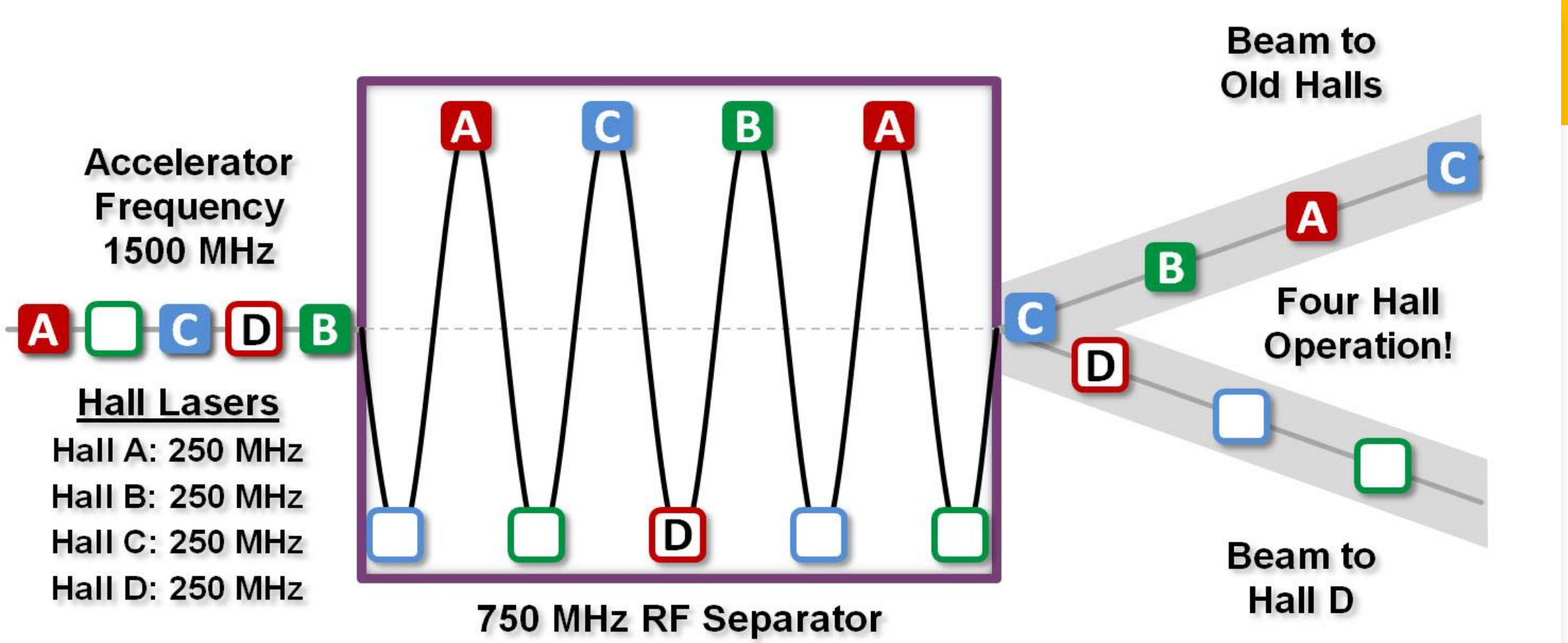
Online Monitoring of the Beam Time Structure

