Table 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **48°** | i | j | <Ai> | <Aj> | <AiAj> |
| Ideal | | | 0.105 | 0.105 | -0.788 |
| Ideal total | | |  | | |
| **Normal**  Sample~  16000 | 1 | 2 | 0.105(0.0095) | 0.104(0.0101) | -0.770(0.0063) |
| 2 | 3 | 0.101(0.0101) | 0.085(0.0099) | -0.783(0.0064) |
| 3 | 4 | 0.111(0.0101) | 0.110(0.0101) | -0.761(0.0065) |
| 4 | 5 | 0.086(0.0100) | 0.111(0.0102) | -0.786(0.0060) |
| 5 | 1 | 0.098(0.0101) | 0.104(0.0100) | -0.785(0.0062) |
| total | |  | | |

Table 2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **48°** | i | j | <Ai> | <Aj> | <AiAj> |
| Ideal | | | 0.105 | 0.105 | -0.788 |
| Ideal total | | |  | | |
| **Reverse**  Sample~ 10000 | 1 | 2 | 0.101(0.0100) | 0.096(0.0093) | -0.782(0.0061) |
| 2 | 3 | 0.091(0.0100) | 0.114(0.0097) | -0.764(0.0061) |
| 3 | 4 | 0.109(0.0102) | 0.088(0.0100) | -0.759(0.0063) |
| 4 | 5 | 0.105(0.0101) | 0.094(0.0095) | -0.769(0.0067) |
| 5 | 1 | 0.084(0.0098) | 0.099(0.0099) | -0.781(0.0062) |
| total | |  | | |

Table 3

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **46.5 °** | i | j | <Ai> | <Aj> | <AiAj> |
| Ideal | | | 0.052 | 0.139 | -0.804 |
| Ideal total | | |  | | |
| **Normal**  Sample~ 10500 | 1 | 2 | 0.056(0.0098) | 0.149(0.0099) | -0.762(0.0068) |
| 2 | 3 | 0.054(0.0101) | 0.129(0.0099) | -0.769(0.0060) |
| 3 | 4 | 0.053(0.0095) | 0.137(0.0096) | -0.778(0.0062) |
| 4 | 5 | 0.050(0.0100) | 0.122(0.0098) | -0.799(0.0060) |
| 5 | 1 | 0.047(0.0101) | 0.139(0.0102) | -0.789(0.0063) |
| total | |  | | |

Table 4

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **46.5 °** | i | j | <Ai> | <Aj> | <AiAj> |
| Ideal | | | 0.052 | 0.139 | -0.804 |
| Ideal total | | |  | | |
| **Reverse**  Sample~ 10000 | 1 | 2 | 0.047(~)z | 0.126(~) | -0.789( ) |
| 2 | 3 | 0.053(~) | 0.140(~) | -0.756( ) |
| 3 | 4 | 0.053(~) | 0.117(~) | -0.764( ) |
| 4 | 5 | 0.033(~) | 0.142(~) | -0.778( ) |
| 5 | 1 | 0.057(~) | 0.115(~) | -0.786( ) |
| total | |  | | |

Table 5

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **45 °** | i | j | <Ai> | <Aj> | <AiAj> |
| Ideal | | | 0 | 0.173 | -0.809 |
| Ideal total | | |  | | |
| **Normal**  Sample ~ 11000 | 1 | 2 | -0.009(0.0099) | 0.188(0.0101) | -0.783(0.0062) |
| 2 | 3 | 0.014(0.0101) | 0.147(0.0098) | -0.785(0.0063) |
| 3 | 4 | -0.002(0.0101) | 0.182(0.0100) | -0.782(0.0065) |
| 4 | 5 | -0.009(0.0098) | 0.169(0.0104) | -0.801(0.0059) |
| 5 | 1 | 0.007(0.0101) | 0.155(0.0098) | -0.787(0.0061) |
| total | |  | | |

Table 6

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **45 °** | i | j | <Ai> | <Aj> | <AiAj> |
| Ideal | | | 0 | 0.173 | -0.809 |
| Ideal total | | |  | | |
| **Reverse**  Sample ~ 10000 | 1 | 2 | 0.002( ) | 0.157( ) | -0.797() |
| 2 | 3 | -0.009( ) | 0.179( ) | -0.785() |
| 3 | 4 | -0.007( ) | 0.161( ) | -0.784() |
| 4 | 5 | -0.007( ) | 0.168( ) | -0.789() |
| 5 | 1 | -0.016( ) | 0.171( ) | -0.803() |
| total | |  | | |

Table 7

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **48 ° p=0.1** | i | j | <Ai> | <Aj> | <AiAj> |
| Ideal | | | 0.128 | 0.128 | -0.743 |
| Ideal total | | |  | | |
| **Normal**  **Mixed state**  Sample ~ 10600 | 1 | 2 | 0.123(0.0101) | 0.126(0.0101) | -0.722(0.0071) |
| 2 | 3 | 0.118(0.0096) | 0.111(0.0100) | -0.720(0.0067) |
| 3 | 4 | 0.118(0.0101) | 0.129(0.0101) | -0.715(0.0072) |
| 4 | 5 | 0.103(0.0102) | 0.120(0.0096) | -0.742(0.0068) |
| 5 | 1 | 0.124(0.0101) | 0.116(0.0098) | -0.739(0.0065) |
| total | |  | | |

