



# BUNCH PURITY MEASUREMENT FOR SSRF

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## Abstract

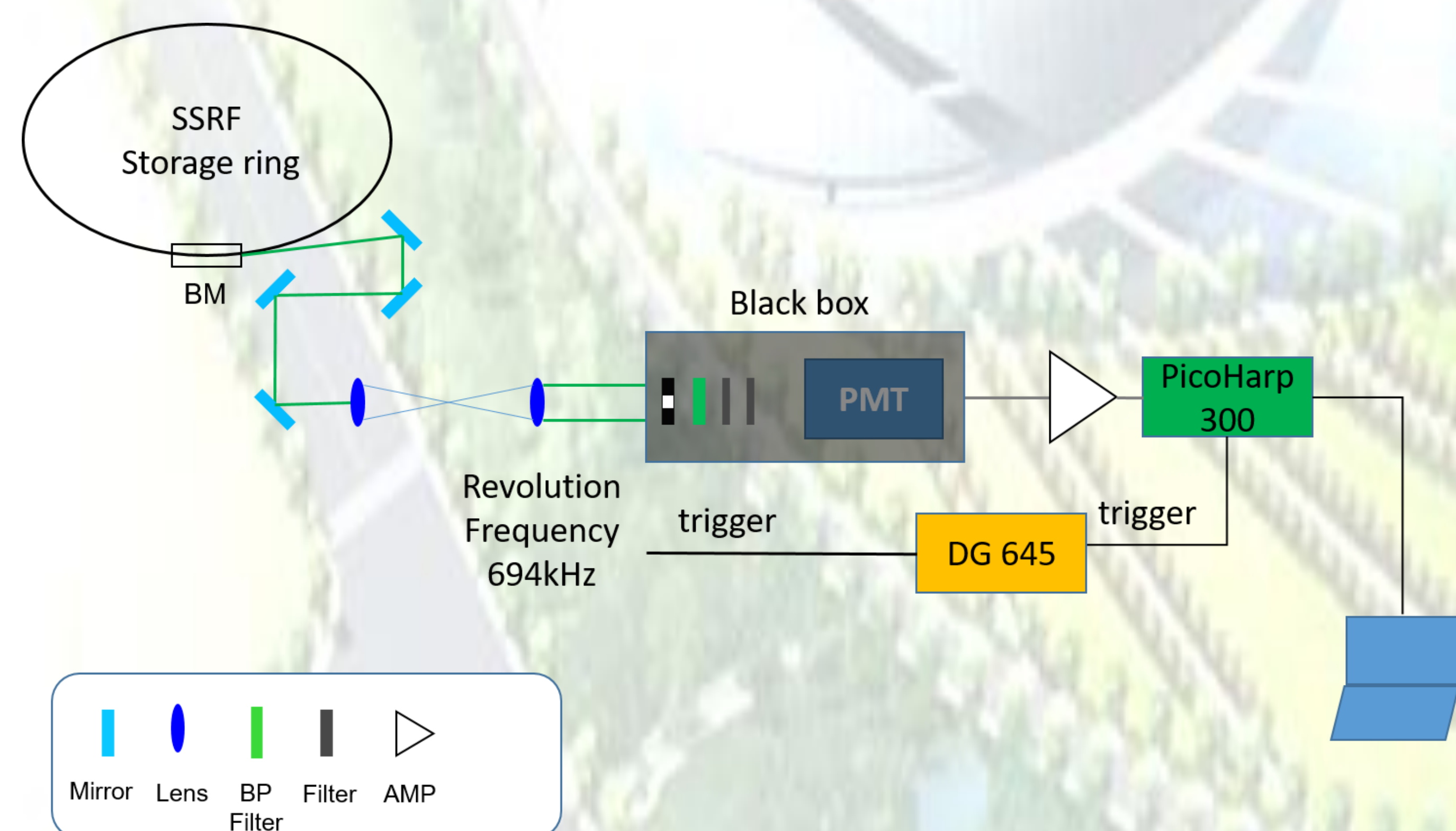
SSRF is currently working on the beam line phase-II project, which has moved toward laser/X-ray pump-probe experiments and the bunch pattern will be the hybrid mode. To quantify the bunch filling pattern and purity of the timing bunch, high precision beam charge measurement is necessary. Therefore, a bunch purity monitor based on the time-correlated single-photon counting techniques has been installed. A series of tests to evaluate the system have been carried out, according to these results, it is able to predict the system performance. The system has exceptionally good time resolution (a few pico seconds) and high dynamic range (more than seven orders of magnitude).

