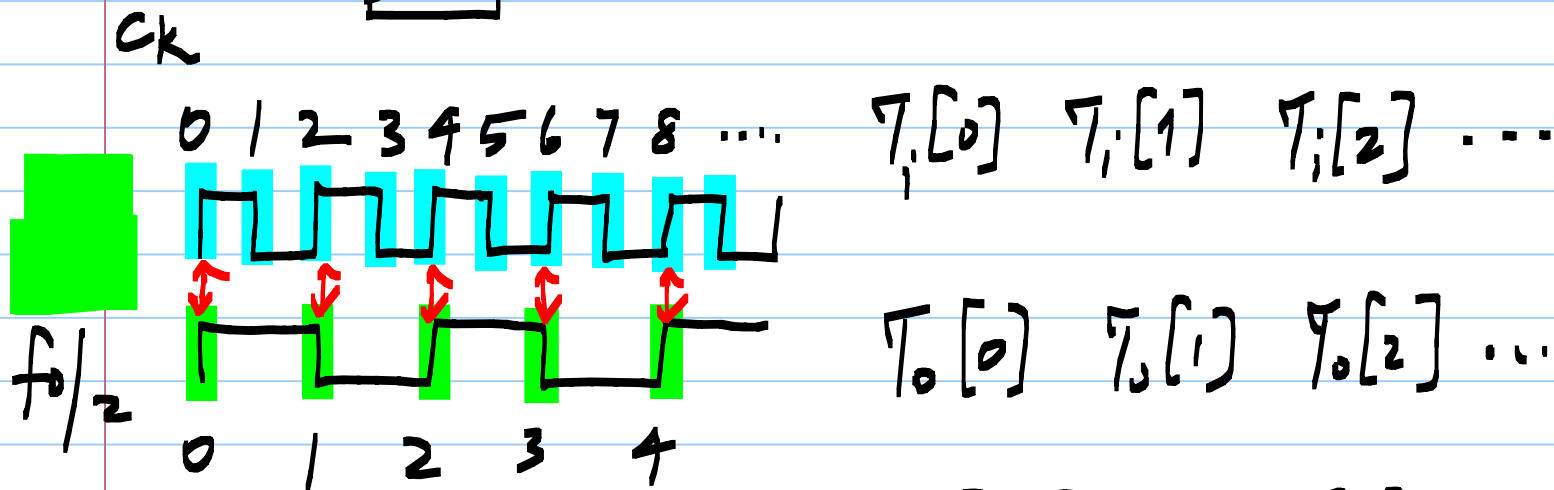
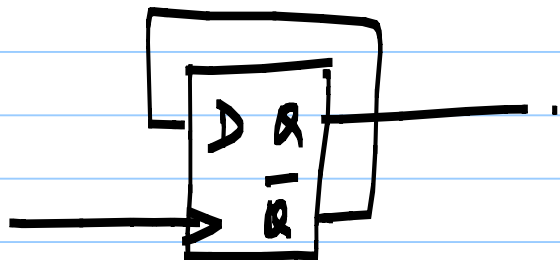


