False asymmetry from target spin flip

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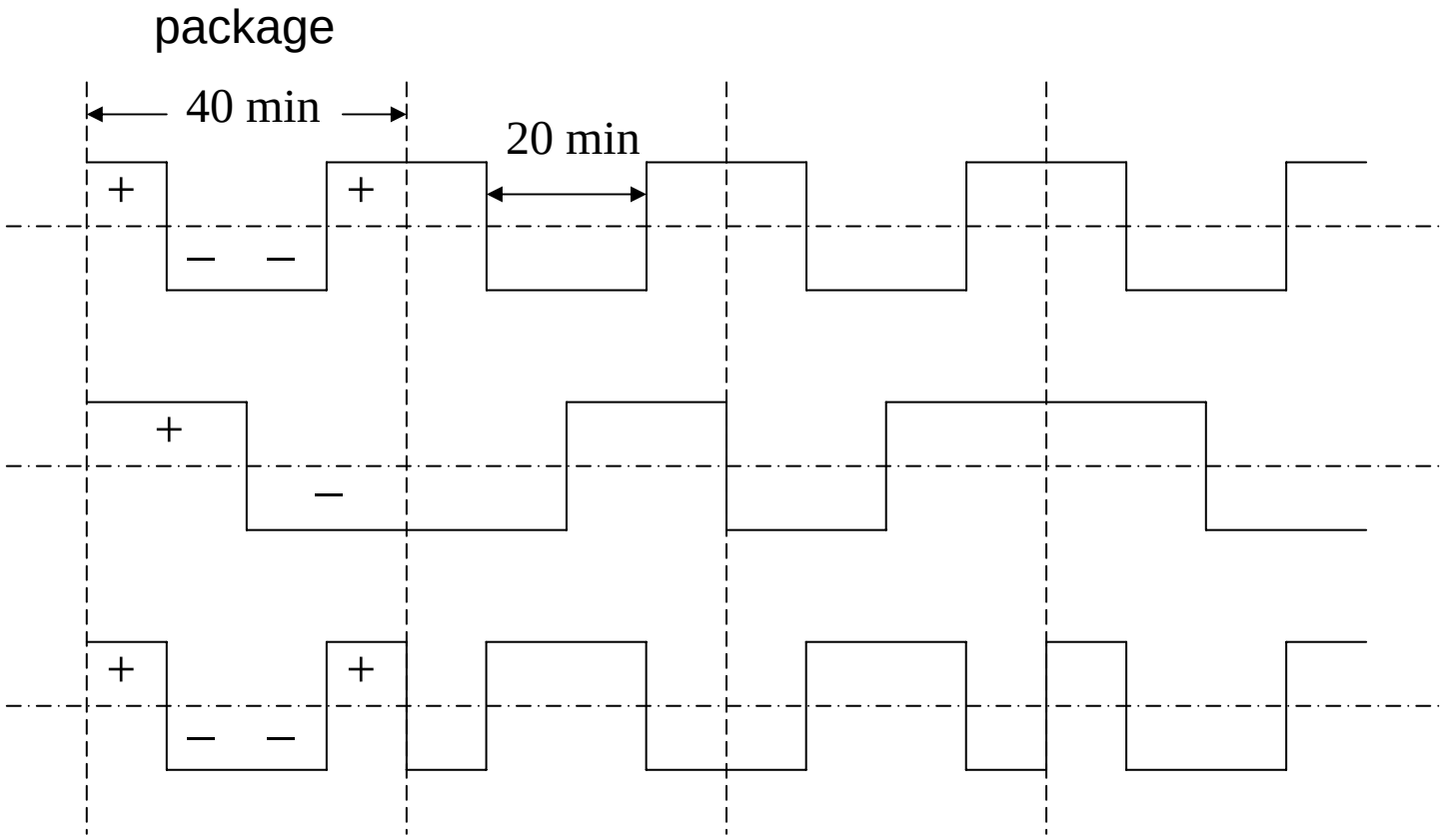
for Transversity Collaboration Meeting

