Beam monitoring on Bifrost

Requirements/wishlist for the detector group

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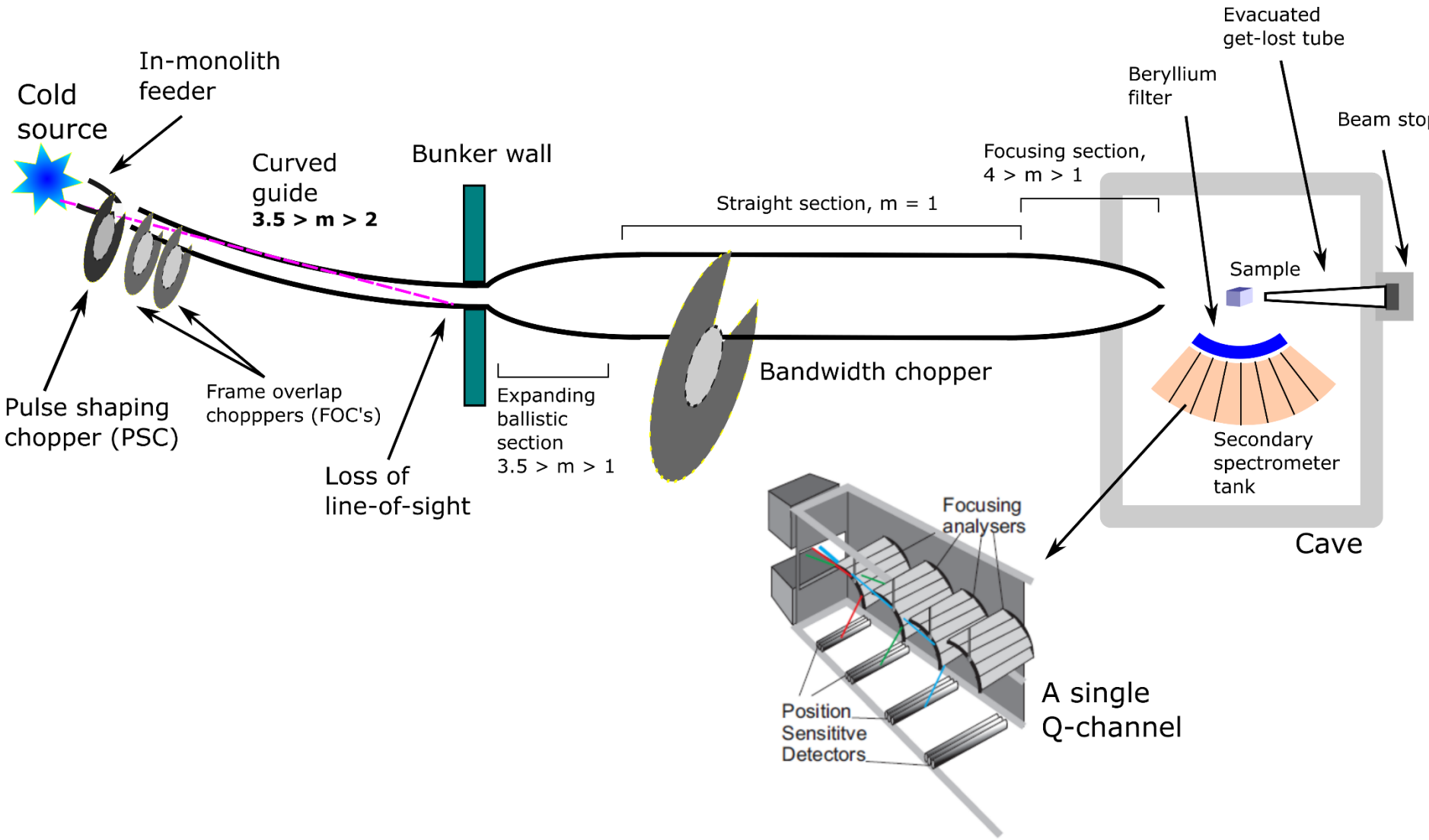
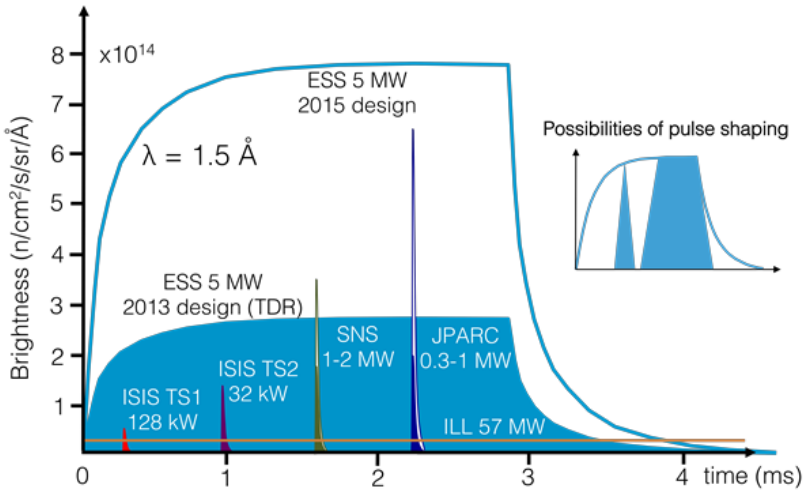
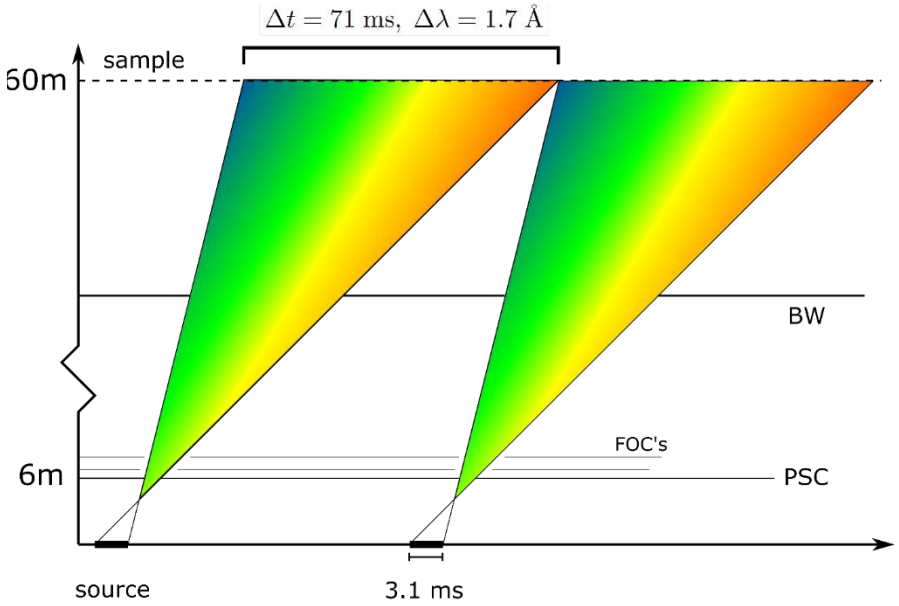
Instrument layout

