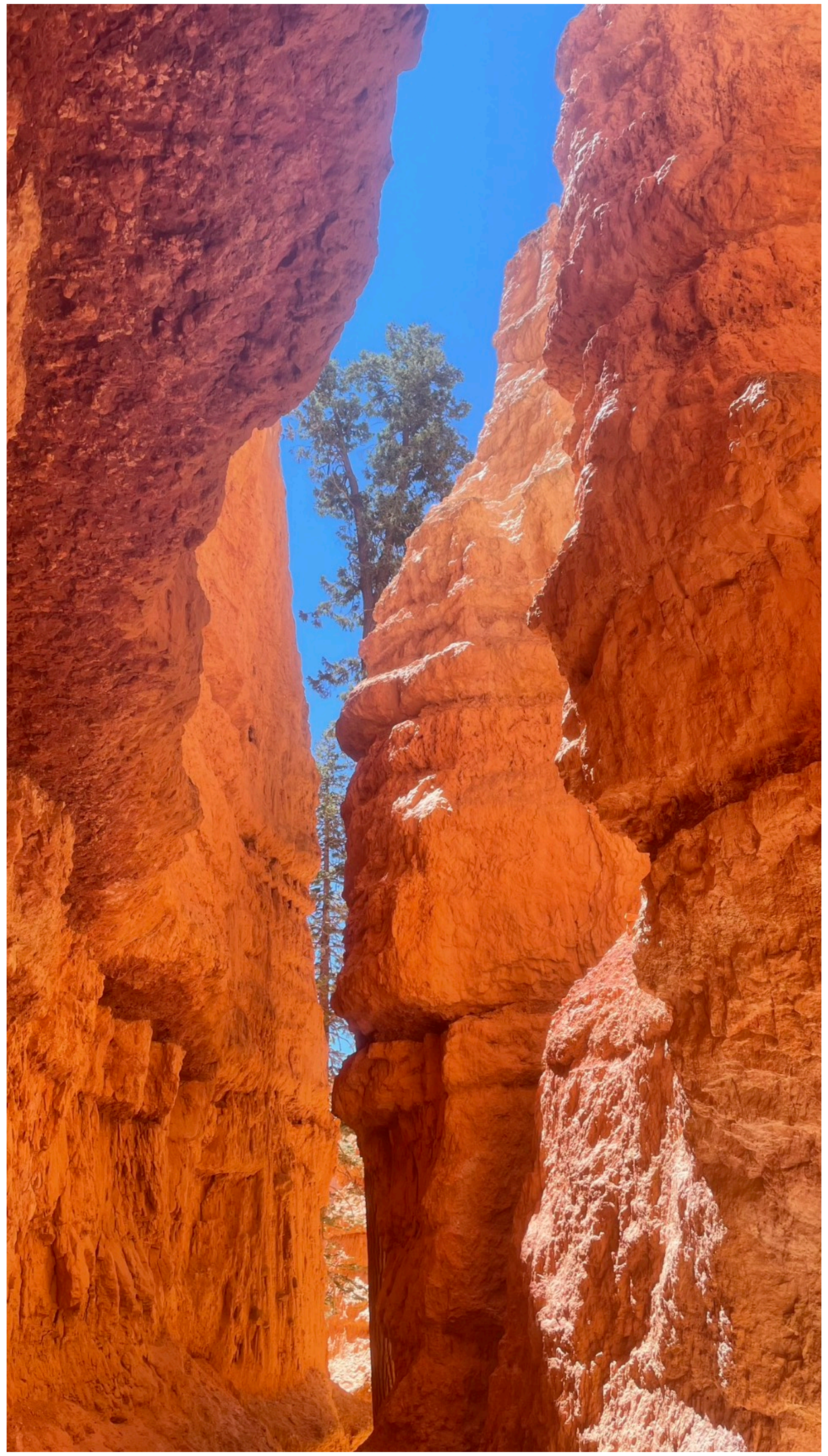
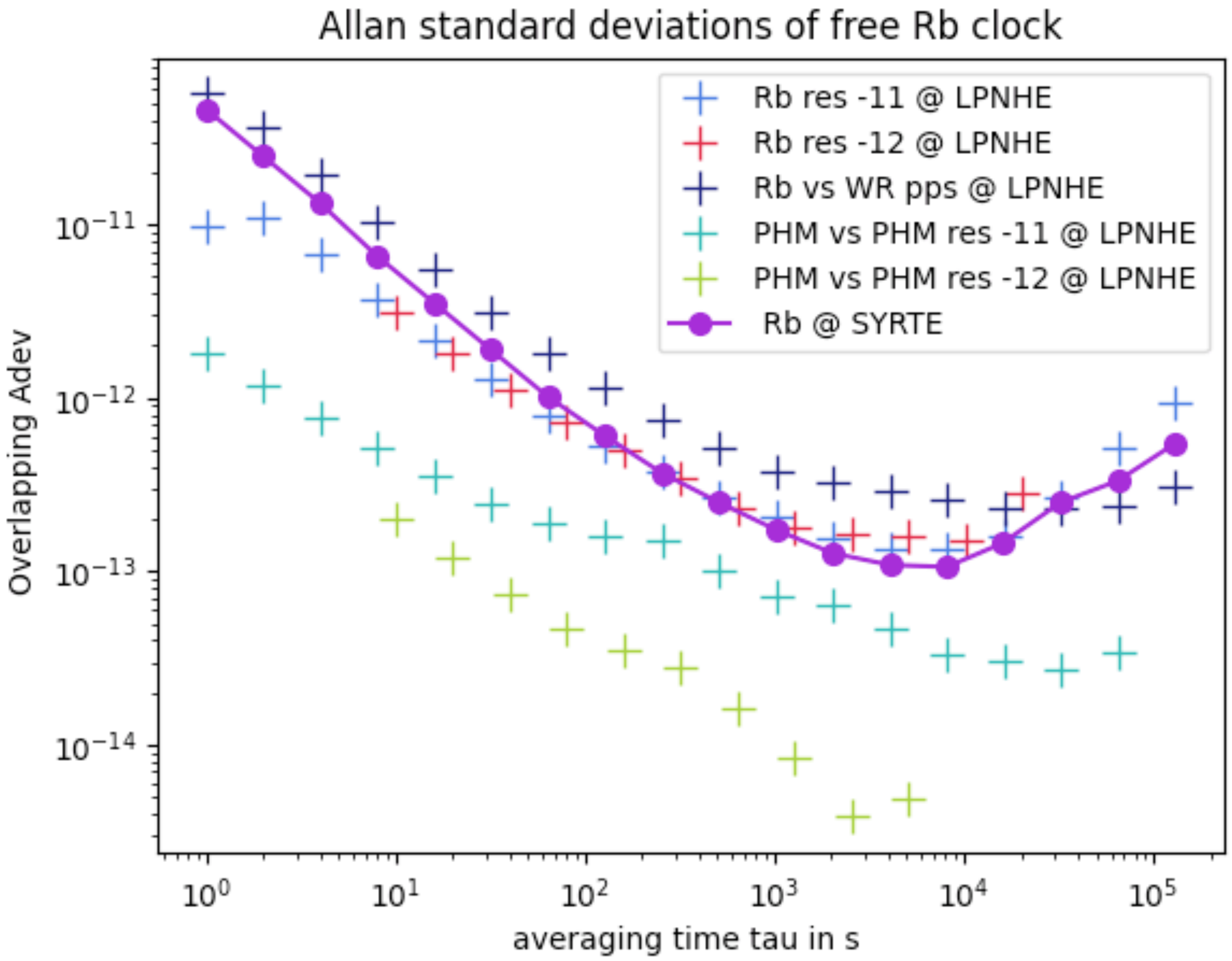
Update on clock studies and simulations



Group meeting 04th oct 2022, LPNHE, Lucile Mellet

Final characterization of the rubidium clock with frequency counter

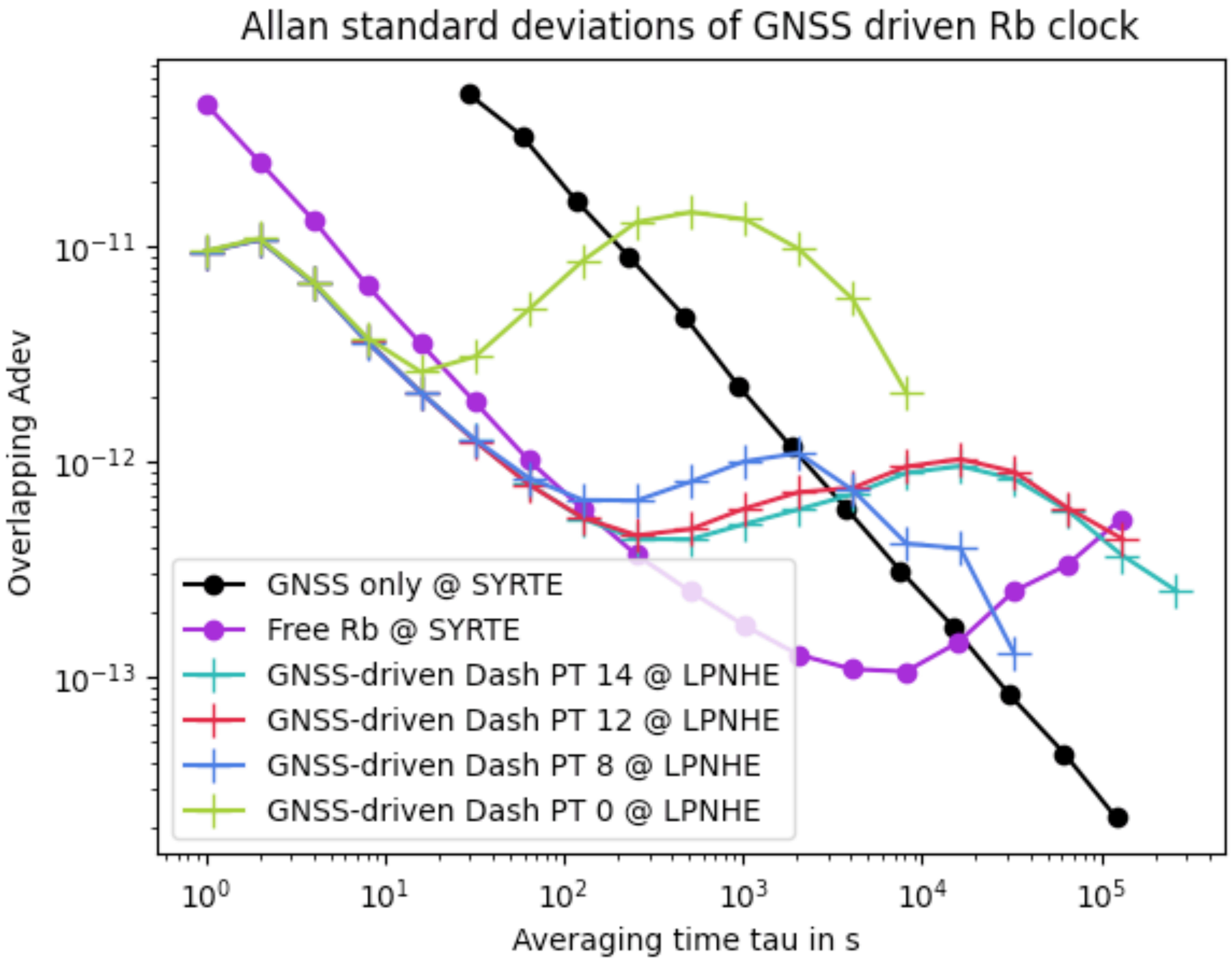


Group meeting 04th oct 2022, LPNHE, Lucile Mellet

SK-like configuration with different time constants

PLL Table for all PT values, assuming a stability factor, ζ=1.

PT Parameter Parameter set by PT command	Integrator Time-Constant (hours)	Integral Gain (SF bits per hour per ns of time-tag)	Proportional Gain (SF bits per ns of time-tag)	Natural Time-Constant Characterizes PLL response (hours)
0	0.07	-14.063	-3.95	0.14
1	0.14	-7.031	-2.80	0.20
2	0.28	-3.516	-1.98	0.28
3	0.57	-1.758	-1.40	0.40
4	1.14	-0.879	-0.99	0.56
5	2.28	-0.439	-0.70	0.80
6	4.55	-0.220	-0.49	1.12
7	9.10	-0.110	-0.35	1.59
8	18.20	-0.055	-0.25	2.25
9	36.41	-0.027	-0.17	3.18
10	72.82	-0.014	-0.12	4.50
11	145.64	-0.007	-0.09	6.36
12	291.27	-0.003	-0.06	8.99
13	582.54	-0.002	-0.04	12.72
14	1,165.08	-0.001	-0.03	17.99