## SSRF phase-II beamline project

The ongoing SSRF beamline phase-II project, the main construction content includes the construction of 16 new beam lines and experimental stations, experimental auxiliary systems, light source performance expansion, etc. The project focuses on major scientific and technical issues in the fields of energy, environment, materials, condensed matter physics, earth sciences, chemistry and life sciences, with the goal of greatly improving the over-all experimental capabilities of SSRF. It also has a lot of technology goals. To realize the third-generation synchrotron radiation light source experimental technology with near-limit resolution (time/space/energy/momentum), realize the innovative combination of photon energy regions and ultra-long station hall experimental technology, and realize online/offline comprehensive experimental capabilities.

## SSRF Bunch purity measurement system(TCSPC)

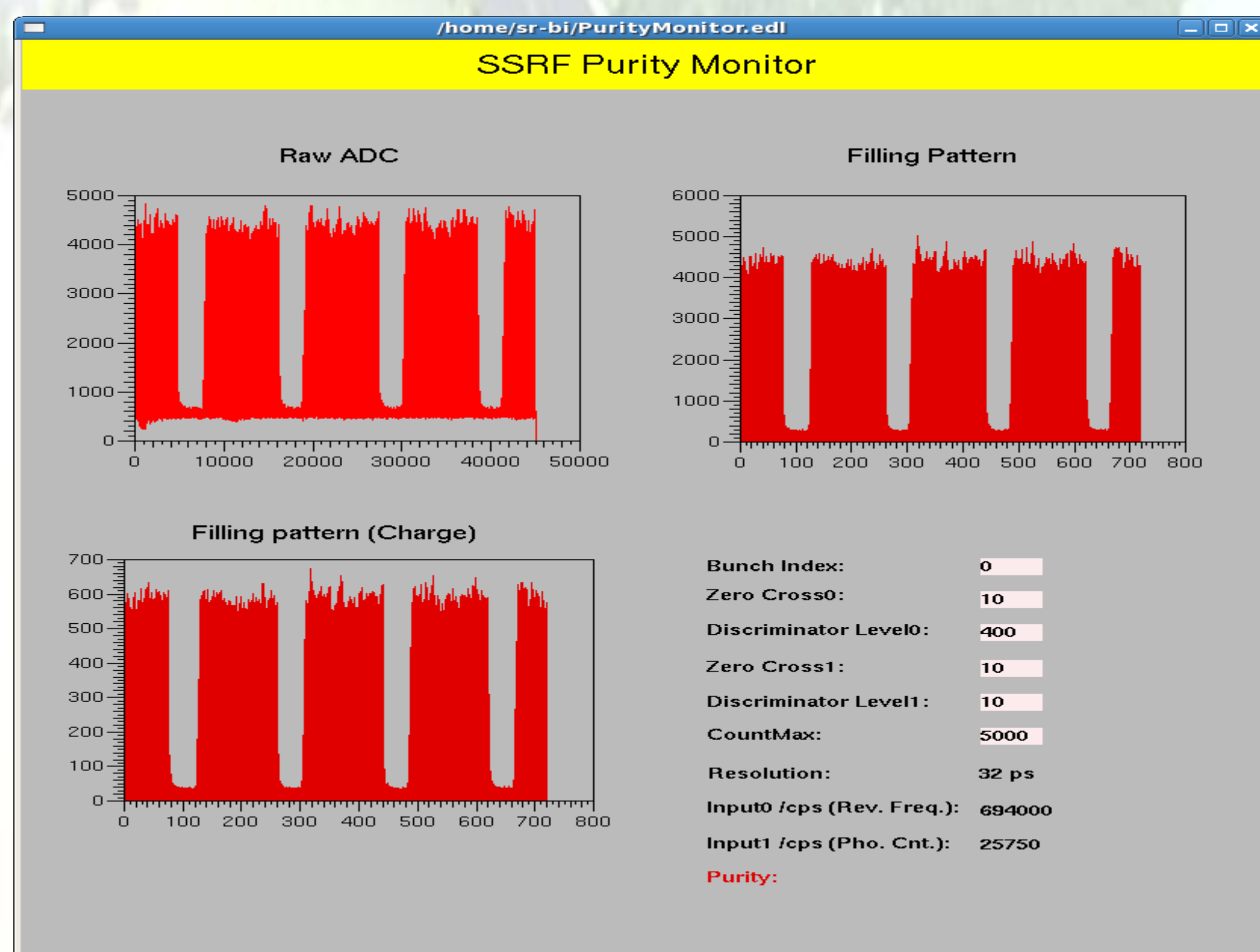
### Hardware



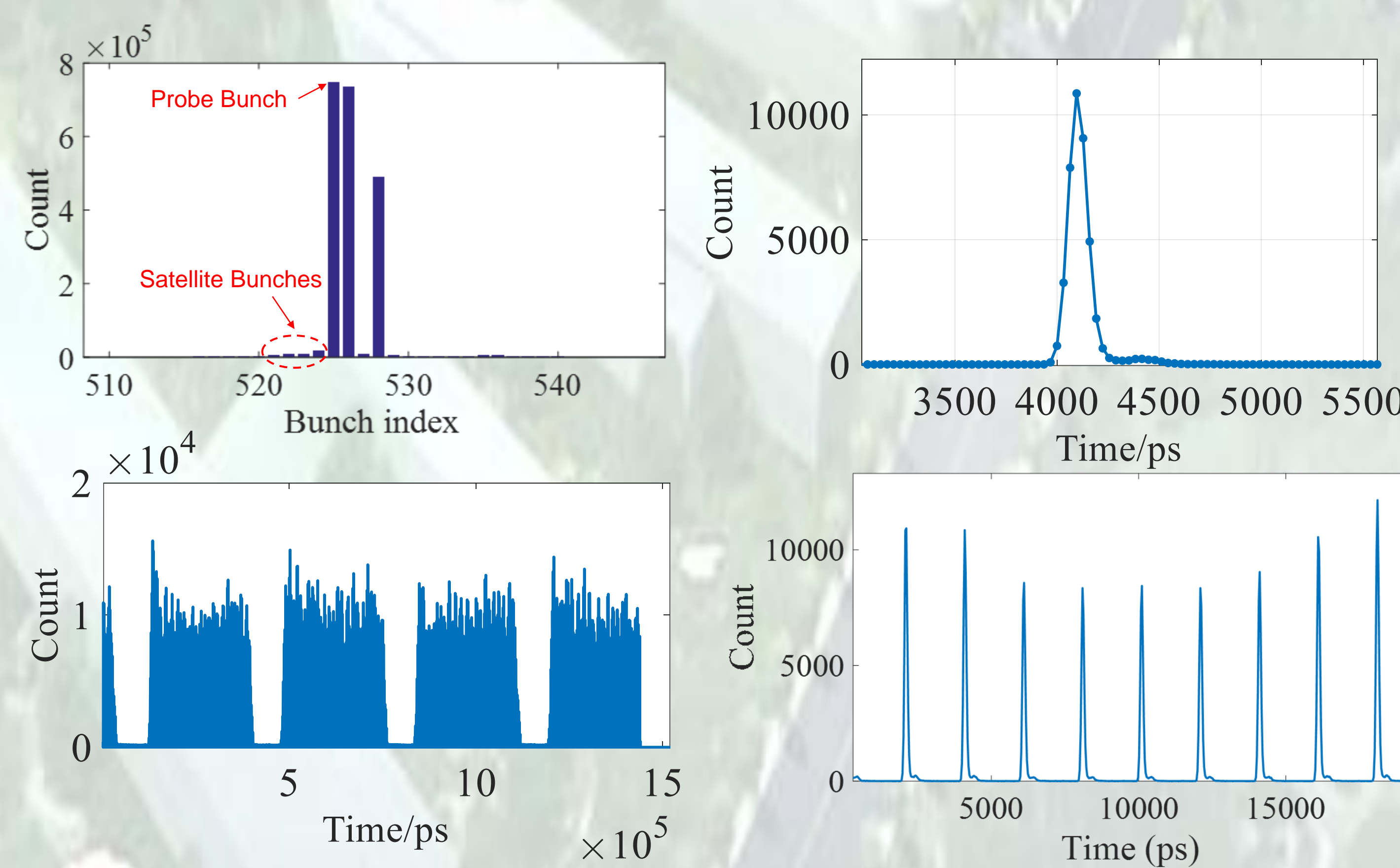
### Key parameter

| Parameters        | Values                    |
|-------------------|---------------------------|
| Attenuation level | 10 orders of magnitude    |
| PMT               | E3059-500                 |
| Time resolution   | 2 ps                      |
| Record bin        | 32 ps                     |
| Trigger           | 694kHz (Revolution Freq.) |
| Count rate        | 69400 counts/sec          |

### Software EDM panel



### Performance evaluation



- Measured purity (ratio of wanted and unwanted populations) can reach  $4 \times 10^6$  for about 2 minutes
- after about 5 minutes of cumulative counting, the measured purity can reach  $2 \times 10^7$  level

## Conclusion & Outlook

- SSRF bunch purity monitor based on TCSPC has been established, purity measurement resolution can reach to  $10^7$  @ 5minutes refresh rate.
- In the future, after the hybrid mode is realized, direct purity measurement will be achieved, and thanks to the time resolution, bunch length measurement is planned to be studied based this new system.