```
In[ ]:= Clear["Global`*"]
        クリア
```

Initial Value

```
In[ ]:= L = 0.1; (*km*)
bit = 25;
λ = 1.55 * 10^-6; (*m*)
d = 16; (*ps/km·nm*)
c = 3 * 10^8;
β2 = d/(2 * Pi * c) λ^2 * 10^-3;
nm = 3.96; (*電気信号の実効屈折率*)
ng = 2.19; (*光波の群屈折率*)
c = 3 * 10^8;
y = 38.25 * 10^-3; (*mm*)
t[l_] := l/c * (nm + ng); (*s*)
total = t[y];
initial = 1000;
pitch = 50 * 10^-6; (*um*)
pitchmm = pitch * 10^3;
Δt = pitch * (nm + ng) / (3 * 10^8);
sumw = (total + Δt * initial) / Δt ;
polnumber = 1 + IntegerPart[sumw] - initial;
                整数部分
electrodelength = N[pitch * polnumber];
                  数値
electrodelengthmm = electrodelength * 10^3;
Print[β2, "ps^2/km"]
出力表示
Print[total * 10^12, "ps"]
出力表示
Print[Δt * 10^12, "ps"]
出力表示
Print[sumw, "point"]
出力表示
Print["Rev pattern is", polnumber, "point"]
出力表示
Print["electrodelength is", electrodelength * 10^3, "mm"]
出力表示
Print[electrodelengthmm, "mm"]
出力表示
```