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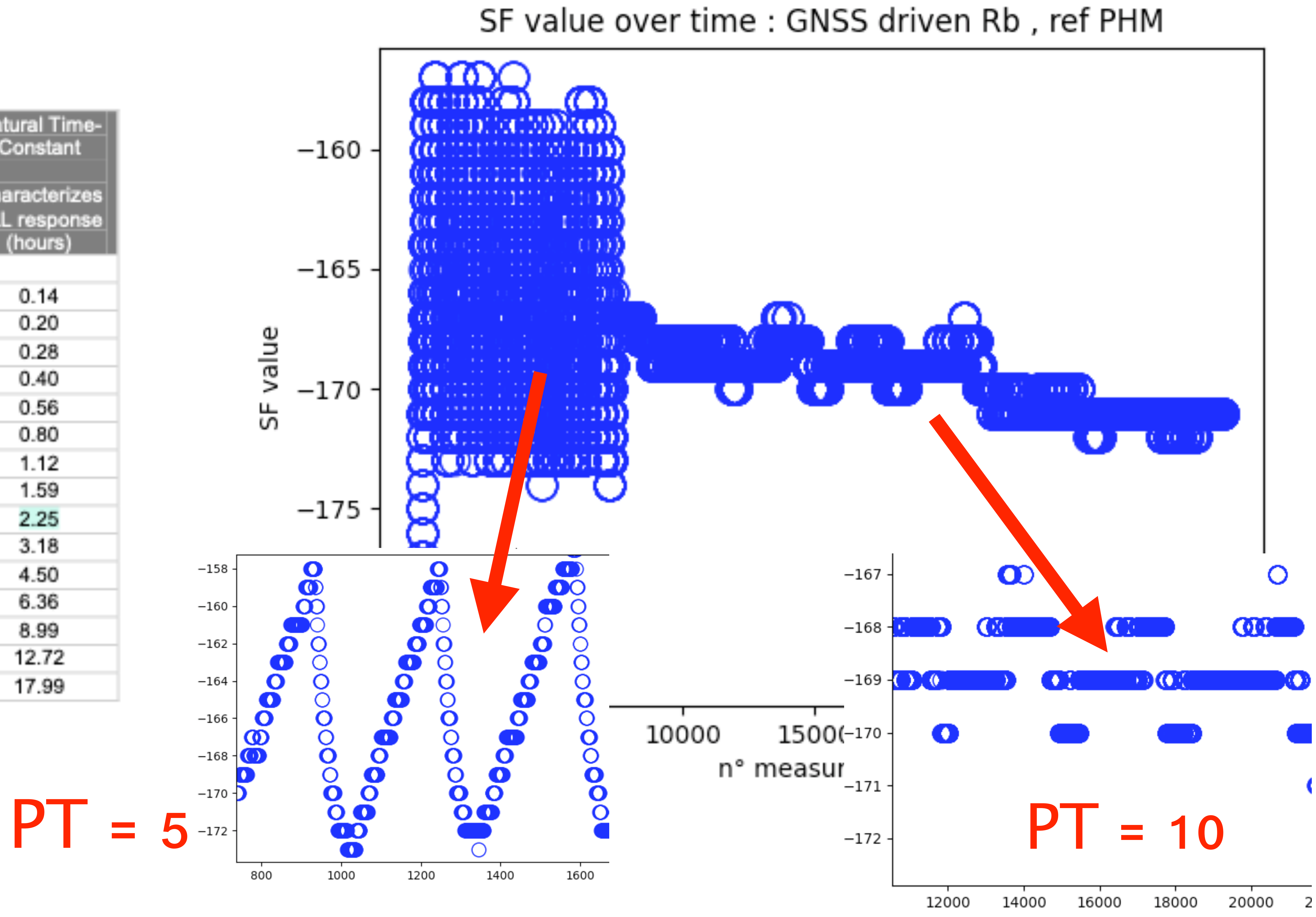
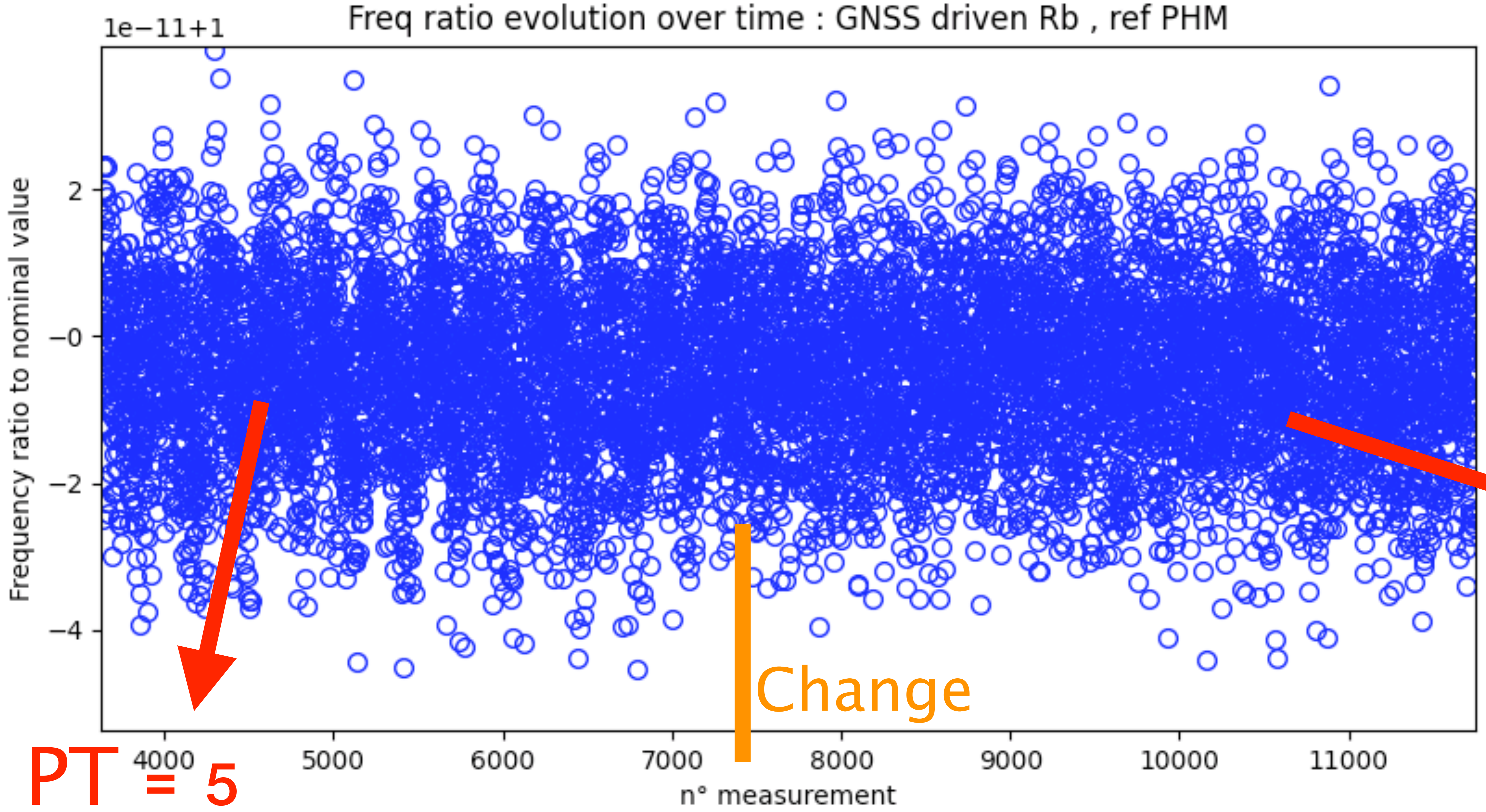
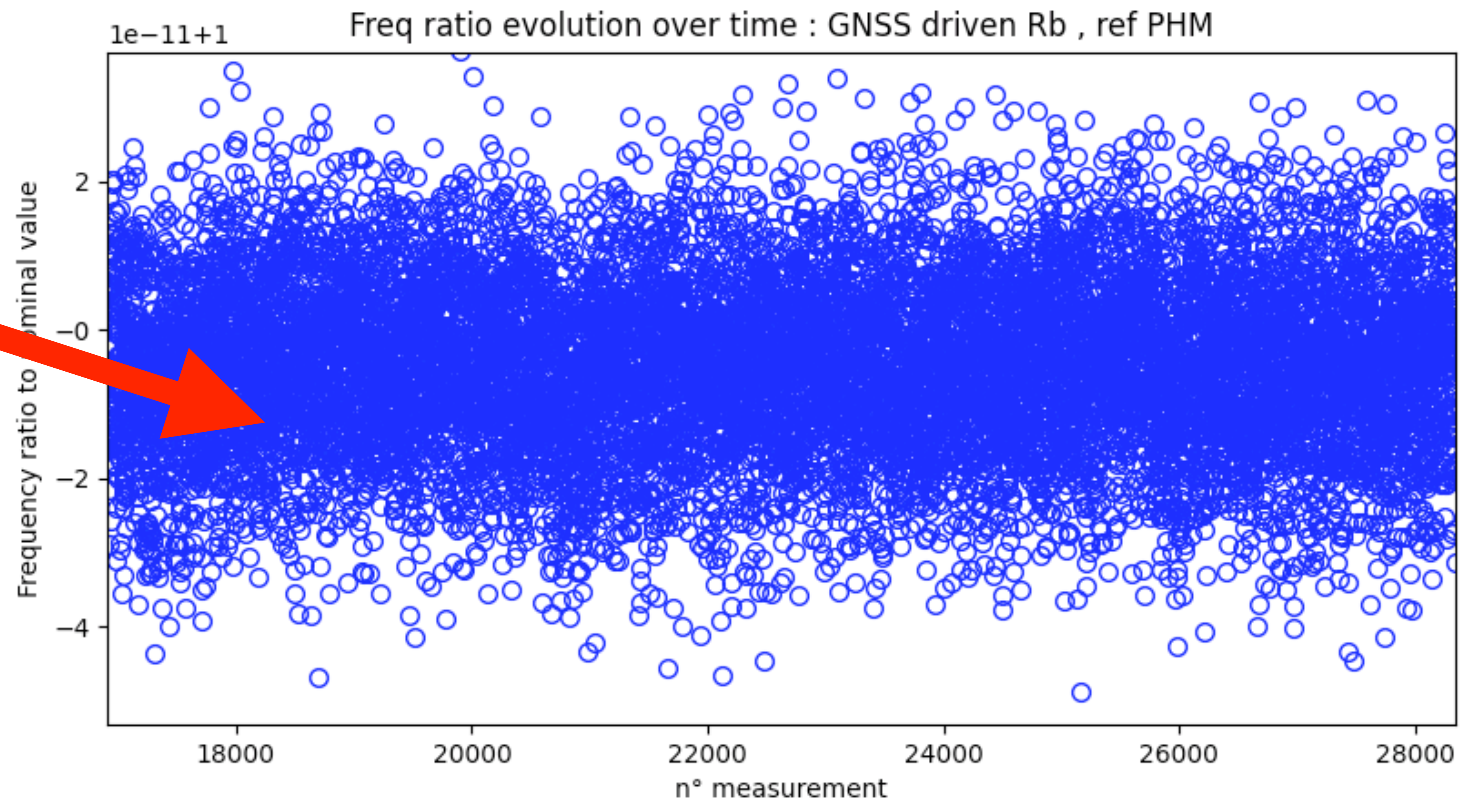


Group meeting 04th oct 2022, LPNHE, Lucile Mellet

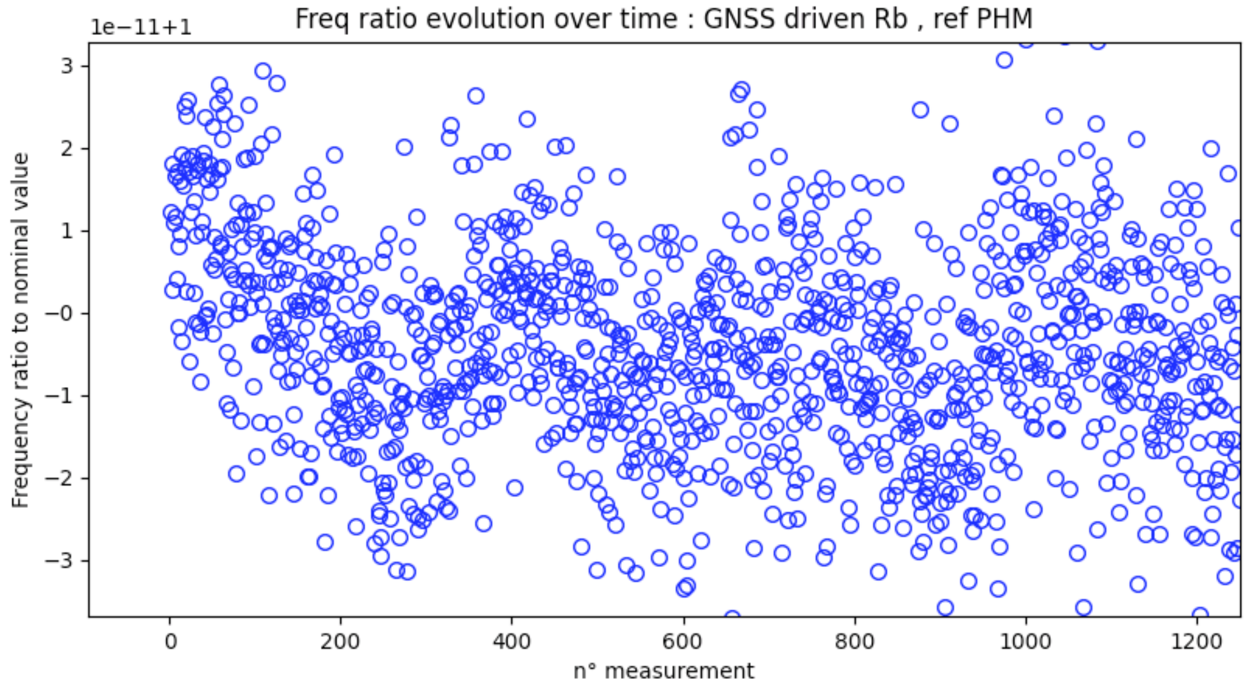
SK-like configuration with different time constants



PT = 5



PT = 10



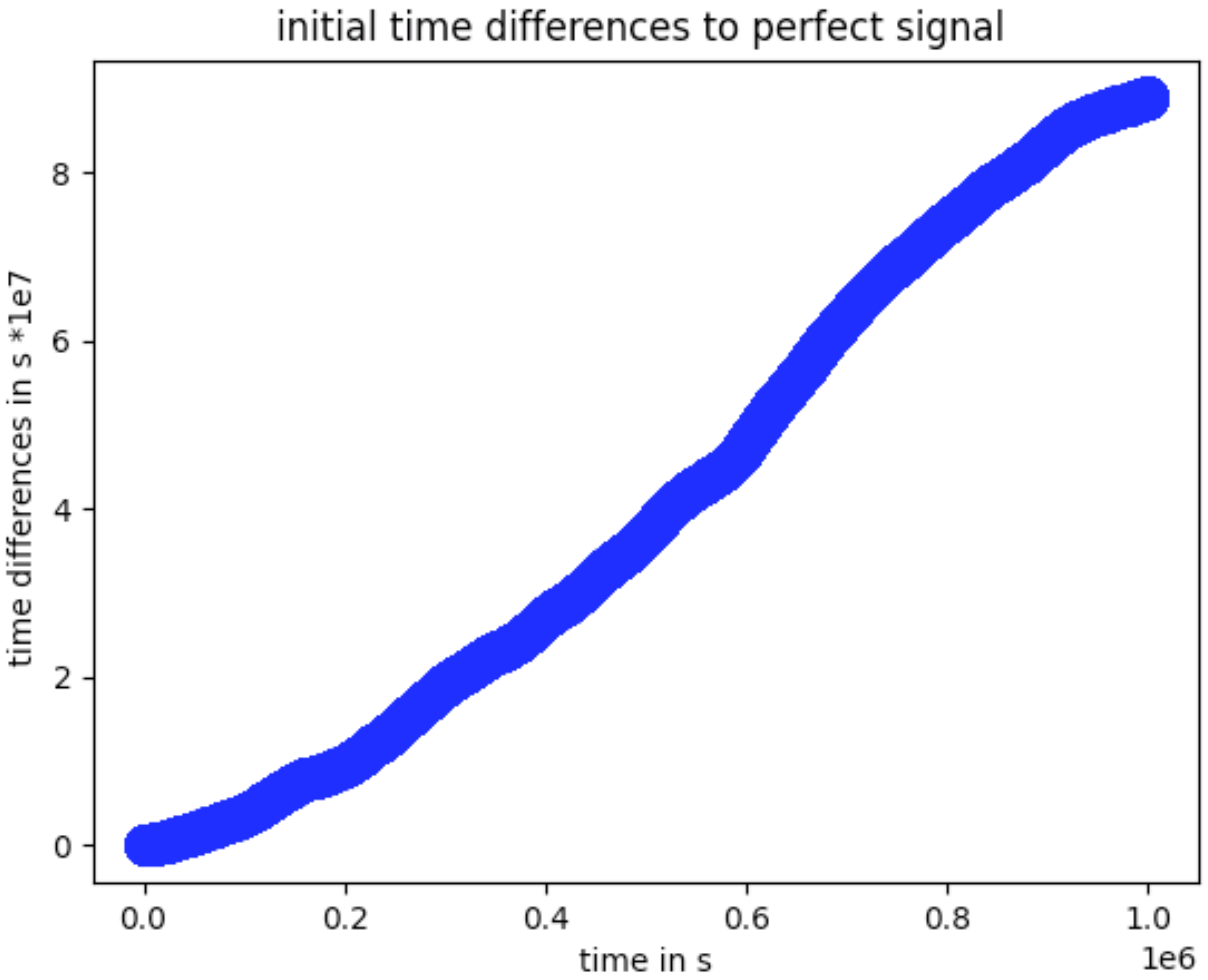
Simulations of data and first correction tests

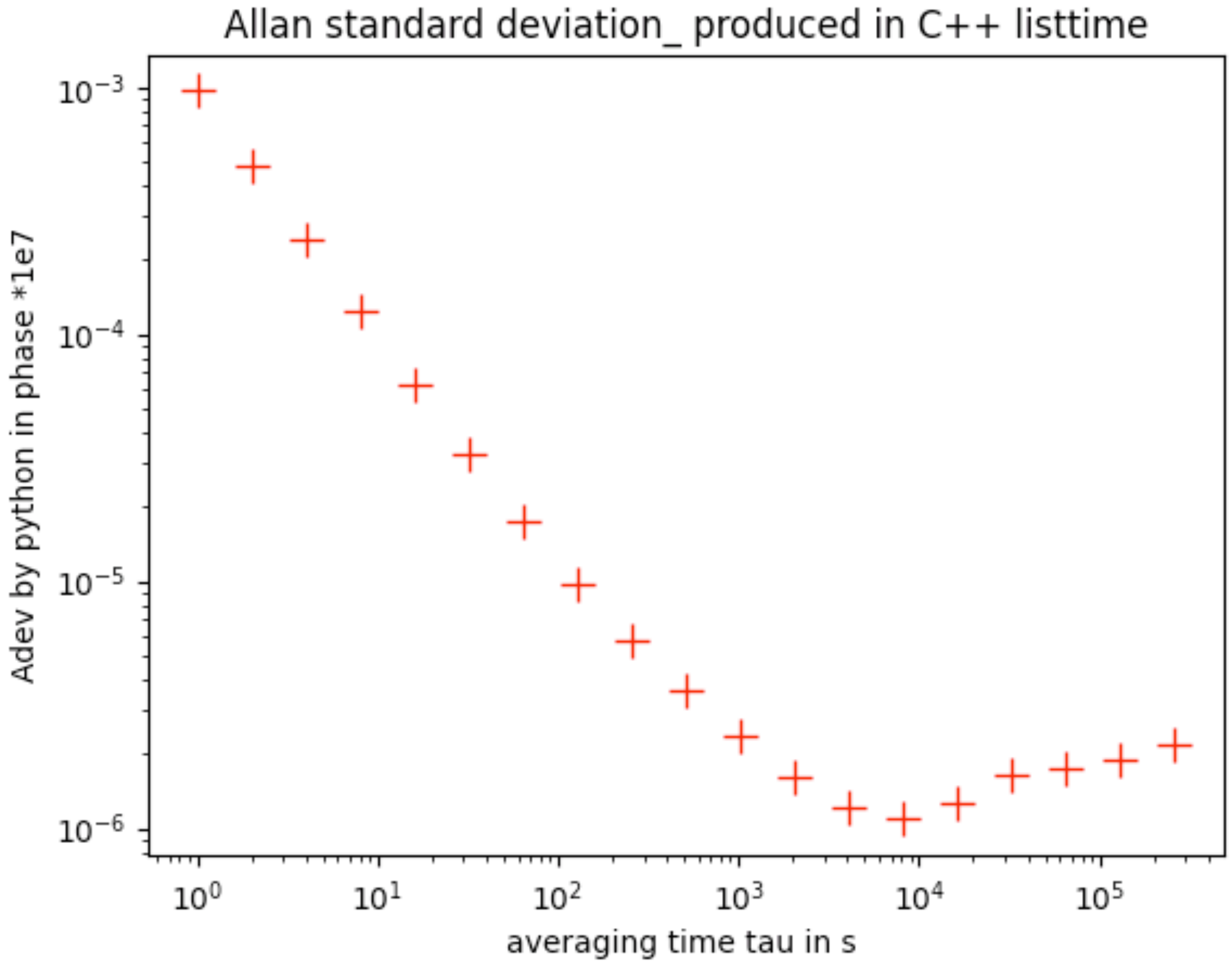
Phase series are simulated with chosen noises (WN freq, WN phase, RW freq) : order of mag coming from a data fit
Time series reconstructed from this
Corrections applied between fake Rb and perfect signal or fake Rb/fake GNSS
For now : Jumps of data, linear or quadratic fits of time differences on fixed interval lengths
Later : overlapping fits, splines, SK like ? , …

