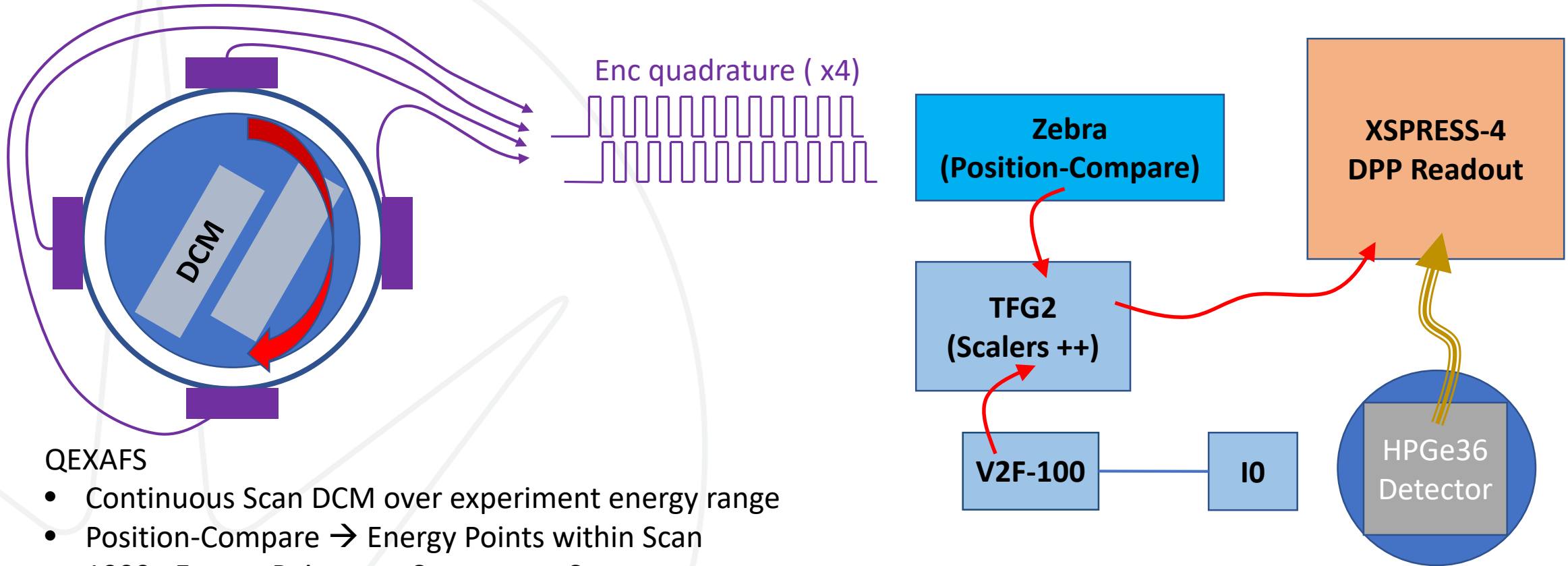


(Very) Quick EXAFS using the Timestamp Capabilities of Xspress-4 DPP at Diamond Light Source



QEXAFS

- Continuous Scan DCM over experiment energy range
- Position-Compare → Energy Points within Scan
- 1000+ Energy Points per Scan, many Scans
- ~20ms per Energy Point (DLS B18)
- HPGe36 readout by Xspress-4 DPP (DLS B18)