$2.03931 \times 10^{-23} \mathrm{ps}^2 / \mathrm{km}$

784.125ps

1.025ps

1765.point

Rev pattern is765point

electrodelength is38.25mm

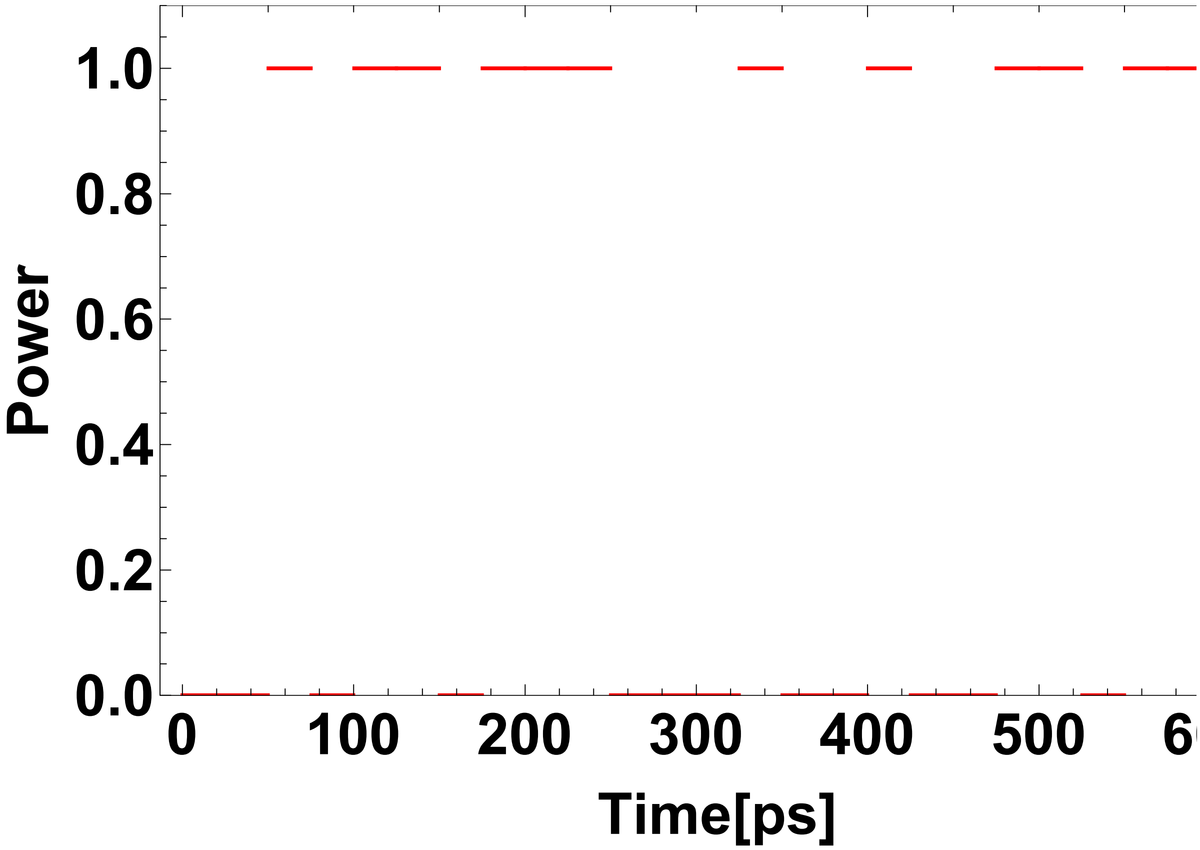
38.25mm

Product Random NRZ Signal

In[ ]:=
```
(*For[i=1;j=0,i≤bit,i++,
 └繰返し評価
   For[m=j;random=RandomChoice[{0,1}],j≤m+1,j=j+1,digital[j]=random]]
   └繰返し評価         └ランダムな選択

  rm=Table[digital[t],{t,1,bit}]*)
     └リストを作成
digital[1] = 0;
digital[2] = 1;
digital[3] = 0;
digital[4] = 1;
digital[5] = 1;
digital[6] = 0;
digital[7] = 1;
digital[8] = 1;
digital[9] = 1;
digital[10] = 0;
digital[11] = 0;
digital[12] = 0;
digital[13] = 1;
digital[14] = 0;
digital[15] = 0;
digital[16] = 1;
digital[17] = 0;
digital[18] = 0;
digital[19] = 1;
digital[20] = 1;
digital[21] = 0;
digital[22] = 1;
digital[23] = 1;
digital[24] = 1;
digital[25] = 1;

rm = Table[digital[t], {t, 1, bit}]
     └リストを作成
step1[t_, i_] := If[digital[i] == 1, If[i * 25 * 10^-12 < t < (i + 1) * 25 * 10^-12, 1, 0],
                 └If文                 └If文
  If[i * 25 * 10^-12 < t < (i + 1) * 25 * 10^-12, 0, 0]]
  └If文

                              bit
signal[t_] := signal[t] =  ∑  step1[t, i]
                             i=1
Plot[signal[t * 10^-12], {t, 0, bit * 25}, PlotStyle → {Red, Thick},
└プロット                                   └プロットスタイル └赤  └太い
 Frame → True, FrameLabel → {"Time[ps]", "Power"},
 └枠     └真   └枠ラベル                 └ベキ
 BaseStyle → {Bold, FontSize → 30}, PlotRange → {0, 1.1}]
 └ベーススタイル └太字 └フォントサイズ  └プロット範囲
```

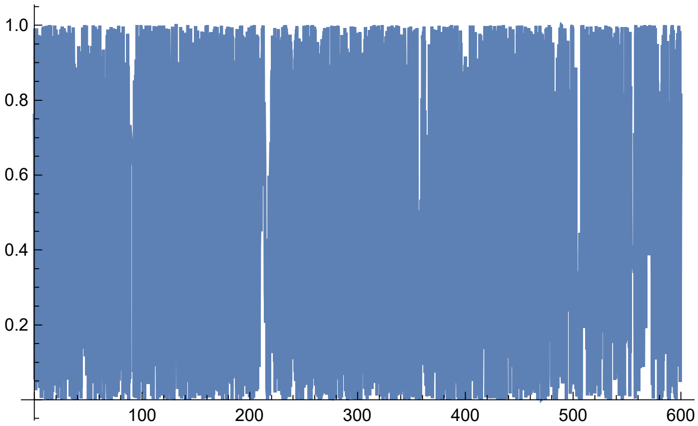
Out[ ]= {0, 1, 0, 1, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 1, 1, 1, 1}

Out[ ]=



In[ ]:=
```
Fc = 200 * 10^12;(*搬送波の周波数[THz]*)
carrier[t] = (Cos[2 * Pi * Fc * t] + 1) / 2
              余弦       円周率
Plot[carrier[t], {t, 0, 600}]
プロット
cs[t_] = signal[t] * carrier[t]
```

Out[ ]= $\frac{1}{2}\left(1+\mathrm{Cos}[400\,000\,000\,000\,000\,\pi\,t]\right)$

Out[ ]=


Out[ ]= $\frac{1}{2}\left(1+\mathrm{Cos}[400\,000\,000\,000\,000\,\pi\,t]\right)$