<u>More details</u> :

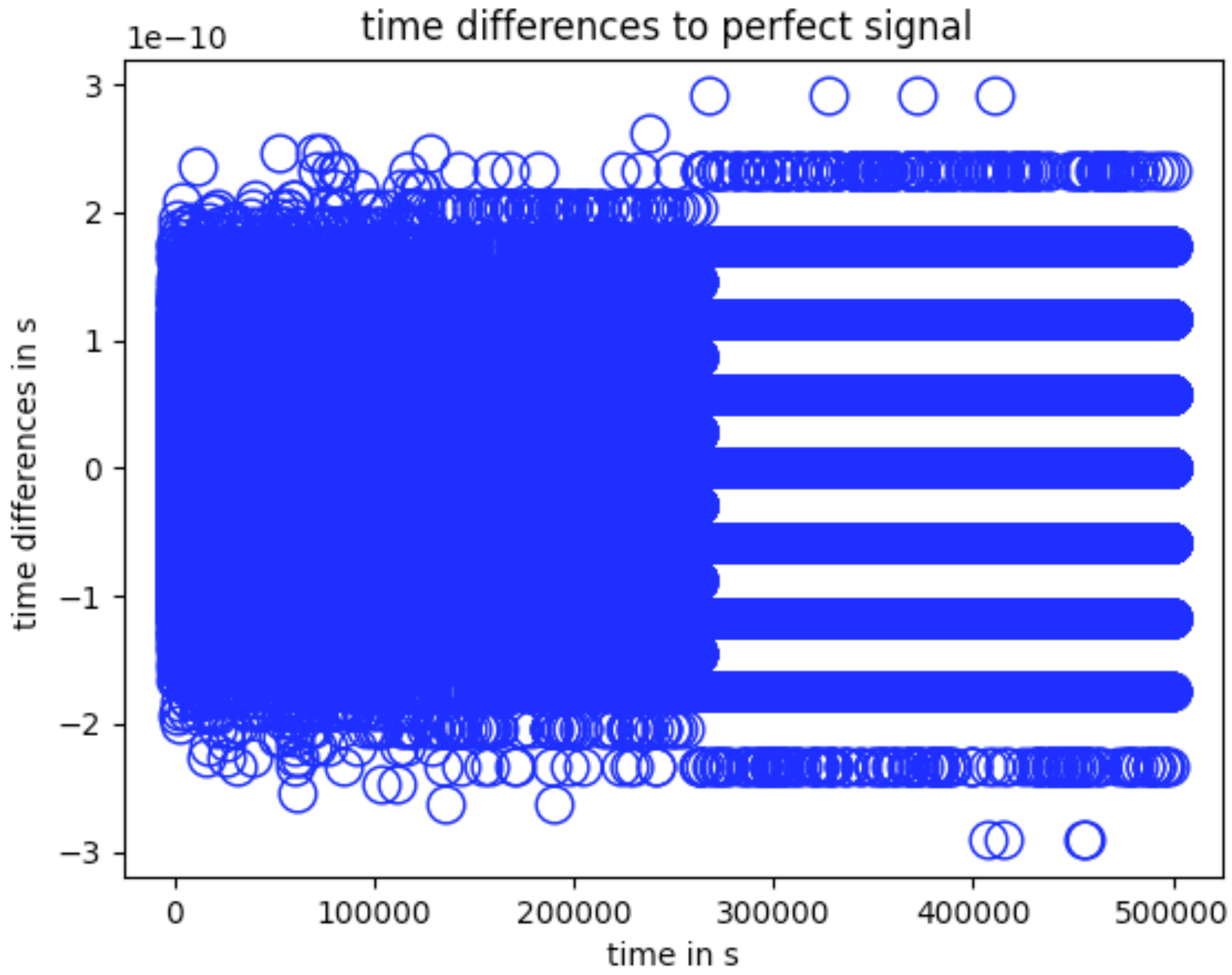
PPS for simulation (easier)
Ref = perfect signal or fake GNSS
-> Production of time series (perfect = 1 2 3 4 5 etc)
$\Delta t_{fakedata-ref}$
Fit this Δt on N intervals of length L
Each interval : Δt = a*j +b
Correction : - a*j +b on each time hit with corresponding a and b
Plot remaining time differences and ASD of those

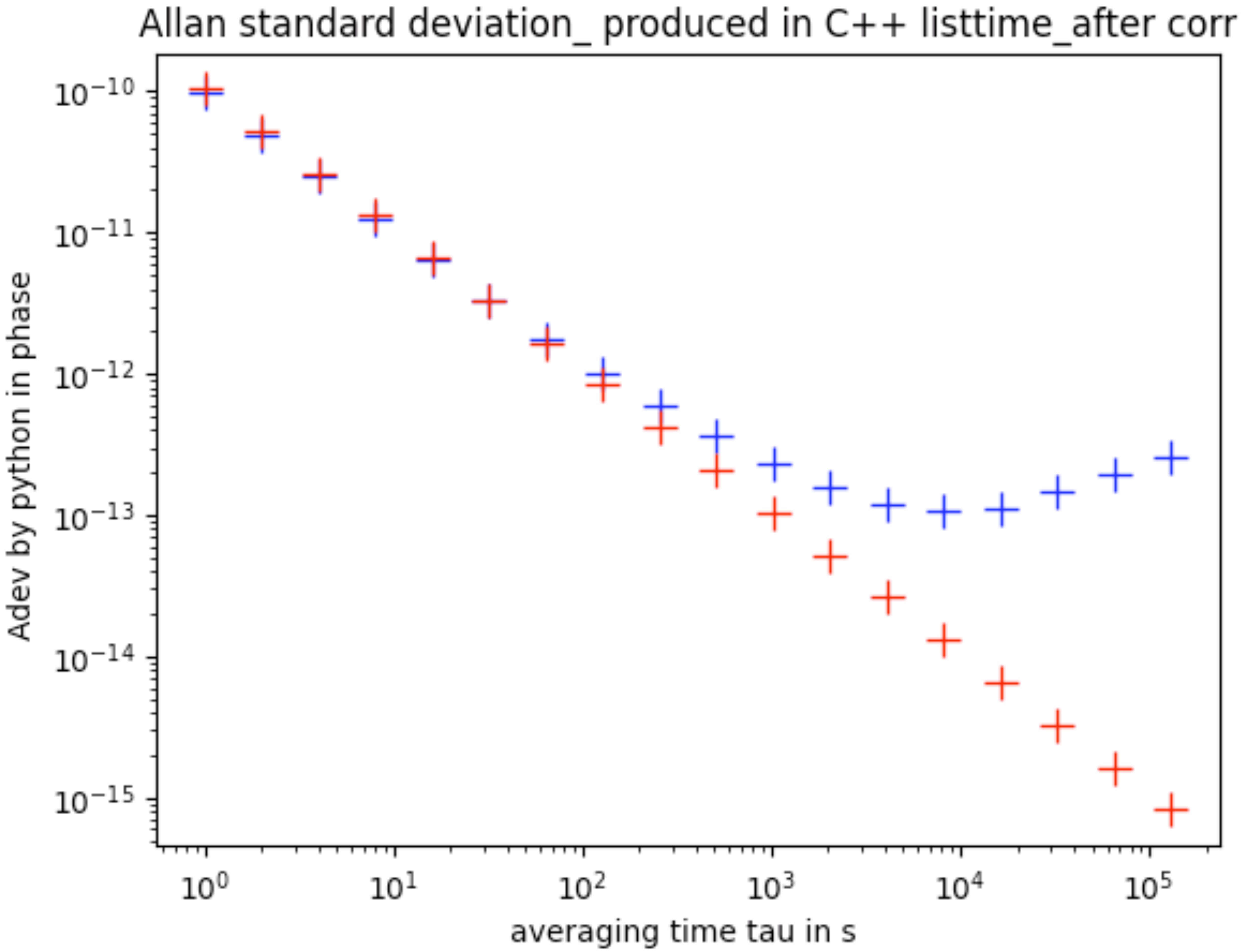
Time series diff sans corrections





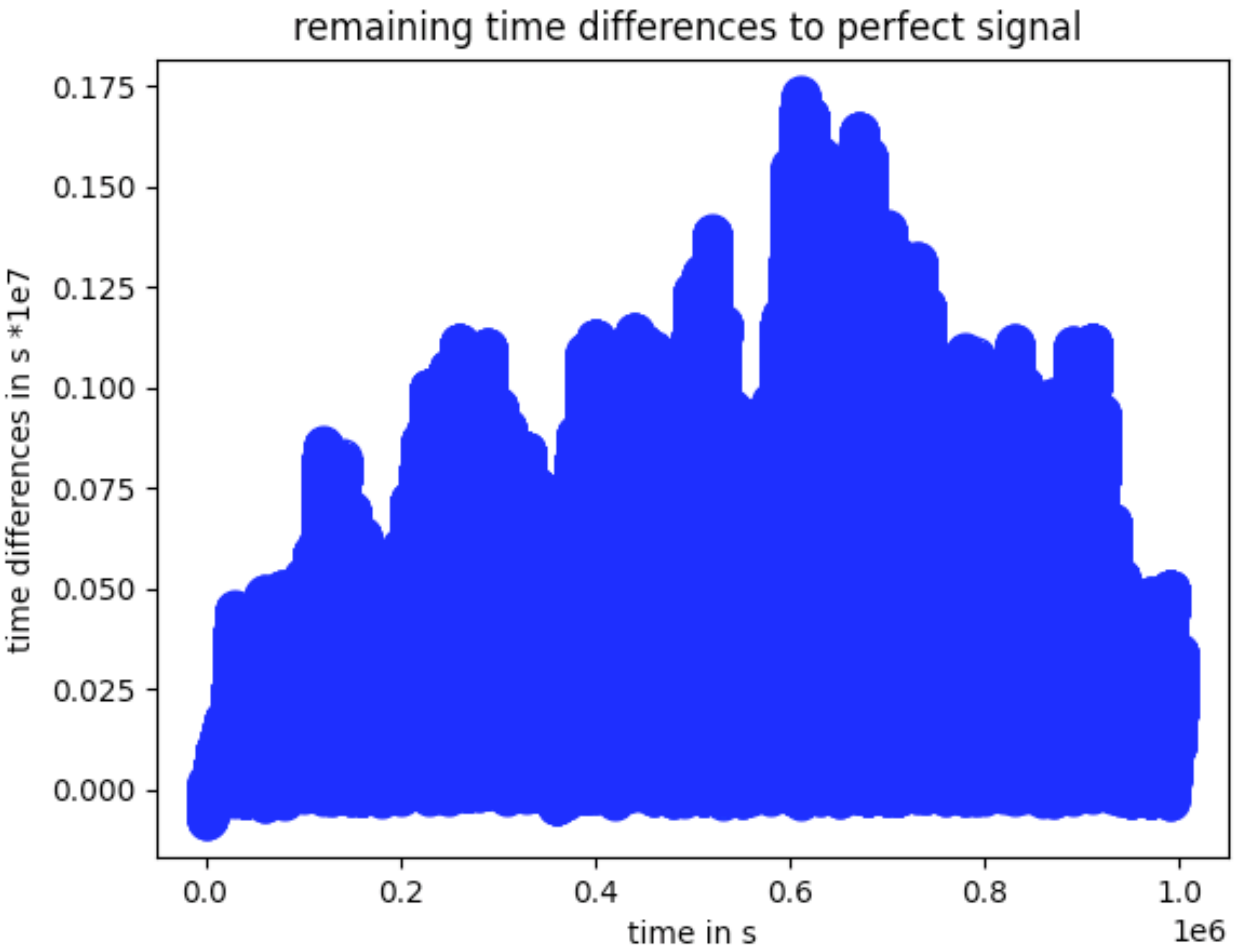
Sur chaque tranche de 10^2 s sans recouvrement, fit quadra des diff par rapport à 1 pps parfait.

