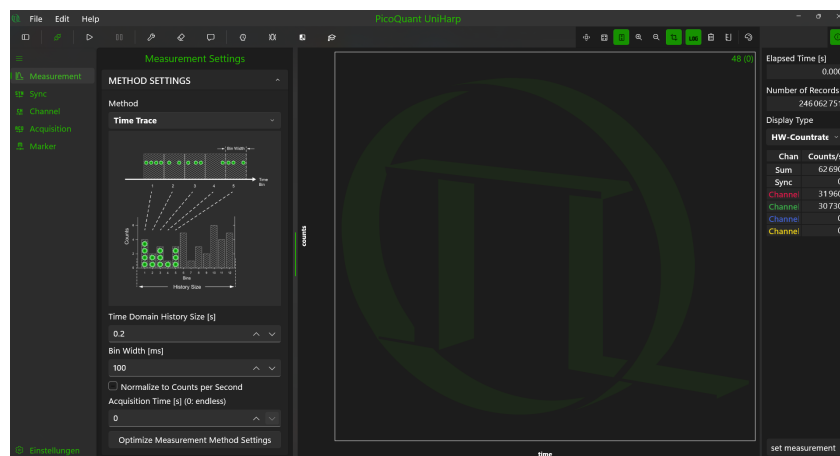# UniHarp

## Free Universal Data Acquisition Software



- Sleek and modern interface for efficient research workflows
- Supports all advanced measurement classes such as histogram, time trace, correlation, unfold and RAW
- Supports real-time data acquisition, visualization, and flexible data saving
- Intuitive parameter-setting tools to streamline complex experiment configurations
- Comprehensive monitoring of device performance
- Compatible with multiple PicoQuant devices and supports PTU/PHU data import/export

UniHarp is a unique, state-of-the-art graphical user interface for data acquisition that brings precision, flexibility, and simplicity to working with PicoQuant's time-correlated single-photon counting (TCSPC) and time-tagging devices. Designed with versatility and ease of use in mind, UniHarp allows researchers to utilize advanced measurement classes such as histogram, time trace, unfold, RAW, and correlation (e.g., FCS and g²) while maintaining full control over all hardware and software parameters. The universal software is compatible with all current PicoQuant time-tagging devices, including the HydraHarp 500, PicoHarp 330, MultiHarp 150/160, and TimeHarp 260 (with optional DLLs). It offers real-time data acquisition, plotting, saving, and loading capabilities, as well as intuitive parameter-setting tools and comprehensive status monitoring for your PicoQuant time-tagging devices. With UniHarp, conducting cutting-edge experiments in quantum optics, photonics, materials science, and life sciences has never been easier.

# Measurement Class Details

The software's data acquisition capabilities are based on the unique time-tagging modes by PicoQuant's TCSPC electronics. In these modes, photons on each detection channel are either tagged with the absolute arrival time since the beginning of the measurement or with the time difference to the last laser pulse. This schemes preserve photon timing information and allow a large range of data interpretation ranging from simple TCSPC histograms to complex correlation analysis.

Histogram

Histograms of photon arrival times are essential for studying temporal kinetics, including excited state lifetimes in time-resolved photoluminescence (TRPL) experiments. UniHarp allows precise parameter adjustments and visualizes the histogram as data is acquired, making it easy to record decay dynamics. Histogramming photon arrival times captures the relative timing between a synchronization signal and photon detection, with picosecond-level resolution. This technique is highly versatile and is utilized in various fields including Quantum Optics, Quantum Cryptography (QC), Time-Of-Flight (TOF), fluorescence decay, and coincidence correlation, among others.
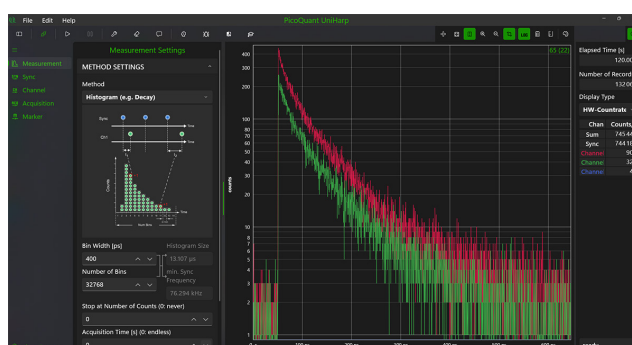