$$\Big(\mathrm{If}\Big[\tfrac{1}{40\,000\,000\,000}<t<\tfrac{1}{20\,000\,000\,000},0,0\Big]+\mathrm{If}\Big[\tfrac{1}{20\,000\,000\,000}<t<\tfrac{3}{40\,000\,000\,000},1,0\Big]+$$
$$\mathrm{If}\Big[\tfrac{3}{40\,000\,000\,000}<t<\tfrac{1}{10\,000\,000\,000},0,0\Big]+$$
$$\mathrm{If}\Big[\tfrac{1}{10\,000\,000\,000}<t<\tfrac{1}{8\,000\,000\,000},1,0\Big]+\mathrm{If}\Big[\tfrac{1}{8\,000\,000\,000}<t<\tfrac{3}{20\,000\,000\,000},1,0\Big]+$$
$$\mathrm{If}\Big[\tfrac{3}{20\,000\,000\,000}<t<\tfrac{7}{40\,000\,000\,000},0,0\Big]+\mathrm{If}\Big[\tfrac{7}{40\,000\,000\,000}<t<\tfrac{1}{5\,000\,000\,000},1,0\Big]+$$
$$\mathrm{If}\Big[\tfrac{1}{5\,000\,000\,000}<t<\tfrac{9}{40\,000\,000\,000},1,0\Big]+\mathrm{If}\Big[\tfrac{9}{40\,000\,000\,000}<t<\tfrac{1}{4\,000\,000\,000},1,0\Big]+$$
$$\mathrm{If}\Big[\tfrac{1}{4\,000\,000\,000}<t<\tfrac{11}{40\,000\,000\,000},0,0\Big]+\mathrm{If}\Big[\tfrac{11}{40\,000\,000\,000}<t<\tfrac{3}{10\,000\,000\,000},0,0\Big]+$$
$$\mathrm{If}\Big[\tfrac{3}{10\,000\,000\,000}<t<\tfrac{13}{40\,000\,000\,000},0,0\Big]+\mathrm{If}\Big[\tfrac{13}{40\,000\,000\,000}<t<\tfrac{7}{20\,000\,000\,000},1,0\Big]+$$
$$\mathrm{If}\Big[\tfrac{7}{20\,000\,000\,000}<t<\tfrac{3}{8\,000\,000\,000},0,0\Big]+\mathrm{If}\Big[\tfrac{3}{8\,000\,000\,000}<t<\tfrac{1}{2\,500\,000\,000},0,0\Big]+$$
$$\mathrm{If}\Big[\tfrac{1}{2\,500\,000\,000}<t<\tfrac{17}{40\,000\,000\,000},1,0\Big]+\mathrm{If}\Big[\tfrac{17}{40\,000\,000\,000}<t<\tfrac{9}{20\,000\,000\,000},0,0\Big]+$$
$$\mathrm{If}\Big[\tfrac{9}{20\,000\,000\,000}<t<\tfrac{19}{40\,000\,000\,000},0,0\Big]+\mathrm{If}\Big[\tfrac{19}{40\,000\,000\,000}<t<\tfrac{1}{2\,000\,000\,000},1,0\Big]+$$
$$\mathrm{If}\Big[\tfrac{1}{2\,000\,000\,000}<t<\tfrac{21}{40\,000\,000\,000},1,0\Big]+\mathrm{If}\Big[\tfrac{21}{40\,000\,000\,000}<t<\tfrac{11}{20\,000\,000\,000},0,0\Big]+$$
$$\mathrm{If}\Big[\tfrac{11}{20\,000\,000\,000}<t<\tfrac{23}{40\,000\,000\,000},1,0\Big]+\mathrm{If}\Big[\tfrac{23}{40\,000\,000\,000}<t<\tfrac{3}{5\,000\,000\,000},1,0\Big]+$$
$$\mathrm{If}\Big[\tfrac{3}{5\,000\,000\,000}<t<\tfrac{1}{1\,600\,000\,000},1,0\Big]+\mathrm{If}\Big[\tfrac{1}{1\,600\,000\,000}<t<\tfrac{13}{20\,000\,000\,000},1,0\Big]\Big)$$

In[]:= $$\int_0^{bit*25*10^{-12}} cs[t1] * e^{-i*2*Pi*f*t1}\, dt1$$

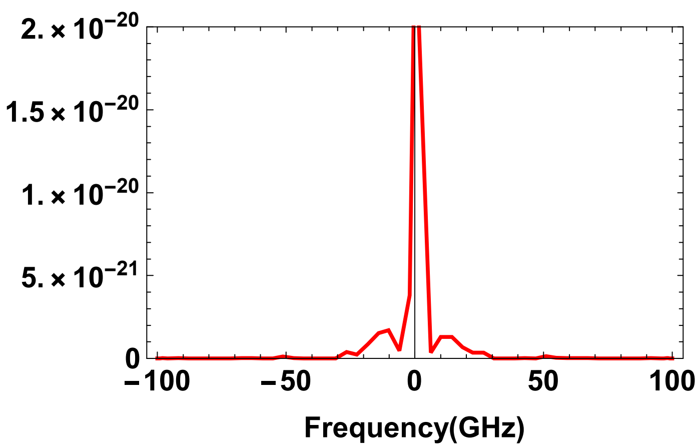
Out[]= $$-\left(\left(i\, e^{-\frac{i f \pi}{800\,000\,000}} \left(-1 + e^{\frac{i f \pi}{20\,000\,000\,000}}\right) \left(1 + e^{\frac{i f \pi}{20\,000\,000\,000}} + e^{\frac{i f \pi}{10\,000\,000\,000}} + e^{\frac{i f \pi}{5\,000\,000\,000}} + e^{\frac{i f \pi}{4\,000\,000\,000}} + e^{\frac{i f \pi}{2\,500\,000\,000}} + e^{\frac{11 i f \pi}{20\,000\,000\,000}} + e^{\frac{3 i f \pi}{4\,000\,000\,000}} + e^{\frac{i f \pi}{1\,250\,000\,000}} + e^{\frac{17 i f \pi}{20\,000\,000\,000}} + e^{\frac{19 i f \pi}{20\,000\,000\,000}} + e^{\frac{i f \pi}{1\,000\,000\,000}} + e^{\frac{11 i f \pi}{10\,000\,000\,000}}\right) \left(-20\,000\,000\,000\,000\,000\,000\,000\,000\,000\,000 + f^2\right)\right) \Big/ \left(2 f \left(-40\,000\,000\,000\,000\,000\,000\,000\,000\,000\,000 + f^2\right) \pi\right)\right)$$