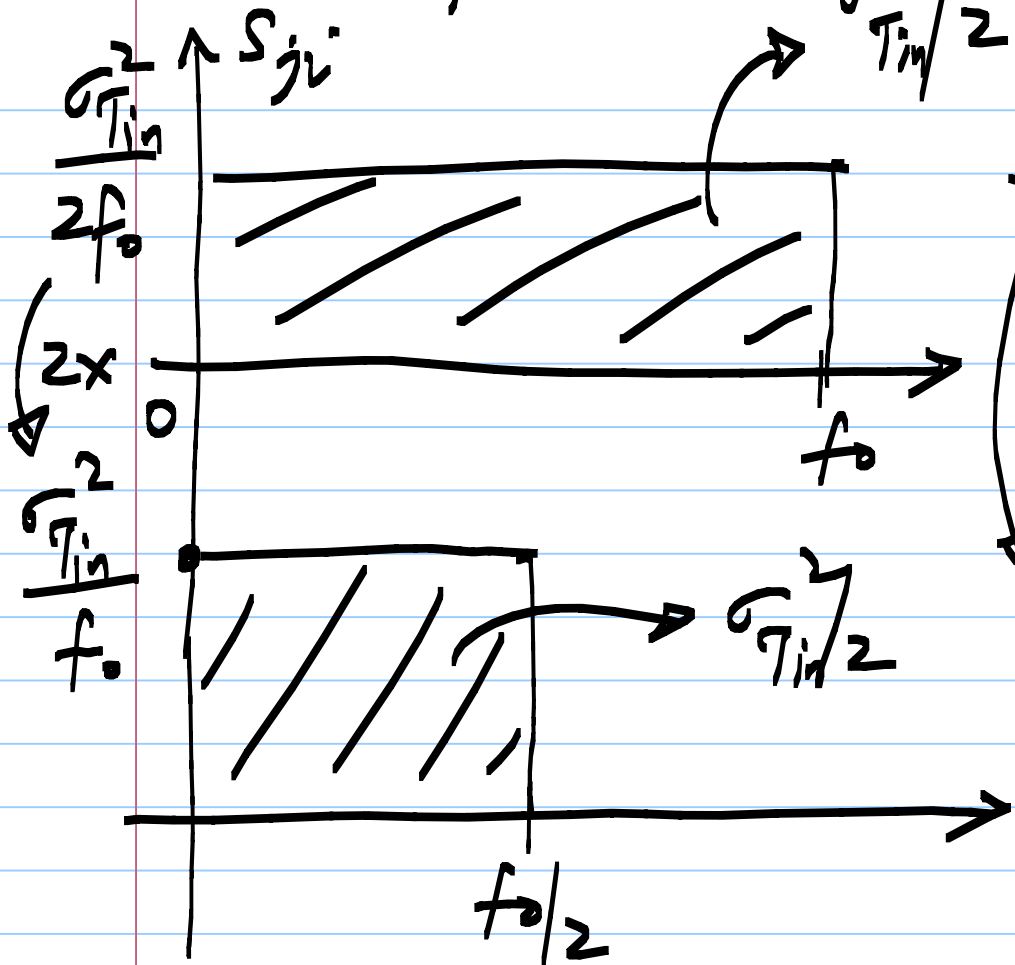
# Frequency divider

(absolute)  
Input jitter:  $\sigma_{T_{in}}$

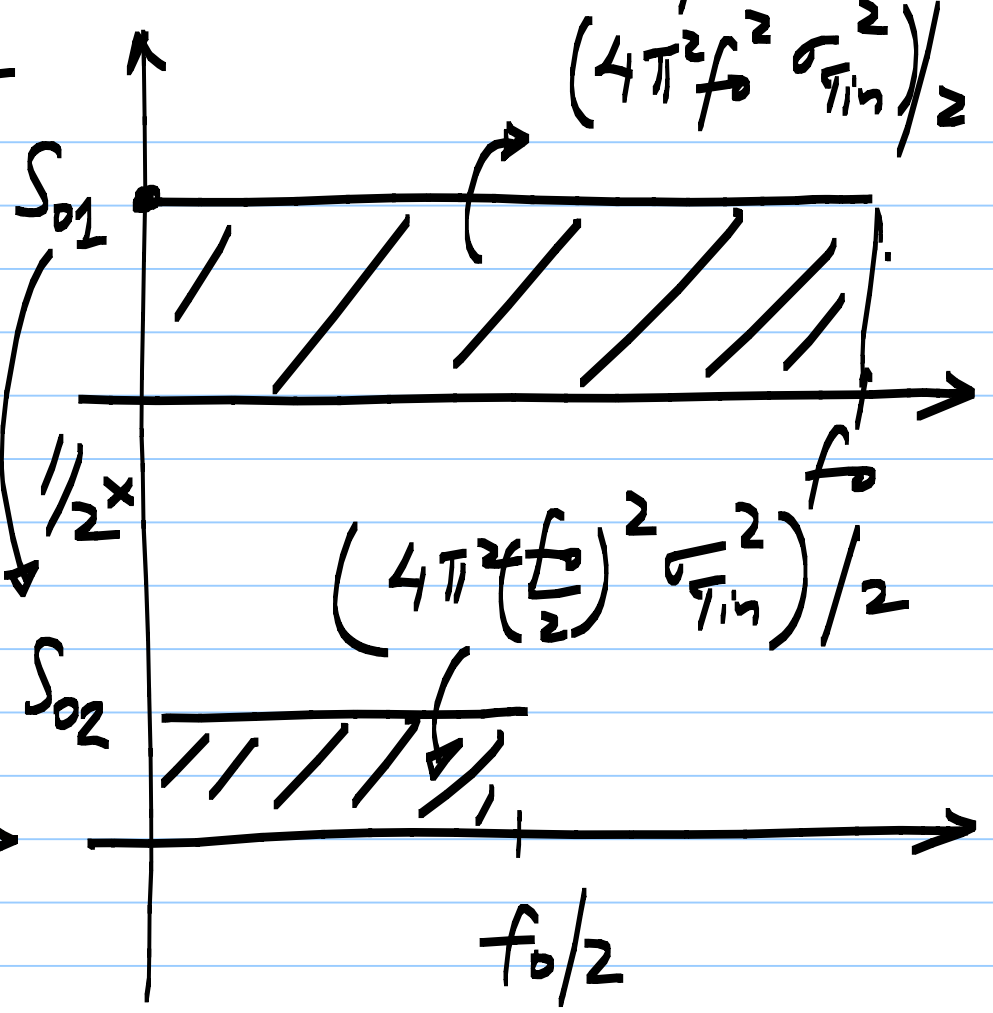


undersampling  $T_0[2k] = T_1[k]$ ,  $k$ : integer  
by  $N$  undersampling the input jitter by  $2x$

# Jitter spectra



# Phase noise spectra



White  $\phi = T \cdot (2\pi f_0)$

Bandlimited (lowpass)

$$S_{o_1} = \frac{4\pi^2 f^2 \sigma_{T_{in}}^2 / 2}{f_0} = \frac{2\pi^2 \sigma_{T_{in}}^2 \cdot f_0}{f_0}$$

