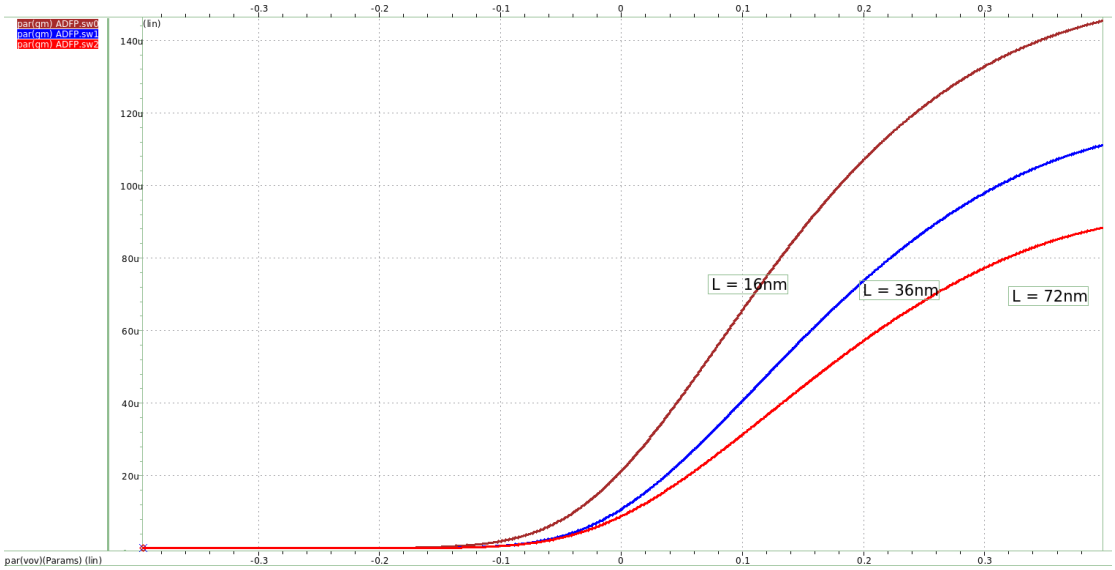
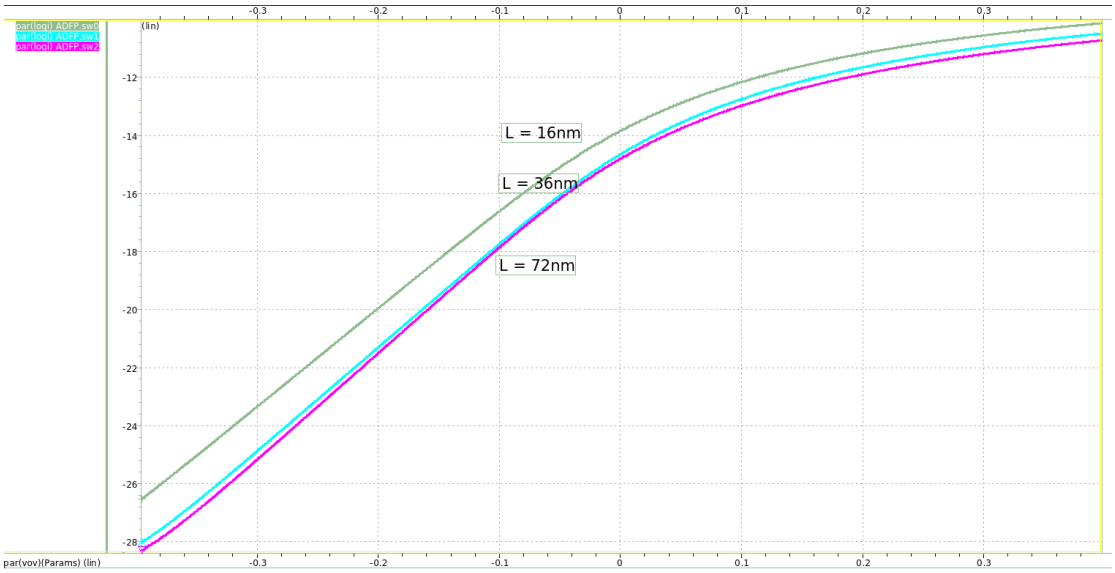
111511076 陳彥宇