In[]:= fc[f_] :=

$$-\left(\left(i\, e^{-\frac{i f \pi}{800\,000\,000}} \left(-1 + e^{\frac{i f \pi}{20\,000\,000\,000}}\right) \left(1 + e^{\frac{i f \pi}{20\,000\,000\,000}} + e^{\frac{i f \pi}{10\,000\,000\,000}} + e^{\frac{i f \pi}{5\,000\,000\,000}} + e^{\frac{i f \pi}{4\,000\,000\,000}} + e^{\frac{i f \pi}{2\,500\,000\,000}} + e^{\frac{11 i f \pi}{20\,000\,000\,000}} + e^{\frac{3 i f \pi}{4\,000\,000\,000}} + e^{\frac{i f \pi}{1\,250\,000\,000}} + e^{\frac{17 i f \pi}{20\,000\,000\,000}} + e^{\frac{19 i f \pi}{20\,000\,000\,000}} + e^{\frac{i f \pi}{1\,000\,000\,000}} + e^{\frac{11 i f \pi}{10\,000\,000\,000}}\right) \left(-20\,000\,000\,000\,000\,000\,000\,000\,000\,000\,000 + f^2\right)\right) \Big/ \left(2 f \left(-40\,000\,000\,000\,000\,000\,000\,000\,000\,000\,000 + f^2\right) \pi\right)\right)$$

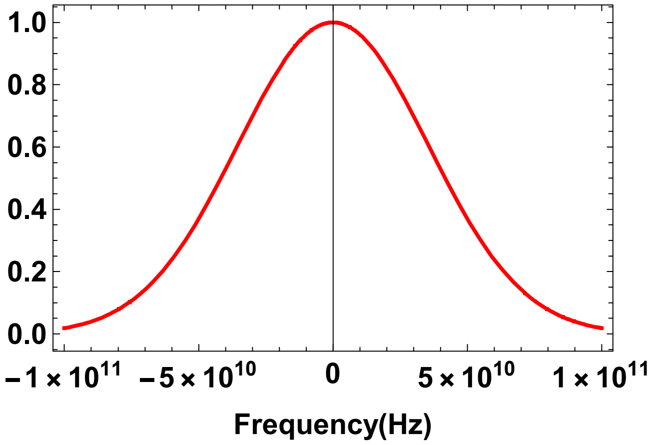
In[]:=
```
Plot[(Re[fc[f * 10^9]]^2 + Im[fc[f * 10^9]]^2), {f, -100, 100},
 PlotStyle → {Red, Thick}, Frame → True, FrameLabel → {"Frequency(GHz)"},
 BaseStyle → {Bold, FontSize → 15}, PlotRange → {0, 20 * 10^-21}]
```
プロット 赤 太い 枠 真 枠ラベル 太字 フォントサイズ プロット範囲

Out[]=



In[ ]:=
```
mado[f_] := e^-(f*10^-10.7)^2
Plot[mado[f], {f, -100*10^9, 100*10^9}, PlotStyle → {Red, Thick}, Frame → True,
プロット                                  プロットスタイル  赤   太い    枠       真
 FrameLabel → {"Frequency(Hz)",}, BaseStyle → {Bold, FontSize → 15}]
 枠ラベル                          ベーススタイル  太字  フォントサイズ
```

Out[ ]=



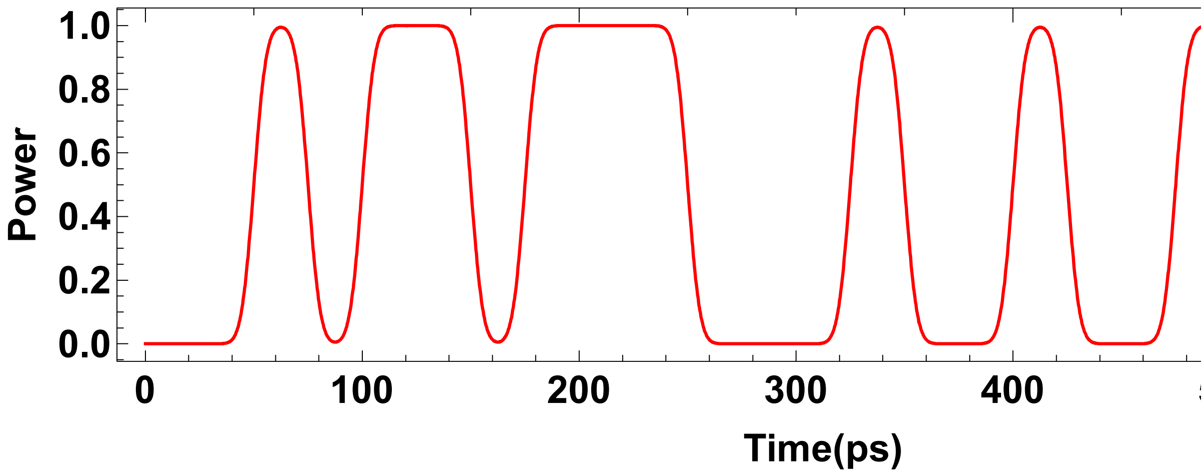
In[ ]:=
```
For[i = 1, i ≤ 1200, i++, sinsper1[i] = Re[fc[i*10^8]] * mado[i*10^8]]
繰返し評価                               実部
For[i = 1, i ≤ 1200, i++, sinspei1[i] = Im[fc[i*10^8]] * mado[i*10^8]]
繰返し評価                               複素数の虚部
sig[t_] := sig[t] =
 (Sum[sinsper1[i] * Cos[2*Pi*i*10^8*t], {i, 1, 1200}] + Sum[sinspei1[i] * Sin[-2*Pi*i*10^8*t], {i, 1, 1200}])
                    余弦   円周率                                          正弦     円周率
```