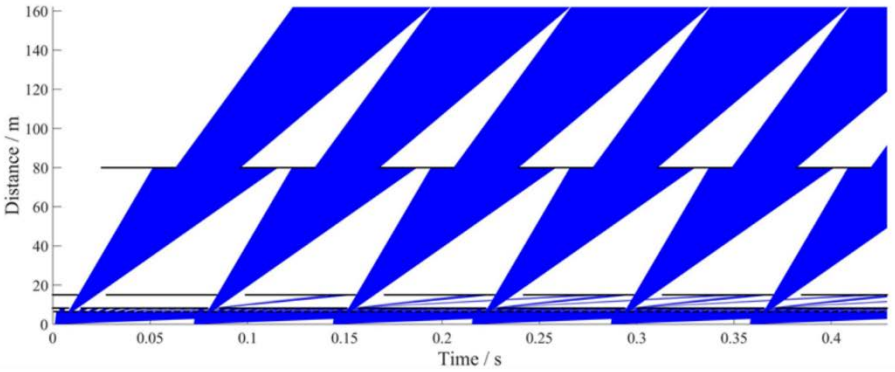


Front end – ToF diagram

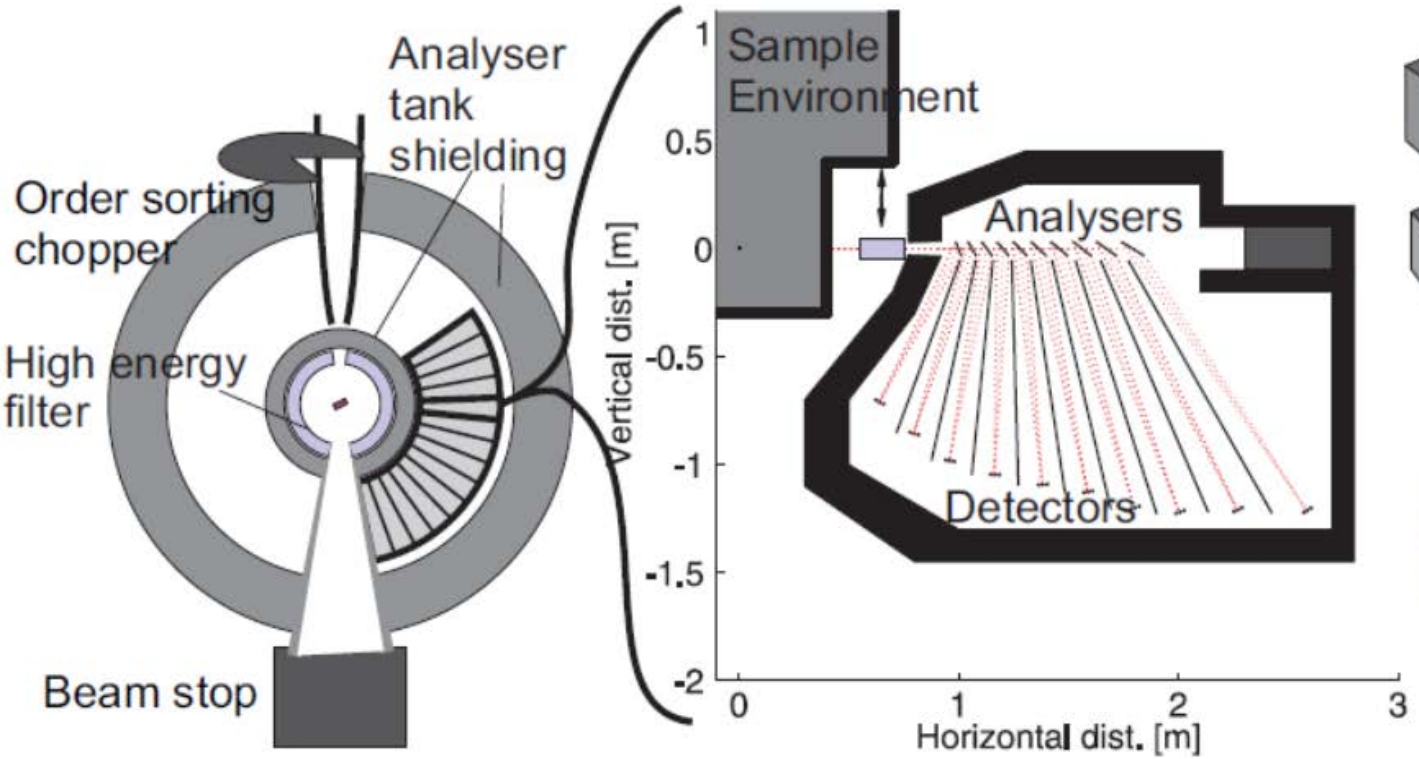
EUROPEAN SPALLATION SOURCE

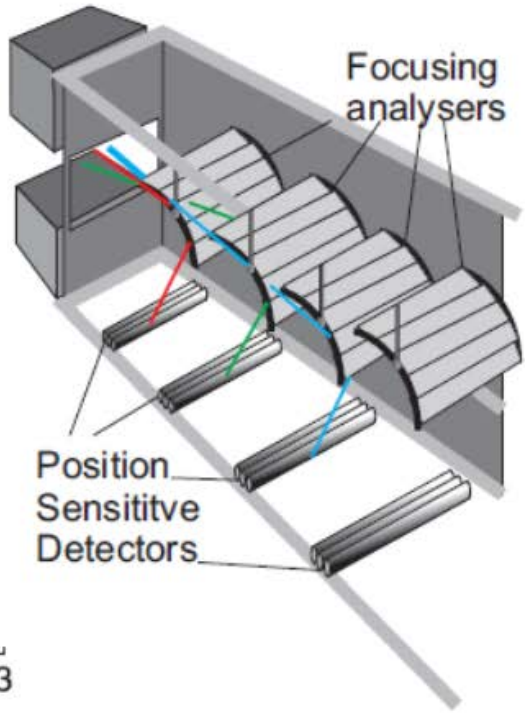




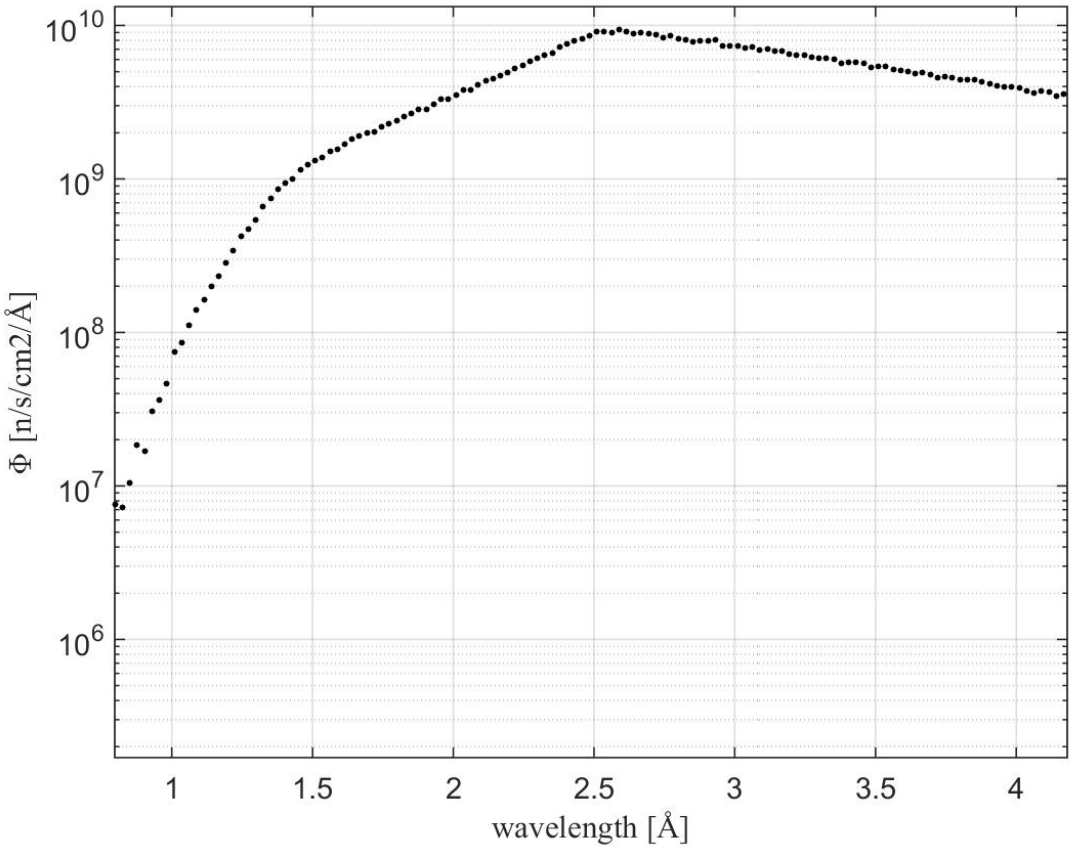


Backend


Analyser
tank
shielding
Order sorting
chopper
High energy
filter
Beam stop
Sample
Environment
Analysers
Detectors
Vertical dist. [m]
Horizontal dist. [m]
1
0.5
0
-0.5
-1
-1.5
-2
0
1
2
3


Focusing
analysers
Position
Sensititve
Detectors

Front end – ToF diagram



Flux curve: The variation In flux is between 10^{10} n/s/cm2/Å and $2*10^{8}$ n/s/cm2/Å.

a factor of 50 variation.