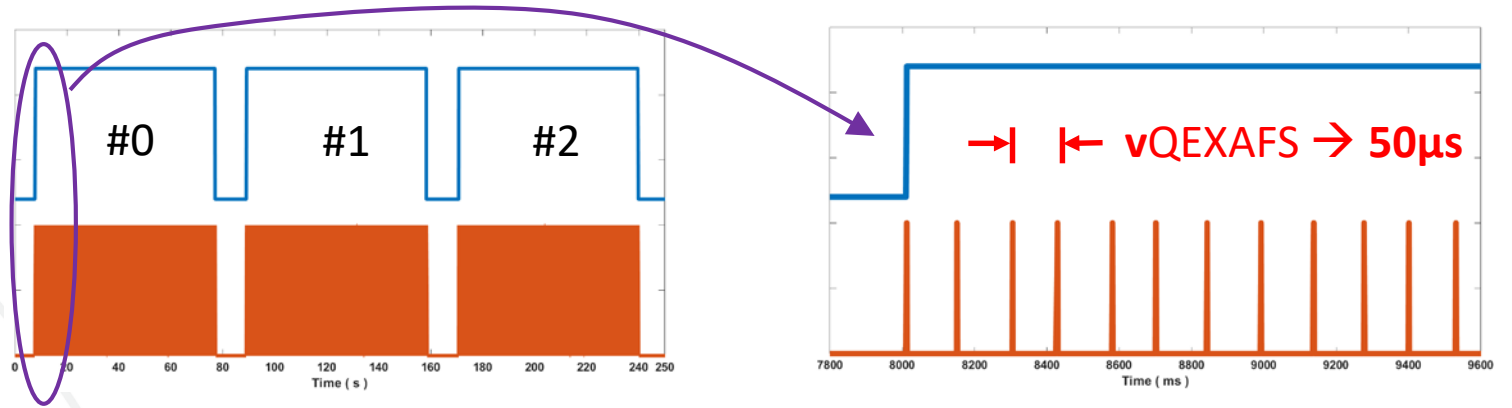
Brighter Source → (very) QEXAFS ~50μs per Energy Point

**Zebra
(Position-Compare)**



HPGe36
Detector

Scan_Active
Energy_Point



(good technical reasons) Xpress-4 has **Variable** Event Processing Latency : **10µs - 20µs**

➔ vQEXAFS (50µs) → *Potential* misallocation of many Events to the wrong Energy Point

Solution : Use Timestamp Capabilities of Xpress-4 ...

- TTL Scan_Active & Energy_Point → Xpress-4 Digital IO
- **Timestamp Event and Marker Chans to ±10ns accuracy**
- Use **List Mode Output Format** (*Timestamped Events List*)
- **Post-process** : Allocate Events to Energy Points relative to Marker Timestamps

