Simplification of equ (12)

$e^{i2\pi kx/2^N}$

N

x_{N-1}	x_{N-2}	......	x_1	x_0

binary Repn of number x

k_0	k_1	......	k_{N-2}	k_{N-1}

reverse binary of k

$$2\pi \frac{kx}{2^N} =$$

$$= 2\pi \sum_{n=0}^{N-1} k_n 2^n \sum_{m=0}^{N-1} x_{N-m-1} 2^{N-m-1} \quad 2^{-N}$$

$$= 2\pi \sum_{n=0}^{N-1} \sum_{m=0}^{N-1} k_n x_{N-m-1} \; 2^{n-m-1}$$

If $n-m-1 \geq 0$ phase is $2\pi 2^k$

$m < n$

$$= 2\pi \sum_{n=0}^{N-1} \sum_{m=n}^{N-1} (k_n x_{N-1-m}) \; 2^{n-m-1}$$

$$= \sum_n \left[\pi k_n x_{N-1-n} + \sum_{m>n} k_n x_{N-1-n} 2^{n-m} \right]$$

$e^{i\pi k_n x_{N-1-n}} = -1$ if $k, x = 1$
1 otherwise.

$(\sigma_x + \sigma_z)$ converts $|x\rangle$ to
$|1\rangle + |0\rangle$ if $|x\rangle = 0$
$|0\rangle - |1\rangle$ if $|x\rangle = 1$.

eqn 12

Each of ther terms convert to $e^{i\frac{\pi}{2r}}$ if $n-m=-r$

Control 0.

Start at $n=0$ Do $\sigma_x-\sigma_x$ on 1st ~~bit~~ bit. Do control phase on 1st bit and each successive

$|00\rangle \rightarrow 1\,|00\rangle$
$|01\rangle \quad 1\,|01\rangle$
$|10\rangle \quad |10\rangle$
$|11\rangle \quad e^{i\pi/2^{m-n}}\,|11\rangle$

for each odder bit.

Go to next bit. Do $\sigma_x-\sigma_z$ on it then step throug rest + do control phase.

Note phases get really small $\frac{\pi}{2^r}$. Can neglect say $r >$ ~~#~~