In[ ]:=
```
minnrz = -MinValue[sig[x1*10^-12], x1];
          最小値
maxnrz = MaxValue[sig[x] + minnrz, x];
         最大値
nrzsig[t_] := (sig[t] + minnrz) / maxnrz;
```

In[◦]:=

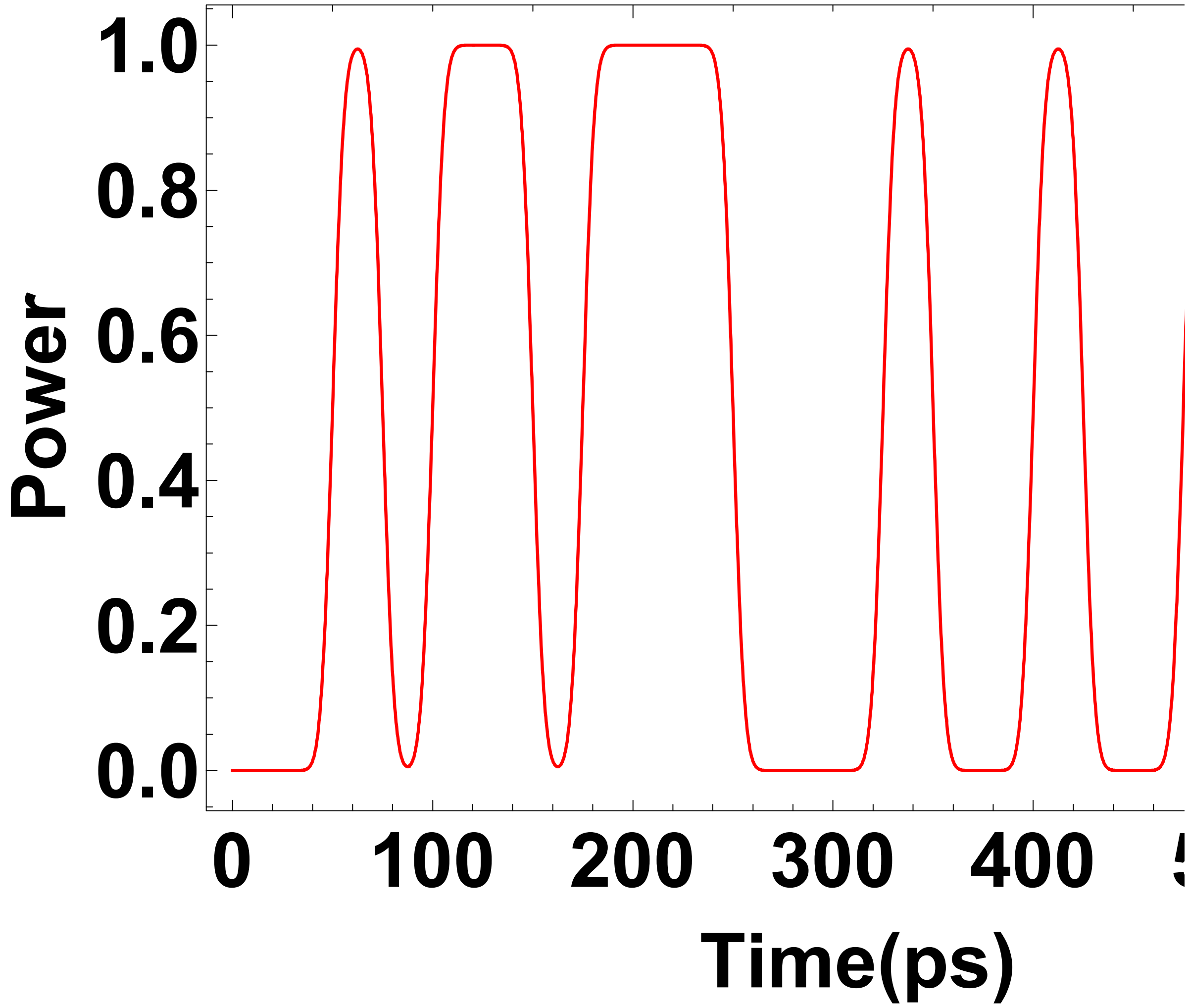
```
Plot[nrzsig[t * 10^-12], {t, 0, bit * 25}, Frame → True, FrameLabel → {"Time(ps)", "Power"},
プロット                                      枠        真       枠ラベル                       ベキ
  PlotStyle → {Red}, BaseStyle → {FontSize → 20, Red, FontWeight → Bold},
  プロットスタイル  赤    ベーススタイル   フォントサイズ      赤   フォントの太さ    太字
  LabelStyle → {GrayLevel[0], Bold}, AspectRatio -> 1 / 4, ImageSize → 800]
  ラベルスタイル   グレーレベル    太字    縦横比                  画像サイズ
```

Out[◦]=



In[ ]:=
```
Plot[nrzsig[t * 10^-12], {t, 0, bit * 25}, Frame → True, FrameLabel → {"Time(ps)", "Power"},
  PlotStyle → {Red}, BaseStyle → {FontSize → 40, Red, FontWeight → Bold},
  LabelStyle → {GrayLevel[0], Bold}, ImageSize → 800]
```
プロット 枠 真 枠ラベル ベキ プロットスタイル 赤 ベーススタイル フォントサイズ 赤 フォントの太さ 太字 ラベルスタイル グレーレベル 太字 画像サイズ