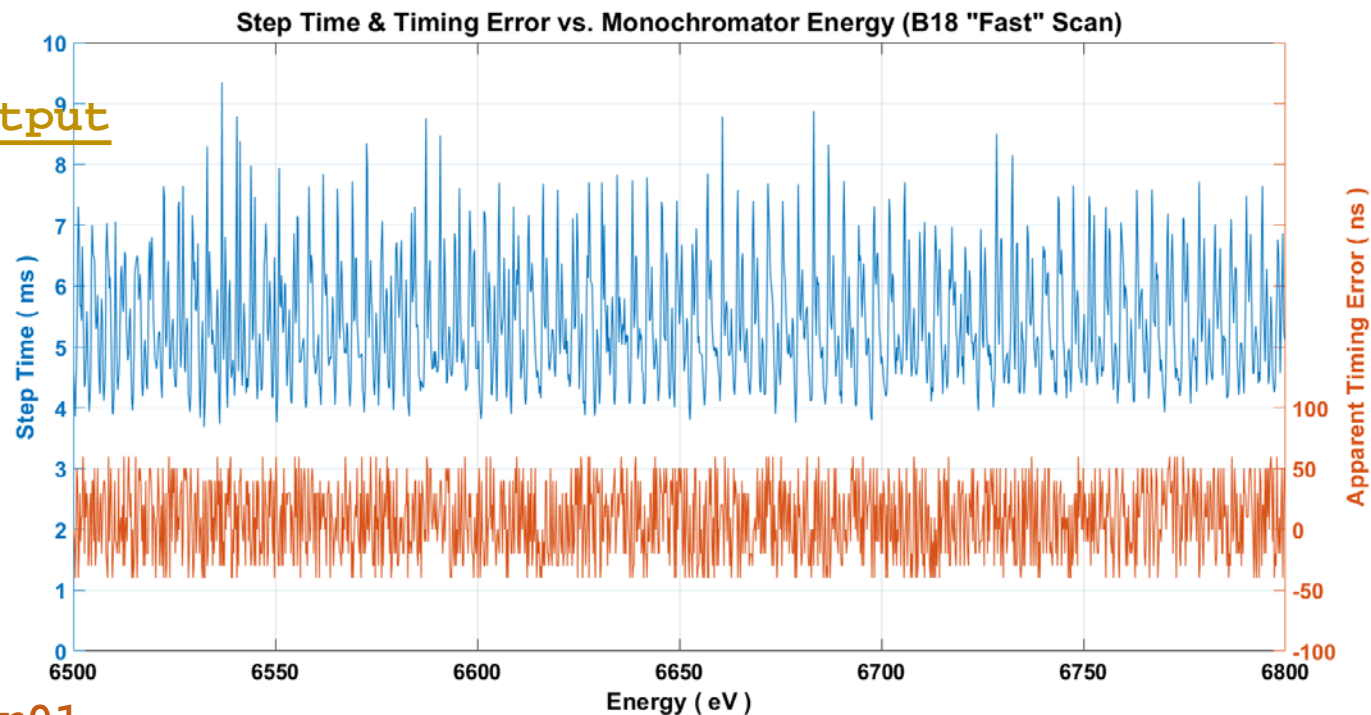
TimeStamp	Hist-Bin	EPoint	Scan
815126683	647	0	0
815128123	657	0	0
815130210	577	0	0
815141687	580	1	0
815209004	659	1	0
815212179	529	1	0

```
# Scan Markers chan37
0 801217715
1 8923517885
2 17074508032
3 25200409134
4 33324168584
5 41452980405
6 49584211216
7 57708278164
# Energy point Markers chan36
0 801217839
0 815138255 End
1 815138354
1 830457206 End
2 830457306
2 842922499 End
3 842922599
3 858113957 End
```

Verify Timing accuracy of Marker Channels ...

Xspress-4 Marker Chan List Mode Output

```
# Energy point Markers chan36
0 683966382
0 684423052 End
1 684423152
1 684847263 End
2 684847363
2 685233107 End
3 685233207
3 685668857 End
4 685668957
4 686179952 End
...
```