TSMC N16 ADFP process

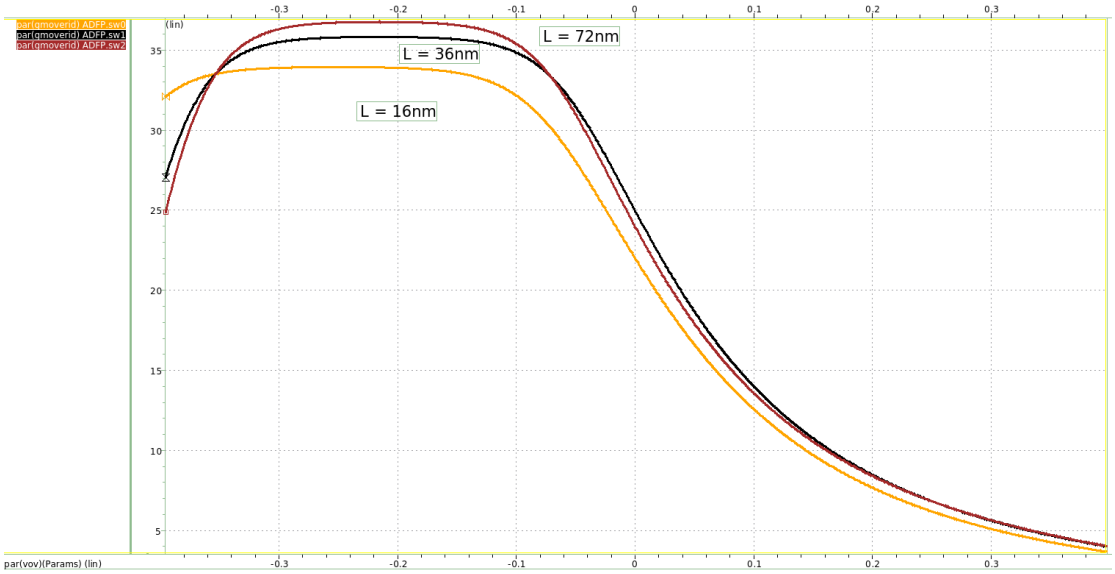
gm-Vov



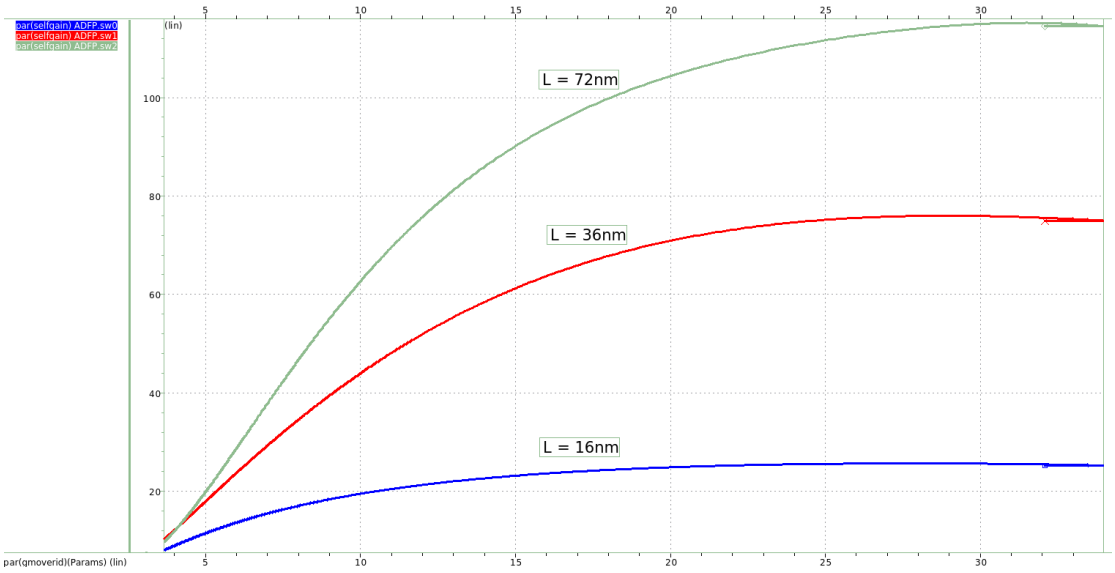
Log(I)-Vov



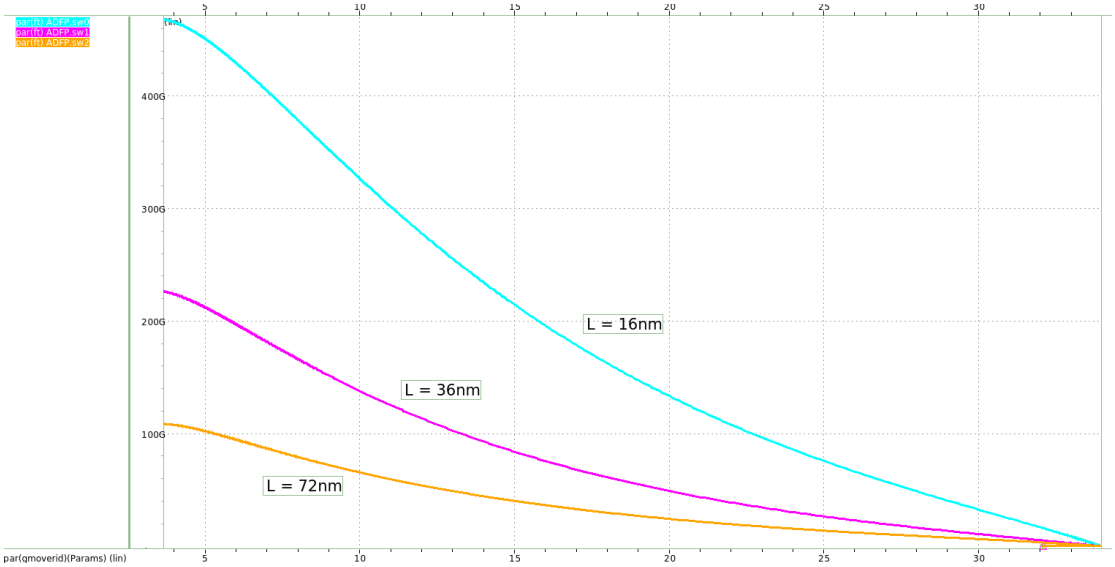
$\frac{g_m}{I_D}$-Vov



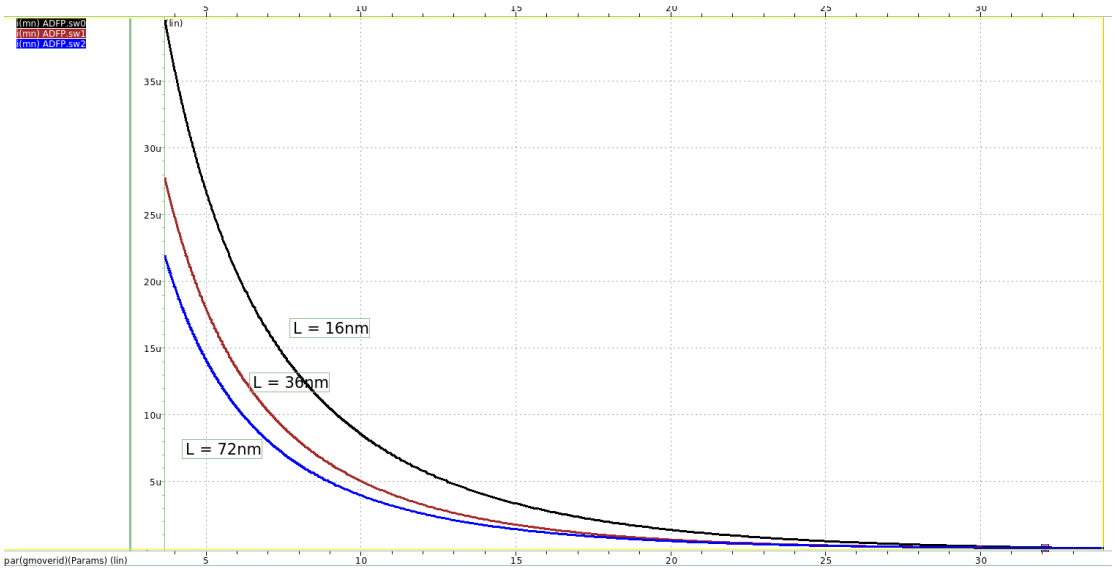
Selfgain-$\frac{g_m}{I_D}$



f_t - $\frac{g_m}{I_D}$



$\frac{I_D}{\text{nfin}}$ - $\frac{g_m}{I_D}$



L = 16nm $V_{DS} =$ 0.4V	$\frac{g_m}{I_D}$ (S/A)		
	5	10	20
$V_{ov}(V)$	305m	144m	17.3m
$\frac{I_D}{nfin}$ (uA/Fin)	26.8u	8.56u	1.39u
Self Gain (V/V)	11.5	19.5	24.9
f_T (GHz)	451	327	133