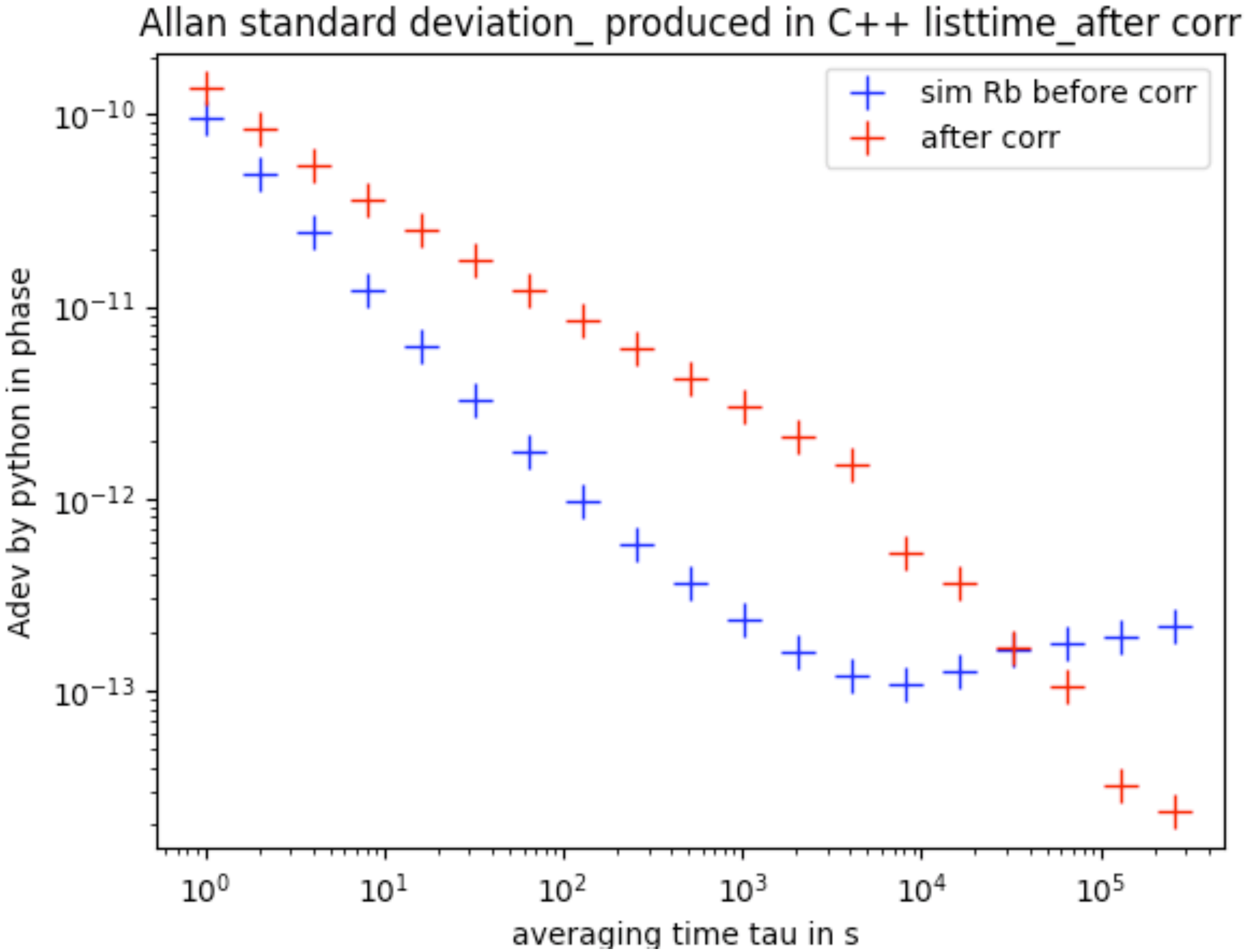




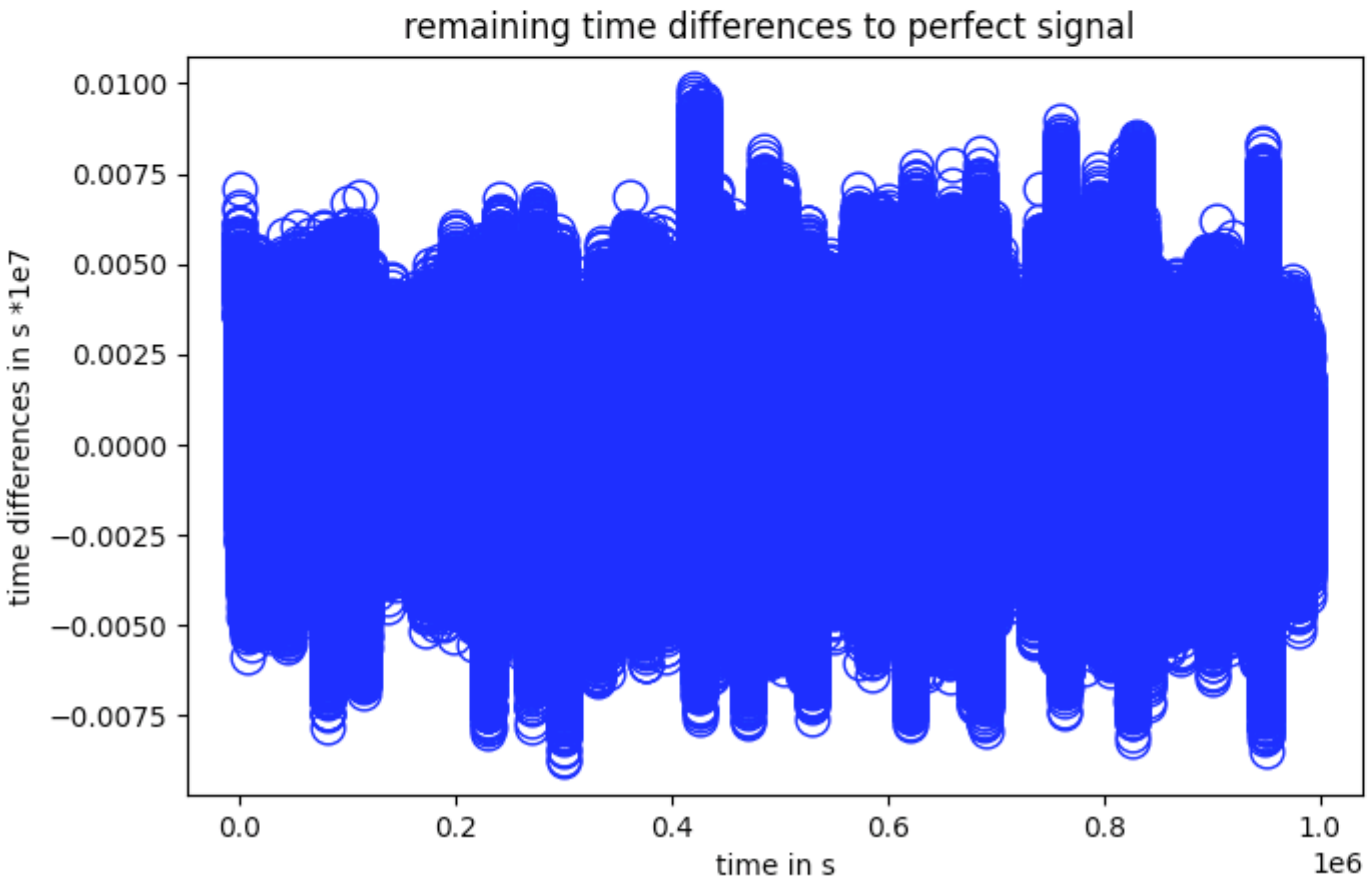
Discretization issue –> Now fixed

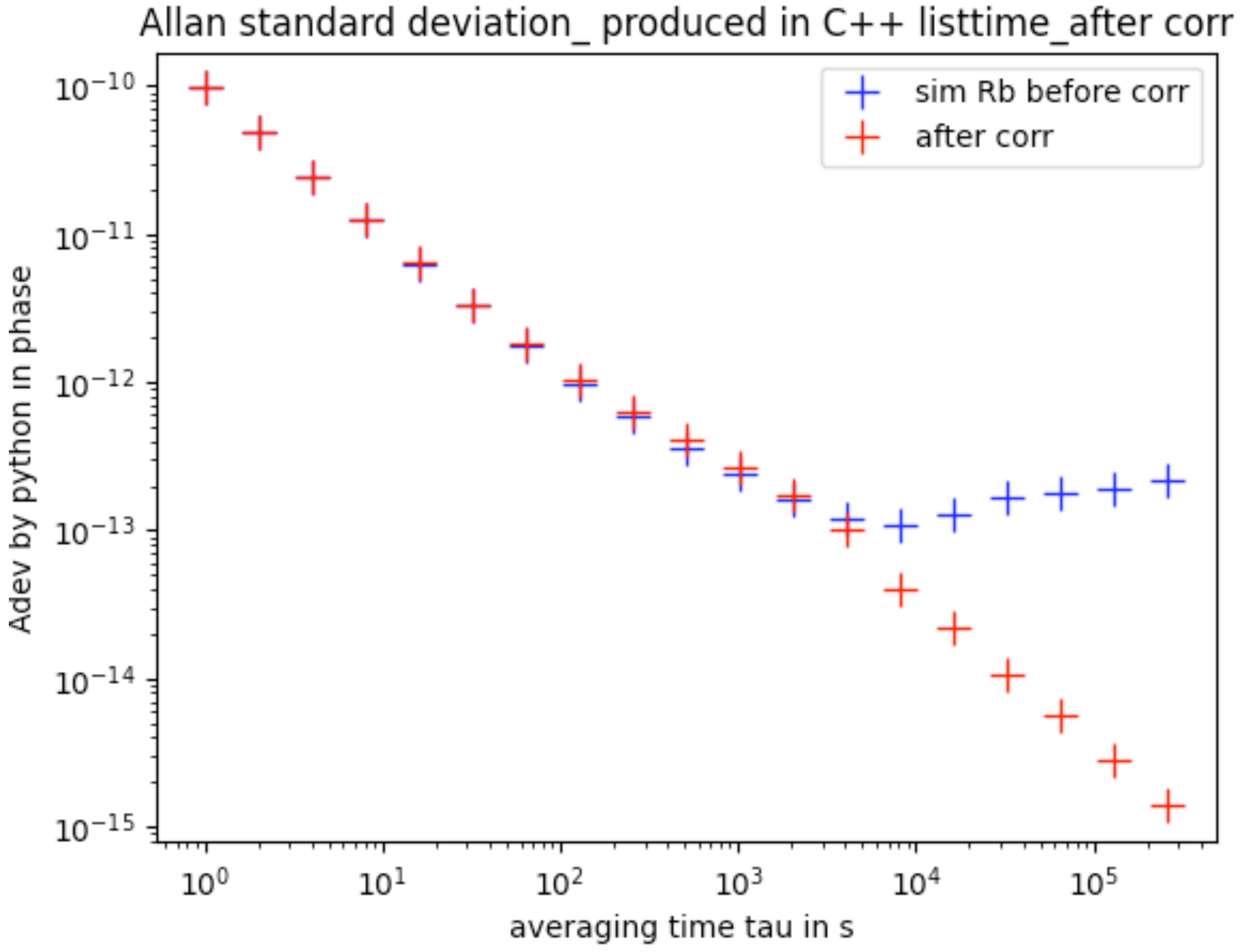
A chaque 10^4 s sans recouvrement, worst case scenario : 1 jump des diff par rapport à 1 pps parfait.



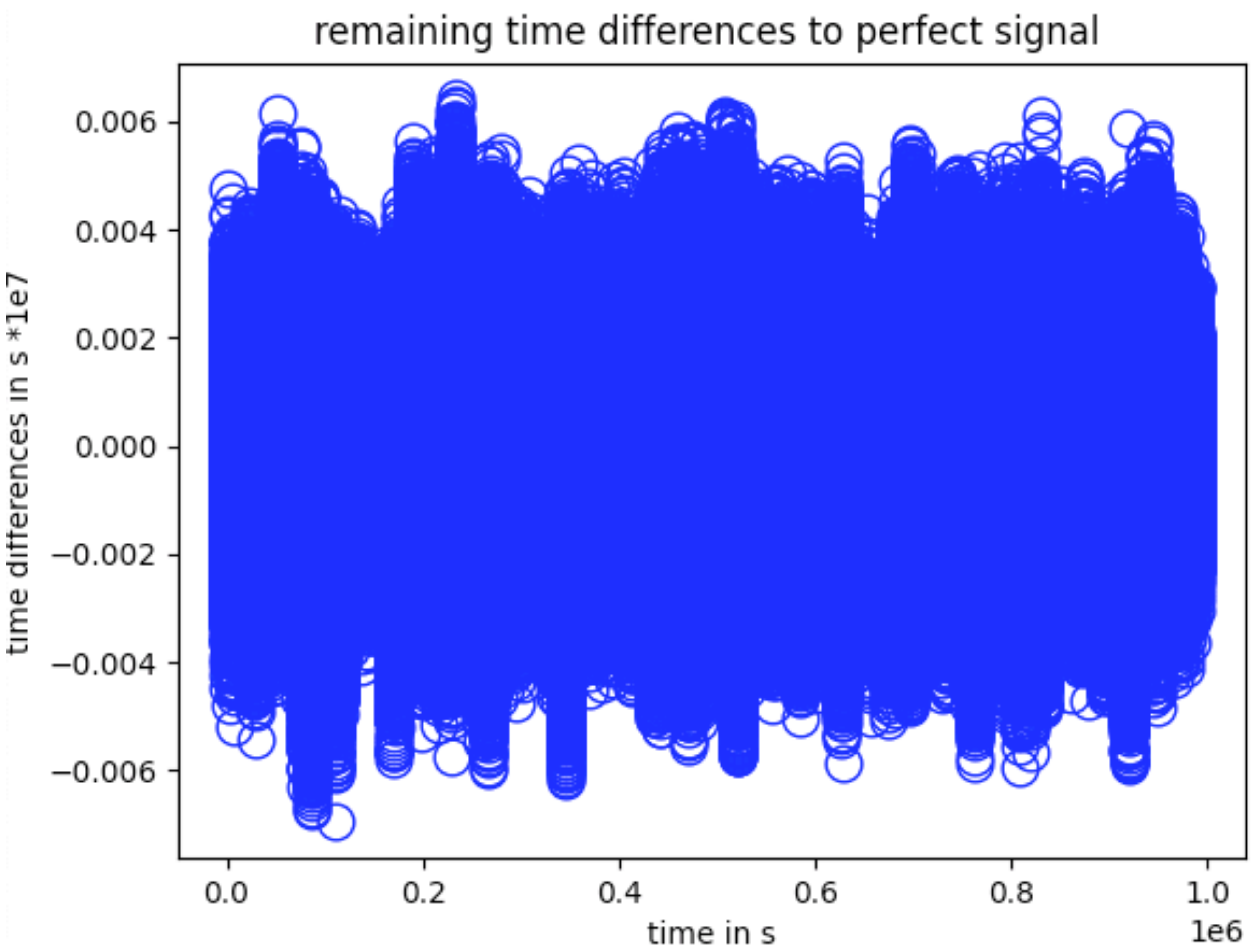


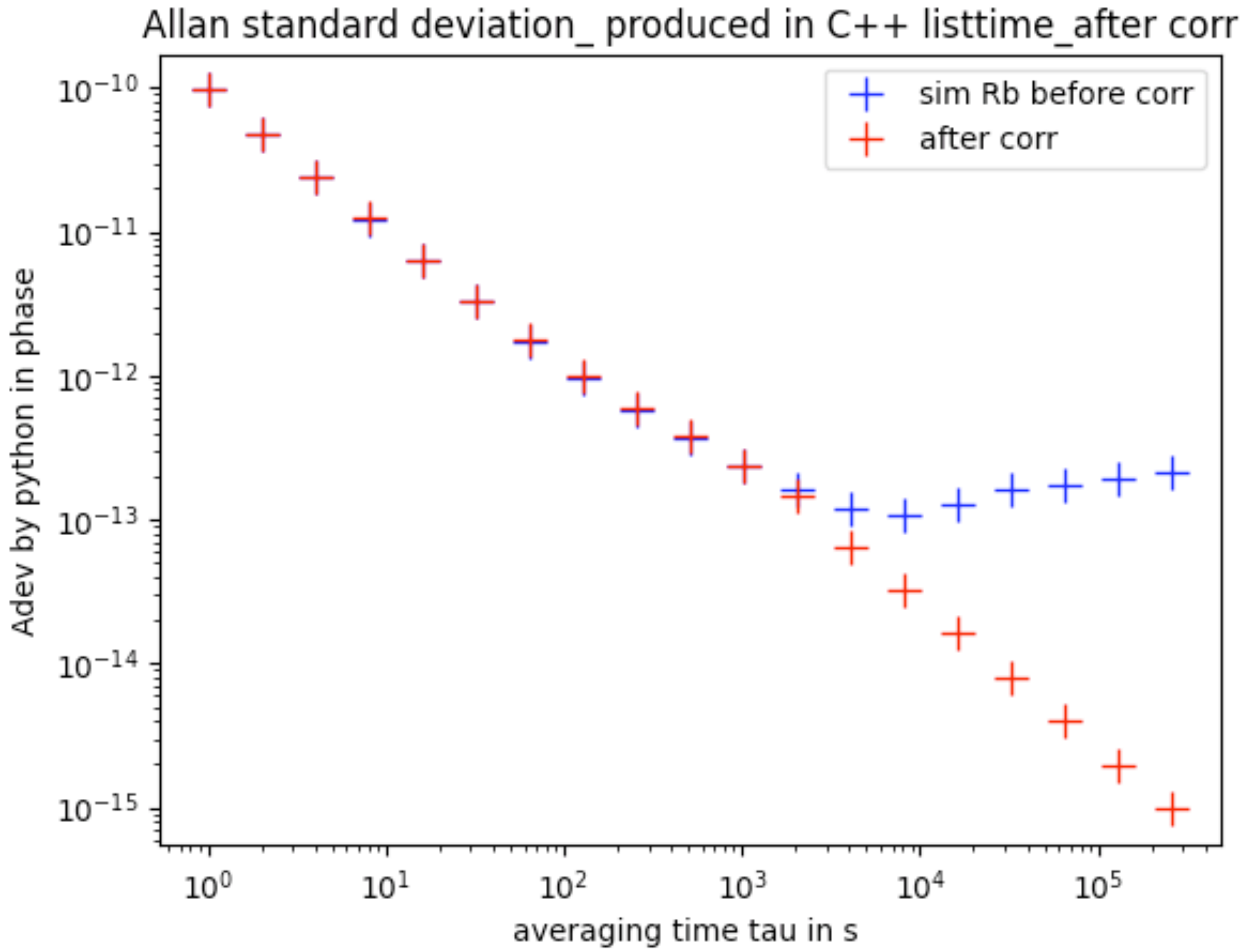
Sur chaque tranche de 10^4 s sans recouvrement, fit linéaire des diff par rapport à 1 pps parfait.