Different flip schemes



Regular

Flip (20 min)

Random

Flip (20 min)

Random

Flip (10 min)

$$A = \frac{N_+ - N_-}{N_+ + N_-} \qquad A^F \approx \frac{N^F{}_+ - N^F{}_-}{N_+ + N_-}$$

False asymmetry from irregular environments

- Linear change
  - Can be canceled by either regular or random sequences
- Higher orders
  - Can be expanded into sine waves of different frequencies
  - The false asymmetry coming from different frequencies and different schemes can be predicted by simulation

Monte Carlo

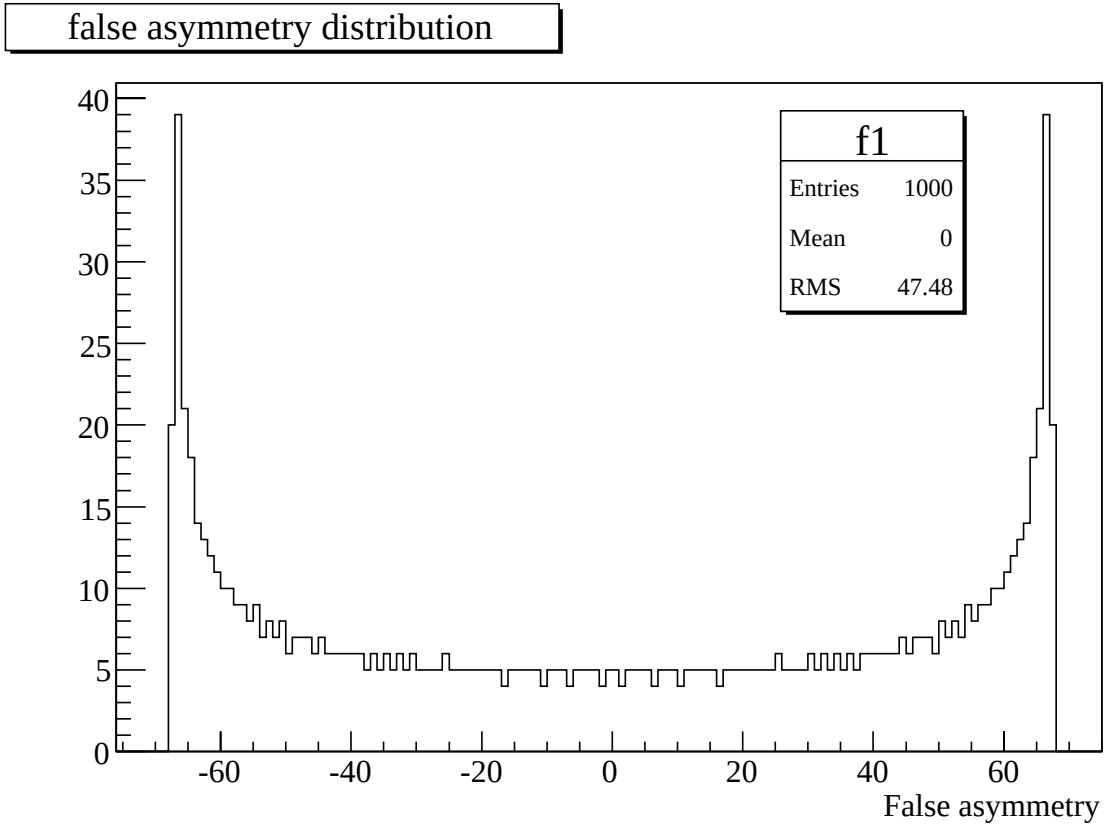
- Total experimental time:

  ~ 15 days ~ 20000 minutes (1000 20 min flips)
- For both regular of random, the period of noise was scanned from 0.01 minutes to 1000 minutes. And a random starting phase shift was generated.
- For random sequences, the initial spin state was determined by a random generator.