Cold flux at fully open: 10^{10} n/s/cm2/Å

Cold flux at 0.1 ms: $5*10^{8}$ n/s/cm2/Å

Near thermal flux at 0.1 ms: 10^{7} n/s/cm2/Å

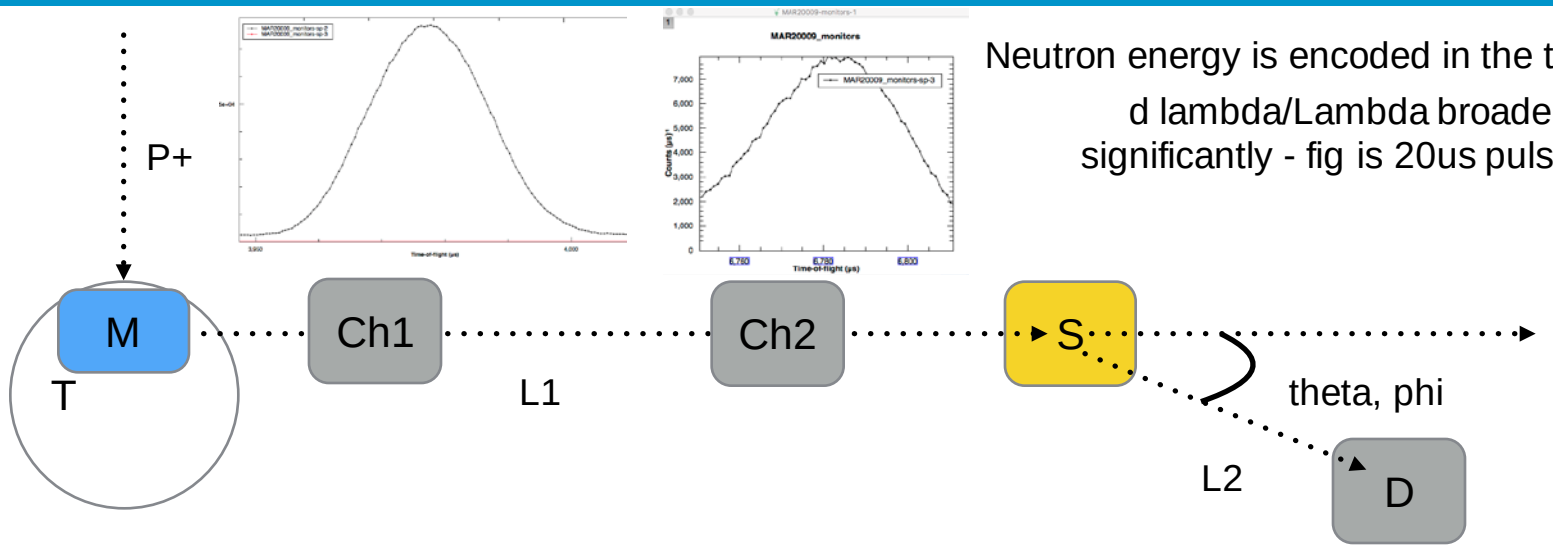
Goals of monitoring

- **Diagnostics**
- **Normalization**

Subgoals of normalization on Bifrost:

1. High precision at high flux
2. Allow for flux changes on minute timescale
3. Do normalization with a complex frame intensity profile

Time of flight



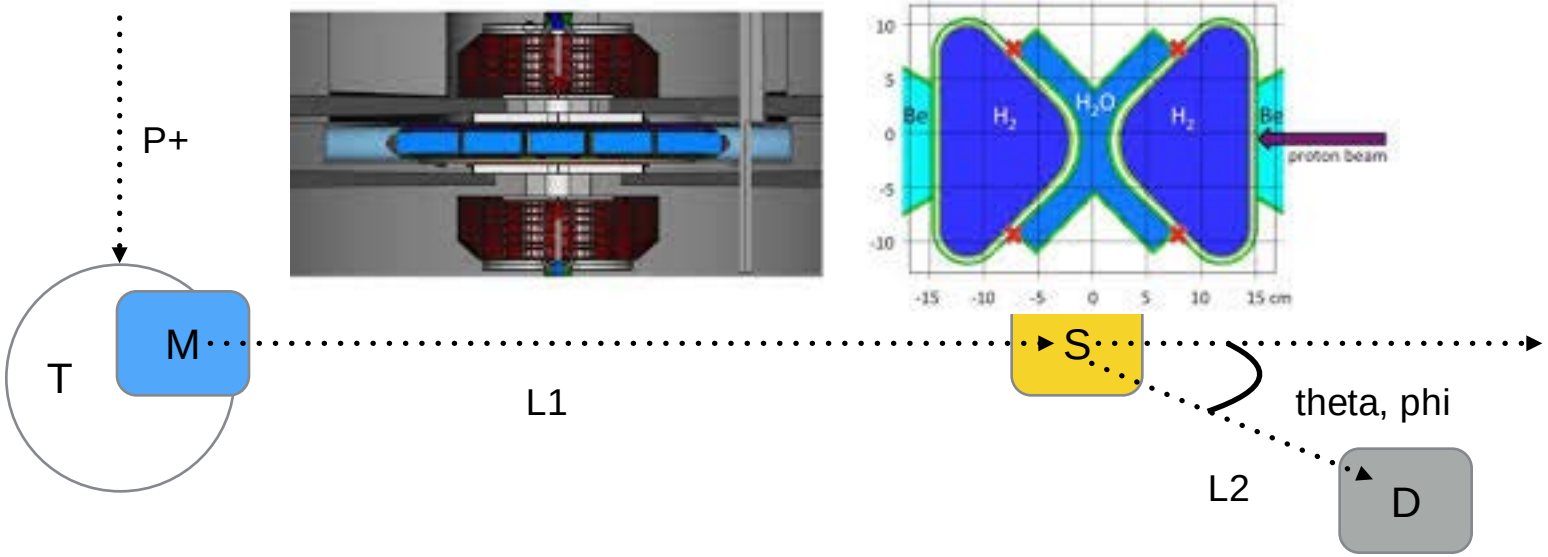
Neutron energy is encoded in the time of flight

d lambda/Lambda broadens pulse significantly - fig is 20us pulse over 6.8m

- Maximum transmission requires calibrated choppers
- To convert T.O.F to energy, wavelength, momentum transfer, d-space.
  - Precise knowledge of flight paths
  - Definition of T0 in the time frame
- Precise knowledge of scattering angle
- Geometry is essential