Independent timer `qexafs_counterTimer01`

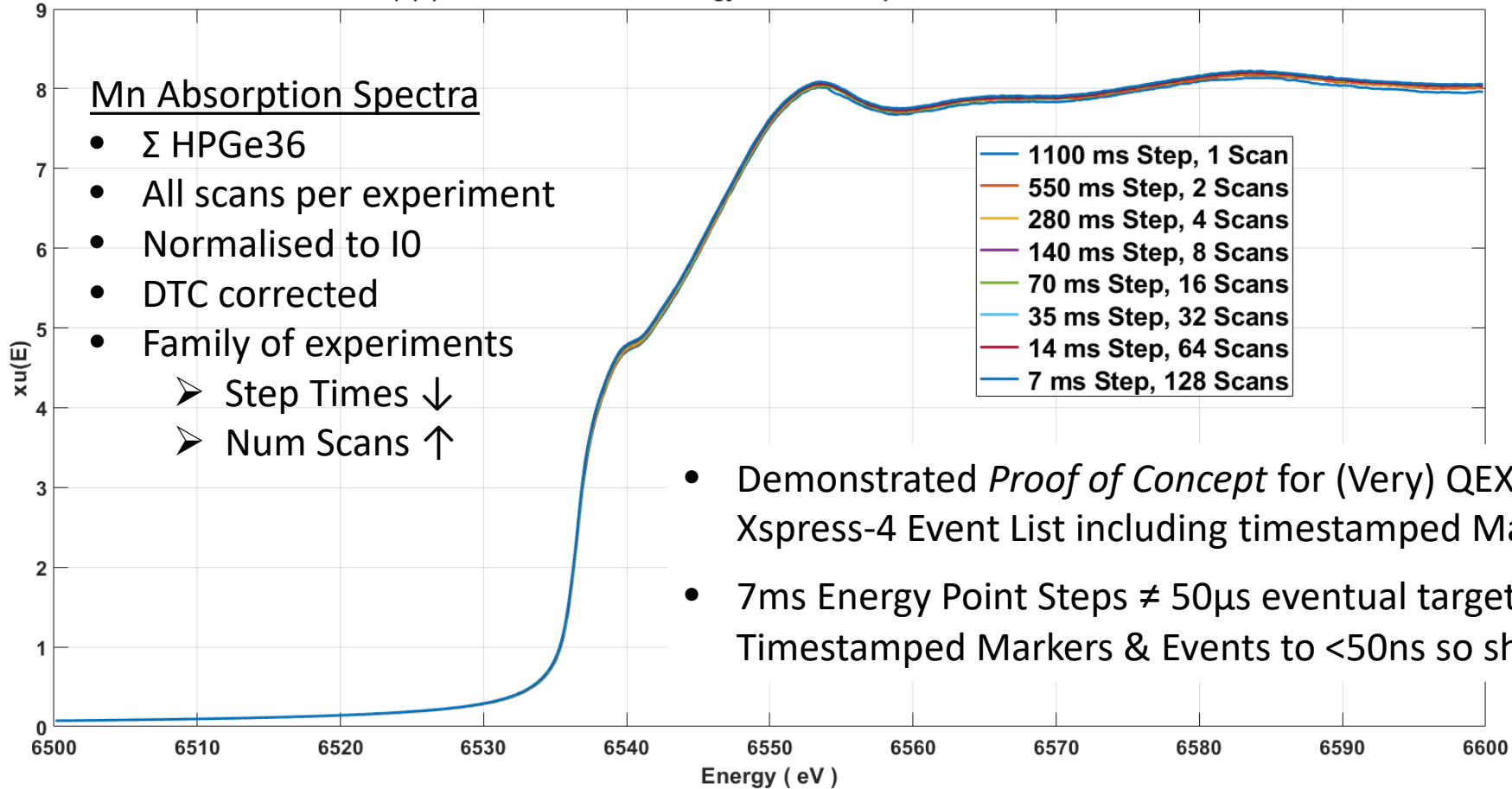
```
# command: qexafs_energy 6500.0 6800.0 1497 8.05 qexafs_counterTimer01
#
#qexafs_energy      time      I0      It      Iref
6500.10             0.0045667 54613.0 21.0    16.0
6500.29             0.0042411 50726.0 18.0    17.0
6500.48             0.0038574 46156.0 18.0    25.0
6500.67             0.0043565 52088.0 21.0    19.0
...
```

Verified $\Delta t < \pm 50\text{ns}$

QEXAFS Scan Mn foil : Single chan HPGe36, Single Scan ... Post-processed List Mode Data



$\chi\mu(E)$ vs. Monochromator Energy - Various Step Times & Scan Iterations



Mn Absorption Spectra

- Σ HPGGe36
- All scans per experiment
- Normalised to I0
- DTC corrected
- Family of experiments
 - Step Times ↓
 - Num Scans ↑

- Demonstrated *Proof of Concept* for (Very) QEXAFS using Xspress-4 Event List including timestamped Marker Channels
- 7ms Energy Point Steps \neq 50 μ s eventual target but Timestamped Markers & Events to <50ns so should be okay

Acknowledgments

- William Helsby (STFC Daresbury) – Firmware Design
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- Nicola Tartoni – Concept and Sponsor

Thank you for listening! 😊

Backup slide in case of movie failure slide 4