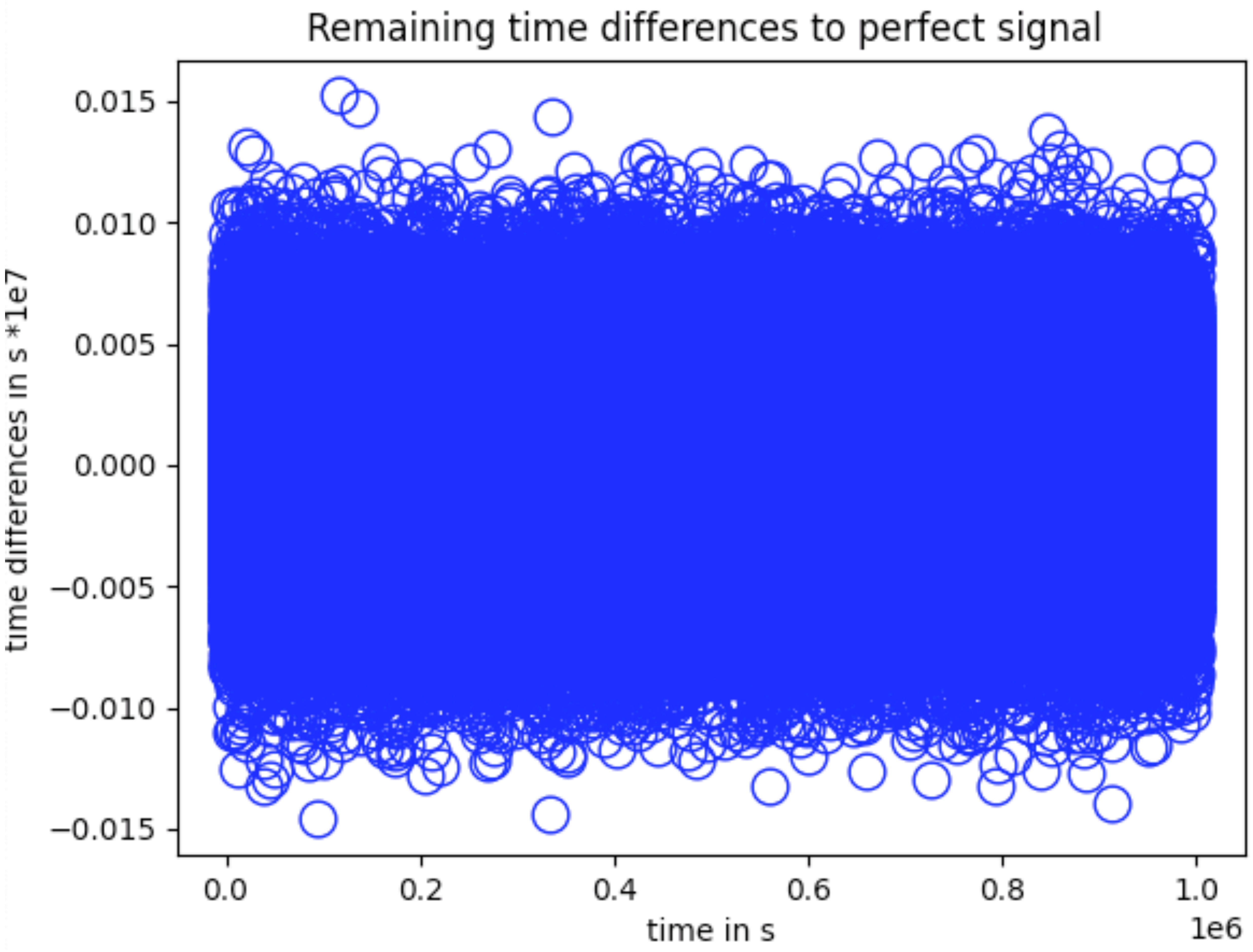


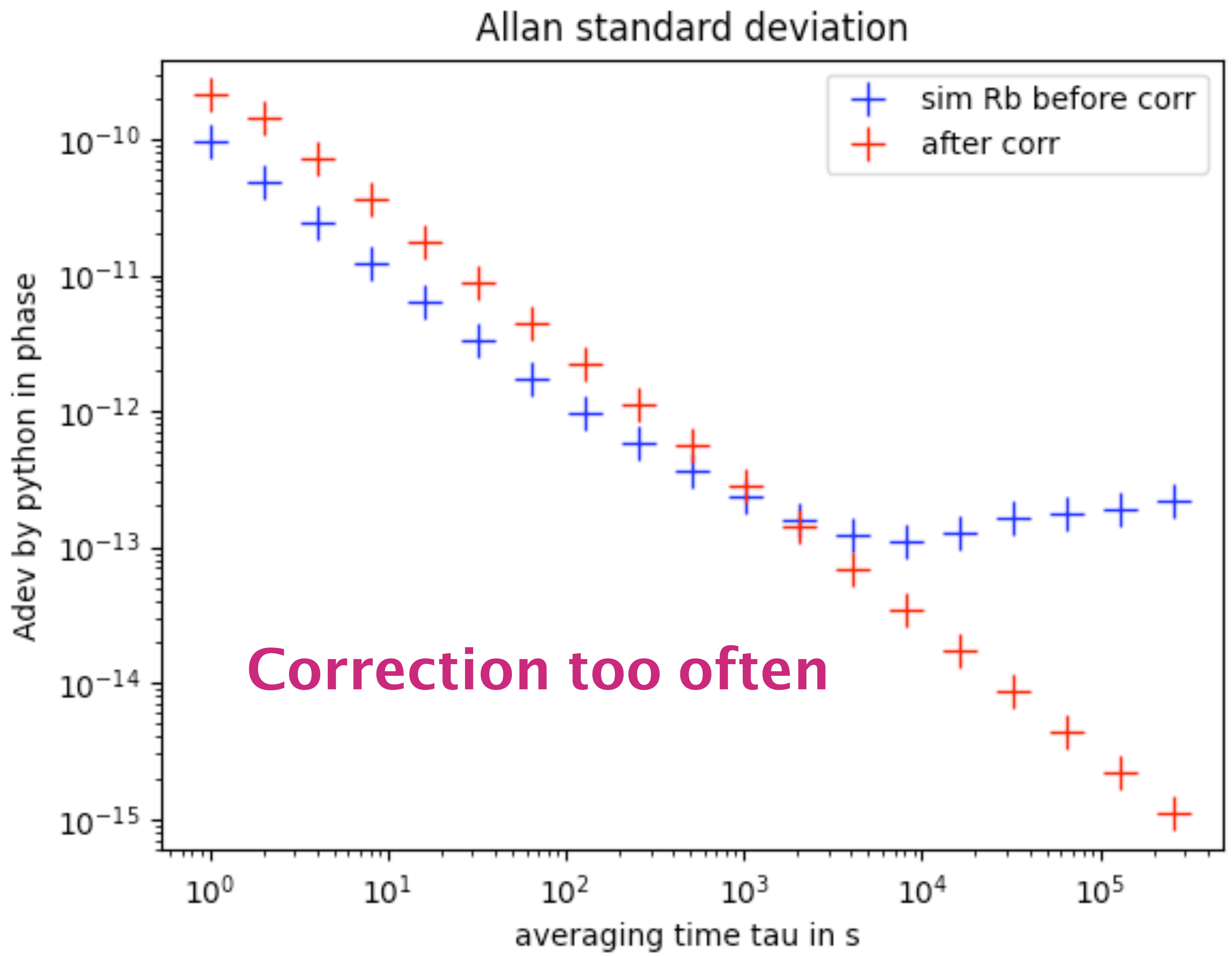
Sur chaque tranche de 10^4 s sans recouvrement, fit quadra des diff par rapport à 1 pps parfait.



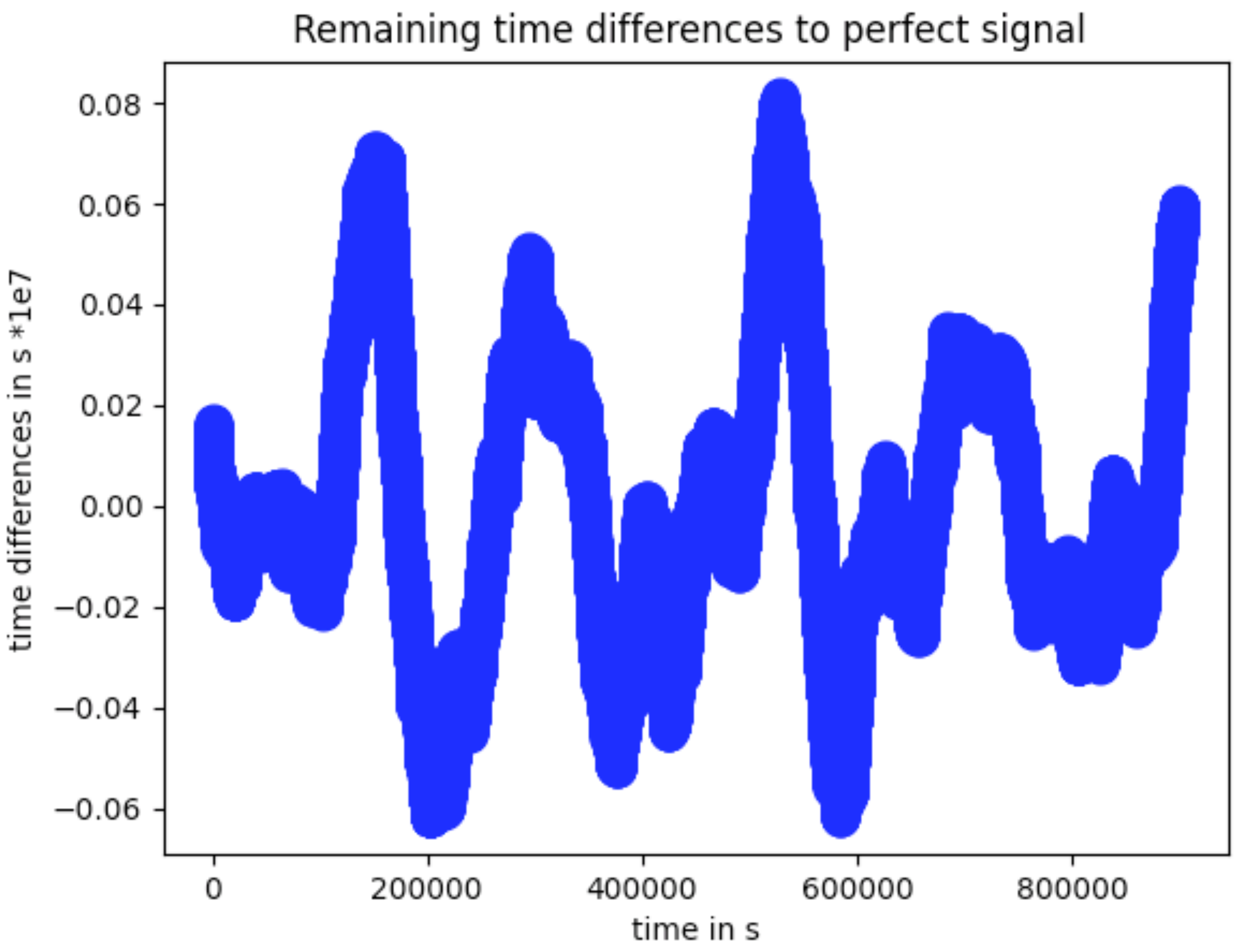


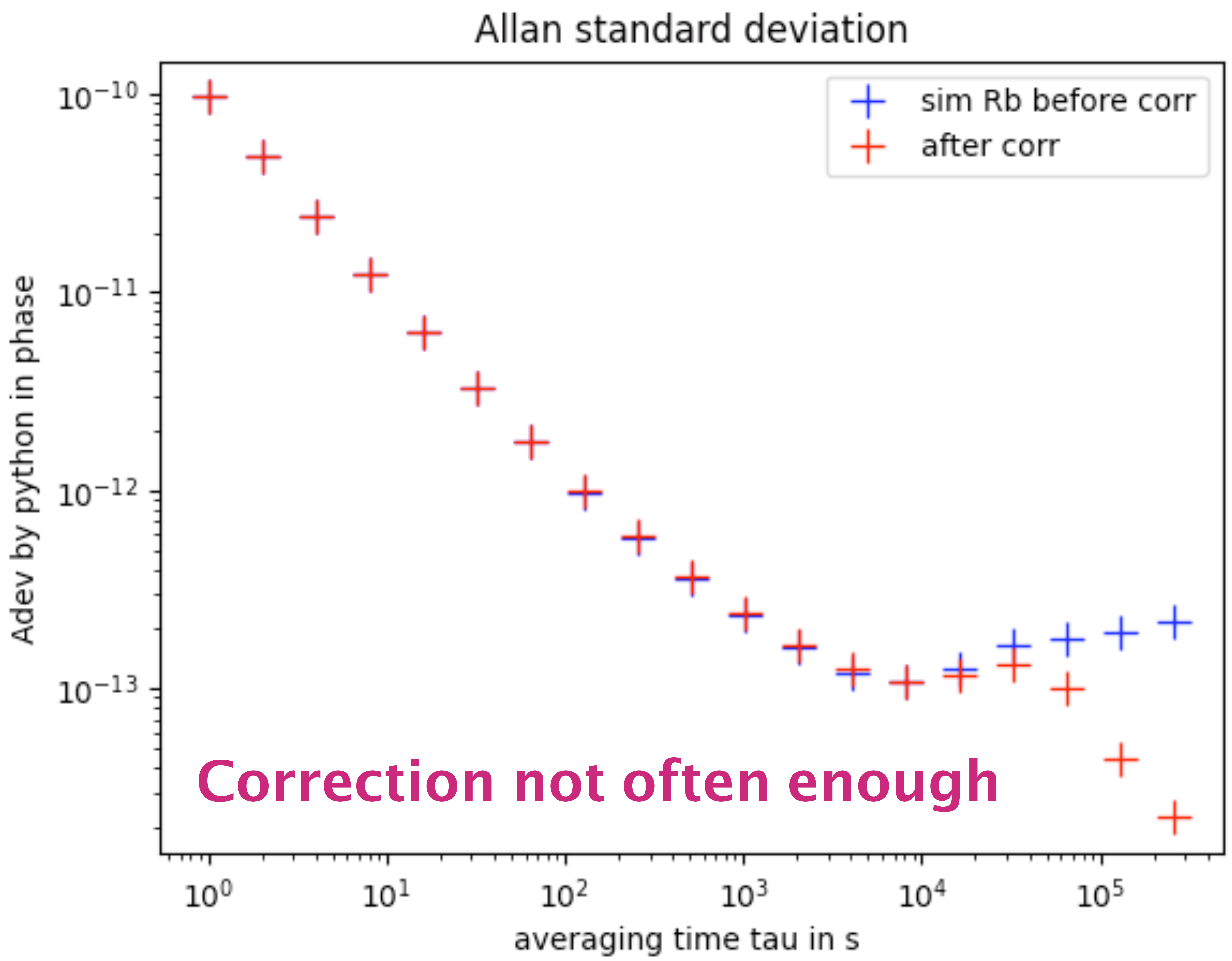
Sur chaque tranche de 5 s sans recouvrement, fit quadra des diff par rapport à 1 pps parfait.





Sur chaque tranche de $3*10^5$s sans recouvrement, fit quadra des diff par rapport à 1 pps parfait.



