

## Using Pulsar Signals in place of detector signals and measuring fluence with SEUSS

The percent difference in the table indicates the order of magnitude of the upper limit of the expected systematic error in measured fluence during an actual run.

|                         | 2/4/21<br>Pulsar Frequency = 1.531 kHz |          |         | Feb. 2022<br>Pulsar Frequency= 1.0 kHz |          |          | Feb. 2023<br>Pulsar Frequency= 1.0 kHz |          |          |
|-------------------------|----------------------------------------|----------|---------|----------------------------------------|----------|----------|----------------------------------------|----------|----------|
| Pulsar Frequency        | 1531                                   |          |         |                                        |          |          |                                        |          |          |
| time (sec)              | 60                                     | 300      | 900     | 59.8                                   | 300      | 900      | 59.8                                   | 300      | 900      |
| Measured Counts (SEUSS) | 92510                                  | 460200   | 1379000 | 59731                                  | 299460   | 899567   | 60051                                  | 302828   | 906734   |
| Calculated Counts       | 91860                                  | 459300   | 1378000 | 59715                                  | 299206   | 899065   | 60095                                  | 302490   | 907932   |
| Percent Difference      | 0.71%                                  | 0.20%    | 0.07%   | 0.03%                                  | 0.08%    | 0.06%    | 0.05%                                  | 0.07%    | 0.09%    |
|                         | Pulsar Frequency = 14.246 kHz          |          |         | Pulsar Frequency= 10 kHz               |          |          | Pulsar Frequency= 10 kHz               |          |          |
| Pulsar Frequency        | 14246                                  |          |         |                                        |          |          |                                        |          |          |
| time (sec)              | 60                                     | 300      | 900     | 60                                     | 300      | 900      | 60                                     | 300      | 900      |
| Measured Counts (SEUSS) | 857100                                 | 4272000  | 1.3E+07 | 601440                                 | 3017600  | 9049333  | 601440                                 | 3017600  | 9049333  |
| Calculated Counts       | 854800                                 | 4274000  | 1.3E+07 | 601290                                 | 3017254  | 9047207  | 601290                                 | 3017254  | 9047207  |
| Percent Difference      | 0.27%                                  | 0.05%    | 0.08%   | 0.02%                                  | 0.01%    | 0.02%    | 0.02%                                  | 0.01%    | 0.02%    |
|                         | Pulsar Frequency = 62.175 kHz          |          |         | Pulsar Frequency= 60 kHz               |          |          | Pulsar Frequency= 60 kHz               |          |          |
| Pulsar Frequency        | 62175                                  |          |         |                                        |          |          |                                        |          |          |
| time (sec)              | 60                                     | 300      | 900     | 60                                     | 300      | 900      | 60                                     | 300      | 900      |
| Measured Counts (SEUSS) | 3745000                                | 18650000 | 5.6E+07 | 3609000                                | 18062000 | 54160000 | 3609000                                | 18062000 | 54160000 |
| Calculated Counts       | 3731000                                | 18650000 | 5.6E+07 | 3608369                                | 18051281 | 54140000 | 3608369                                | 18051281 | 54140000 |
| Percent Difference      | 0.37%                                  | 0.00%    | 0.04%   | 0.02%                                  | 0.06%    | 0.04%    | 0.02%                                  | 0.06%    | 0.04%    |

## Using Pulsar Signals Originating in Cave 1 and going through detector signal cables

The percent difference in the table indicates the order of magnitude of the upper limit of the expected systematic error in measured fluence during an actual run.

|                           | Pulsar Frequency = 1.531 kHz |        |         | Feb. 2022                    |        |        | Feb. 2023                    |        |        |
|---------------------------|------------------------------|--------|---------|------------------------------|--------|--------|------------------------------|--------|--------|
| Pulsar Frequency = 823 Hz | 1531                         |        |         | Pulsar Frequency = 1.004 kHz |        |        | Pulsar Frequency = 1.004 kHz |        |        |
| time (sec)                | 60                           | 300    | 900     | 59.8                         | 300    | 900    | 59.8                         | 300    | 900    |
| Measured Counts (SEUSS)   | 91510                        | 458700 | 1380000 | 60000                        | 301500 | 904200 | 60096                        | 301478 | 901402 |
| Calculated Counts         | 91960                        | 459300 | 1378000 | 5999                         | 301300 | 904600 | 60138                        | 299940 | 901230 |
| Percent Difference        | 0.49%                        | 0.13%  | 0.15%   | 0.02%                        | 0.05%  | 0.05%  | 0.11%                        | 0.85%  | 0.000  |