Table 8

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **48°p=0.1** | i | j | <Ai> | <Aj> | <AiAj> |
| Ideal | | | 0.128 | 0.128 | -0.743 |
| Ideal total | | |  | | |
| Reverse  Sample~ 10000 | 1 | 2 | 0.120 | 0.122 | -0.729 |
| 2 | 3 | 0.129 | 0.130 | -0.703 |
| 3 | 4 | 0.108 | 0.123 | -0.734 |
| 4 | 5 | 0.114 | 0.129 | -0.724 |
| 5 | 1 | 0.122 | 0.116 | -0.735 |
| total | |  | | |

Table 9

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **48 ° p=0.2** | i | j | <Ai> | <Aj> | <AiAj> |
| Ideal | | | 0.151 | 0.151 | -0.698 |
| Ideal total | | |  | | |
| **Normal**  Mixed state  Sample ~ 11000 | 1 | 2 | 0.150(0.0100) | 0.144(0.0101) | -0.675(0.0074) |
| 2 | 3 | 0.151(0.0096) | 0.135(0.0099) | -0.672(0.0073) |
| 3 | 4 | 0.139(0.0095) | 0.154(0.0096) | -0.676(0.0074) |
| 4 | 5 | 0.146(0.0096) | 0.145(0.0103) | -0.681(0.0076) |
| 5 | 1 | 0.135(0.0099) | 0.135(0.0095) | -0.703(0.0072) |
| total | |  | | |

Table 10

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **48 ° p=0.2** | i | j | <Ai> | <Aj> | <AiAj> |
|  |  |  |  |  |  |
| Ideal | | | 0.151 | 0.151 | -0.698 |
| Ideal total | | |  | | |
| **Reverse**  **Mixed state**  Sample ~ 10000 | 1 | 2 | 0.158 | 0.134 | -0.683 |
| 2 | 3 | 0.142 | 0.150 | -0.683 |
| 3 | 4 | 0.142 | 0.144 | -0.680 |
| 4 | 5 | 0.134 | 0.155 | -0.686 |
| 5 | 1 | 0.134 | 0.142 | -0.699 |
| total | |  | | |

Table 11

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **46 ° p=0.1** | i | j | <Ai> | <Aj> | <AiAj> |
|  |  |  |  |  |  |
| Ideal | | | 0.065 | 0.169 | -0.759 |
| Ideal total | | |  | | |
| **Normal**  **Mixed state**  Sample ~ 10000 | 1 | 2 | 0.065 | 0.161 | -0.724 |
| 2 | 3 | 0.062 | 0.161 | -0.715 |
| 3 | 4 | 0.062 | 0.182 | -0.721 |
| 4 | 5 | 0.054 | 0.161 | -0.752 |
| 5 | 1 | 0.053 | 0.167 | -0.745 |
| total | |  | | |

Table 12

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **47 ° p=0.05** | i | j | <Ai> | <Aj> | <AiAj> |
|  |  |  |  |  |  |
| Ideal | | | 0.083 | 0.138 | -0.777 |
| Ideal total | | |  | | |
| **Normal**  **Mixed state**  Sample ~ 10000 | 1 | 2 | 0.093 | 0.128 | -0.751 |
| 2 | 3 | 0.071 | 0.131 | -0.749 |
| 3 | 4 | 0.081 | 0.138 | -0.742 |
| 4 | 5 | 0.082 | 0.130 | -0.745 |
| 5 | 1 | 0.080 | 0.125 | -0.762 |
| total | |  | | |

Table 13

|  |  |  |  |
| --- | --- | --- | --- |
| Fdelity of the initial state  (4000 samples for each experimental run) | state | Fidelity to self | Fidelity to |0> |
| |0> | 0.9998 | 0.9998 |
| |1> | 0.9957 | 0.0042 |
| |2> | 0.9928 | 0.0058 |
| Mixed with p=0.05 | 0.9990 | 0.9665 |
| Mixed with p=0.1 | 0.9962 | 0.9348 |
| Mixed with p=0.2 | 0.9924 | 0.8456 |

Table 14

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sharp measurement | 1 | 2 | 3 | 4 | 5 | total |
| 15000 Samples for each run | 0.9936 | 0.9913 | 0.9900 | 0.9925 | 0.9941 | 0.9923 |

Table 15

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Fdelity of the POVM Operator    4000 samples for each Experimental run |  | order | fidelity | error |
| 48 | 1 | 0.9936 |  |
| 2 | 0.9906 |  |
| 3 | 0.9961 |  |
| 4 | 0.9945 |  |
| 5 | 0.9896 |  |
| 47 | 1 | 0.9921 |  |
| 2 | 0.9862 |  |
| 3 | 0.9924 |  |
| 4 | 0.9890 |  |
| 5 | 0.9958 |  |
| 46.5 | 1 | 0.9889 |  |
| 2 | 0.9966 |  |
| 3 | 0.9980 |  |
| 4 | 0.9920 |  |
| 5 | 0.9883 |  |
| 46 | 1 | 0.9898 |  |
| 2 | 0.9903 |  |
| 3 | 0.9936 |  |
| 4 | 0.9946 |  |
| 5 | 0.9874 |  |
| 45 | 1 | 0.9878 |  |
| 2 | 0.9916 |  |
| 3 | 0.9877 |  |
| 4 | 0.9914 |  |
| 5 | 0.9831 |  |

注：Table 15 的fidelity是按照参考文献的第二种计算方法计算的，与python程序计算结果有所不同，优点是不会出现超过1的保真度。