Hovanes Egiyan

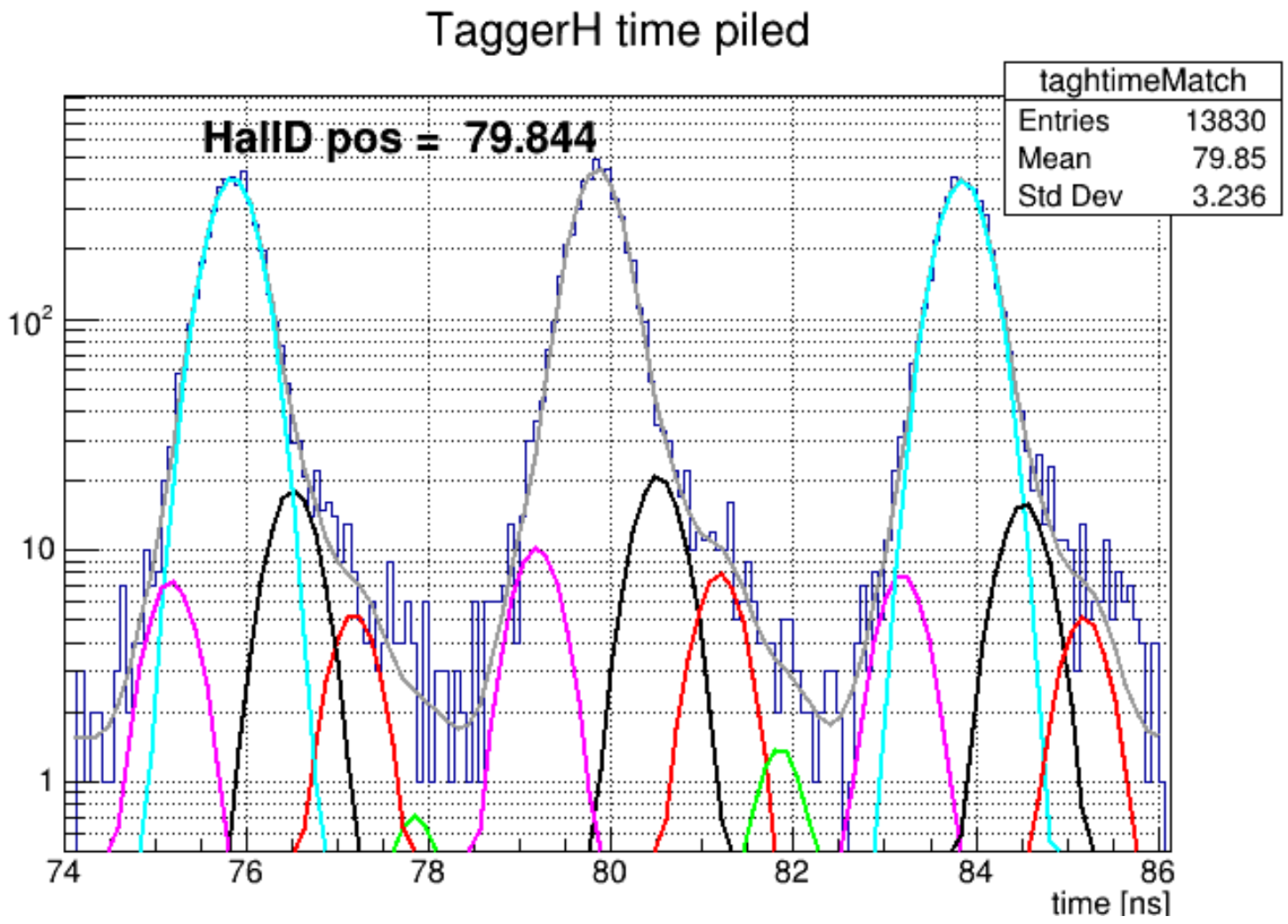


Bleedthrough and Beam Bunches

- For the four-hall operations the lasers are fired with 750 MHz frequency.
- The “top” neighboring bunches should be arriving empty to Hall D if 750MHz separator works well. Otherwise, peaks offset by 0.6ns ±Nx1.33ns might be visible arriving to Hall D.
- The “bottom” neighboring bunches should be arriving empty to Hall D if there is no DC noise from other lasers. Otherwise, peaks separated by ±Nx1.33ns might be visible arriving to Hall D.

Beni's Studies from 2021

- Beni looked at the TAGH time difference with RF using the offline data with unbiased hits
  - This could be done online using a RootSpy plugin.
- Nice RF-structure with a time resolution of about 350ps.
- The shoulder on the right-hand-side of the peaks is asymmetric, it could be from bleedthrough.
  - The interpretation was not clear.
- The phase of the peaks can change every time new time calibrations kick in.
  - Need to analyze data within the same run with different injector configurations.

