The experimental asymmetry is defined in one ϕ-bin by the number of counts for each helicity :

$$PA = A_{\rm exp} = \frac{N^+ - N^-}{N^+ + N^-} = \frac{N^+ - N^-}{N}$$

Define the shorthand

$$\partial_+ = \frac{\partial}{\partial N^+}$$

and similarly for N_-. Then

$$\partial_+ A_{\rm exp} = \frac{2N^-}{N^2} \qquad\qquad \partial_- A_{\rm exp} = -\frac{2N^+}{N^2}$$

For uncorrelated helicity counts, the error matrix is diagonal

$$\begin{aligned}
\left(\sigma_{A_{\rm exp}}\right)^2 &= \left(\partial_+ A_{\rm exp} \quad \partial_- A_{\rm exp}\right) \begin{pmatrix} \sigma^2_{N^+} & 0 \\ 0 & \sigma^2_{N^-} \end{pmatrix} \begin{pmatrix} \partial_+ A_{\rm exp} \\ \partial_- A_{\rm exp} \end{pmatrix} \\
&= \left(\partial_+ A_{\rm exp}\right)^2 \sigma^2_{N^+} + \left(\partial_- A_{\rm exp}\right)^2 \sigma^2_{N^-} \\
&= \frac{4N^{-2}}{N^4} \sigma^2_{N^+} + \frac{4N^{+2}}{N^4} \sigma^2_{N^-}
\end{aligned}$$

In the case $N^- = 0$,

$$\sigma_{A_{\rm exp}} = \frac{2}{N^+} \sigma_{N^-}$$

In the case that both helicity counts are non-zero

$$\left(\sigma_{A_{\rm exp}}\right)^2 = \frac{4N^{+2}N^{-2}}{N^4} \left[\left(\frac{\sigma_{N^+}}{N^+} \right)^2 + \left(\frac{\sigma_{N^-}}{N^-} \right)^2 \right]$$

Assume Poisson distribution of counts and errors

$$\begin{aligned}
\left(\sigma_{A_{\rm exp}}\right)^2 &= \frac{4N^{+2}N^{-2}}{N^4} \left[\frac{1}{N^+} + \frac{1}{N^-} \right] \\
&= \frac{4N^+N^-}{N^3} \\
&= \frac{N^2 - (A_{\rm exp}N)^2}{N^3} = \frac{1 - A^2_{\rm exp}}{N} \\
\sigma_{A_{\rm exp}} &= \sqrt{\frac{1 - A^2_{\rm exp}}{N}}
\end{aligned}$$

Finally, put back in polarization

$$\boxed{\sigma_A = \frac{1}{P} \sqrt{\frac{1 - (AP)^2}{N}}}$$

Check that the result is correct if $A_{\rm exp}$ is large. Take

$$\begin{aligned}
N^- &= \epsilon N^+ \\
A_{\rm exp} &= \frac{1 - \epsilon}{1 + \epsilon} \approx 1 - 2\epsilon \\
A^2_{\rm exp} &\approx 1 - 4\epsilon \\
\left(\sigma_{A_{\rm exp}}\right)^2 &\approx \frac{4\epsilon}{N^+} \\
\sigma_{A_{\rm exp}} &\approx \frac{2}{N^+} \sqrt{\epsilon N^+} = \frac{2}{N^+} \sigma_{N^-}
\end{aligned}$$