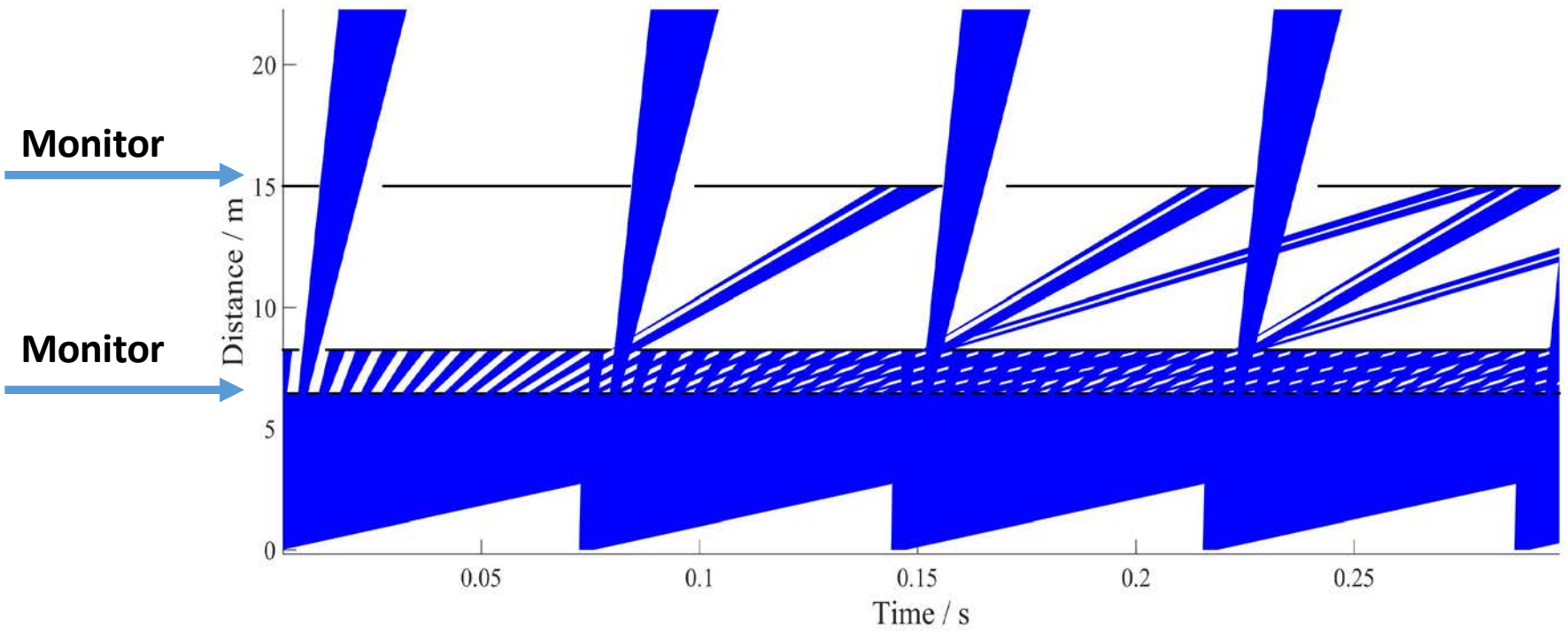
} Monitors are useful

What is T_0



- Moderator has a depth
- Emission point of neutrons is wavelength dependent - uncertainty in flightpath
- Reposition source onto a monitor (in software)

