Tests of stroboscopic mode of data acquisition at HRPT

slicing time down

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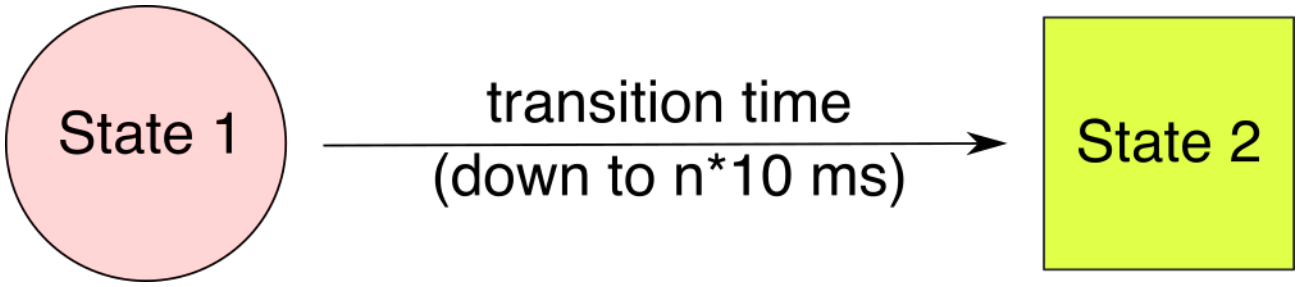
2015

The essence of the HRPT stroboscopic mode:

A repeating fast process, for which the typical timings don't allow for any reasonable data statistics, is run multiply, over and over again; the time of acquisition is split into whatever tiny portions (10.4 ms being the minimum), for each of these slices the data is being accumulated together with the identical slices in all later repetitions. Thus, the total stats for each representative state of the system is then be approaching the values reasonable for data treatment.



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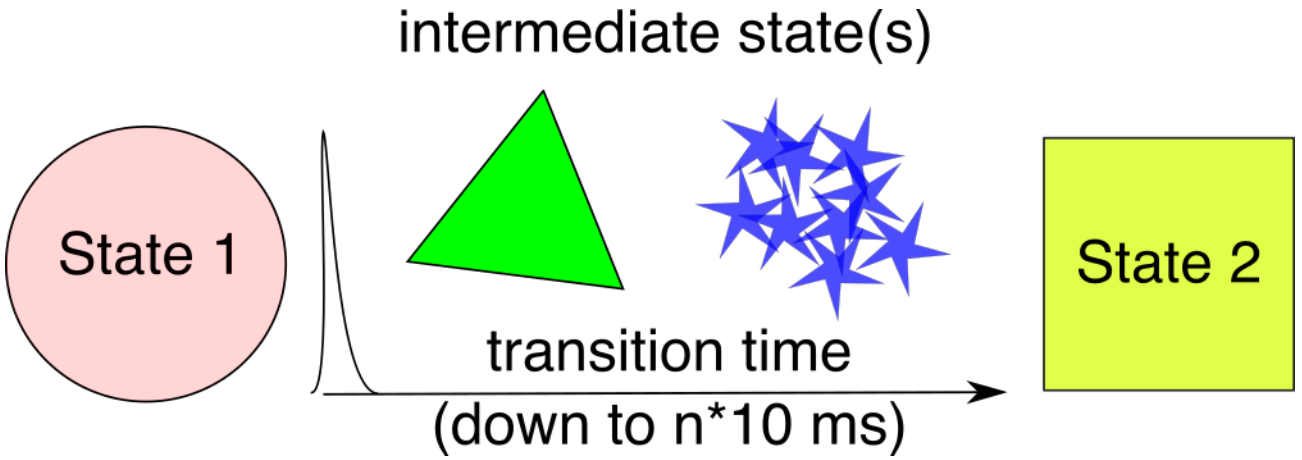

