Wigner 121 Scientific Symposium

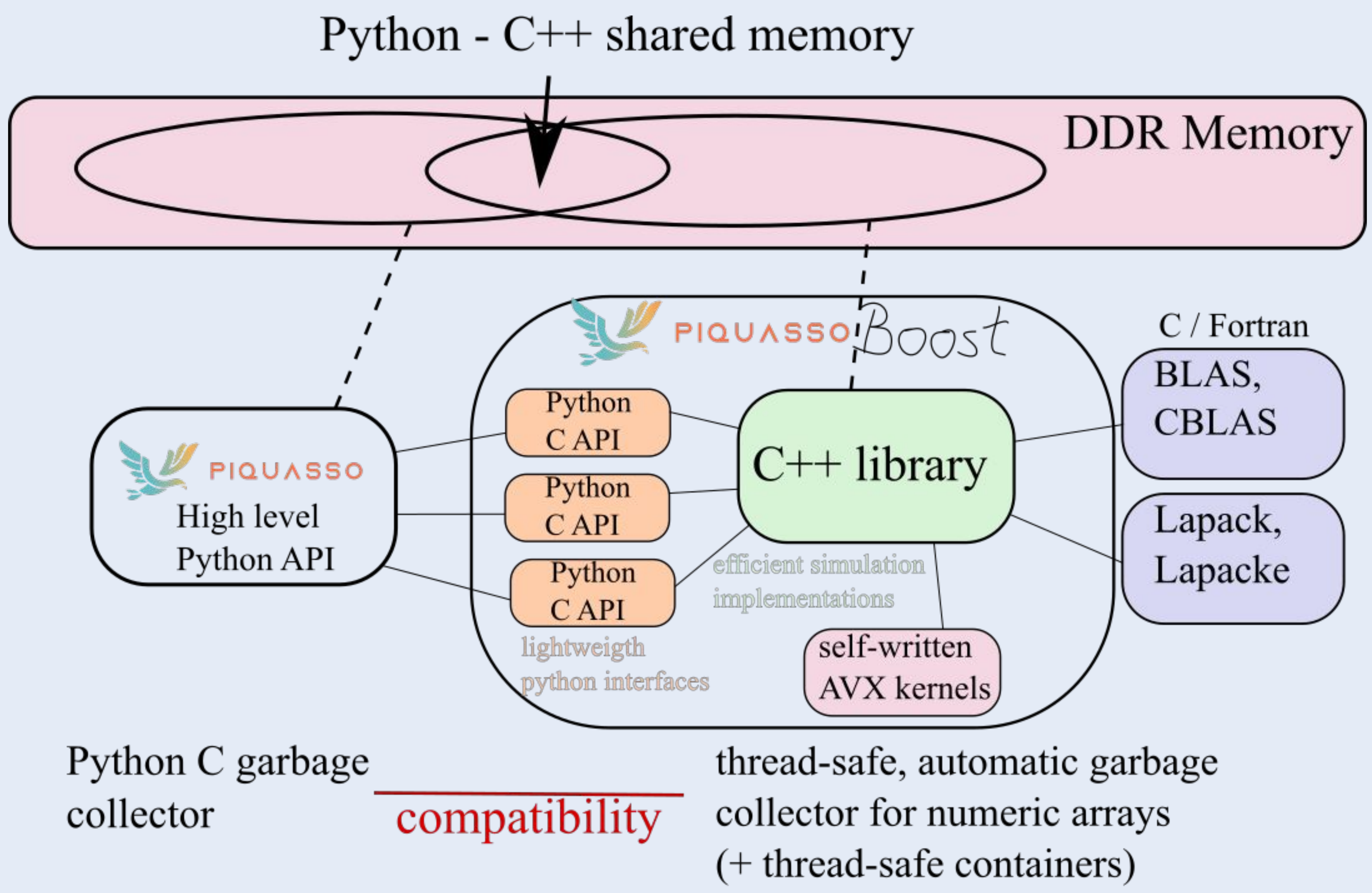
Wigner Research Centre for Physics
Institute for Particle and Nuclear Physics
Department of Computational Science
Quantum Computing and Quantum Information Research Group

PIQUASSO Boost
We make it fast!

A Photonic Quantum Computer Simulation Software Platform

Zoltán Kolarovszki, Péter Rakyta, Ágoston Kaposi, Henrik Varga, Szabolcs Jócszik, Dániel Nagy, and Zoltán Zimborás

We introduce the Piquasso quantum programming framework, a full-stack open-source platform for the simulation and programming of photonic quantum computers. Piquasso can be programmed via a high-level Python programming interface enabling users to perform efficient quantum computing with discrete and continuous variables. Via optional high-performance C++ backends Piquasso provides state-of-the-art performance in the simulation of photonic quantum computers. The Piquasso framework is supported by an intuitive web-based graphical user interface where the users can design quantum circuits, run computations and visualize the results.



