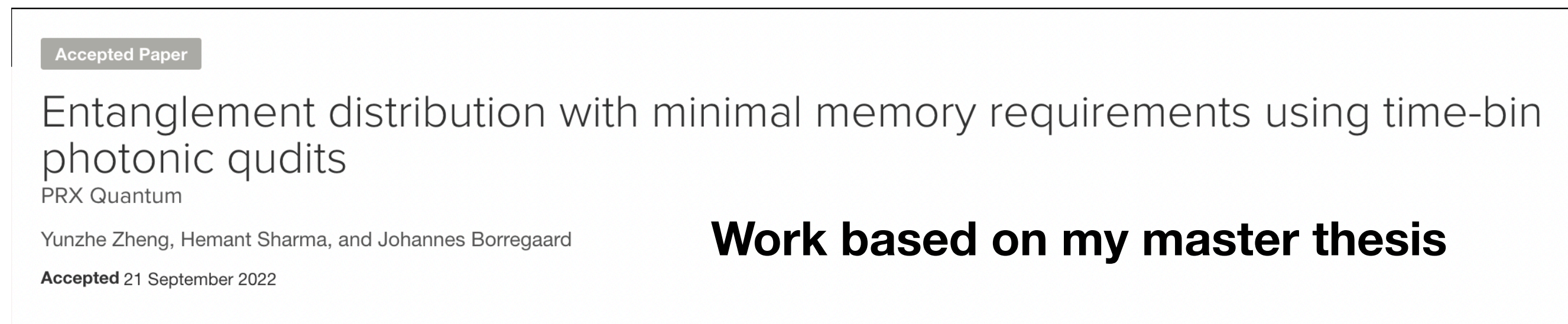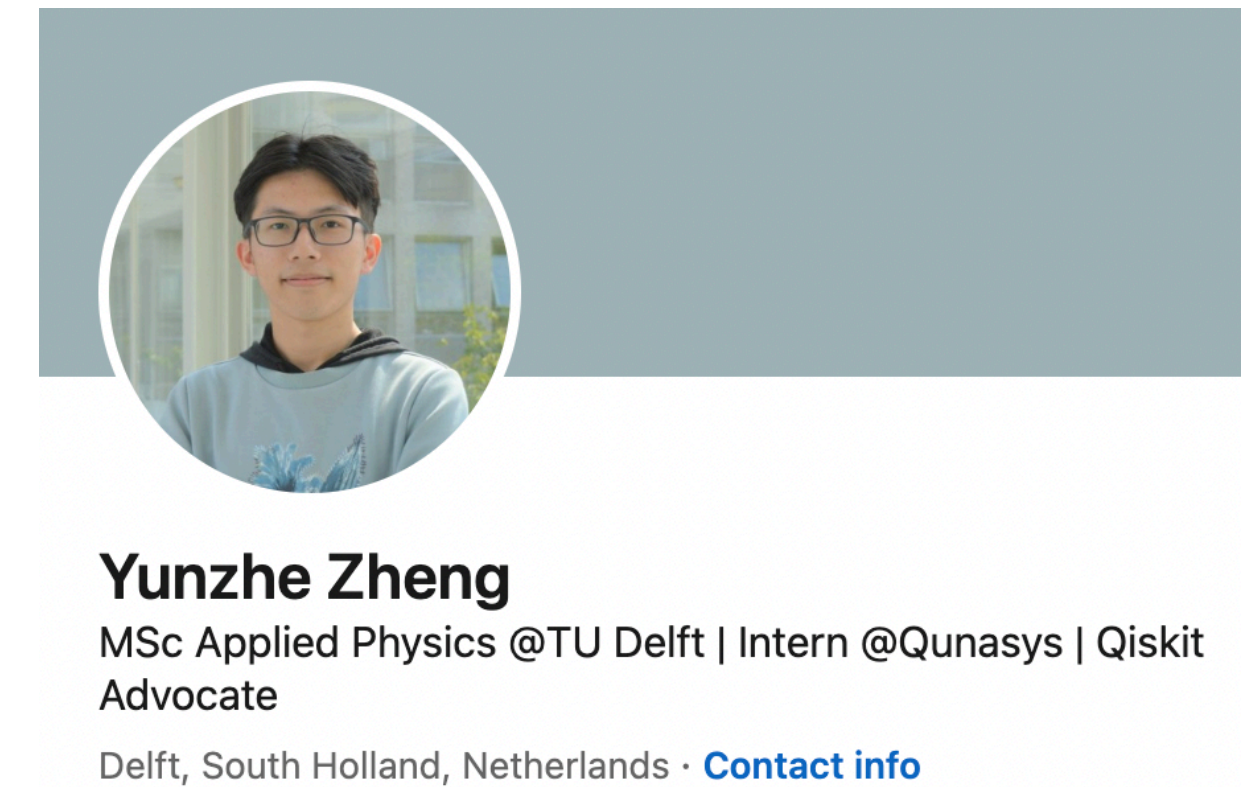# #2 Implement MILP solver within Qiskit Optimization - About us

- I just graduated from TU Delft with a MSc Applied Physics.
  - Interest: Quantum network & Quantum algorithm & Error correction (mitigation)
  - Now an intern @ Qunasys (a Tokyo startup focusing on quantum algorithm)
  - I am a heavy fan for Formula 1🏎️

Yunzhe Zheng
MSc Applied Physics @TU Delft | Intern @Qunasys | Qiskit Advocate

Delft, South Holland, Netherlands · **Contact info**

Accepted Paper

Entanglement distribution with minimal memory requirements using time-bin photonic qudits

PRX Quantum

Yunzhe Zheng, Hemant Sharma, and Johannes Borregaard

Accepted 21 September 2022

Work based on my master thesis

- My mentor Takashi is a Research Scientist @ IBM Research -Tokyo

Takashi Imamichi · 1st
Research Scientist at IBM Research – Tokyo
Japan · **Contact info**

Motivation

- Mixed-Interger Linear Programming (MILP) solver
  - A powerful solver that allows part of variables to take only integer values.

  - *scipy.optimize.milp* come out with Scipy v1.9.0 (July 29 2022)

  - Useful for many linear problems, but not incorporated with *Qiskit Optimization.*

$$\min_{x} c^T x$$
$$\text{such that } b_l \leq Ax \leq b_u,$$
$$l \leq x \leq u,$$
$$x_i \in \mathbb{Z}, i \in X_i$$

scipy.optimize.milp

```
scipy.optimize.milp(c, *, integrality=None, bounds=None, constraints=None, options=None)
```

Why we need MILP for Qiskit?

- In qiskit-optimization, we can use CPLEX and Gurobi to classically solve quadratic problems

  - but they are commercial APIs and limited by free access! (# of variables & constraints)

  - On the other hand: Scipy doesn't ask for you to pay :p.

- Our goal: integrate the MILP solver with qiskit-optimization library.

  - We expect to build a `*SciPyMILPOptimizer*` class in `*qiskit_optimization.algorithms*`

  - A tutorial introducing how to use our new optimizer!

-   ** Our work is fully about classical optimizers.