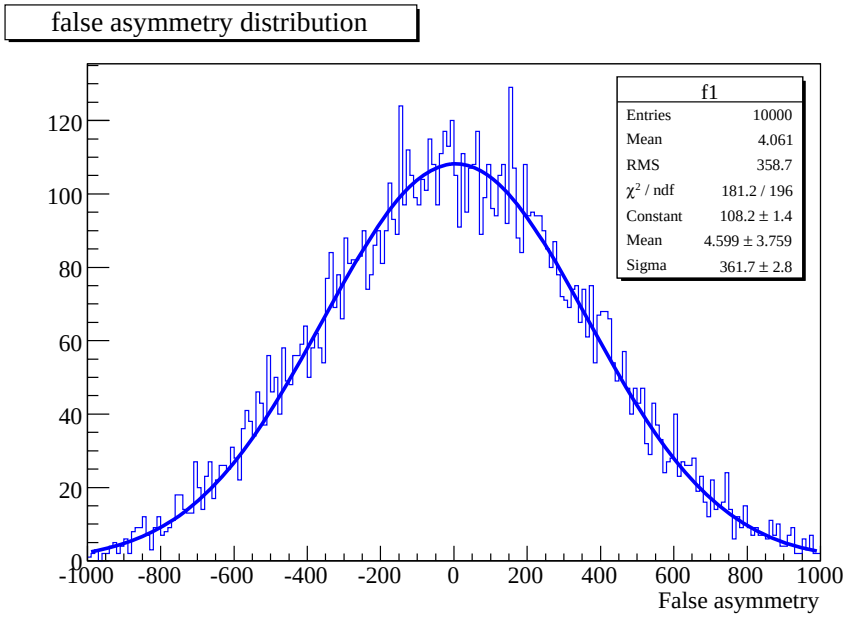
Typical False asymmetry distribution from regularly flipped target (20 min)

T_{noise} = 45 min

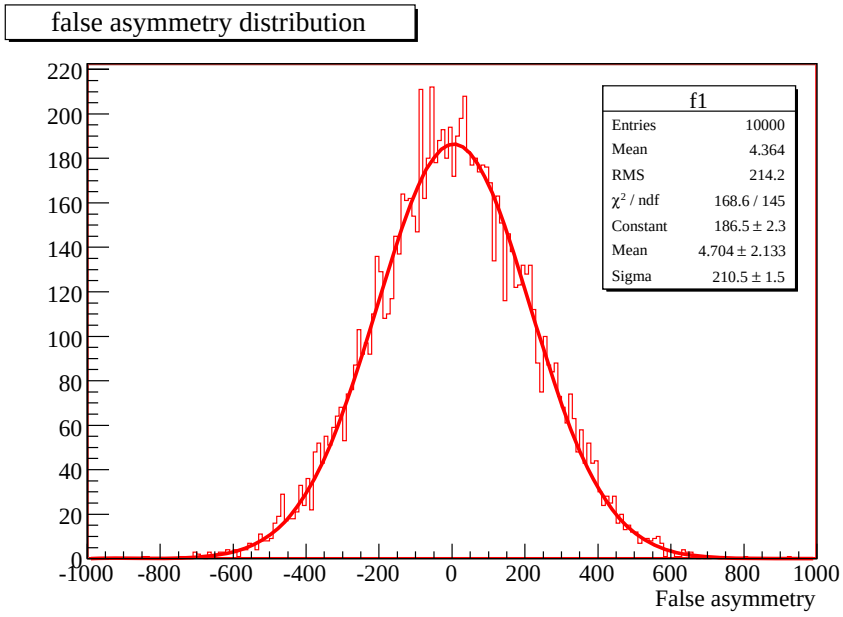
Pretty much like a Y projection of a sine wave



False asymmetry distribution from randomly flipped target (10 or 20 min)



