CO 639 Scribe Notes

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Ancilla Purification:

Start with N ancillas
1. Do bit flip verification (have $N/3$ ancillas)
2. Do phase EC (have $N/9$ ancillas)
3. Do bit flip verification (have $N/27$ ancillas)
$\vdots$

Error rates (assume none in gates):
$$p \to 3p^2 \to 9p^2 \to 243p^4 \to \ldots \to (9p)^{2^n}/9$$

So if $p < \frac{1}{9}$ approach 0 quickly. Important that it is quick since we are losing ancillas quickly.

If there are errors in gates, the logical error rate asymptotes to some value - given by roughly the probability that a single round fails by itself.

Assumptions on Error Model and Circuits:

Let us examine which of the assumptions on the error model are truly necessary:

With local gates, we still have a threshold (see problem set 5).

Parallel operations:
– consider storage and gate errors
– with 3 qubit ops, so qubit must wait time $N/3$ (with N qubits in computer) between gates. For large enough N, EC will be impossible
– necessary for threshold

Fresh ancillas (necessary)

Classical computation:
– implement with quantum circuit. But error could cause multiple errors in data block.
– implement using classical FT (repetition code)
– not necessary for threshold

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