Time Trace

Time trace measurement captures photon arrival times over extended periods, ideal for monitoring signal intensity over time or analyzing time-dependent behaviors such as molecular blinking. UniHarp provides intuitive controls to configure these measurements and allows real-time plotting for immediate feedback.
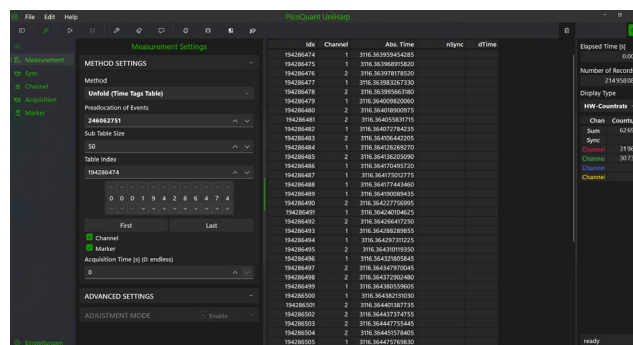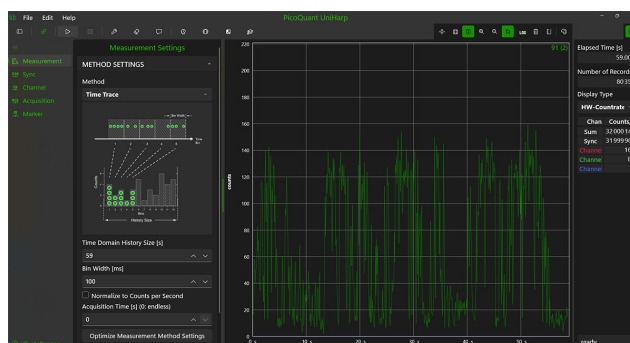
## Correlation

Correlation analysis, including auto- and cross-correlation for FCS or g(2) measurements, is integral for characterizing molecular interactions and quantum emitter properties. UniHarp simplifies correlation setups and visualizes results for instant interpretation.
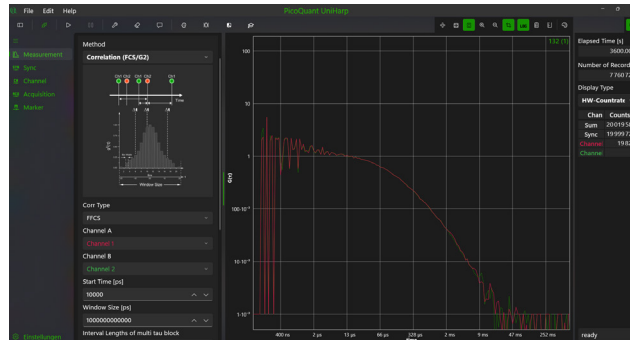


## Unfold

Unfold measurement processes data streams to extract detailed photon timing information. This class is essential for experiments requiring high temporal resolution and provides a robust interface for managing unfolded photon arrival data.



## RAW

RAW data acquisition enables direct access to unprocessed photon data, empowering researchers to develop custom analysis pipelines or validate device performance under unique conditions. UniHarp makes exporting and managing RAW data seamless.
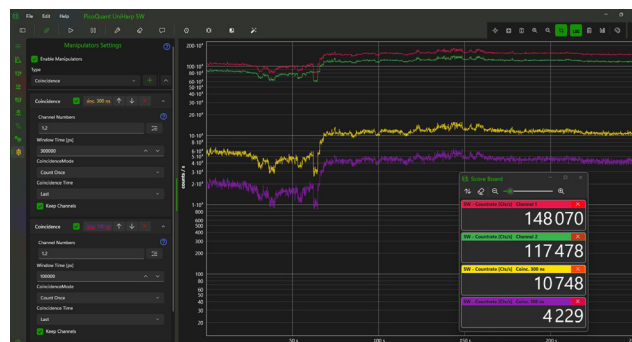
# Data Manipulators

With powerful built-in manipulators functioning as „virtual channels", you can process and transform data on-the-fly:

- Coincidence - Study coincidences between any channels for user-defined time windows
- Herald - Use a reference channel to flexibly gate the time tags of target channels
- Substream - Filter your time tags by a start and stop time
- Merge - Combine the data streams of various channels
- Delay - Add a time shift on your channel of interest in post processing

Manipulator "Coincidence"

Coincidences between selectable channels can now be studied for a user-defined coincidence time window directly in the UniHarp software. The example shows the time traces coming from two SNSPDs, whose coincidence count rates are displayed for coincidence windows of 300ns and 100ns, respectively.