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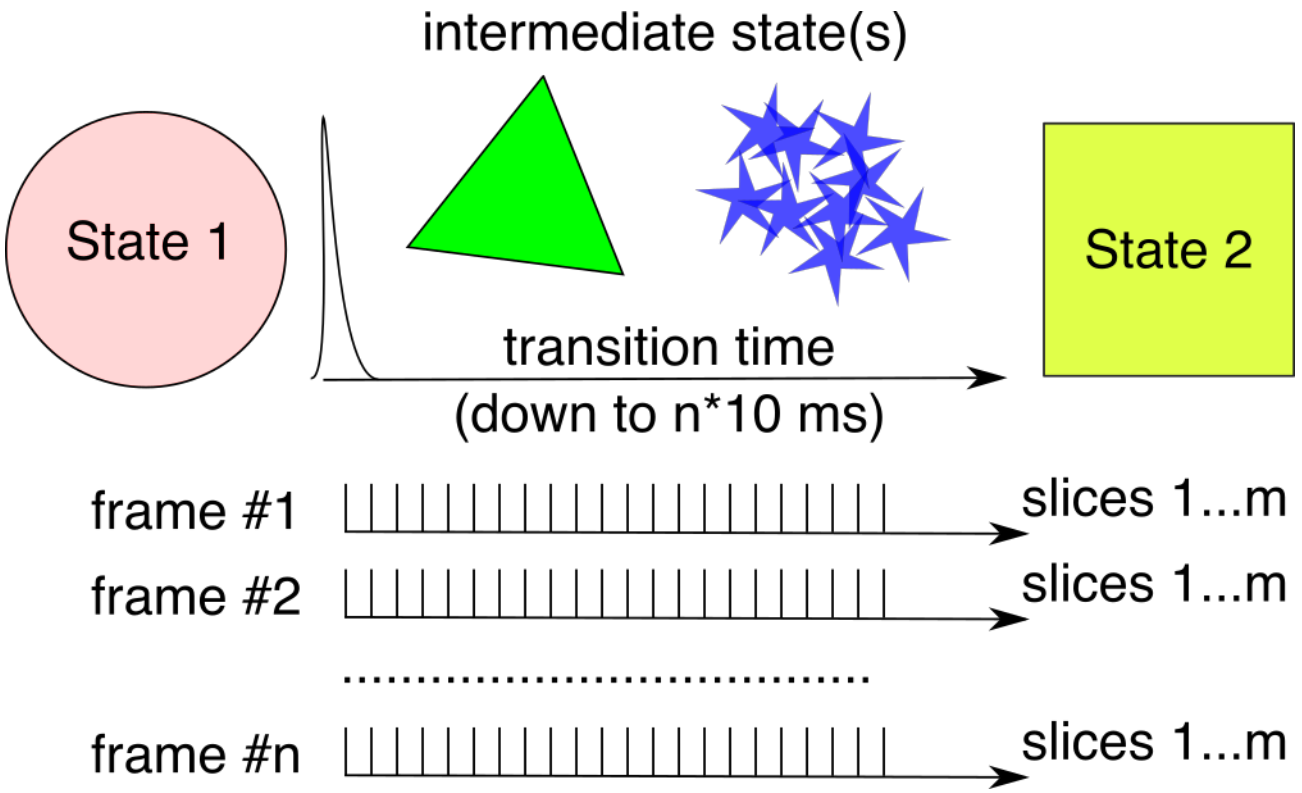