Diagnostics

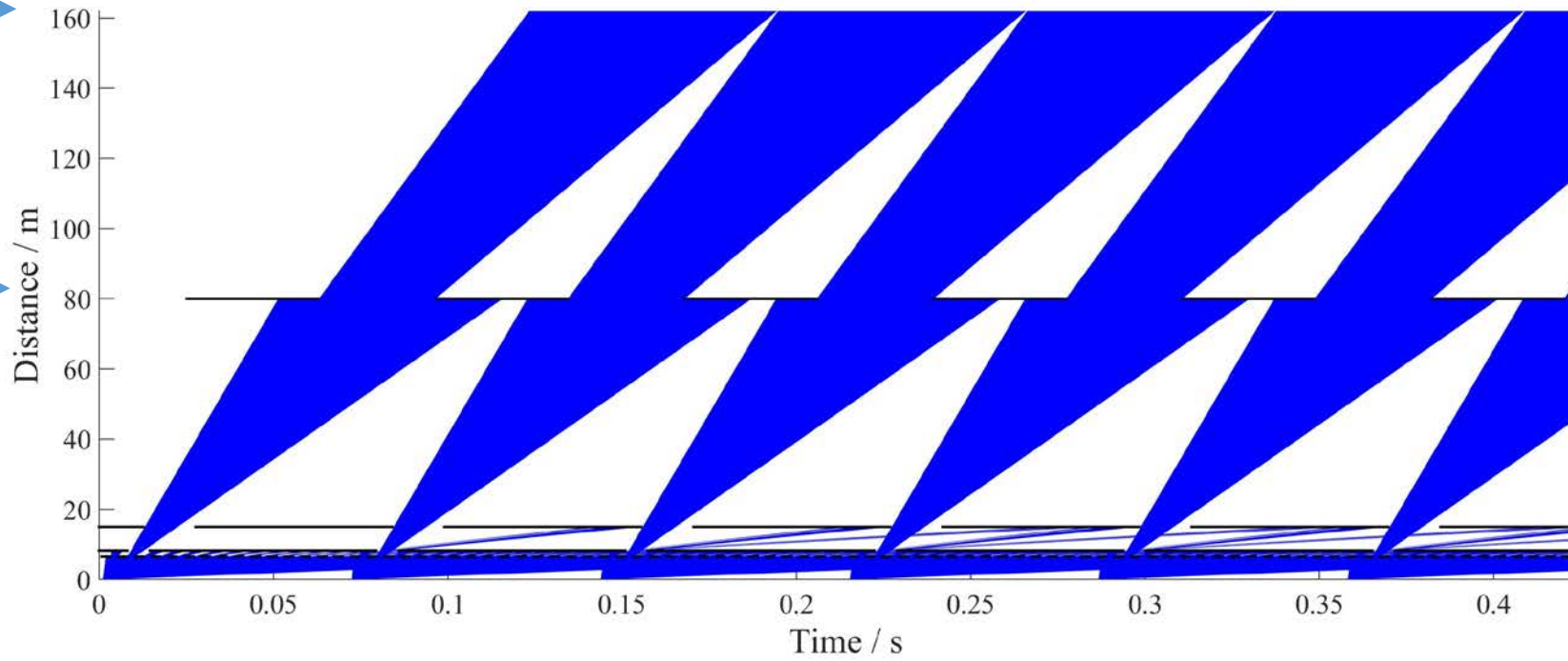


Diagnostics

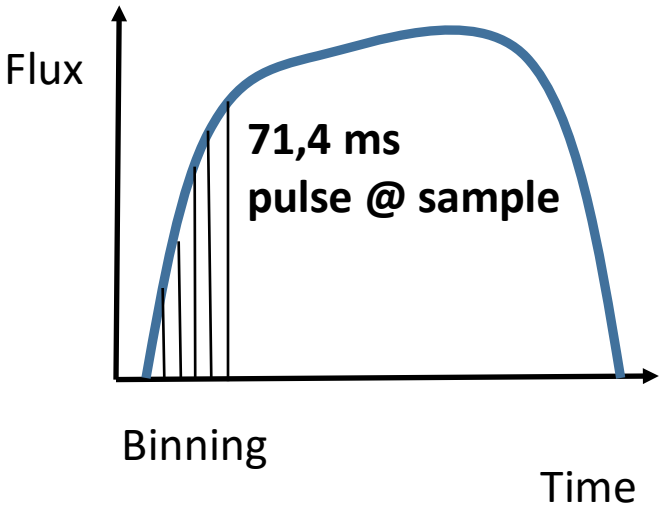
EUROPEAN SPALLATION SOURCE

Monitor

Monitor

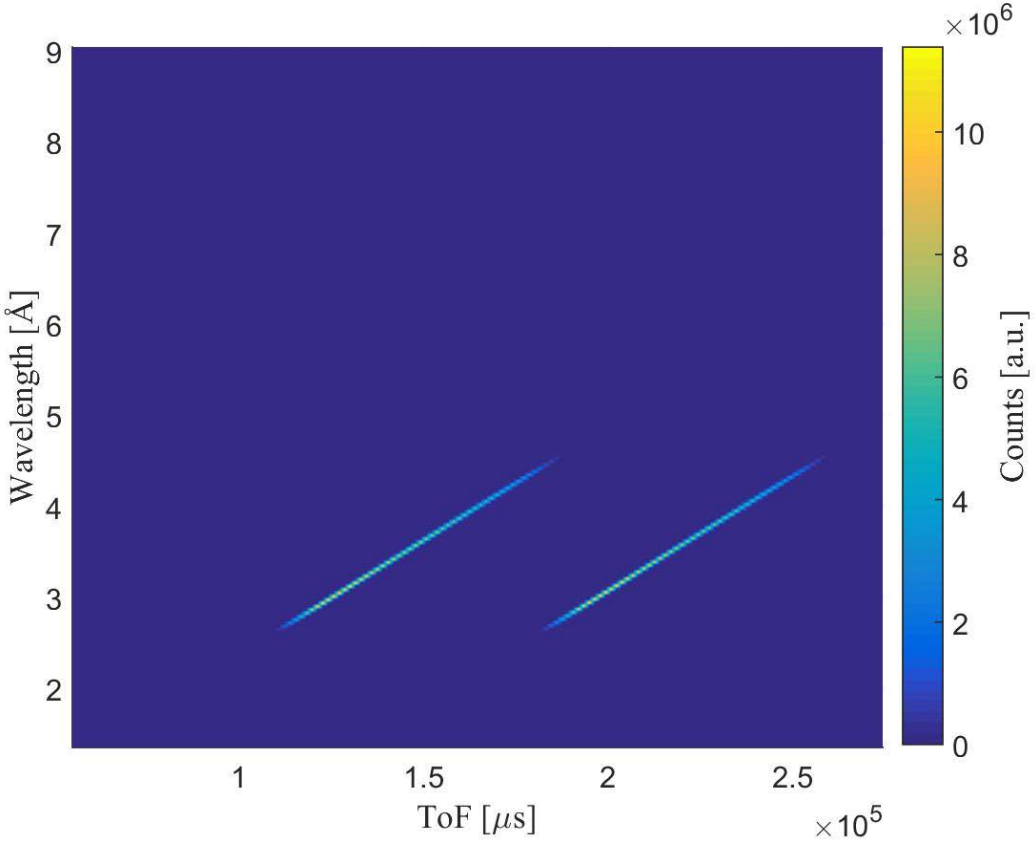


Normalization

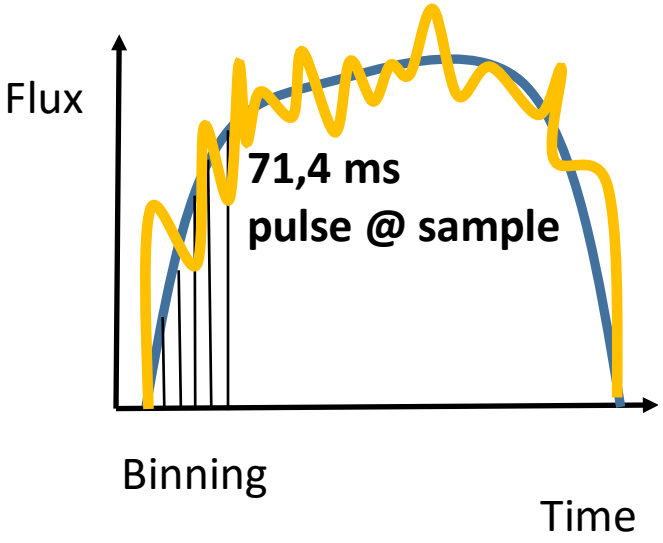