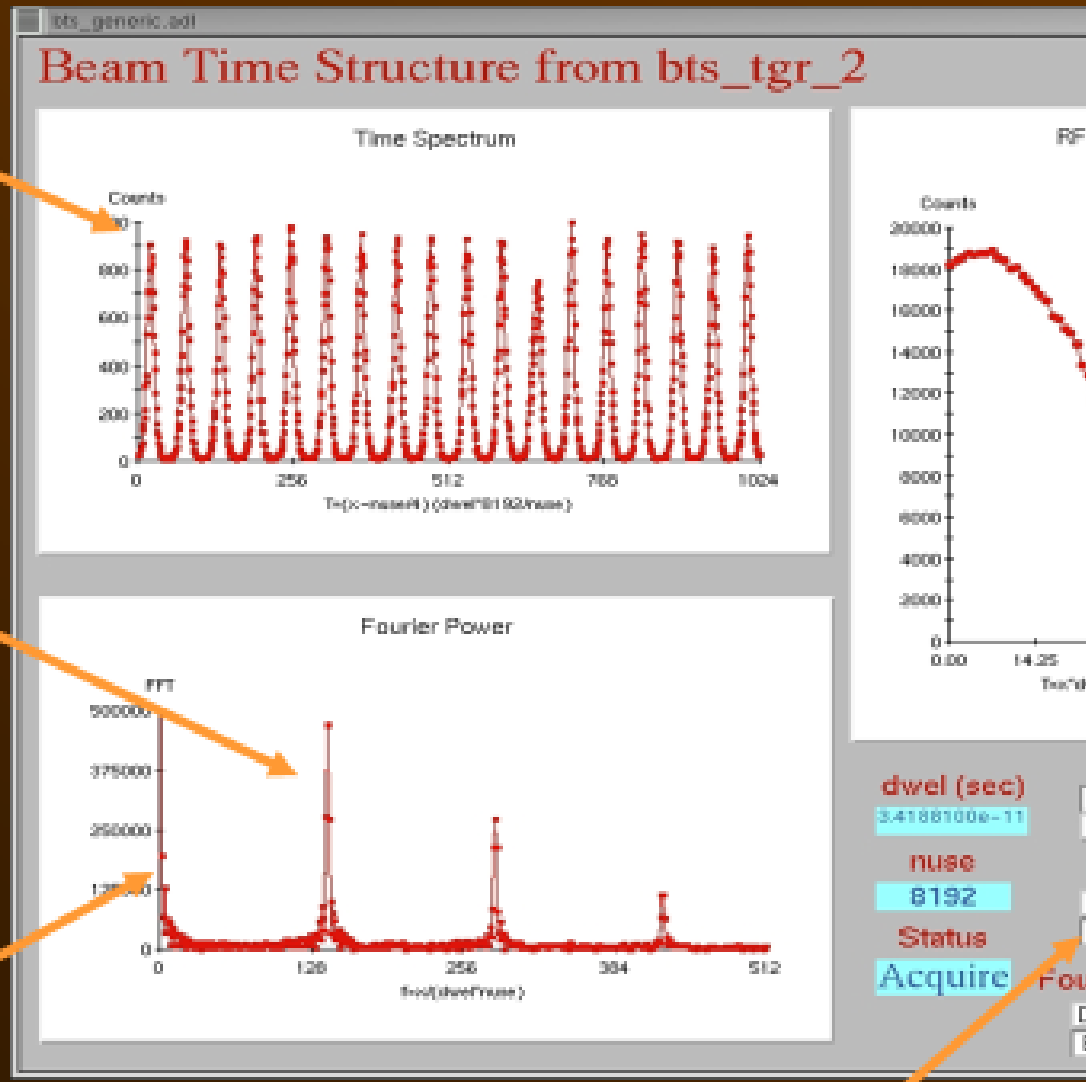


Hall D laser is on, using Hall C slit

Old CLAS-6 Application

- Take signals from Hall B tagger and the RF-signal prescaled by a factor of 40.
- Uses CAEN V775 TDC with Start and Stop signals to measure the time with 35ps resolution.
- EPICS-based application to subtract the times and to the math.
- Time resolution of ~300ps for the RF-peaks.
- Allowed us to monitor the changes in the phase in time.