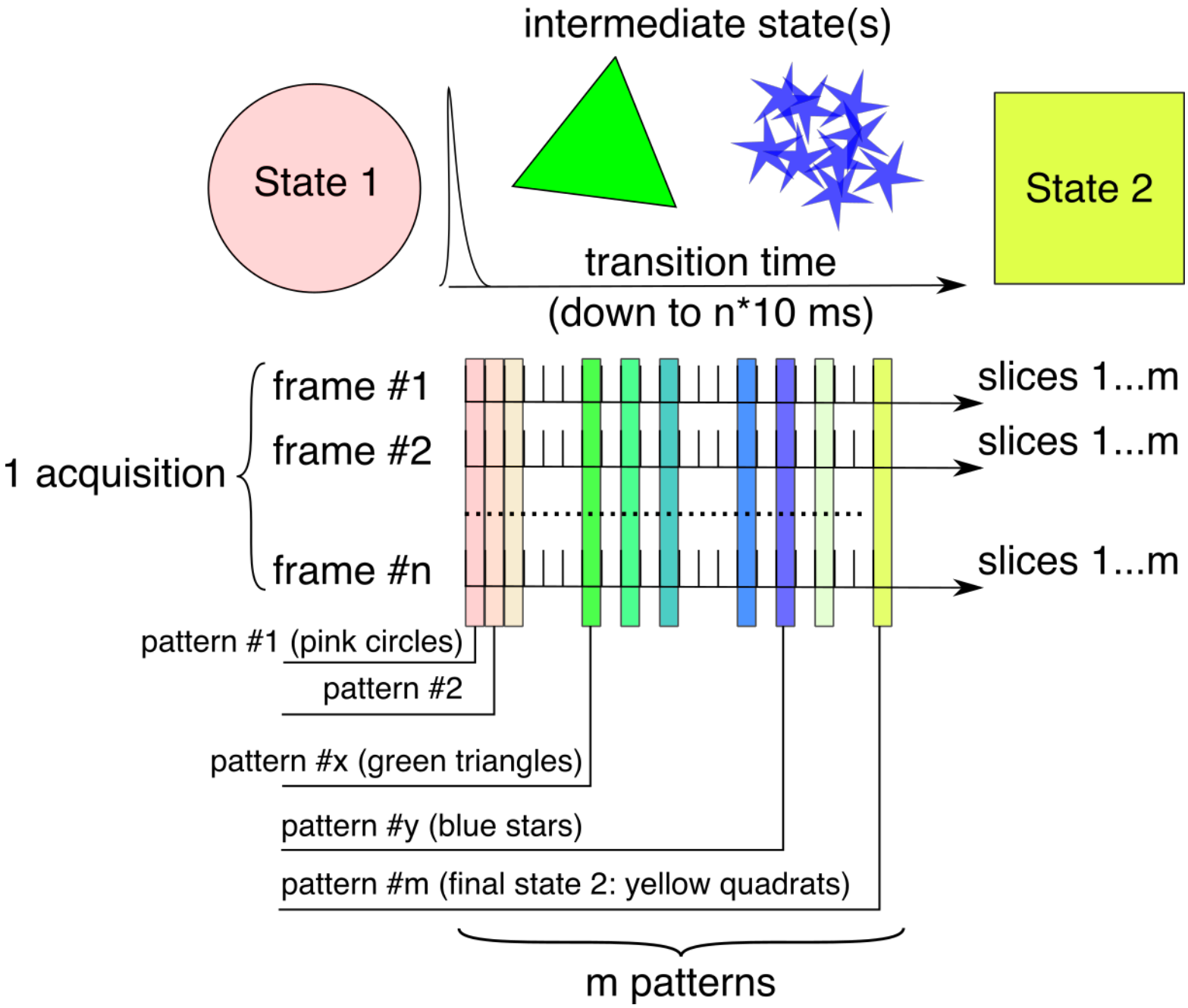
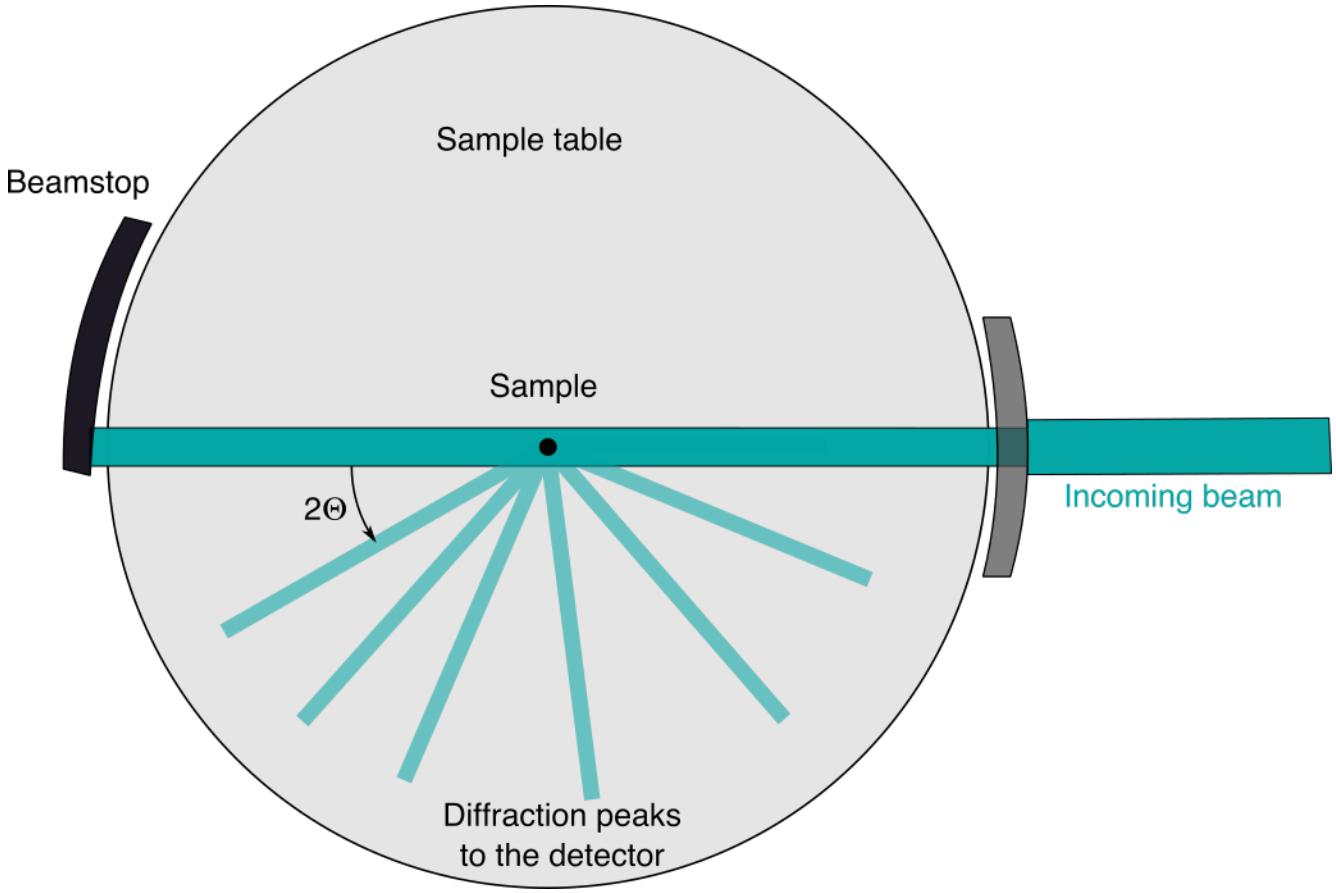