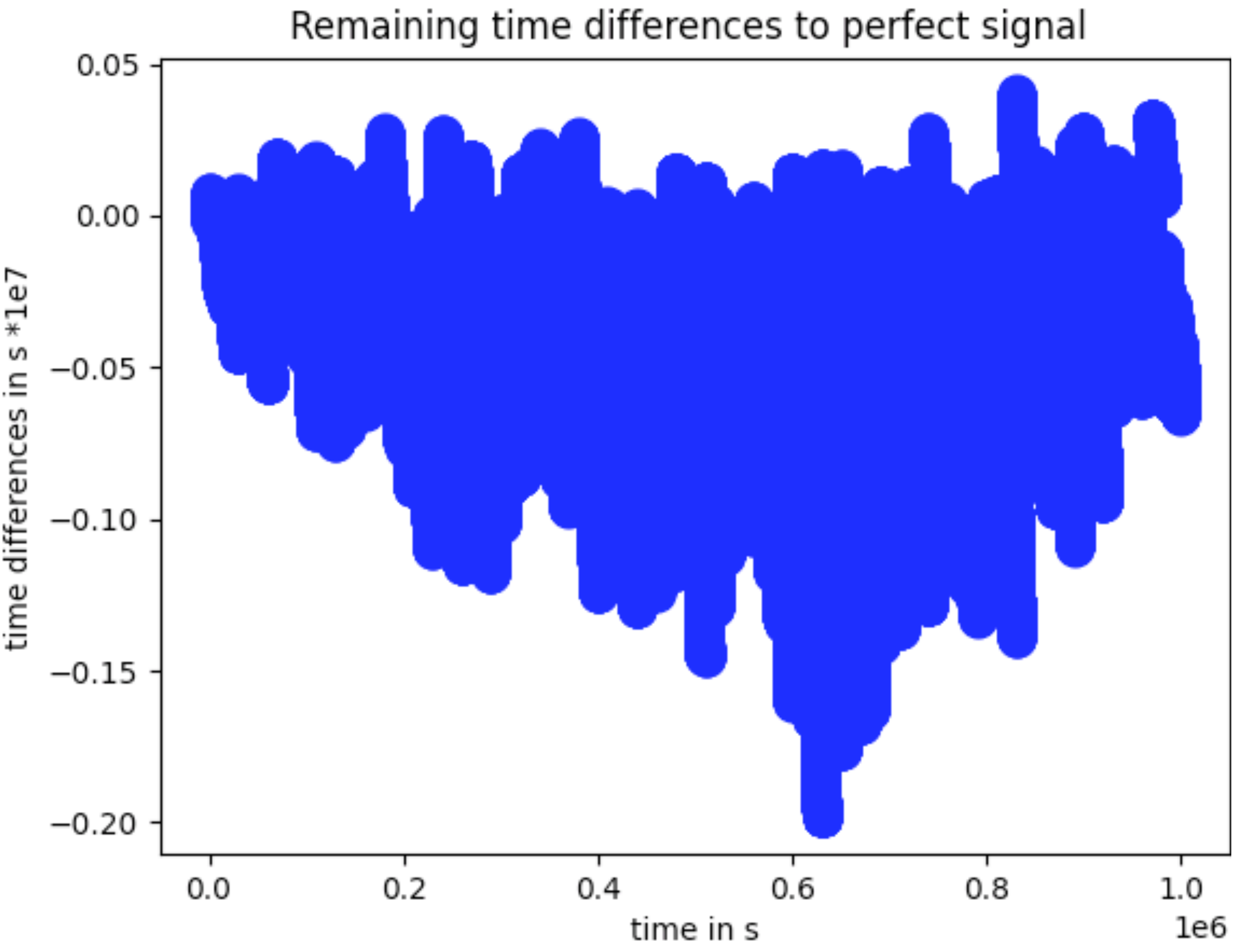


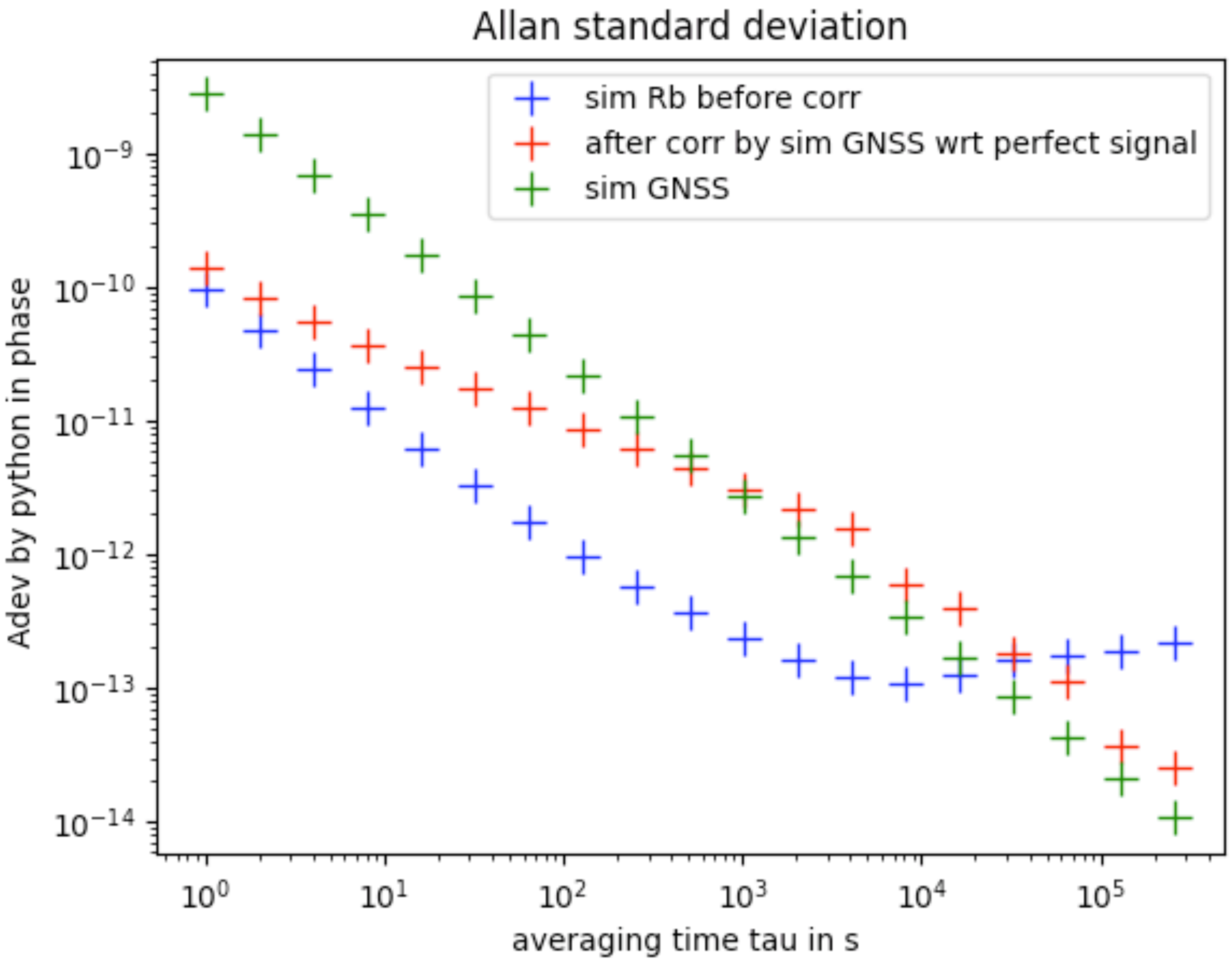
Simulations of data and first correction tests

These were corrections wrt « perfect signal »
Now we simulate a GNSS receiver (only white phase noise)
Corrections wrt fake GNSS
ASD computed wrt « perfect signal »

A chaque 10^4 s sans recouvrement, worst case scenario : 1 jump des diff

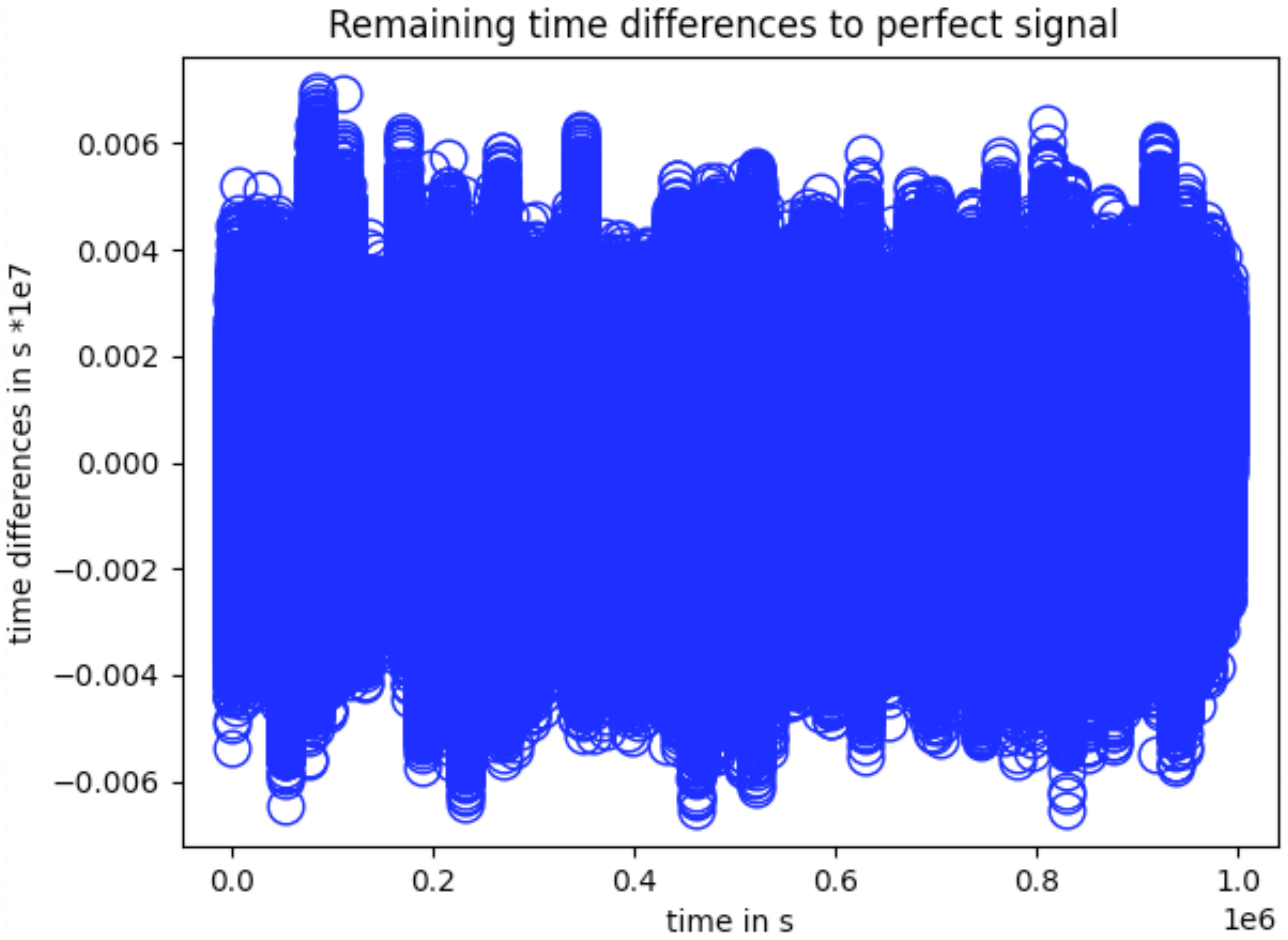
Reference = simulated GNSS

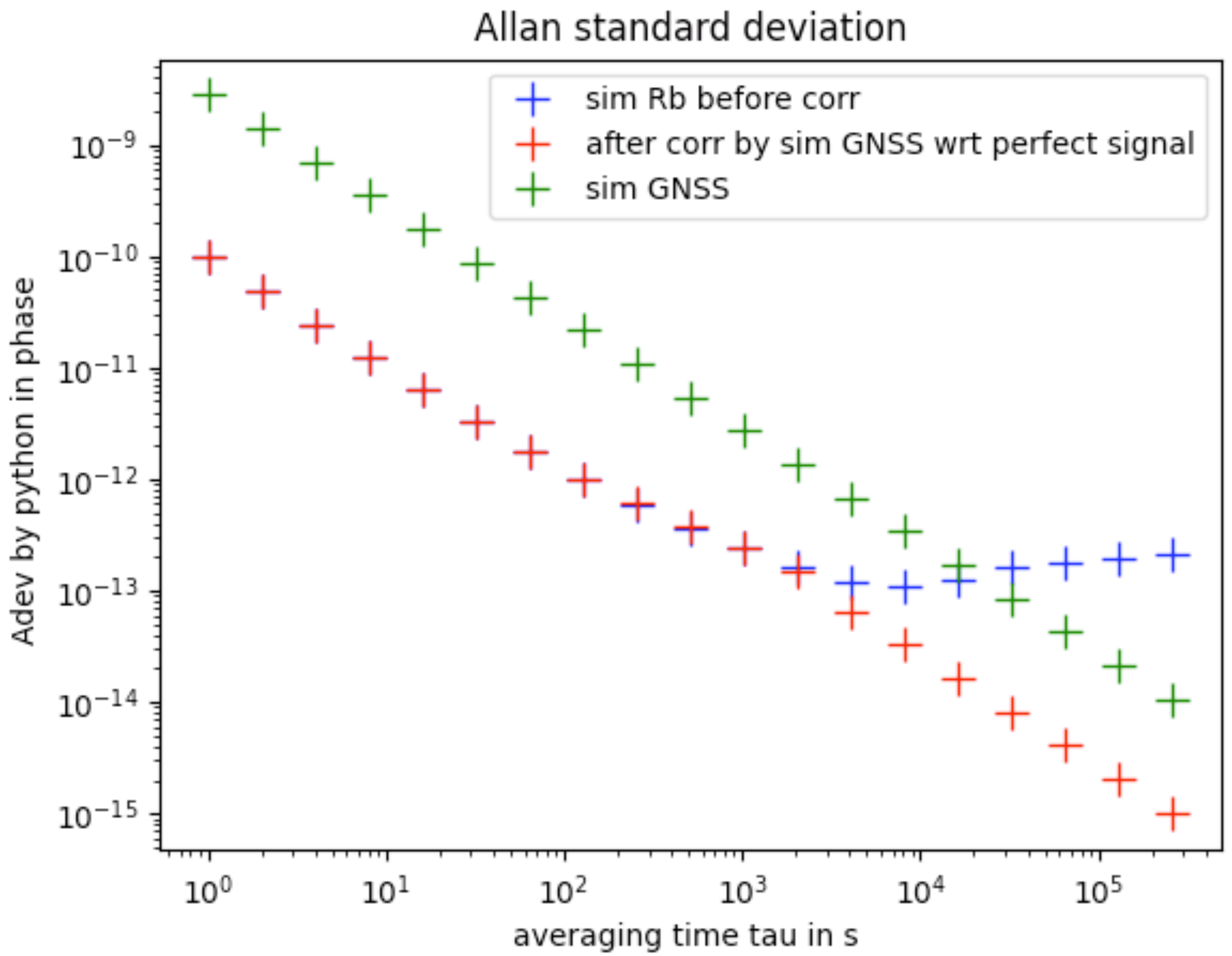




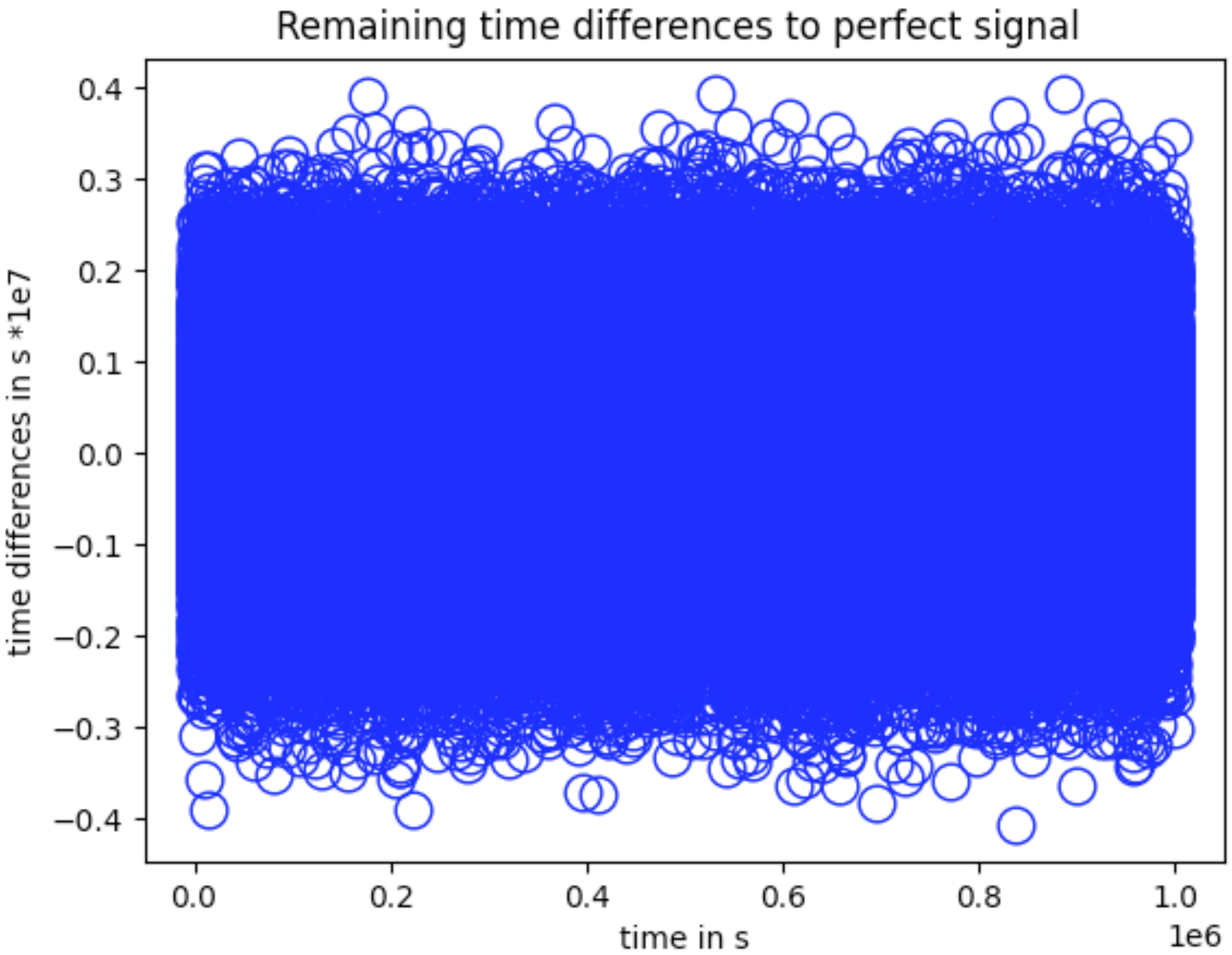
Sur chaque tranche de 10^4 s sans recouvrement, fit quadra des diff