Online EPICS Screen



Raw Time Spectrum

- Can clearly see *2 ns* structure of the beam
- Can clearly see the *499 MHz* peak
- There are other higher frequency peaks due to the gaussian shape of the peaks.

Fourier Transform Spectrum

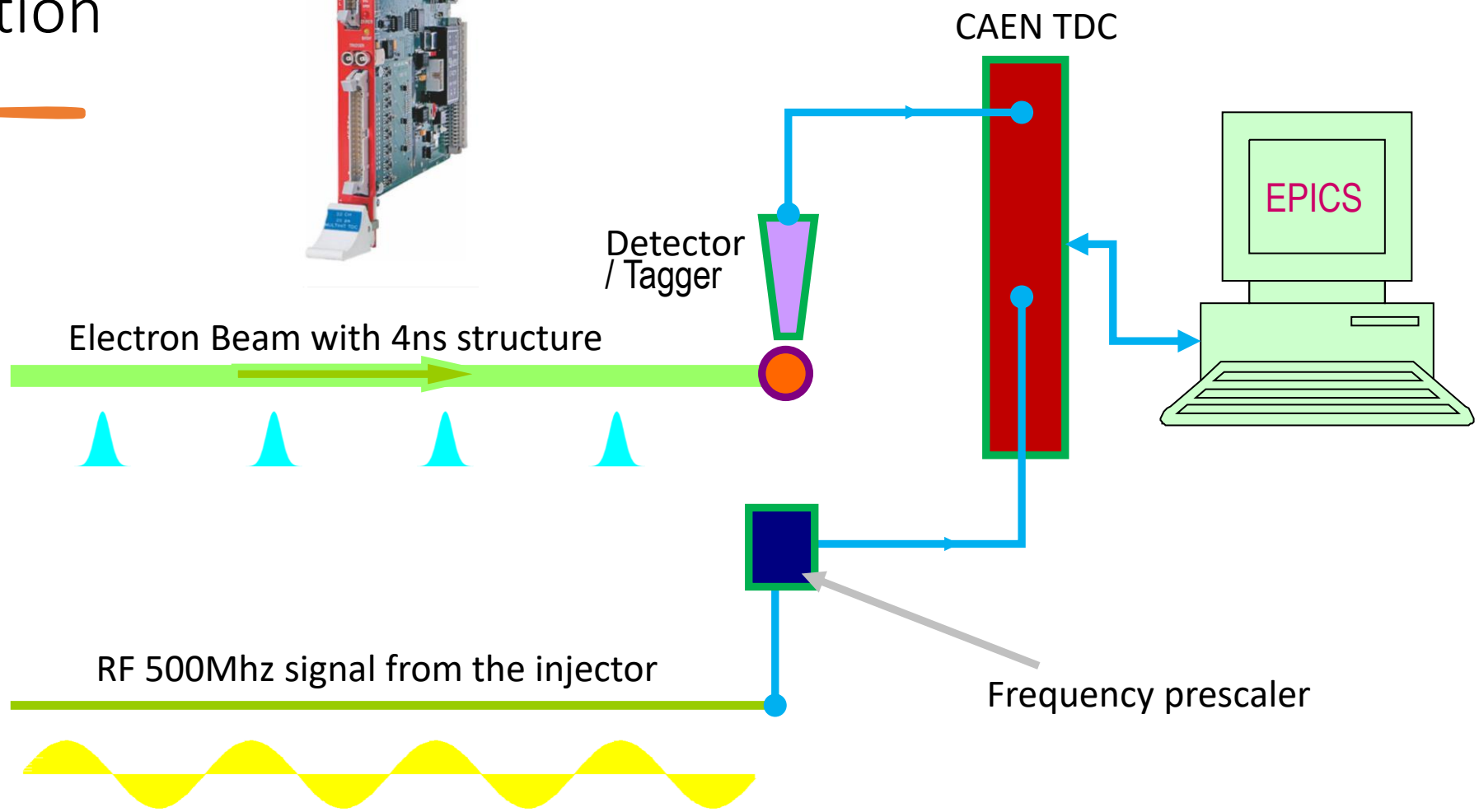
Control Buttons

New GlueX Application

- LE discriminator signals from 16 TAGM counters and prescaled RF-signal as inputs.
- Use CAEN VX1290 pipeline TDC with 25ps resolution
  - The same module as for TOF channels
  - This time I used VX1190 TDC with 100ps resolution
- Modified the existing CLAS12 EPICS application to quickly see the results.
- Can view the time spectrum immediately
  - On the order of 1 minute exposure time may be needed.
- The phase of the time difference will not be calibrated out as for the processed data.
- No possibility of time-walk corrections.