intermediate state(s)
State 1
State 2
transition time
(down to n*10 ms)
1 acquisition
frame #1
frame #2
frame #n
slices 1...m
slices 1...m
slices 1...m
pattern #1 (pink circles)
pattern #2
pattern #x (green triangles)
pattern #y (blue stars)
pattern #m (final state 2: yellow quadrats)
m patterns

First trials: model different states by offsetting the sample



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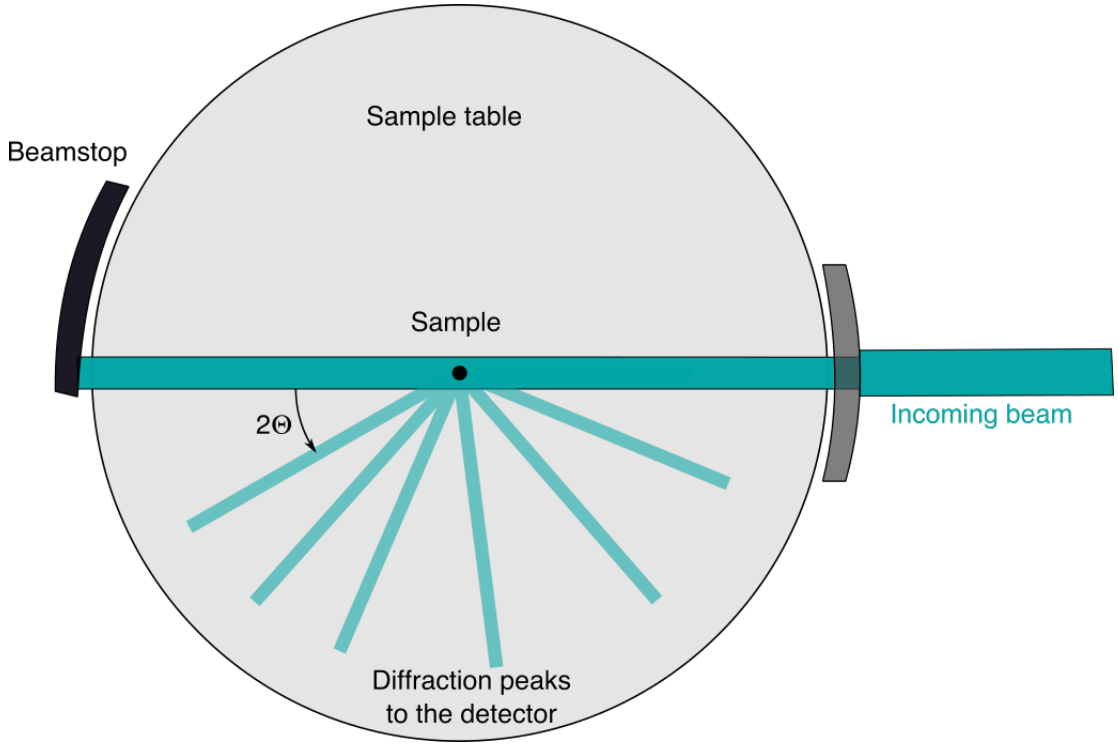
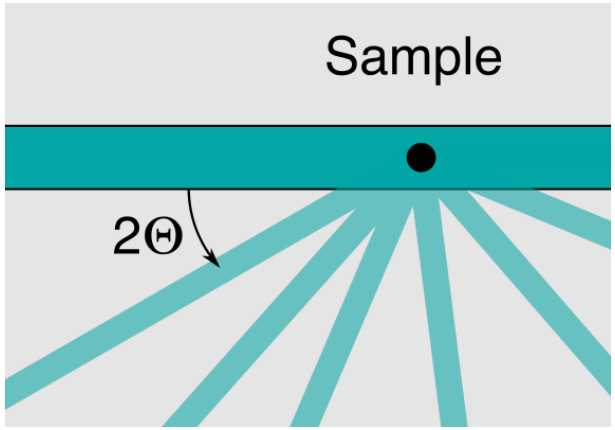
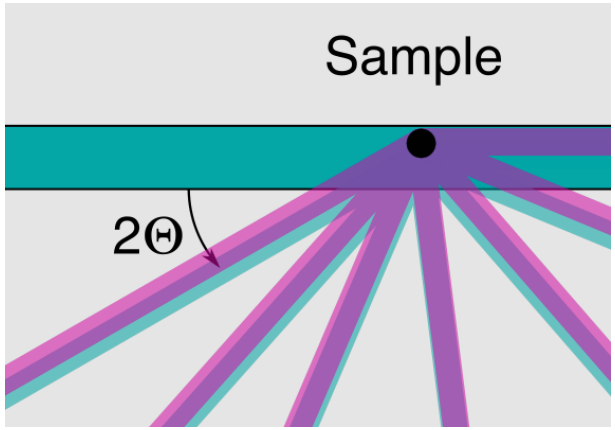
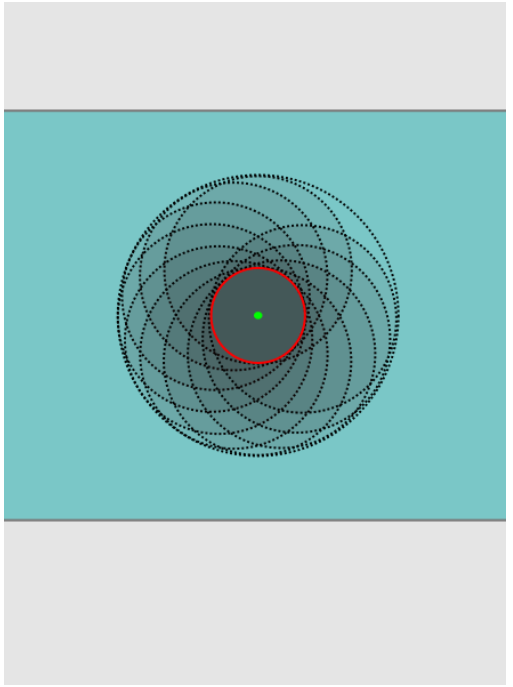
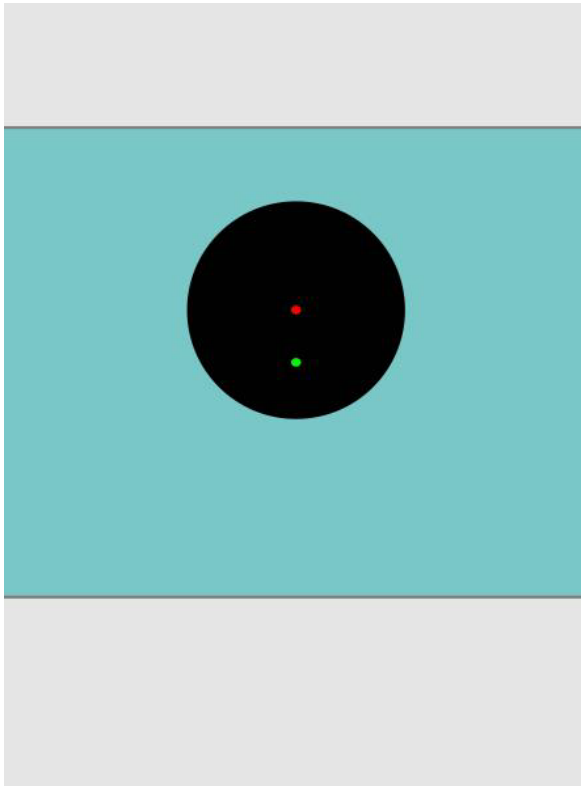