Out[ ]=



Function for Compensation Fiber Dispersion

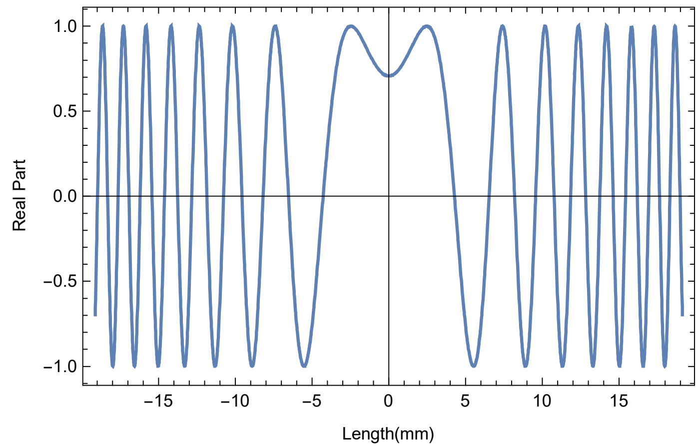
In[ ]:= $f[x\_] := \dfrac{1}{\sqrt{2 * Pi * \beta 2 * 80}} * 10^6 * \mathrm{Exp}\left[+i * \left(\dfrac{(t[x] * 10^{-3})^2}{2 * \beta 2 * 80} - \dfrac{Pi}{4}\right)\right];$

指数関数

In[ ]:=
```
FindMaximum[{Re@f[x1], {0 < x1 < 10}}, {x1, 3}]
```
極大値を求める 実部

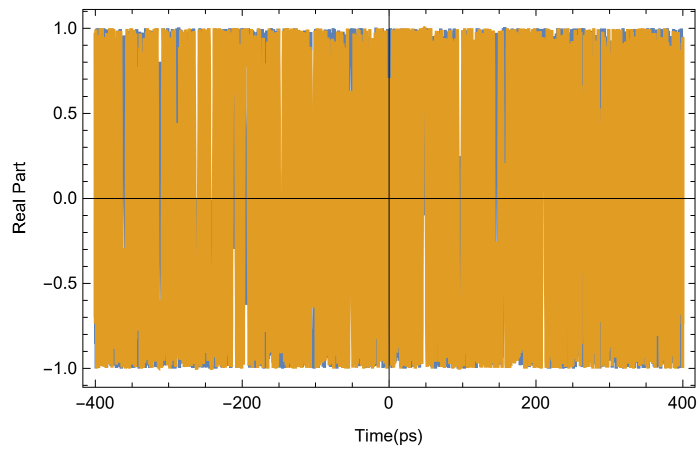
Out[ ]= $\{9.87697 \times 10^{15}, \{x1 \to 2.4694\}\}$

In[ ]:=
```
max = 9.87972350691273`*^15;
Plot[Re@f[l] / max, {l, -electrodelengthmm/2, electrodelengthmm/2},
 Frame → True, FrameLabel → {"Length(mm)", "Real Part"}]
```
プロット 実部 真 枠ラベル 長さ 実… 部分

Out[ ]=


Impulse Responce for Fiber Dispersion

In[ ]:=
```
hdis[t_] := (*1/Sqrt[2*Pi*β2*L]*10^6**) Exp[-ⅈ * (t^2/(2 * β2 * L) - Pi/4)]; (*Impluse ver.time*)

(*FindMaximum[{Re@hdis[x1],{0<x1<10}},{x1,3}]
max=9.876974769287008`*^15;*)
Plot[{Re@hdis[t * 10^-12], Im@hdis[t * 10^-12]},
 {t, -400, 400}, Frame → True, FrameLabel → {"Time(ps)", "Real Part"}]
```
指数関数 極大値を求める 実部 実部 複素数の虚部 枠 真 枠ラベル 実… 部分

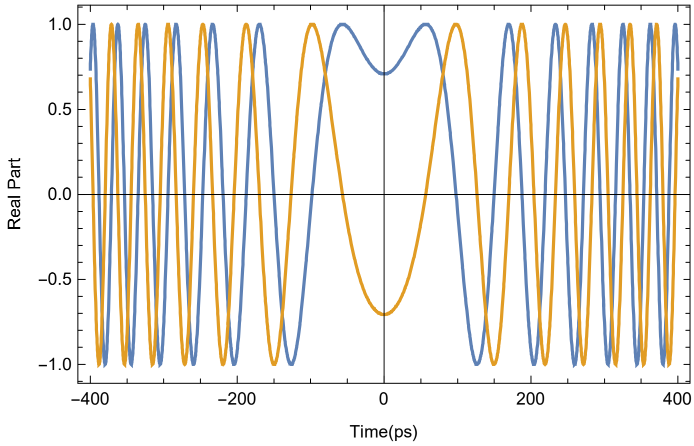
Out[ ]=


Impulse Responce for CompensationDispersion

In[ ]:=
```
hcmp[t_] :=
  (* 1/Sqrt[2*Pi*β2*80] *10^6 *) Exp[+ⅈ * (t^2/(2 * β2 * 100) - Pi/4)];
      指数関数
```