Manipulator "Herald"

Heralded measurements are typically used to confirm the presence of a photon by detection of its (entangled) pair, i.e. produced by a SPDC source. The Herald manipulator can be understood as a time-gating filter in post-processing. The $g2$ antibunching dip of a single emitter is demonstrated to be significantly lowered when time tags caused by irrelevant transitions are suppressed with the Herald manipulator.
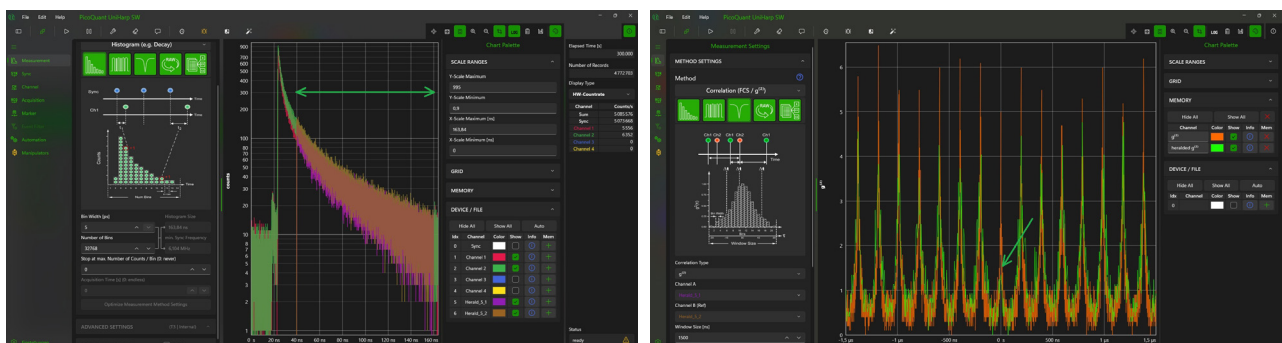
Manipulator "Substream"

The Substream manipulator is an ideal data analysis tool allowing you to have a closer look at certain time intervals and to check for changes that may have occurred during a measurement. This is especially useful to suppress artifacts in the analysis, which are caused by instabilities in the experiment. In this example, the Substream manipulator is used to correct for a baseline-shift in a g2 correlation, which has been caused by realignment of the setup during data acquisition.
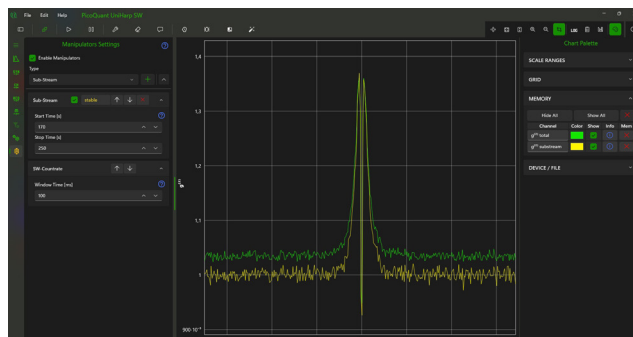


# Specifications

| Graphical user interface | Windows based GUI |
|---|---|
| Supported TCSPC modules | HydraHarp 500<br>PicoHarp 330<br>TimeHarp 260 (with optional DLLs)<br>MultiHarp 150/160 |
| Supported Channels | 1 to 64 |
| Measurement Classes | Histogram<br>Time Trace<br>Correlation (FCS or g²)<br>Unfold<br>RAW |
| Measurement preview | TCSPC histogram<br>Time Trace<br>FCS |
| Display | Linear or logarithmic scale, zoomable |
| Export Data Format | PTU<br>PHU<br>ASCII also via Windows clipboard |
| Operating System | Win 10/11 |