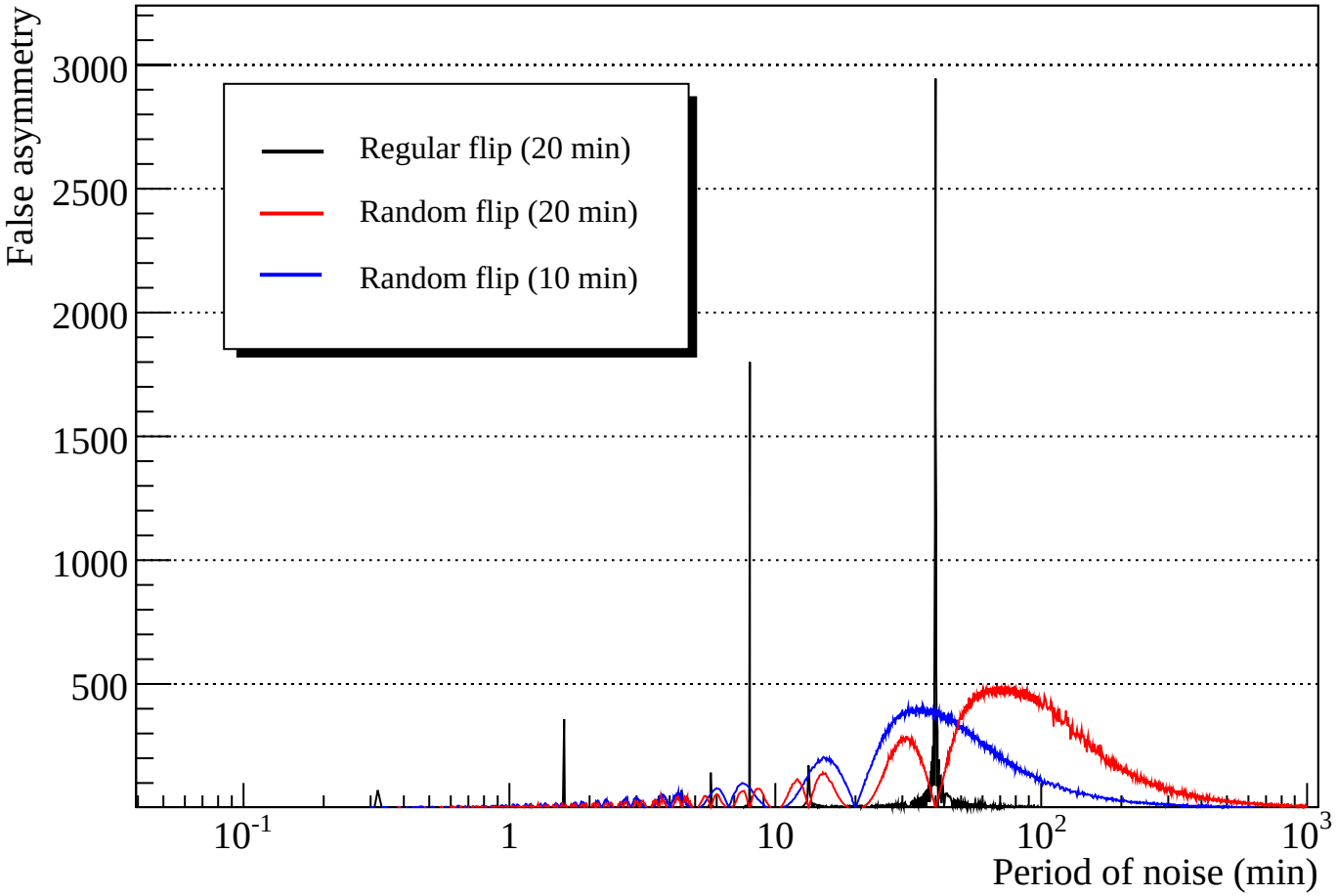
Random flip (10 min)