In[ ]:=
```
Plot[{Re@hcmp[t * 10^-12], Im@hcmp[t * 10^-12]}, {t, -400, 400},
プロット 実部            複素数の虚部
  Frame → True, FrameLabel → {"Time(ps)", "Real Part"}]
        真      枠ラベル              実…  部分
```

Out[ ]=



Sampling

In[ ]:=
```
samp = 0.5; (*sampling number*)
```

In[ ]:=
```
bound = IntegerPart[total * 10^12];
        整数部分
```

In[ ]:=
```
For[i = -100000, i ≤ -bound / 2, i = i + samp, hcmp2[i] = 0]
繰返し評価
For[j = 0;
繰返し評価
  i = -bound / 2, i ≤ bound / 2, i = i + samp;
  j = j + samp, hcmp2[i] = hcmp[j * 10^-12]]
For[i = bound / 2, i ≤ 100000, i = i + samp, hcmp2[i] = 0]
繰返し評価
```

In[ ]:=
```
IntegerPart[total * 10^12]
整数部分
```

Out[ ]= 784

In[ ]:=
```
For[i = -100., i ≤ bit * 25 + 100, i = i + samp,
繰返し評価
  nrzsig2[i] = nrzsig[i * 10^-12];
  If[Mod[i, 500] == 0, Print[i]]]
  If文 剰余              出力表示
```

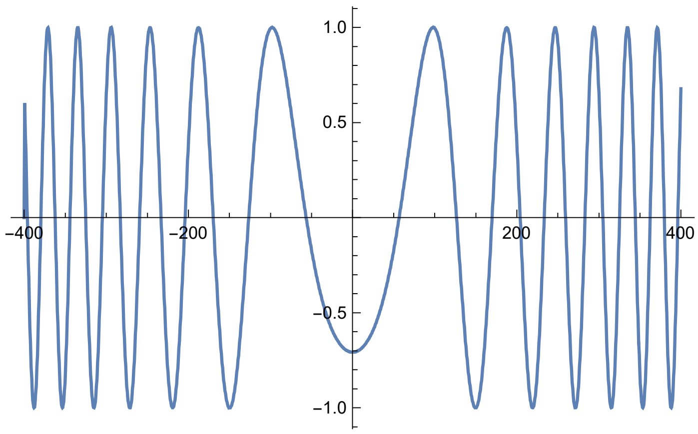
```
0.

500.
```

In[ ]:=
```
For[i = -100000, i ≤ -400, i = i + samp, hcmp3[i] = 0]
```
繰返し評価
```
For[i = -400, i ≤ 400, i = i + samp, hcmp3[i] = hcmp[i * 10^-12]]
```
繰返し評価
```
For[i = 400, i ≤ 100000, i = i + samp, hcmp3[i] = 0]
```
繰返し評価

In[ ]:=
```
For[i = -100000, i ≤ 100000, i = i + samp, hdis2[i] = hdis[i * 10^-12]]
```
繰返し評価

In[ ]:=
```
ListLinePlot[Table[{m, Im@hcmp3[m]}, {m, -400, 400, samp}]]
```
折れ線グラフ(… リストを作成 複素数の虚部

Out[ ]=



Simulation

In[ ]:=
```
simu0[a_] := simu0[a] = Sum[hdis2[z] * hcmp3[a - z], {z, -10000, 10000, samp}]
```
総和
```
simu1[a_] := simu1[a] = Sum[nrzsig2[t] * simu0[a - t], {t, -100, 25 * bit + 100, samp}]
```
総和

In[ ]:=
```
simu1[-100.]
```
Out[ ]=
```
1233.79 - 7850.33 i
```

In[ ]:=
```
For[i = -100., i ≤ 25 * bit + 100, i = i + samp, after[i] = simu1[i];
 If[Mod[i, 50] == 0, Print[i]]]
```
繰返し評価 If文 剰余 出力表示

```
-100.

-50.

0.

50.

100.

150.

200.

250.

300.

350.

400.

450.

500.

550.

600.

650.

700.
```

In[•]:=
```
aftersig = Table[{m, Abs[after[m]]}, {m, -100, 25 * bit + 100, samp}]
```
リストを作成　絶対値