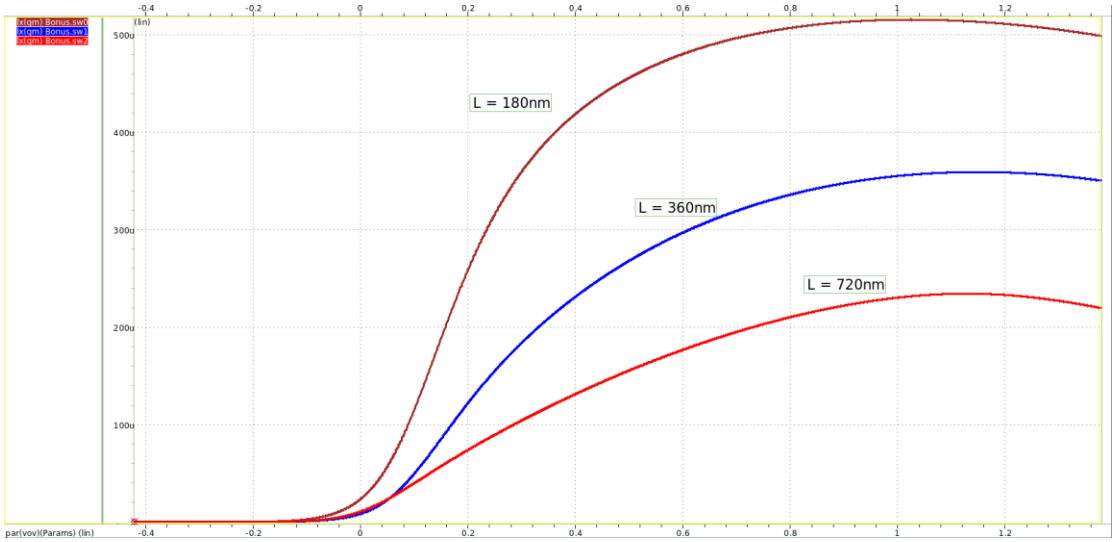
L = 36nm $V_{DS} =$ 0.4V	$\frac{g_m}{I_D}$ (S/A)		
	5	10	20
$V_{ov}(V)$	298m	136m	8.27m
$\frac{I_D}{nfin}$ (uA/Fin)	18u	5.05u	654n
Self Gain (V/V)	17.9	44	70.9
f_T (GHz)	212	138	49

L = 72nm $V_{DS} =$ 0.4V	$\frac{g_m}{I_D}$ (S/A)		
	5	10	20
$V_{ov}(V)$	314m	151m	22.8m
$\frac{I_D}{nfin}$ (uA/Fin)	14.1u	3.97u	550n
Self Gain (V/V)	19.8	62.7	104
f_T (GHz)	102	65.5	24.2