So we use the white beam, and can simulate a nice flux distribution in the frame.

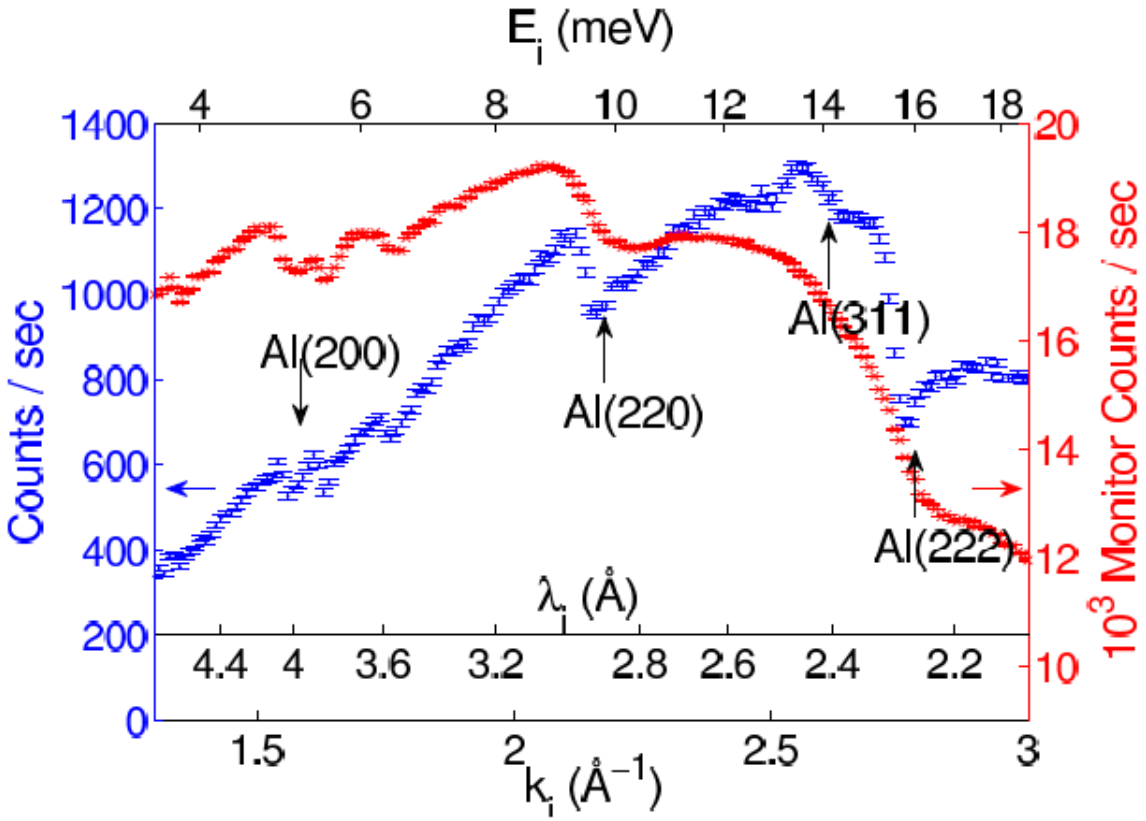
But that's not how it looks in real life!



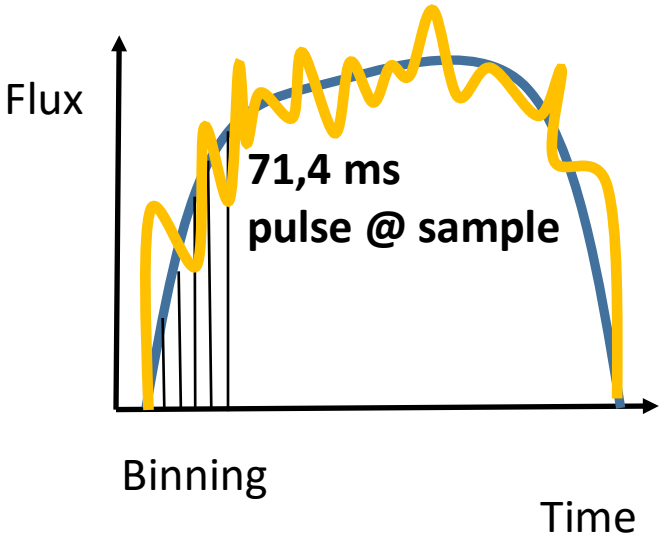
Real life (I)