  

|                            | Pulsar Frequency = 14.250 kHz |         |         | Pulsar Frequency=10.1 kHz |         |         | Pulsar Frequency=10.1 kHz |         |         |
|----------------------------|-------------------------------|---------|---------|---------------------------|---------|---------|---------------------------|---------|---------|
| Pulsar Frequency = 6494 Hz | 14250                         |         |         | Pulsar Frequency=10.1 kHz |         |         | Pulsar Frequency=10.1 kHz |         |         |
| time (sec)                 | 60                            | 300     | 900     | 60                        | 300     | 900     | 60                        | 300     | 900     |
| Measured Counts (SEUSS)    | 852900                        | 4270000 | 1.3E+07 | 604870                    | 3026400 | 9097667 | 602201                    | 3007821 | 9074434 |
| Calculated Counts          | 855000                        | 4275000 | 1.3E+07 | 603982                    | 3023345 | 9089839 | 601697                    | 3006951 | 9069633 |
| Percent Difference         | 0.25%                         | 0.12%   | 0.00%   | 0.15%                     | 0.10%   | 0.09%   | 0.02%                     | 0.01%   | 0.01%   |

  

|                             | Pulsar Frequency = 62.406 kHz |          |         | pulser frequency=60 kHz |          |          | pulser frequency=60 kHz |          |          |
|-----------------------------|-------------------------------|----------|---------|-------------------------|----------|----------|-------------------------|----------|----------|
| Pulsar Frequency = 23810 Hz | 62406                         |          |         | pulser frequency=60 kHz |          |          | pulser frequency=60 kHz |          |          |
| time (sec)                  | 60                            | 300      | 900     | 60                      | 300      | 900      | 60                      | 300      | 900      |
| Measured Counts (SEUSS)     | 3739000                       | 18730000 | 5.6E+07 | 3611100                 | 18042000 | 54133333 | 3689320                 | 18070000 | 54183333 |
| Calculated Counts           | 3744000                       | 18720000 | 5.6E+07 | 3610024                 | 18028698 | 54103200 | 3606546                 | 18053247 | 54161325 |
| Percent Difference          | 0.13%                         | 0.05%    | 0.02%   | 0.03%                   | 0.07%    | 0.06%    | 0.44%                   | 0.02%    | 0.01%    |

## Using Stroboscope to Test PMTs

The percent difference in the table indicates the order of magnitude of the upper limit of the expected systematic error in measured fluence during an actual run.

|                         | Strobe Frequency = 60.003 Hz |       |       | Feb. 2022<br>Strobe Frequency = 60 Hz |       |       | Feb. 2023<br>Strobe Frequency = 60 Hz |       |       |
|-------------------------|------------------------------|-------|-------|---------------------------------------|-------|-------|---------------------------------------|-------|-------|
|                         | 60                           | 300   | 900   | 60                                    | 300   | 900   | 60                                    | 300   | 900   |
| time (sec)              | 60                           | 300   | 900   | 60                                    | 300   | 900   | 60                                    | 300   | 900   |
| Measured Counts (SEUSS) | 3576                         | 17970 | 53880 | 3599                                  | 18170 | 53930 | 3552                                  | 17663 | 52991 |
| Calculated Counts       | 3600                         | 18000 | 54000 | 3596                                  | 17990 | 53920 | 3531                                  | 17566 | 52906 |
| Percent Difference      | 0.67%                        | 0.17% | 0.22% | 0.06%                                 | 1.00% | 0.01% | 1.00%                                 | 0.92% | 0.08% |

Intermediate frequency test not performed

Intermediate frequency test not performed

Intermediate frequency test not performed

Measured Counts (SEUSS)  
Calculated Counts  
Percent Difference

|                         | Strobe Frequency = 413.07 Hz |        |        | Strobe Frequency = 400 Hz |        |        | Strobe Frequency = 400 Hz |        |        |
|-------------------------|------------------------------|--------|--------|---------------------------|--------|--------|---------------------------|--------|--------|
|                         | 413.07                       | 300    | 900    | 60                        | 300    | 900    | 60                        | 300    | 900    |
| time (sec)              | 60                           | 300    | 900    | 60                        | 300    | 900    | 60                        | 300    | 900    |
| Measured Counts (SEUSS) | 24710                        | 123900 | 370500 | 24030                     | 120300 | 360800 | 24141                     | 120402 | 362215 |
| Calculated Counts       | 24784                        | 123921 | 371763 | 24010                     | 120100 | 360600 | 24068                     | 120088 | 361260 |
| Percent Difference      | 0.30%                        | 0.02%  | 0.34%  | 0.05%                     | 0.14%  | 0.05%  | 0.15%                     | 0.13%  | 0.13%  |