Reference = simulated GNSS

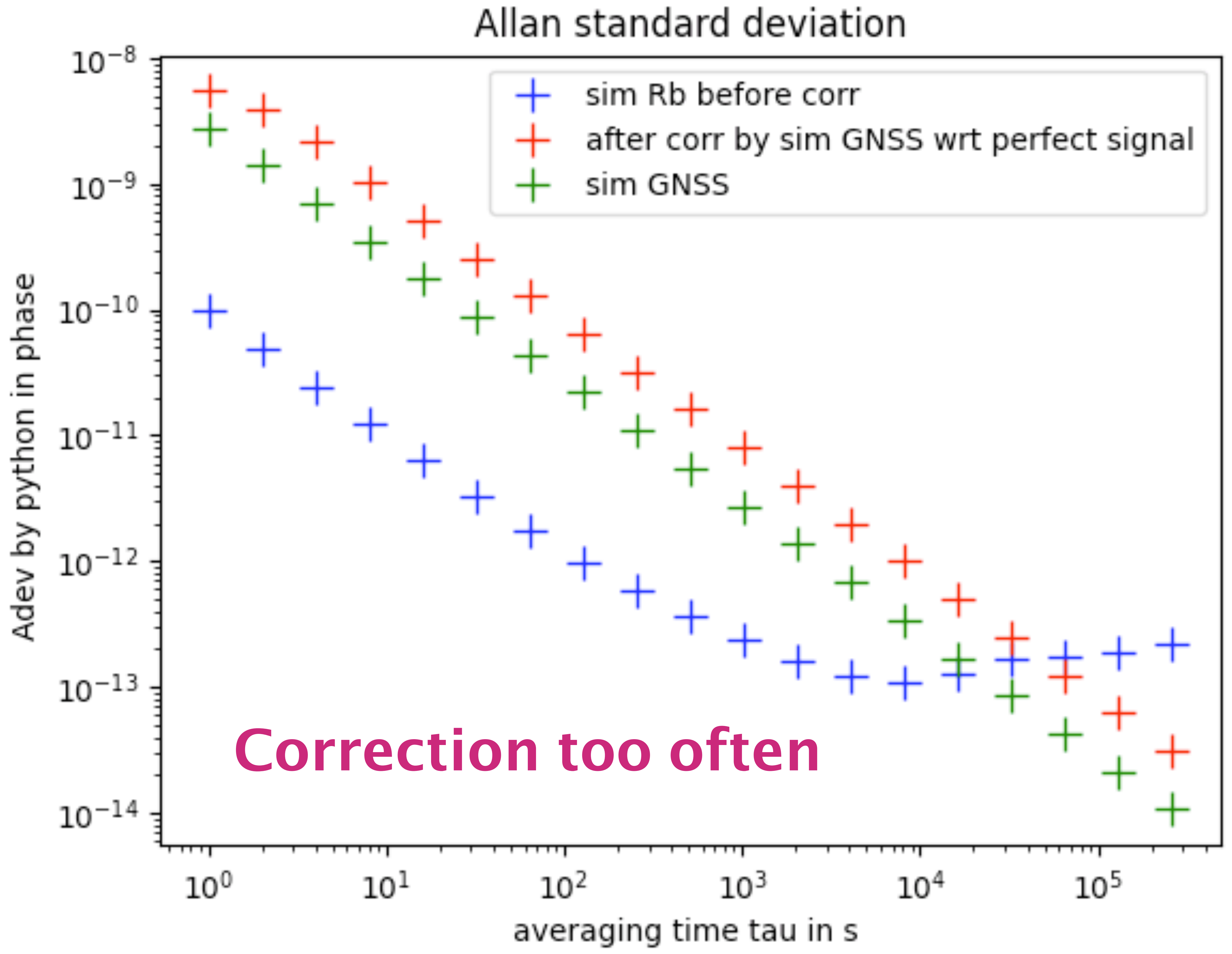




Sur chaque tranche de 5 s sans recouvrement, fit quadra des diff

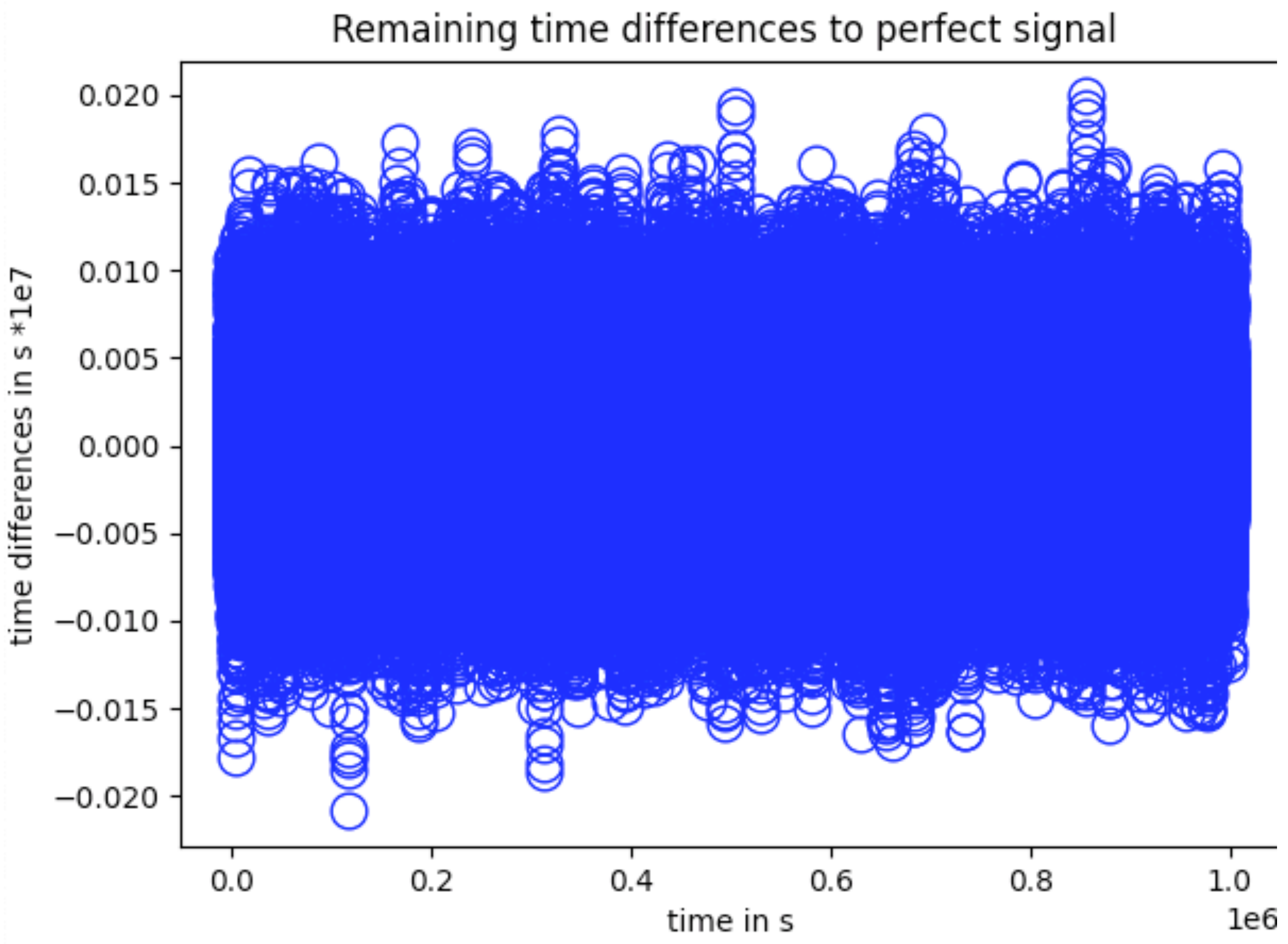


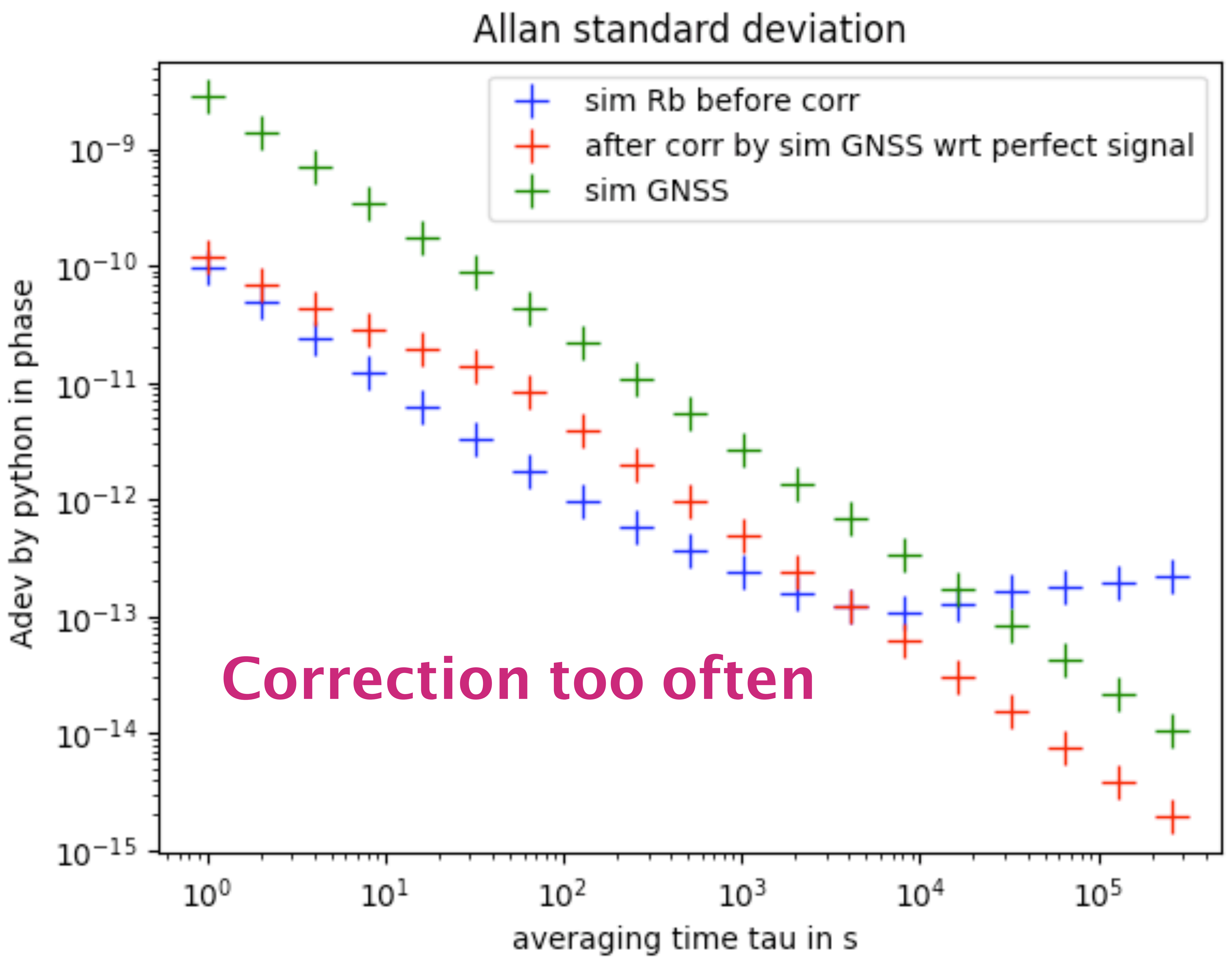
Reference = simulated GNSS



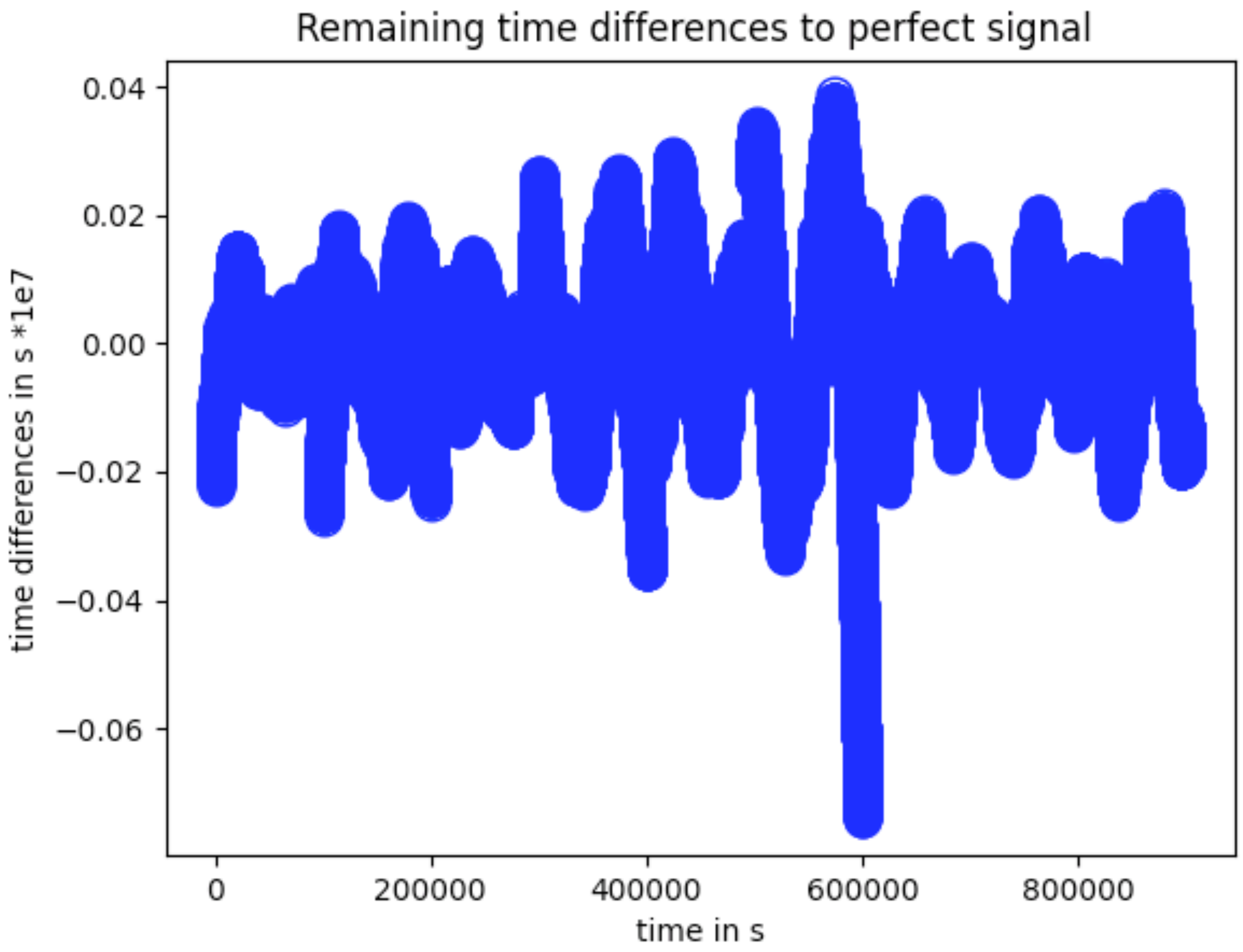
Sur chaque tranche de 10^2 s sans recouvrement, fit quadra des diff