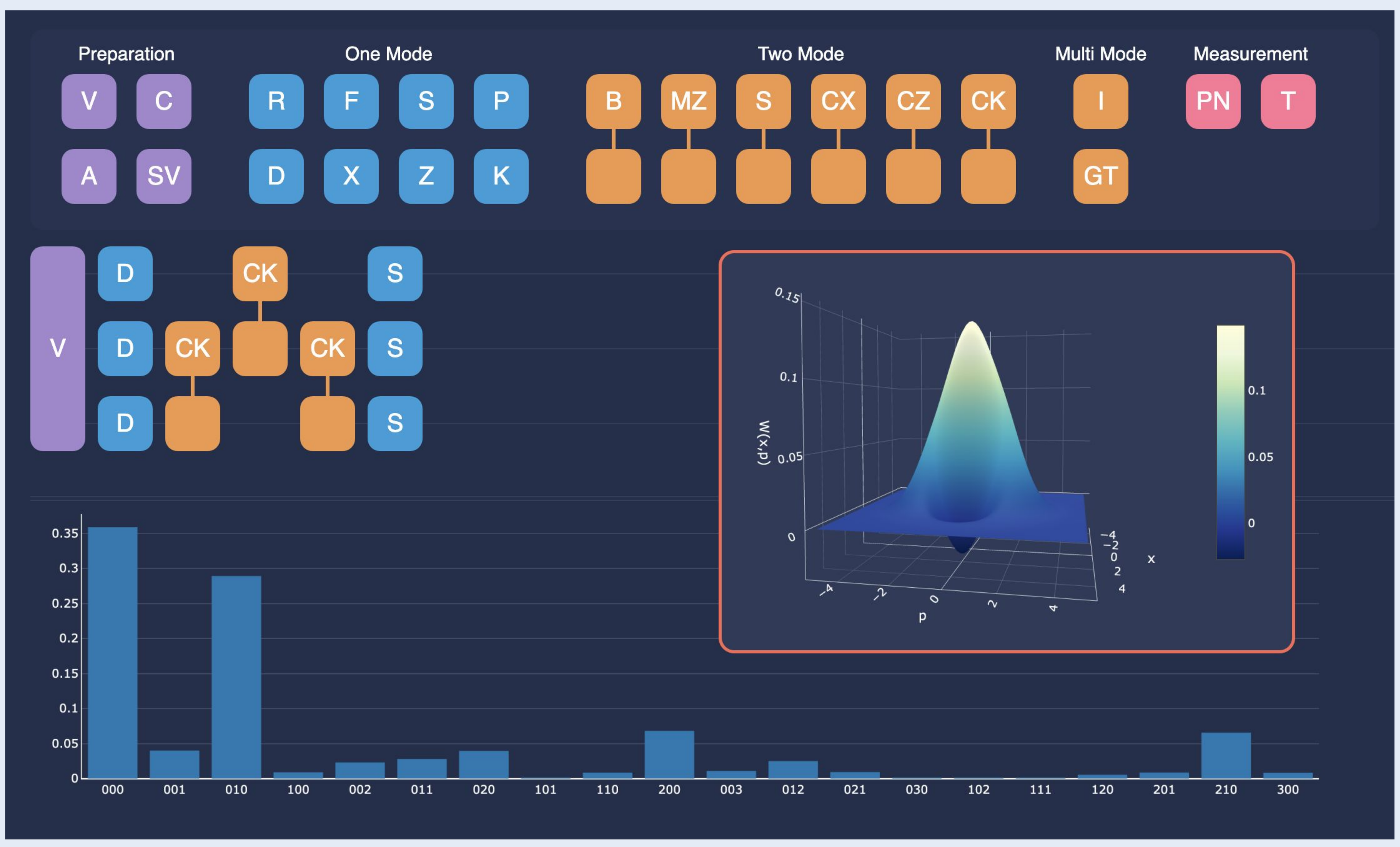
Stable memory management without leaks.

Piquasso implements a different set of calculations for different computational models corresponding to certain special cases, such as computations solely with pure states or Gaussian states. The explicit use of these special cases results in certain benefits, e.g. using Gaussian states are generally faster than using Fock states.

To increase computational performance while keeping the benefits coming from the flexibility and the popularity of a high-level Python API the Piquasso simulation package is coming with low-level C++ engines that can be optionally incorporated into the Piquasso framework via lightweight Python C++ extensions interface.

The PiquassoBoost package unifies all the C/C++ components working behind the Piquasso API onto common grounds by utilizing a general development framework responsible for the management of data arrays. Furthermore, it can off-load certain computations to an FPGA-based accelerator backend which operates according to the Data-Flow Engine (DFE) paradigm.

The Piquasso web application is a dynamic drag-and-drop circuit called the Composer, which can be used to compose quantum circuits. The created quantum program can be sent to the server for simulation. After the simulation, one can acquire information about the particle number detection probabilities, the Wigner function or the canonical momentum and position distribution. One can also export the generated data in a JSON file for further processing and the application even generates a Python code, which could be run using the installed Piquasso/PiquassoBoost libraries.



We thank the support of the NKFIH through the Quantum Information National Laboratory of Hungary and through OTKA Grant No. FK 135220.

Quantum Information National Laboratory HUNGARY

HUN-REN Hungarian Research Network

MTA Centre of Excellence