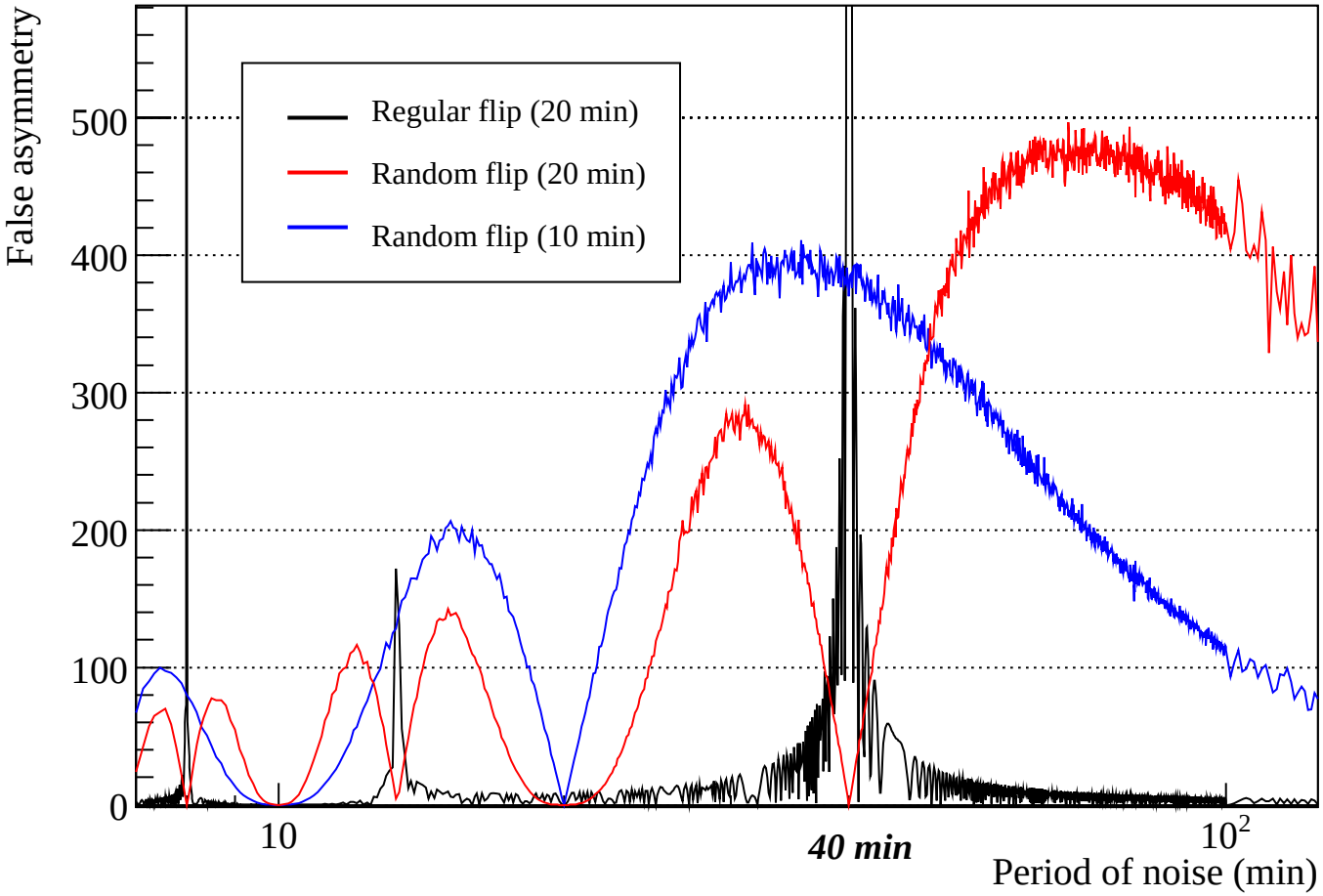
Random flip (20 min)

The distribution is in Gaussian distribution.

