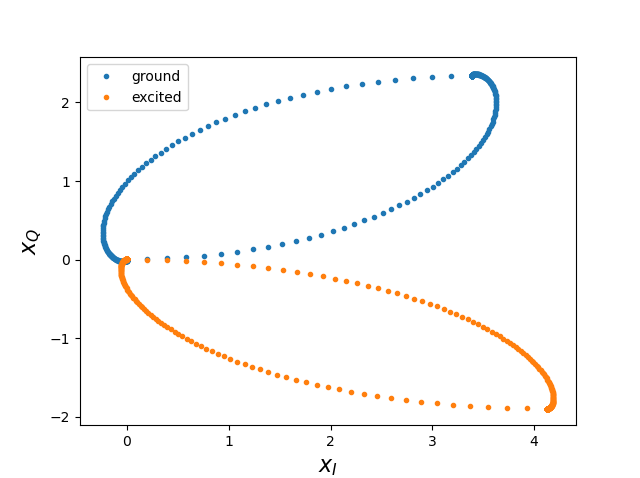
**g-e discrimination**

**Intuition for Integration weights optimization:**

Let’s say we are playing a readout pulse to the readout resonator. The pulse is reflected, downconverted with an IQ mixer and digitized at the inputs of the OPX. So we have a vector of complex numbers in time resolution of 1ns.

If we will demodulate it, we will get:

Expected signal for qubit in ground and excited states are



The most probable state is:

⬄

So in order to discriminate we would like to perform a dot product of the demodulated signal with a pre-defined vector, and compare the results to a threshold. The pre-defined vector is the integration weights!

**Complex numbers ⬄ OPX demodulations ⬄ Matrix form:**

**Optimal weights proof:**

The Maximum-Likelihood estimator is given by:

If , this is equivalent to:

Or, by denoting :

**Implementation on the OPX:**

|  |  |  |
| --- | --- | --- |
|  | **Demod 1** | **Demod 2** |
| **Input** |  |  |
| **Cos weights:** |  |  |
| **Sin weights:** |  |  |
| **Result:** |  |  |