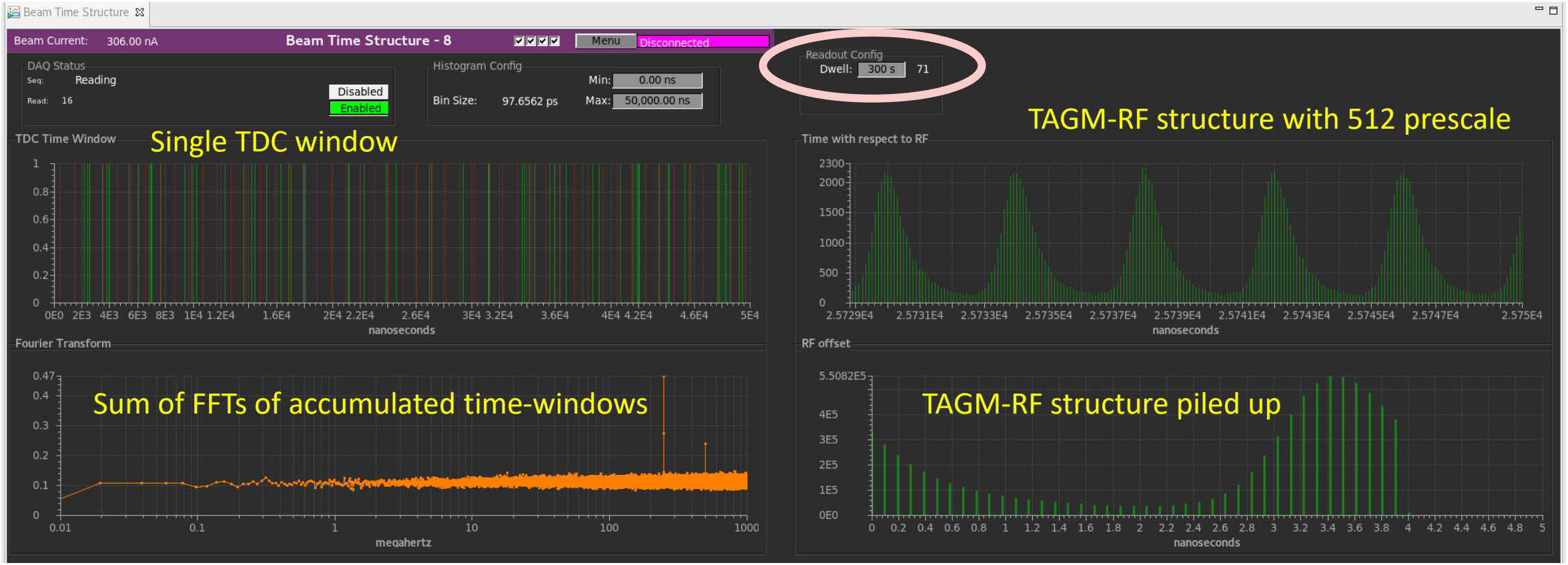
CAEN
VX1290

Beam bunches and 499 MHz signal are in-phase with each other. The RF-signal is prescaled.



Current Results

- The EPICS application works in general, can clearly see the 4ns beam structure
- The RF-peaks are too wide ~700ps
  - TAGM has too much time-walk, does not allow to see 1%-level structures near the peaks
- Need to use TAGH signals instead of TAGM during the next year run
  - Better time resolution due to smaller time walk
  - About five times higher counting rate, shorted exposer times.
  - Only need a longer cable
- Use VX1290 CAEN module with 25ps time resolution



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