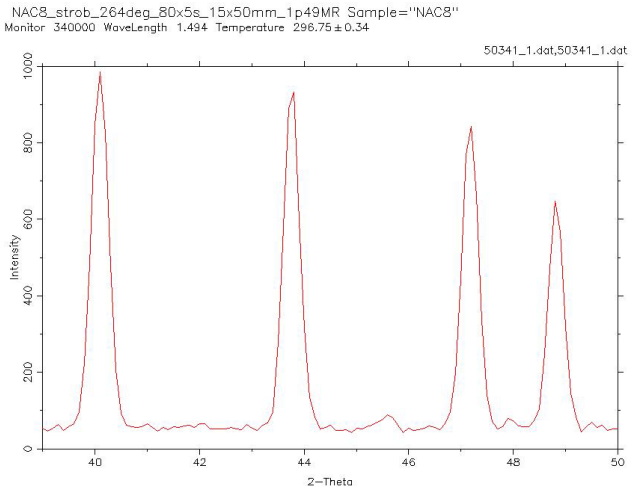


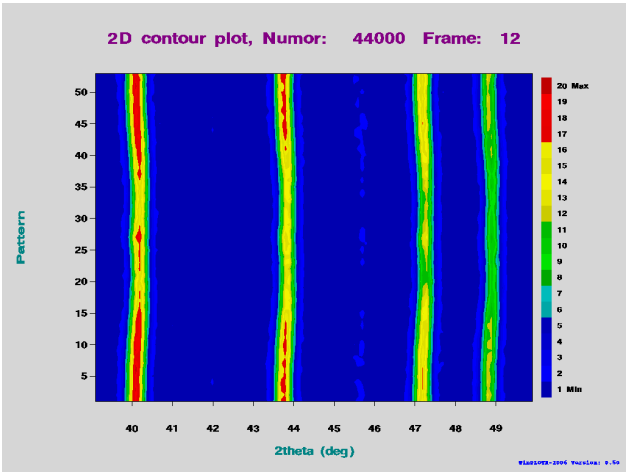


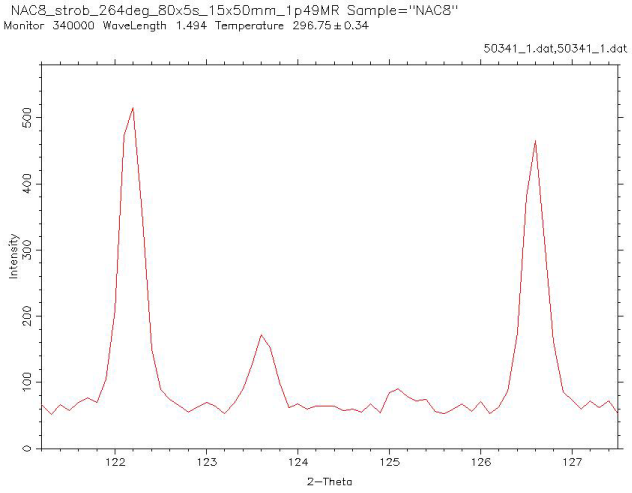


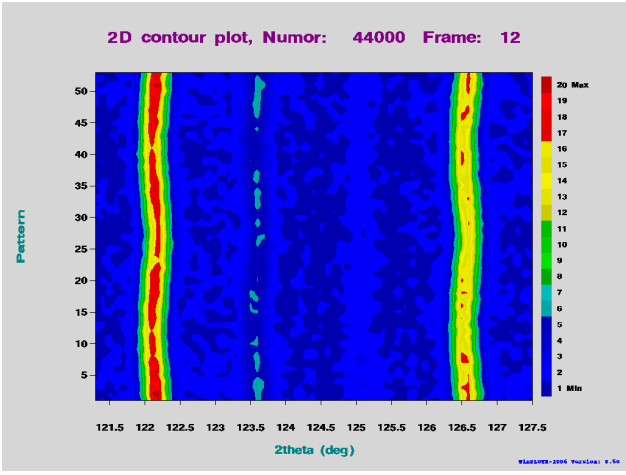
First trials: model different states: sample table (a3) oscillations:







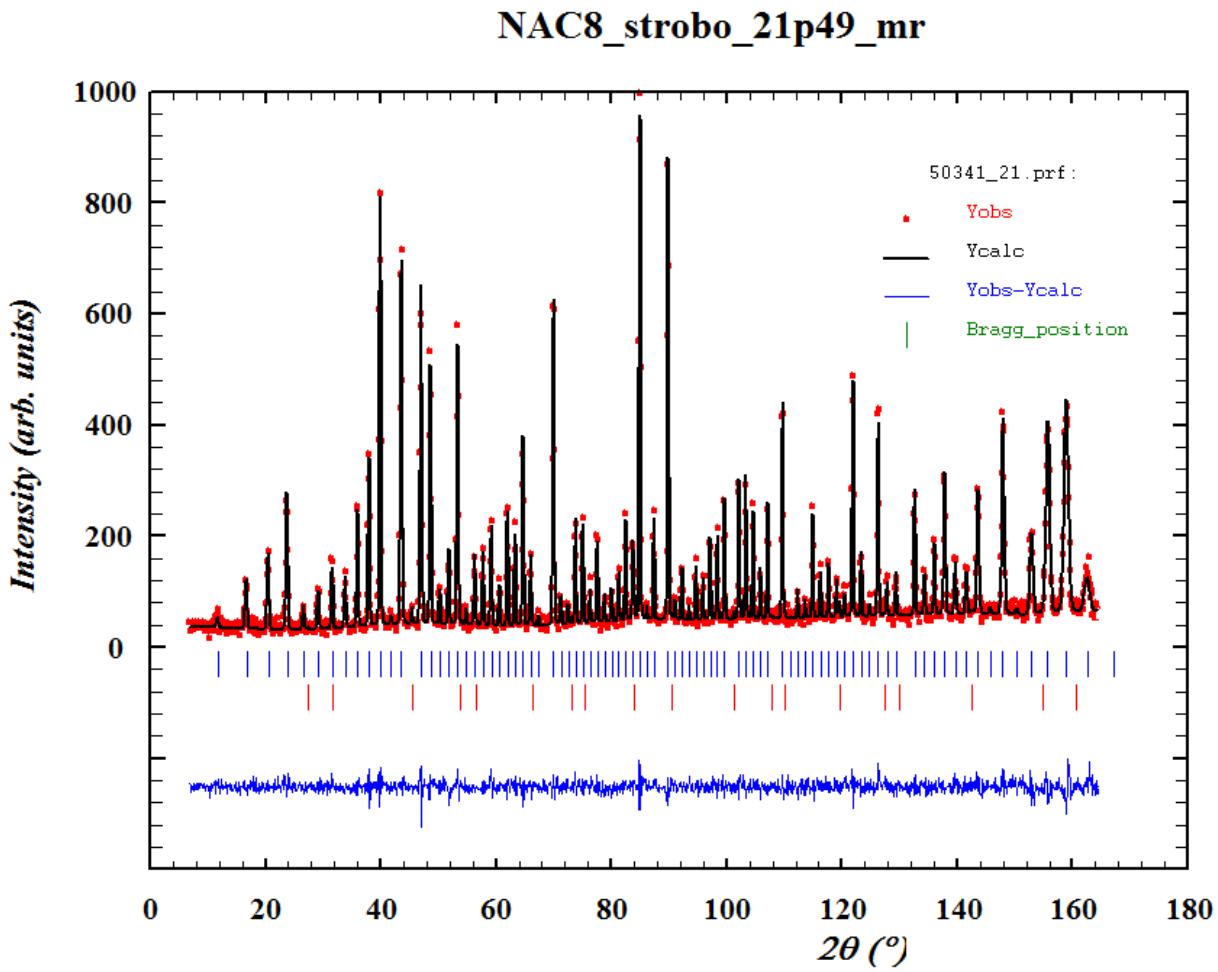




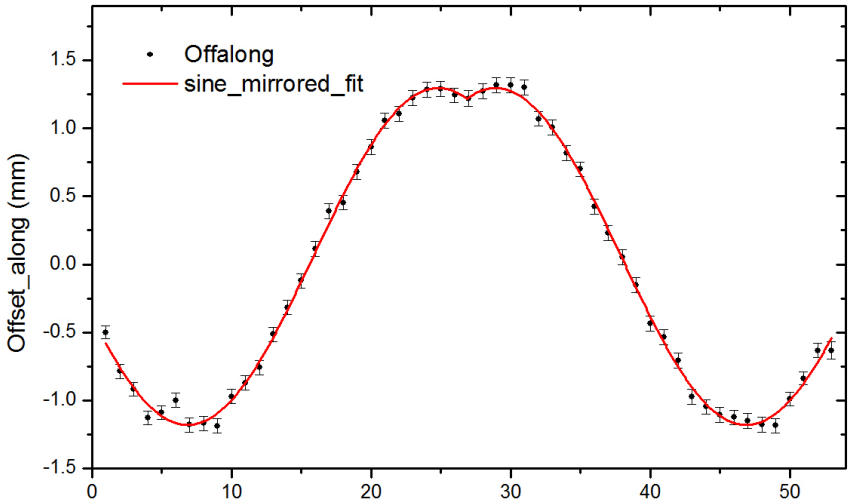
- red point: actual sample center (2 mm offset);
- green point – ideal sample position;
- measurement time: 5 sec per slice;
- number of repetitions: n~135;
- Speed of the movies: ~15 x the actual speed

! – also quite informative concerning the sample offsets at HRPT
the instrument is precise enough to safely capture some 0.1 mm !

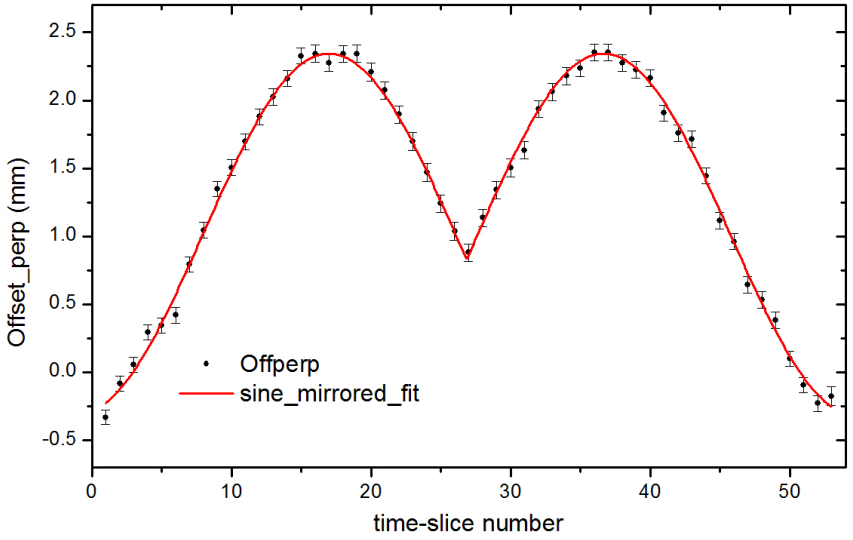
First trials: model different states: sample table (a3) oscillations:



Rietveld refinement done on one particular slice
(here arbitrary chosen slice # 21):
Acquisition time for this pattern ~135 x 5 sec ≈ 11 minutes in total.
Main refined parameters: crystal structure + offsets in detector coordinates