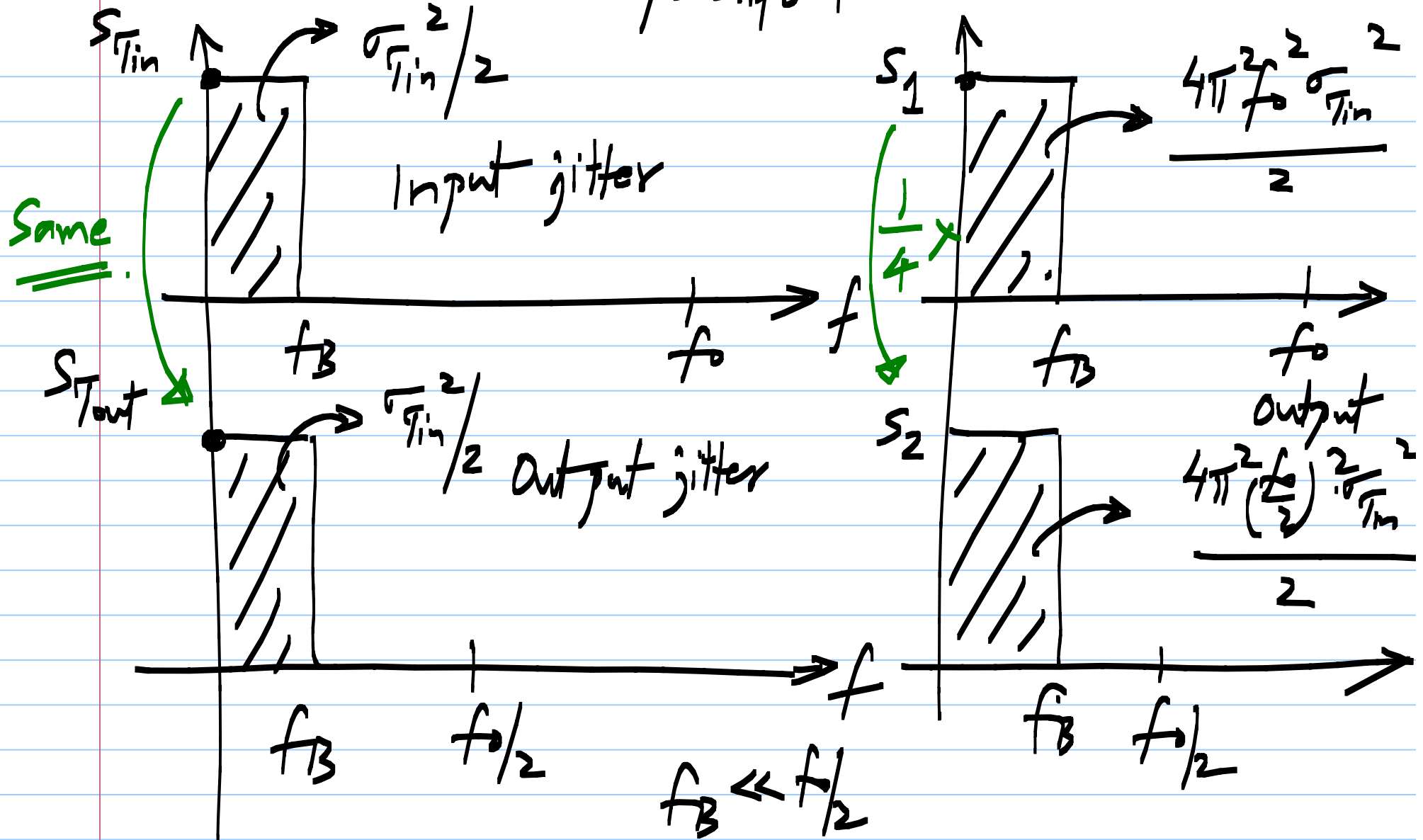
$$S_{o_2} = \frac{4\pi^2 \left(\frac{f_0}{2}\right)^2 \cdot \sigma_{T_{in}}^2 / 2}{f_0/2} = \frac{\pi^2 \sigma_{T_{in}}^2 \cdot f_0}{f_0/2}$$

$\frac{1}{2} \times$   
||

Bandlimited jitter

$$\phi = 2\pi f_0 \cdot \sigma$$

Phase noise spectra



Relationship between input & output  
phase noise of a divider:  $(\div N)$

---

\* White jitter: o/p phase noise =  $\frac{1}{N} \cdot \text{i/p phase noise}$

\* Bandlimited jitter: o/p phase noise =  $\frac{1}{N^2} \cdot \text{i/p phase noise}$

Output jitter variance = input jitter variance  
(white, bandlimited)

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White jitter: o/p jitter spectral density  
=  $N \cdot$  i/p jitter spectral density

Bandlimited jitter: o/p jitter spectral density  
( $f_B \ll \frac{f_0}{\sqrt{N}}$ ) = i/p jitter spectral density

spectral density wrt absolute freq.