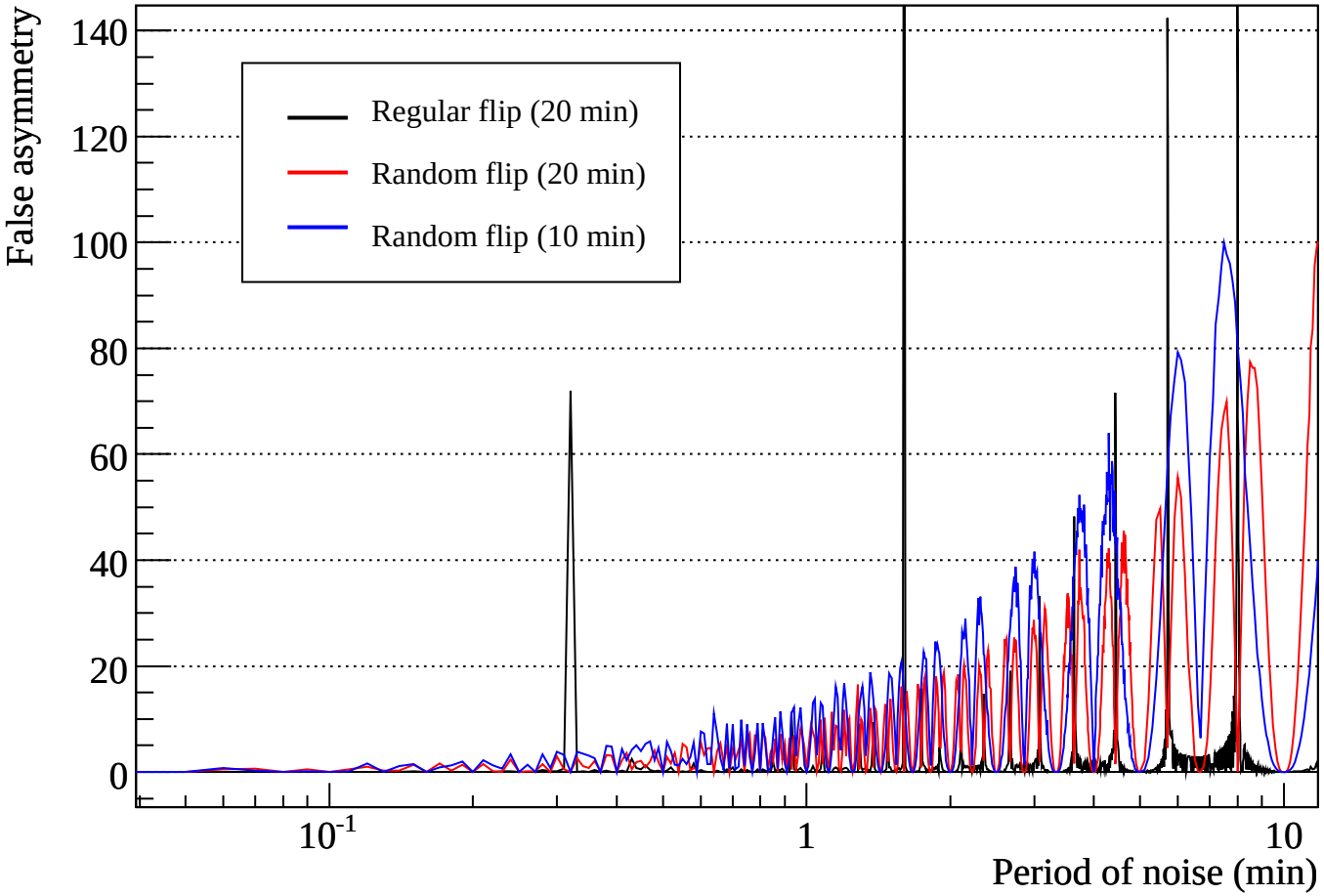
False asymmetry comparison



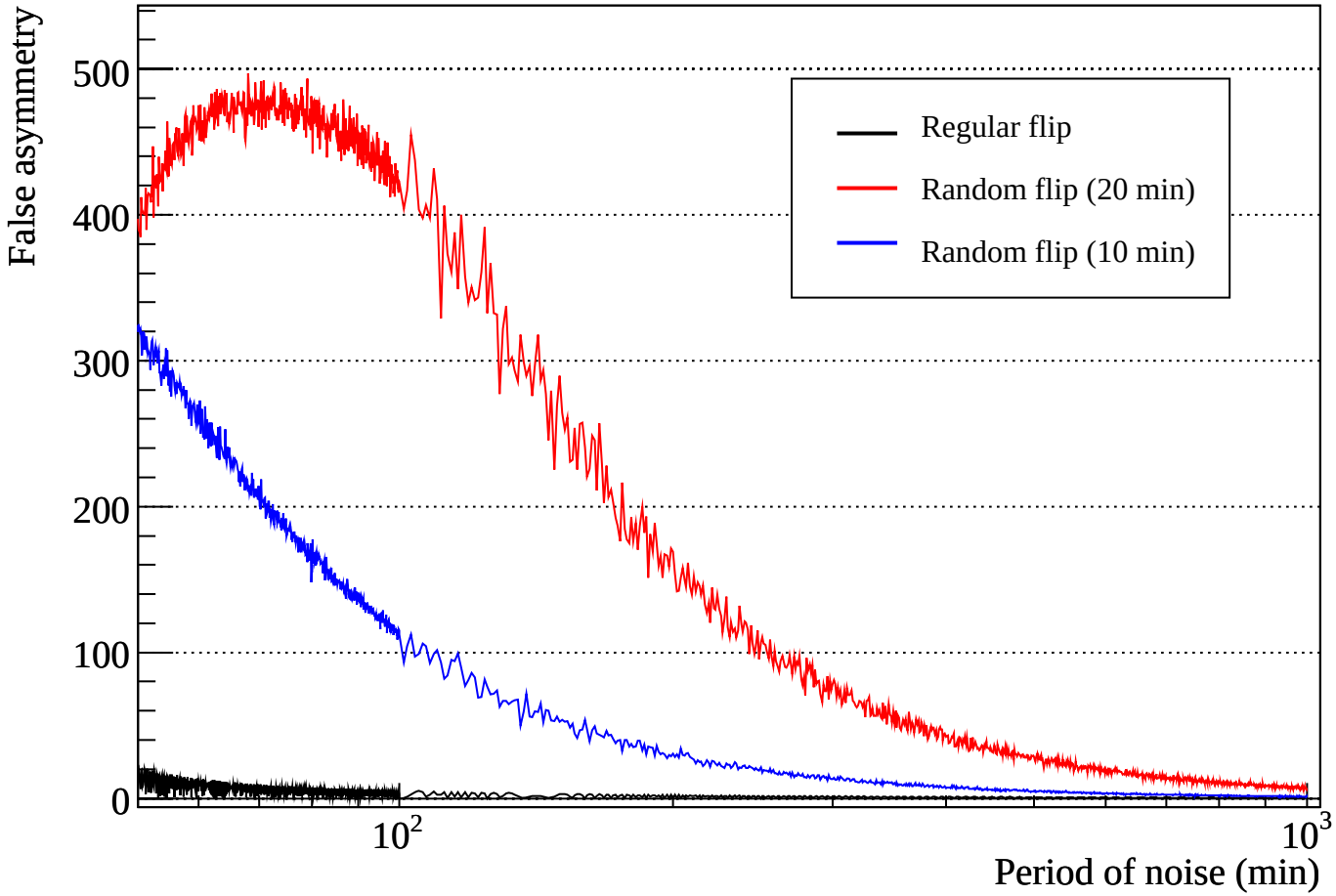
Comparison in middle range



Comparison of high frequency noises



Comparison of low frequency noises



Summary

- Random flips were beat in most frequencies due to low statistics ~ 500 flips.
- Regular flip is extremely sensitive to 40 min noise: spin flip itself.
- More frequent random flip brings more false asymmetry from lower frequency noises but less from higher frequencies.
- A possible improvement to the random flips is to make the + and – packages in the same amount. And this will be investigated soon.