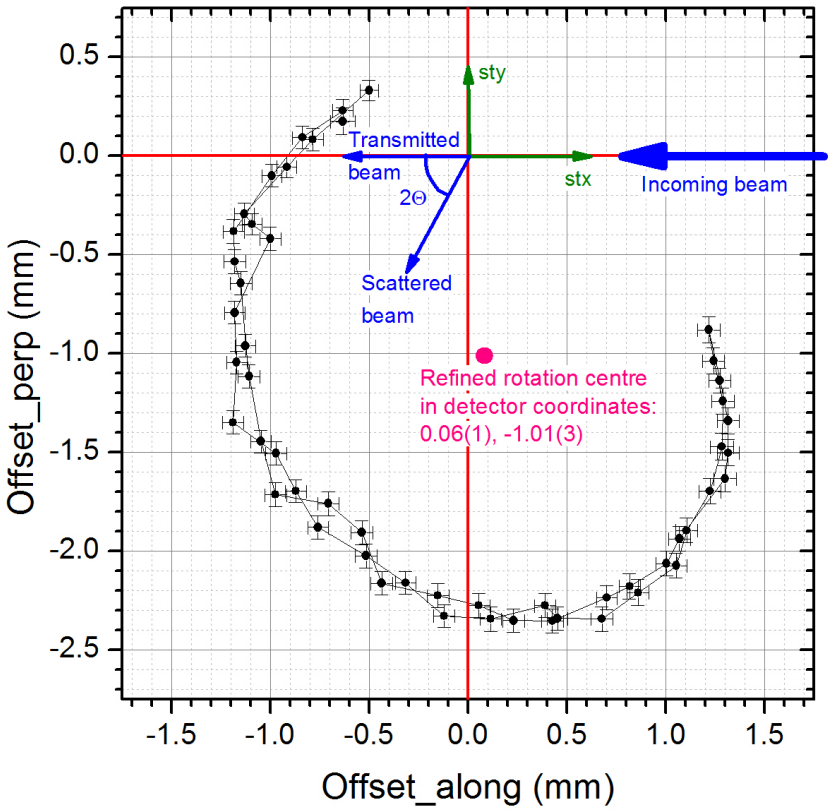


sine_mirrored_01 (User)				
a+b*sin(2*pi*(abs(x-d)-e)/c)				
--	Offset_along_the_beam		Offset_perpend_to_the_beam	
a	0.05828	0.01042	1.01446	0.0283
b	1.23883	0.00997	1.3296	0.0238
c	35.92146	0.37568	36.20035	0.62859
d	26.89286	0.0511	26.84629	0.04609
e	-6.9284	0.24111	0.79832	0.16355

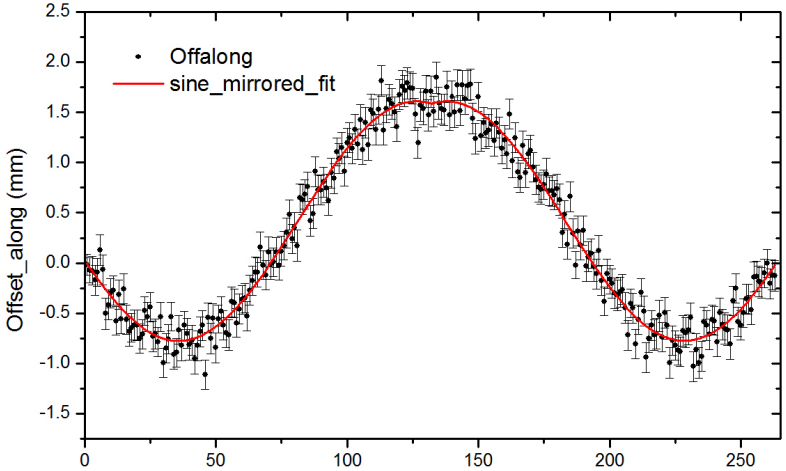


Sample table (a3) oscillations, with an offset sample

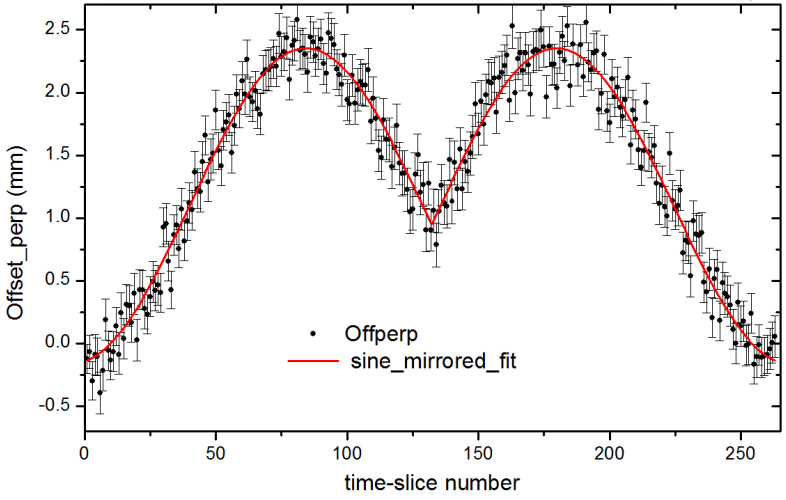
Refined parameters:
crystal structure + offsets in detector coordinates.
Each point: from a refinement based on a stroboscopic slice of 5 sec, repeated ~135 times



Pushing the limits further: finer time slicing.