Reference = simulated GNSS

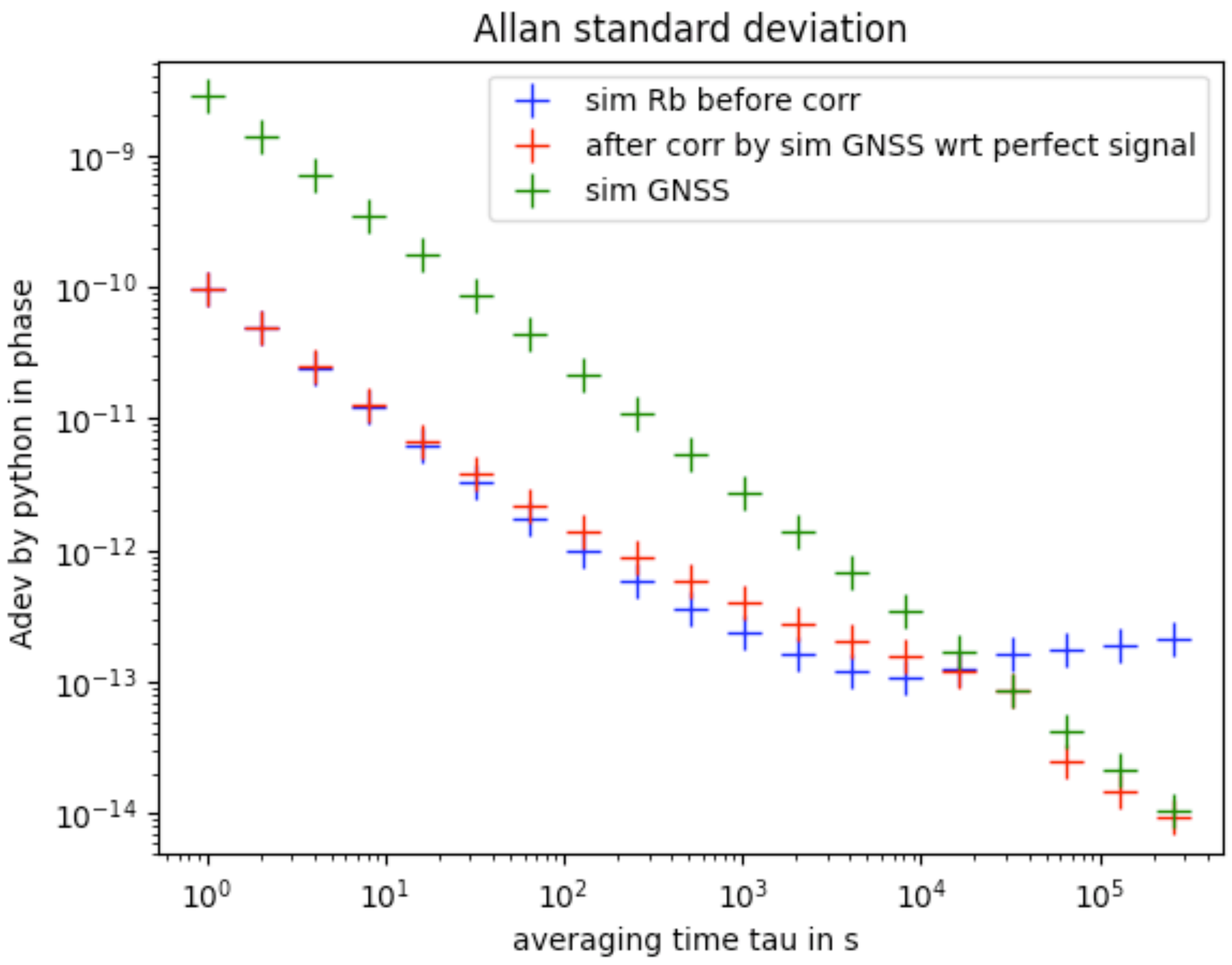




Sur chaque tranche de 10^5 s sans recouvrement, fit quadra des diff



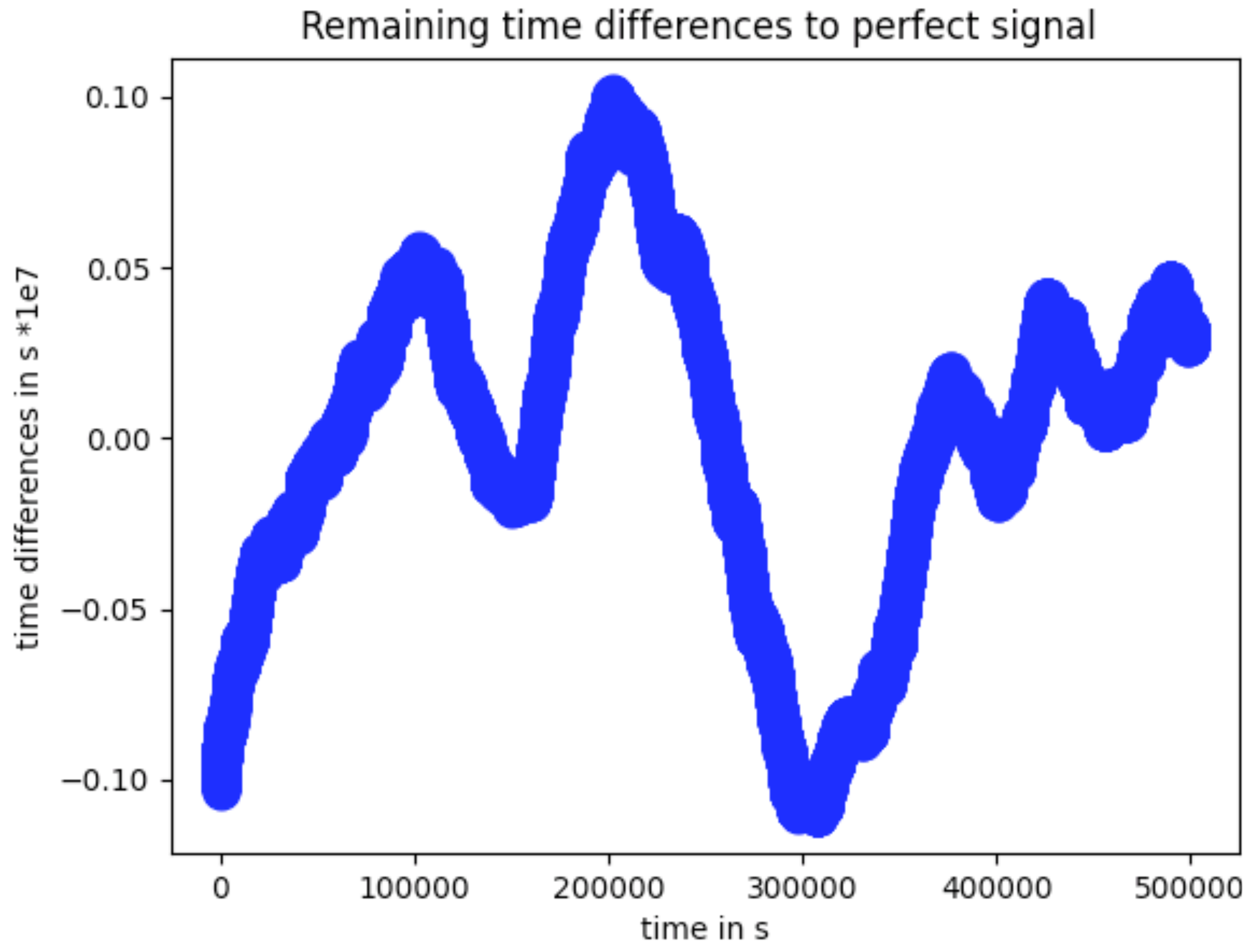
Reference = simulated GNSS

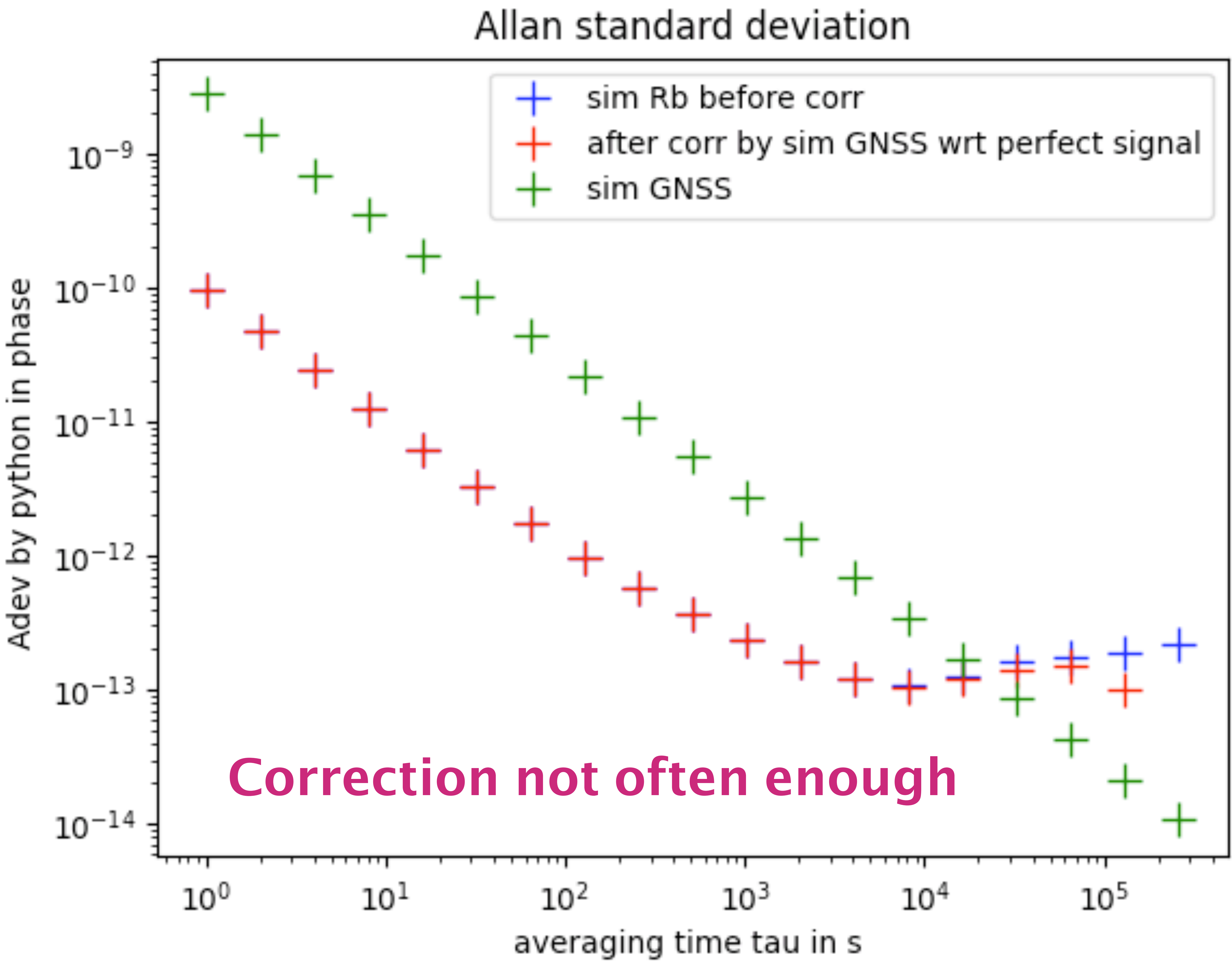


Correction not often enough

Sur chaque tranche de $5*10^5$ s sans recouvrement, fit quadra des diff

Reference =
simulated GNSS

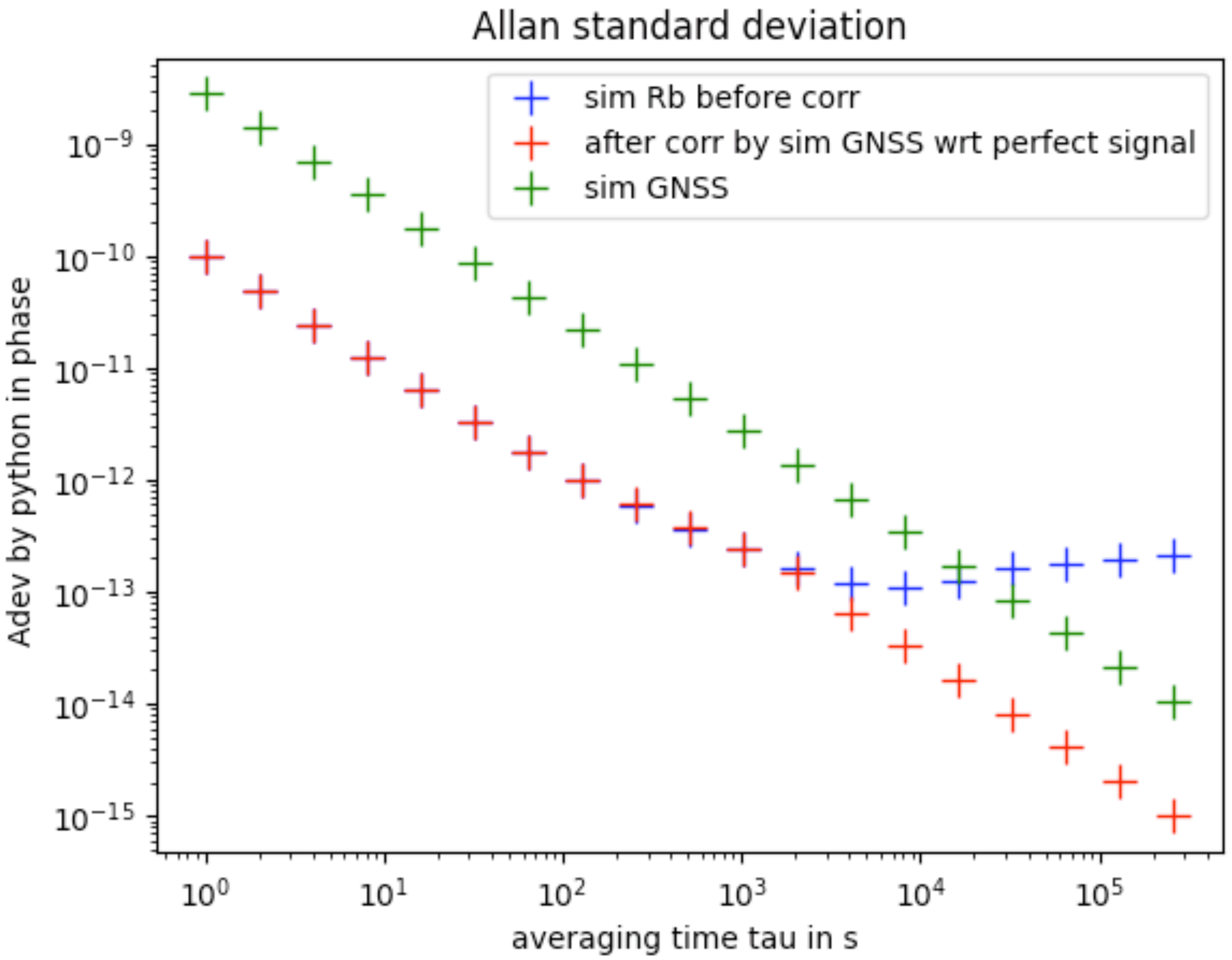


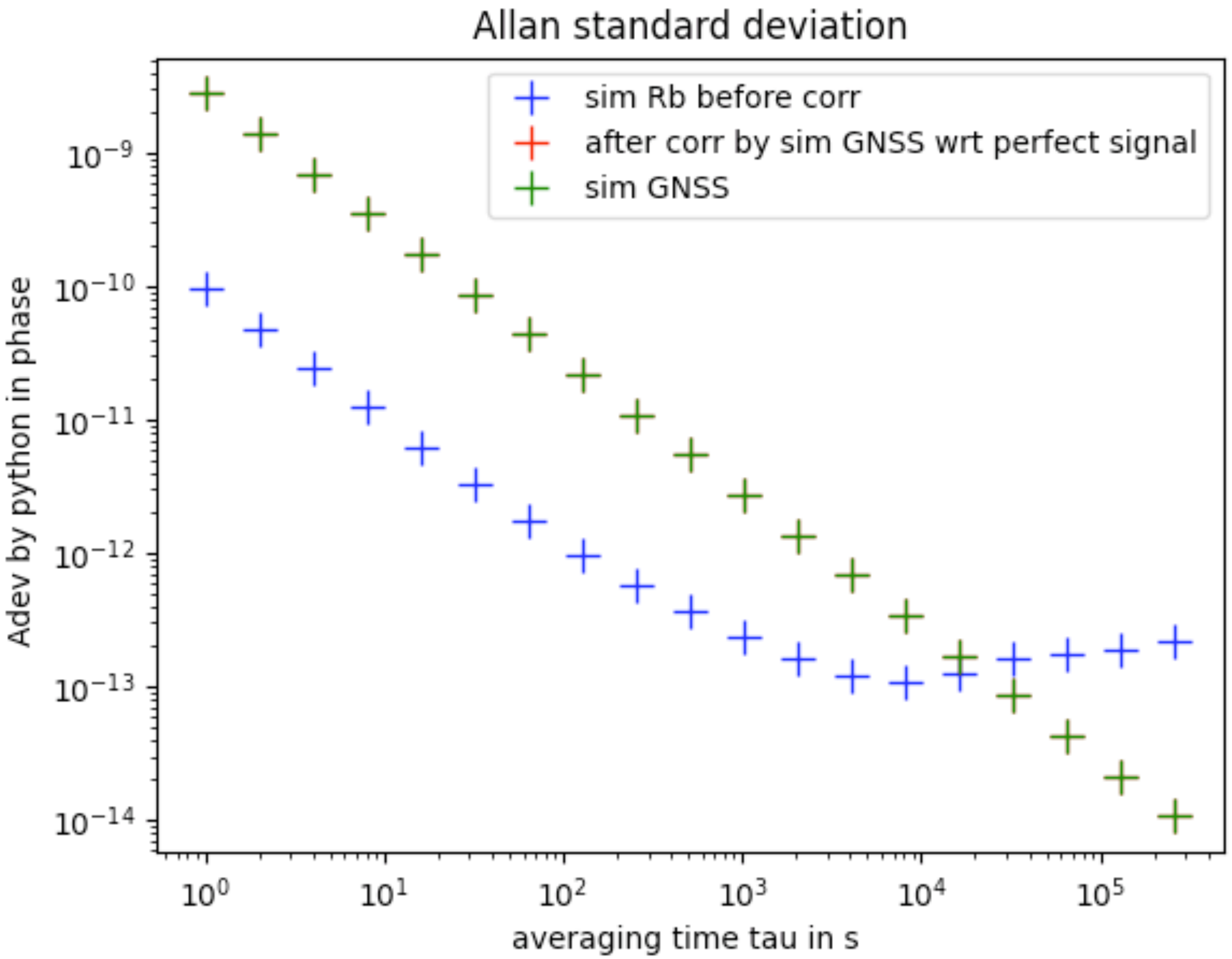


Sur chaque tranche de 10^4s sans recouvrement, fit quadra des diff

Comparison corrected diff wrt
to ref and wrt perfect signal

Reference = simulated GNSS





ASD of remaining diff wrt perfect signal

ASD of remaining diff wrt ref signal

-> We cannot have a representation of final stability for data (no suitable reference, unless we have a PHM as well for instance)

To-do lists for next steps

- Test more complicated corrections (~~overlap~~, SK-like, splines …)
- Test on data ?

- Finish final characterization Rb and PHM and counter
- Take SK-like data with restricted elevation
- Redo time transfer with SYRTE to understand uncertainty values

(calculations for ASD slopes)