Expected BRIKEN Precision Versus Total Number of Implant-β Counts

B. C. Rasco

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We present the estimated statistical precision for various P_{xn} that can be measured by BRIKEN.

1 Introduction

Estimates of *statistical* uncertainties for P_{xn} ($x < 3$) can help with estimating time needed for an experiment. We present some expected statistical uncertainties for the BRIKEN experiment based on P_{xn} ($x < 3$) calculations and input of the noise levels from the RUN128 data as a function of the number of implant-β correlated counts. Throughout this report the number of counts is always the number of implant-β correlated counts, therefore in order to estimate the number of implants needed the β efficiency needs to be taken into account.

First we present the estimated statistical precision for various P_{1n} values with P_{2n} assumed to be zero. Next we present the estimated statistical precision for various P_{1n} and P_{2n} values. From this analysis it looks like the required number of implant-β correlations is large in order to identify "small" $P_{>2n}$ values, due to the similarity with "small" P_{2n} values shown below. In order to determine what "small" is for P_{3n}, the P_{3n} analysis needs to be performed.

This report is meant to inform proposal writing and is not meant to explain the details of the analysis.

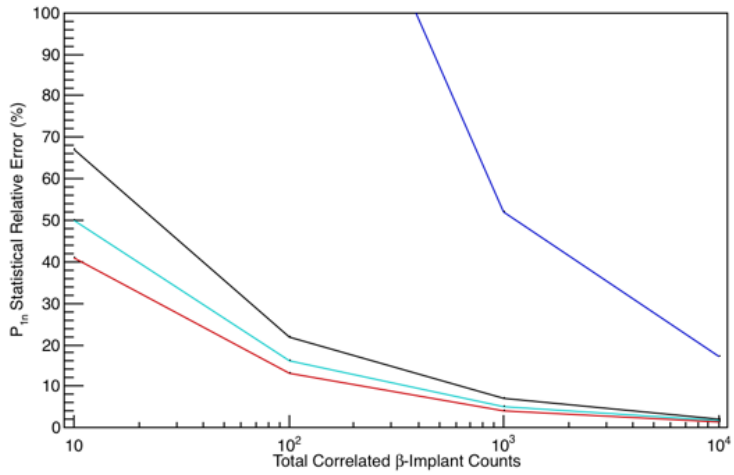

Figure 1: Estimated relative error versus number of implant-β counts for various P_{1n} values, $P_{1n} = 0.01$ (blue), $P_{1n} = 0.33$ (black), $P_{1n} = 0.50$ (cyan), $P_{1n} = 0.66$ (red). For all curves shown in this figure P_{2n} is assumed to be identically zero.

2 Statistical Error Estimates for P_{1n} Only

The plots for various nonzero P_{1n} are shown in Figure 1. The resolution depends on the actual P_{1n} value. For small values, in addition to fewer actual P_{1n} counts, there is a competition with the noise and it takes more counts to get smaller error estimates. For larger P_{1n} values we should be able to get reliable P_{1n} values with fairly few total implant-β counts. The real challenge is to tell if there is any P_{2n} counts that go with the measurement.

3 Statistical Error Estimates for P_{1n} and P_{2n}

For nonzero P_{1n} and P_{2n}, estimating the errors is even more dependent on the actual P_{1n} and P_{2n} values.

We show several error estimates for various P_{1n} and P_{2n} values in Figures 2 to 4. In Figure 2 shows the error for a hypothetical fairly large P_{1n} and small P_{2n}. In Figure 3 shows the error for P_{1n} and P_{2n} value similar to ^{86}Ga. In Figure 4 is a hypothetical 50-50% P_{1n} and P_{2n} (*i.e.* no P_{0n}).