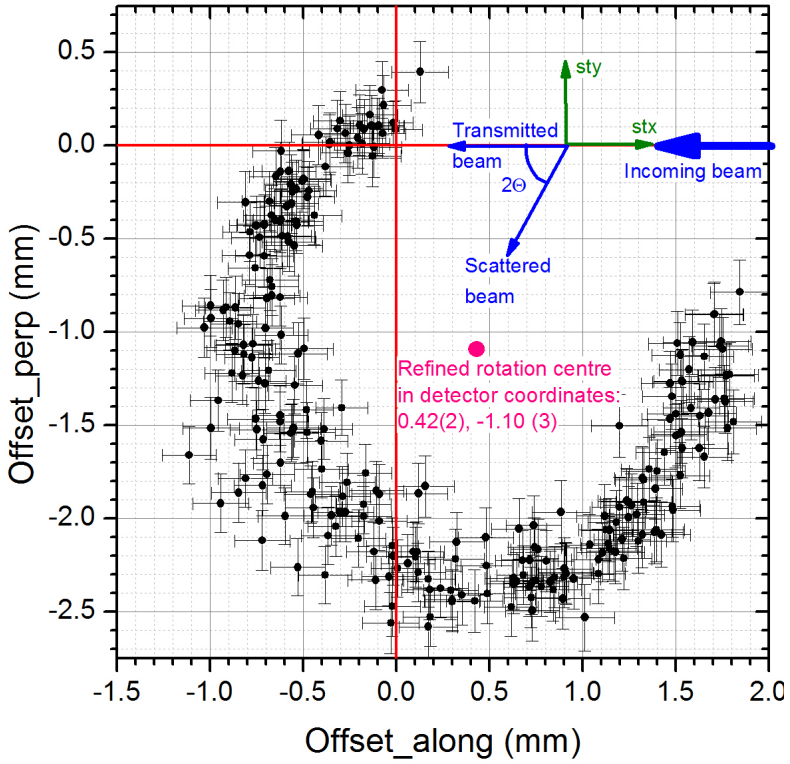


sine_mirrored_01 (User) a+b*sin(2*pi*(abs(x-d)-e)/c)	Offset_along_the_beam		Offset_perpend_to_the_beam	
	Value	Standard Error	Value	Standard Error
a	0.41751	0.01546	1.09572	0.03208
b	1.19301	0.01362	1.25716	0.02672
c	181.31962	2.69609	177.87164	3.78847
d	132.23477	0.32256	132.13811	0.30135
e	-39.65369	1.81266	3.31288	1.00919

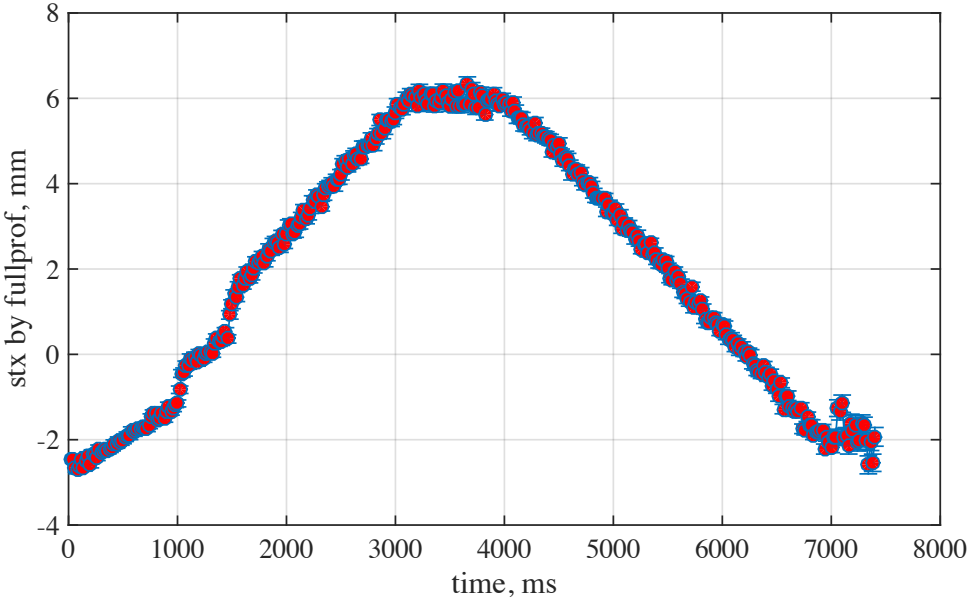


Sample table (a3) oscillations, with an offset sample

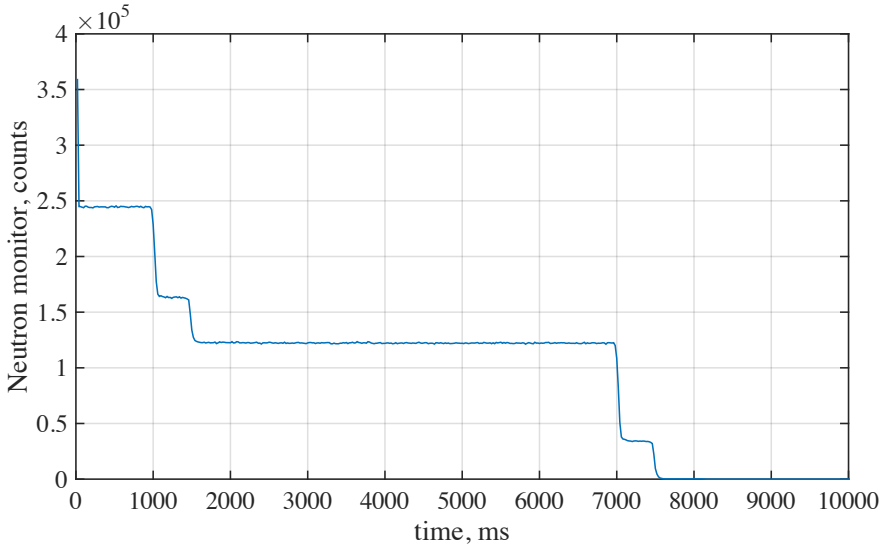
Refined parameters:
crystal structure + offsets in detector coordinates.
Each point: from a refinement based on a stroboscopic slice of 1 sec, repeated ~55 times (i.e. just < 1 minute per point in total).
Results same reasonable!



Reaching for the unreachable: resolving what happens on timescales of 20 msec with neutron diffraction.



Sample table offsets perpendicular to the beam: stx motor oscilaltions between +4 and -4, with a3 = -89



Refined parameters:
crystal structure + offsets in detector coordinates.
Each point out of these ~350 is a refinement result: from a refinement based on a stroboscopic slice of 20 msec long, repeated xx times
(just ~1 minute per point in total, some 6 hours total measurement time).
The refined “peculiarities” in the offset vs. time graph are real (compare to the graph of neuton monitors): these are different speeds of motor when approaching the target positions.