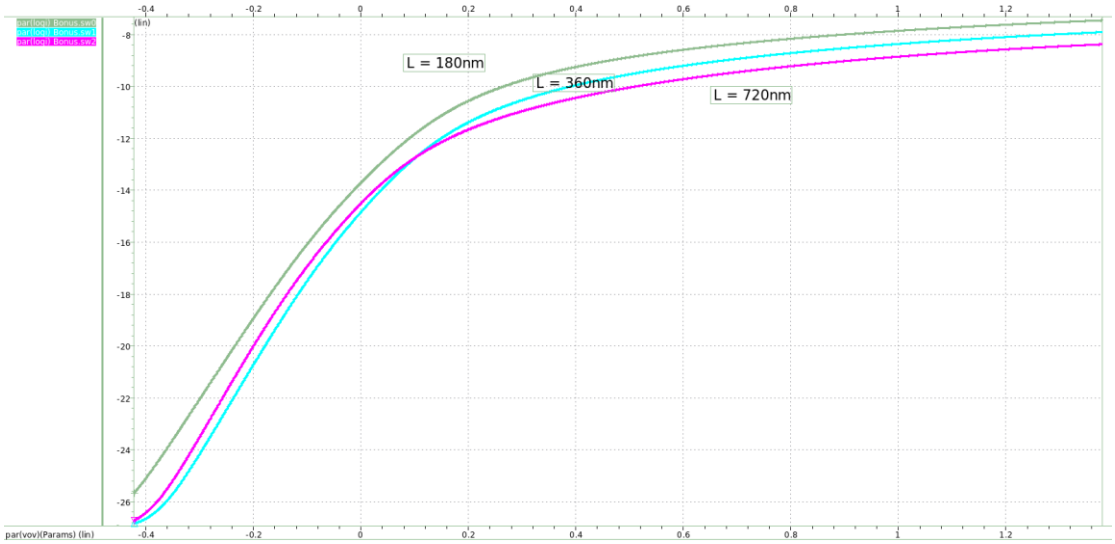
```
.title bonus
.lib './N16ADFP_SPICE_MODEL/toplevel.l'top_tt

.TEMP 25
.op

.option post
.option accurate=1

.DC V_gs 0V 0.8V 1m
.probe id = I(M1)
.probe gm = par('lx7(MN)')
.probe logI = par('log(I(MN))')
.probe gmoverid = par('lx7(MN)/I(MN)')
.probe selfgain = par('lx7(MN)/lx8(MN)')
.probe vov = par('lx2(MN) - lv9(MN)')
.probe ft = par('lx7(MN)/ (2*3.1415926*lx18(MN))')
.probe(i/nfin) = par('I(MN)/k')

.param k = 1
.param ln = 16n

Vsupply VDD GND 1.8
V_gs    Vgs GND 0.8
V_ds    Vds GND 0.4

MN Vds Vgs GND GND nch_svt_mac l="ln" nfin=k multi=1 nf=1

.alter
.param ln = 36n
.alter
.param ln = 72n

.end
```