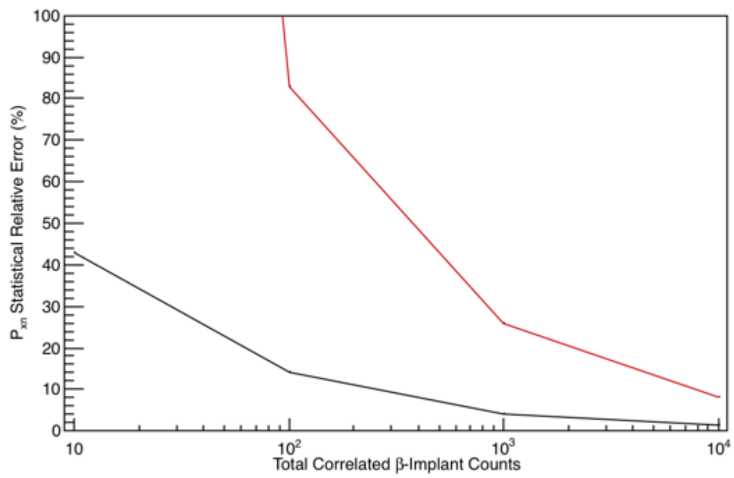

Figure 2: Estimated relative error for P_{1n} (black) and P_{2n} (red) versus number of implant-β counts for $P_{0n} = 0.25$, $P_{1n} = 0.70$, and $P_{2n} = 0.05$.

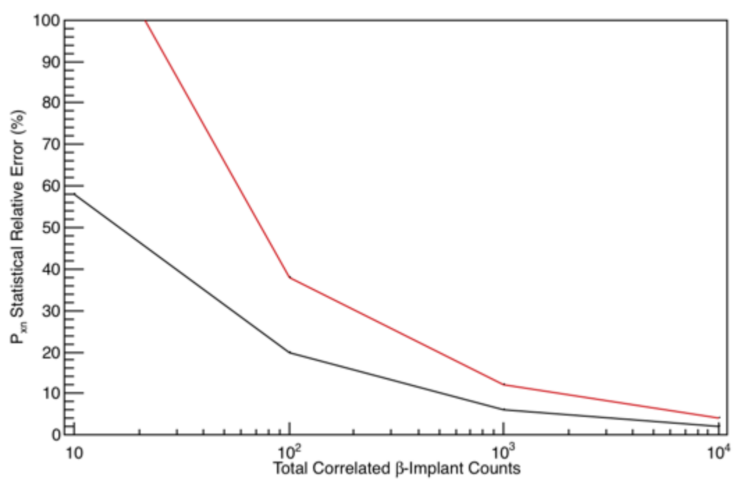

Figure 3: Estimated relative error for P_{1n} (black) and P_{2n} (red) versus number of implant-β counts for $P_{0n} = 0.20$, $P_{1n} = 0.60$, and $P_{2n} = 0.20$. These are the literature values for the ^{86}Ga P_{xn}.

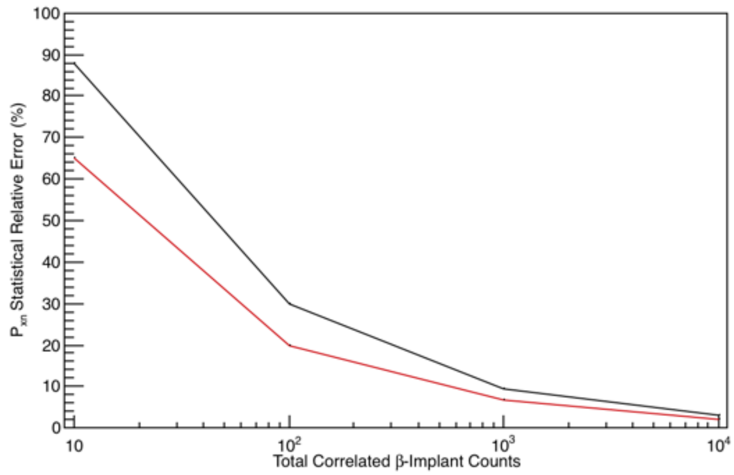

Figure 4: Estimated relative error for P_{1n} (black) and P_{2n} (red) versus number of implant-β counts for $P_{0n} = 0.00$, $P_{1n} = 0.50$, and $P_{2n} = 0.50$. Notice in this case P_{2n} is a more precise meaasurement than P_{1n}.

4 Summary

From the various graphs shown here, one can estimate the statistical uncertainty of the expected P_{xn} for $x < 3$ given the number of implant-β correlated counts. This can influence the estimated required beam time needed for a given nucleus. This is especially sensitive when looking for small P_{2n} values, which seems to be a common case.