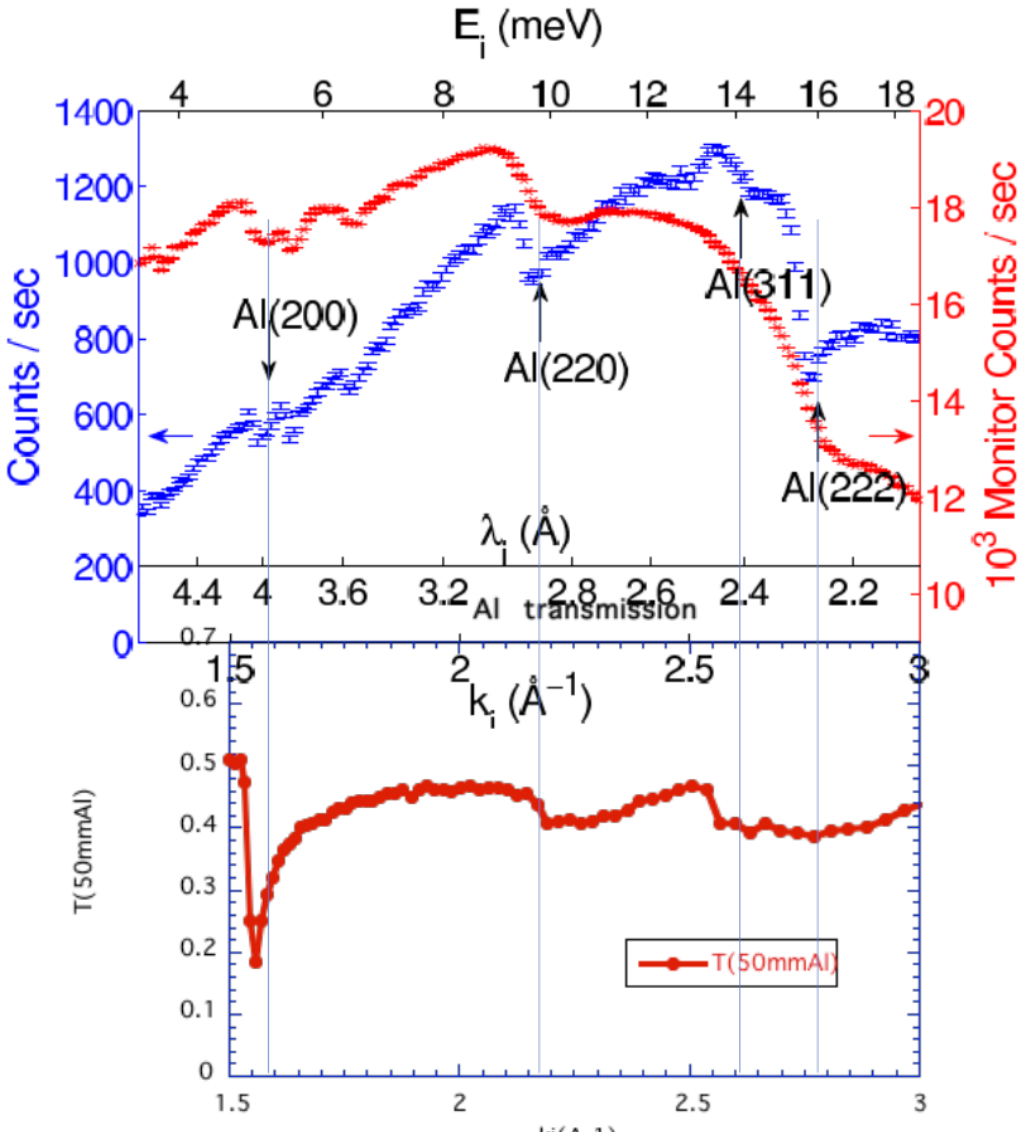
Example from TAS



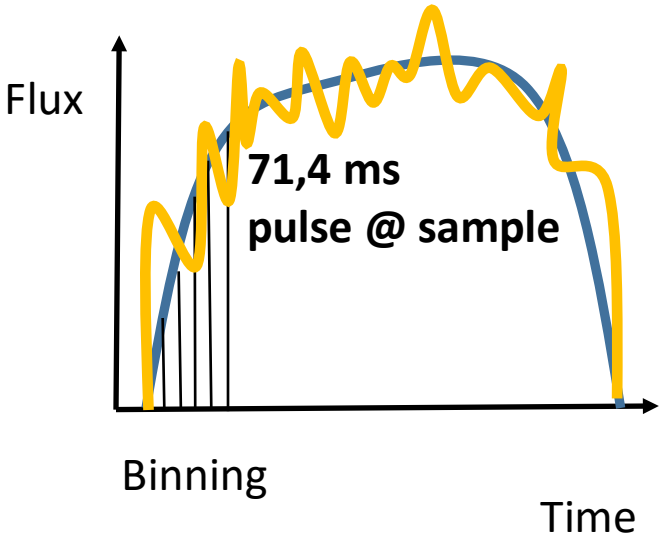
Real life (2)



Ken's measurements from D17. They don't match up!



Front end – ToF diagram



The flux might be changing, but not much on a time scale smaller than the pulse duration.

But you might want

Wavelength band - 1.2-2.9 Å
Flux: **10^7 n/s/cm2/Å**
Pulse duration: 0.1 ms.

Lets say we need a sampling 3 times better than the pulse duration – **2000 bins**

If we want flux determination better than 1,5 % in each bin we need 5000 cts pr bin:

This is 10^7 counts. We would need 0.5 % efficiency at 1.2 Å in 3 mins. That would normally go to 2.5 % at 6 Å.

Gigahertz range… Safety, attenuators, another monitor? Argh.

Conclusion

- As everybody else, we need monitors for normalization and diagnostics
- Our normalization case is messy
- The monitor will be too efficient at large wavelengths. Possibly a nasty problem…
- We will go for being able to normalize properly during 3 mins
- We won't go for single pulse normalization.
- We would like eventmode, to have full flexibility.