U18 process

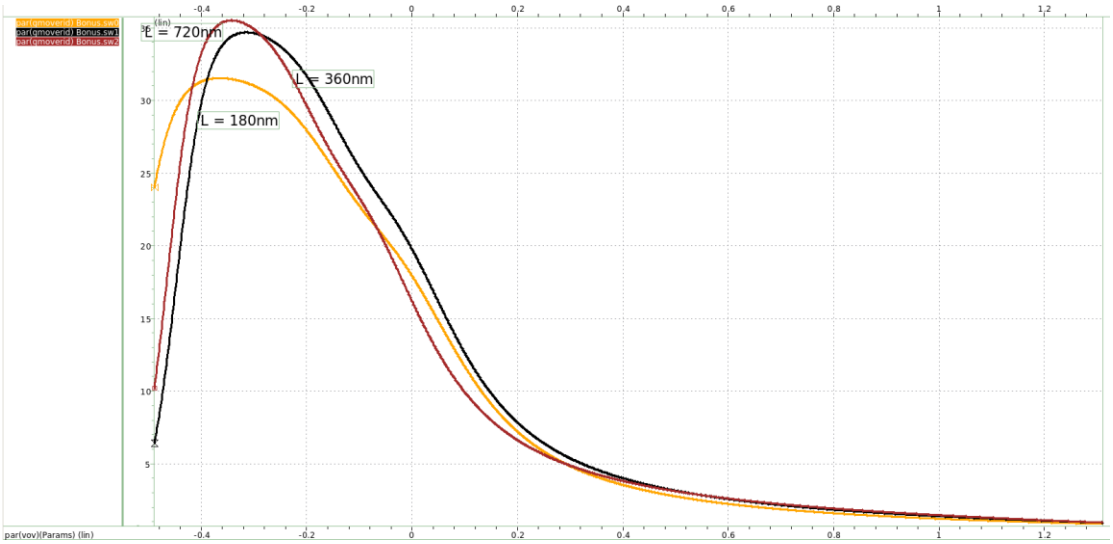
gm-Vov



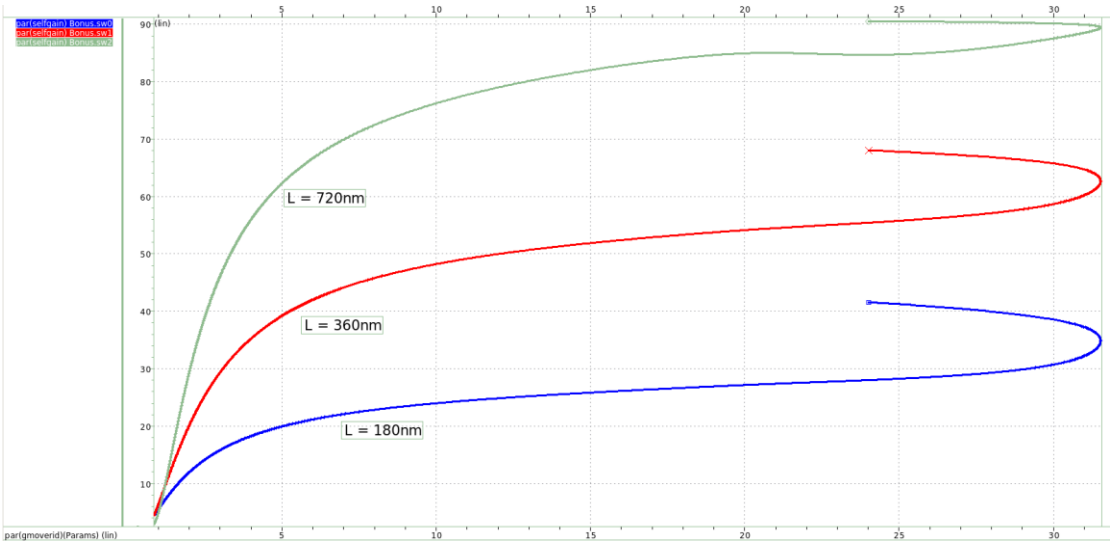
Log(I)-Vov



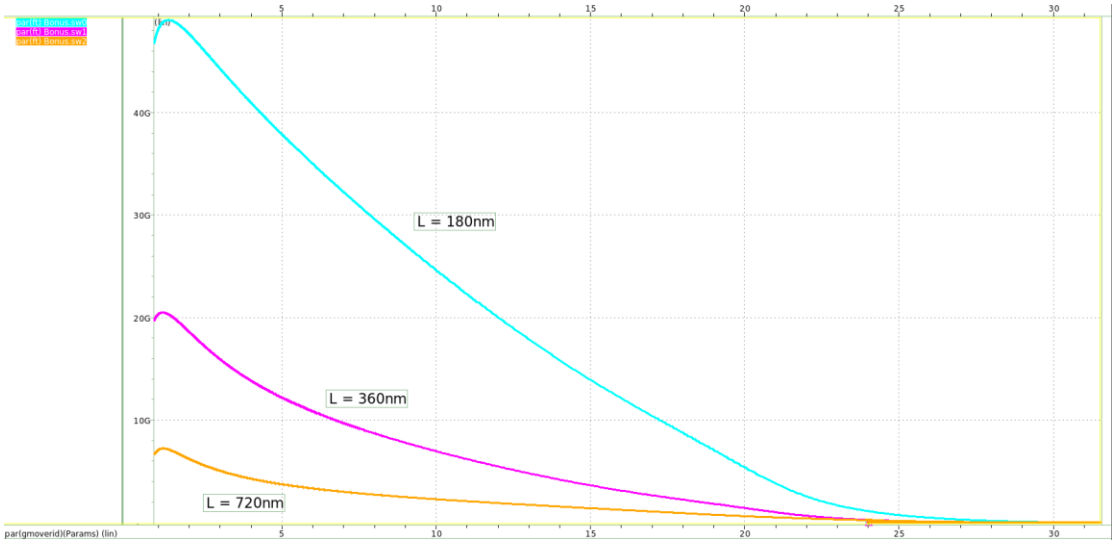
$\frac{g_m}{I_D}$-Vov



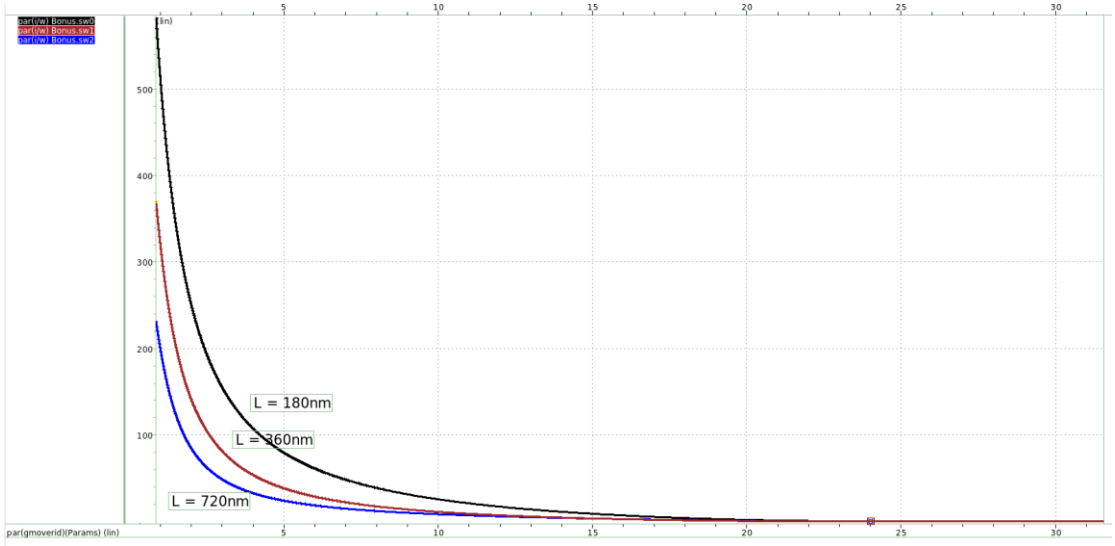
Selfgain-$\frac{g_m}{I_D}$



f_t - $\frac{g_m}{I_D}$



$\frac{I_D}{W}$ - $\frac{g_m}{I_D}$



L = 180nm V_{DS} = 0.9V	$\frac{g_m}{I_D}$ (S/A)		
	5	10	20
$V_{ov}(V)$	291m	131m	-39.9m

$\frac{I_D}{W}$ (uA/um)	79.6	25.7	1.95
Self Gain (V/V)	19.9	24	27.2
f_T (GHz)	37.9	24.6	5.38

L = 360nm V_{DS} = 0.9V	$\frac{g_m}{I_D}$ (S/A)		
	5	10	20
$V_{ov}(V)$	331m	155m	4.9m
$\frac{I_D}{W}$ (uA/um)	45.4	13.2	4.11u
Self Gain (V/V)	37.3	47.4	53.4
f_T (GHz)	13	7.56	2.18

L = 720nm V_{DS} = 0.9V	$\frac{g_m}{I_D}$ (S/A)		
	5	10	20
$V_{ov}(V)$	358m	166m	17.8m
$\frac{I_D}{W}$ (uA/um)	24.1	6.26	3.95u
Self Gain (V/V)	62.3	78.7	85
f_T (GHz)	3.73	1.95	0.572

```
***------------------------***
***          setting          ***
***------------------------***
.lib "~/U18_HSPICE_Model/mm180_reg18_v124.lib" tt
.TEMP 25
.op
***------------------------***
***          simulation       ***
***------------------------***
.option post
.DC V_gs   0V 1.8V 1m
```

```
.probe id_mos = I(MN)
.probe gm = lx7(MN)
.probe LogI = par('log(I(MN))')
.probe gmoverid = par('lx7(MN)/I(MN)')
.probe SelfGain = par('lx7(MN)/lx8(MN)')
*self gain = intrinsic gain = gm/gds
.probe vov = par('lx2(MN)-lv9(MN)')
.probe ft = par('lx7(MN) / (2 * 3.1415926 * lx18(MN))')
.probe I/w = par('I(MN)/wn')
*ro = 1/gds
*self gain = intrinsic gain = gm/gds
*ft = transition frequency = the frequency at which gain = 1
*= gm / [2*pi*(Cgs + Ggd)]

***----------------------***
***        parameters          ***
***----------------------***
.param wn = 1u
.param ln = 180n
.param ls = 0.48u
.global VDD GND

***----------------------***
***        power/input        ***
***----------------------***
Vsupply VDD GND 1.8v
V_ds Vds GND 0.9V
V_gs Vgs GND 1.8V
***----------------------***
***           circuit           ***
***----------------------***
MN   Vds Vgs GND GND n_18_mm w=wn l=ln

***----------------------***
***             alter             ***
***----------------------***
.alter
.param ln = 360n
```

```
50. .alter
51. .param ln = 720n
52. .end
```