Out[•]=
```
{{-100., 7946.69}, {-99.5, 7929.63}, {-99., 7912.48}, {-98.5, 7895.14},
 {-98., 7877.51}, {-97.5, 7859.47}, {-97., 7840.86}, {-96.5, 7821.5}, {-96., 7801.21},
 {-95.5, 7779.79}, {-95., 7757.02}, {-94.5, 7732.67}, {-94., 7706.54},
 {-93.5, 7678.37}, {-93., 7647.95}, {-92.5, 7615.04}, {-92., 7579.42},
 {-91.5, 7540.89}, {-91., 7499.23}, {-90.5, 7454.26}, {-90., 7405.82},
 {-89.5, 7353.75}, {-89., 7297.94}, {-88.5, 7238.3}, {-88., 7174.78}, {-87.5, 7107.35},
 {-87., 7036.06}, {-86.5, 6960.96}, {-86., 6882.2}, {-85.5, 6799.94}, {-85., 6714.43},
 {-84.5, 6625.96}, {-84., 6534.9}, {-83.5, 6441.68}, {-83., 6346.78},
 {-82.5, 6250.76}, {-82., 6154.25}, {-81.5, 6057.93}, {-81., 5962.55},
 {-80.5, 5868.91}, {-80., 5777.84}, {-79.5, 5690.25}, {-79., 5607.02},
 {-78.5, 5529.08}, {-78., 5457.32}, {-77.5, 5392.61}, {-77., 5335.75},
 {-76.5, 5287.43}, {-76., 5248.25}, {-75.5, 5218.62}, {-75., 5198.8},
 {-74.5, 5188.82}, {-74., 5188.52}, {-73.5, 5197.49}, {-73., 5215.12},
 {-72.5, 5240.57}, {-72., 5272.84}, {-71.5, 5310.72}, {-71., 5352.93},
 {-70.5, 5398.04}, {-70., 5444.59}, {-69.5, 5491.08}, {-69., 5536.}, {-68.5, 5577.9},
 {-68., 5615.36}, {-67.5, 5647.04}, {-67., 5671.68}, {-66.5, 5688.13}, {-66., 5695.36},
 {-65.5, 5692.42}, {-65., 5678.53}, {-64.5, 5653.}, {-64., 5615.27}, {-63.5, 5564.9},
 {-63., 5501.59}, {-62.5, 5425.16}, {-62., 5335.53}, {-61.5, 5232.77},
 {-61., 5117.05}, {-60.5, 4988.69}, {-60., 4848.09}, {-59.5, 4695.81},
 {-59., 4532.53}, {-58.5, 4359.06}, {-58., 4176.36}, {-57.5, 3985.53},
 {-57., 3787.87}, {-56.5, 3584.86}, {-56., 3378.24}, {-55.5, 3170.01},
 {-55., 2962.54}, {-54.5, 2758.66}, {-54., 2561.72}, {-53.5, 2375.73},
 {-53., 2205.46}, {-52.5, 2056.38}, {-52., 1934.44}, {-51.5, 1845.47},
 {-51., 1794.11}, {-50.5, 1782.66}, {-50., 1810.27}, {-49.5, 1873.02}, {-49., 1964.9},
 {-48.5, 2079.07}, {-48., 2208.86}, {-47.5, 2348.32}, {-47., 2492.41},
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```

```
In[ ]:= maxsig = Max[Table[{Abs[after[m]]}, {m, 1, 25 * bit + 100, samp}]];
                 最大 リスト…  絶対値
        aftersig2 = Table[{m, Abs[after[m]] / maxsig}, {m, -100, 25 * bit + 100, samp}];
                    リストを作成 絶対値
        ListLinePlot[aftersig2, Frame → True, FrameLabel → {"Time(ps)", "Power"},
        折れ線グラフ(点を繋いでプロット) 枠  真  枠ラベル  ベキ
         BaseStyle → {FontSize → 20, Red, FontWeight → Bold}, LabelStyle → {GrayLevel[0], Bold},
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                                プロット範囲       画像サイズ
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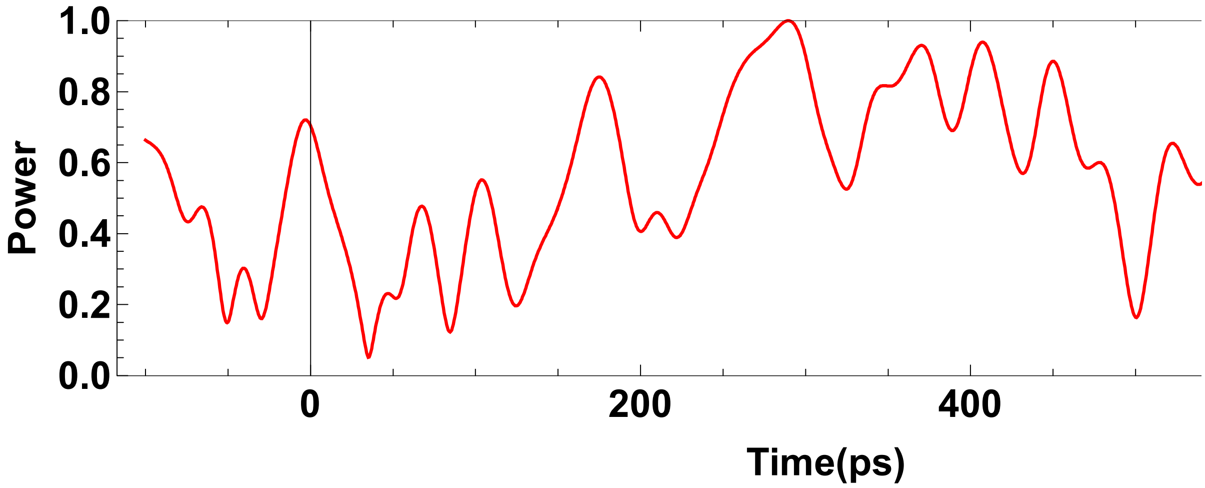
Out[ ]=



In[ ]:=
```
maxsig = Max[Table[{Abs[after[m]]}, {m, 1, 25 * bit + 100, samp}]];
           最大 リスト…   絶対値
aftersig2 = Table[{m, Abs[after[m]] / maxsig}, {m, -100, 25 * bit + 100, samp}];
            リストを作成  絶対値
ListLinePlot[aftersig2, Frame → True, FrameLabel → {"Time(ps)", "Power"},
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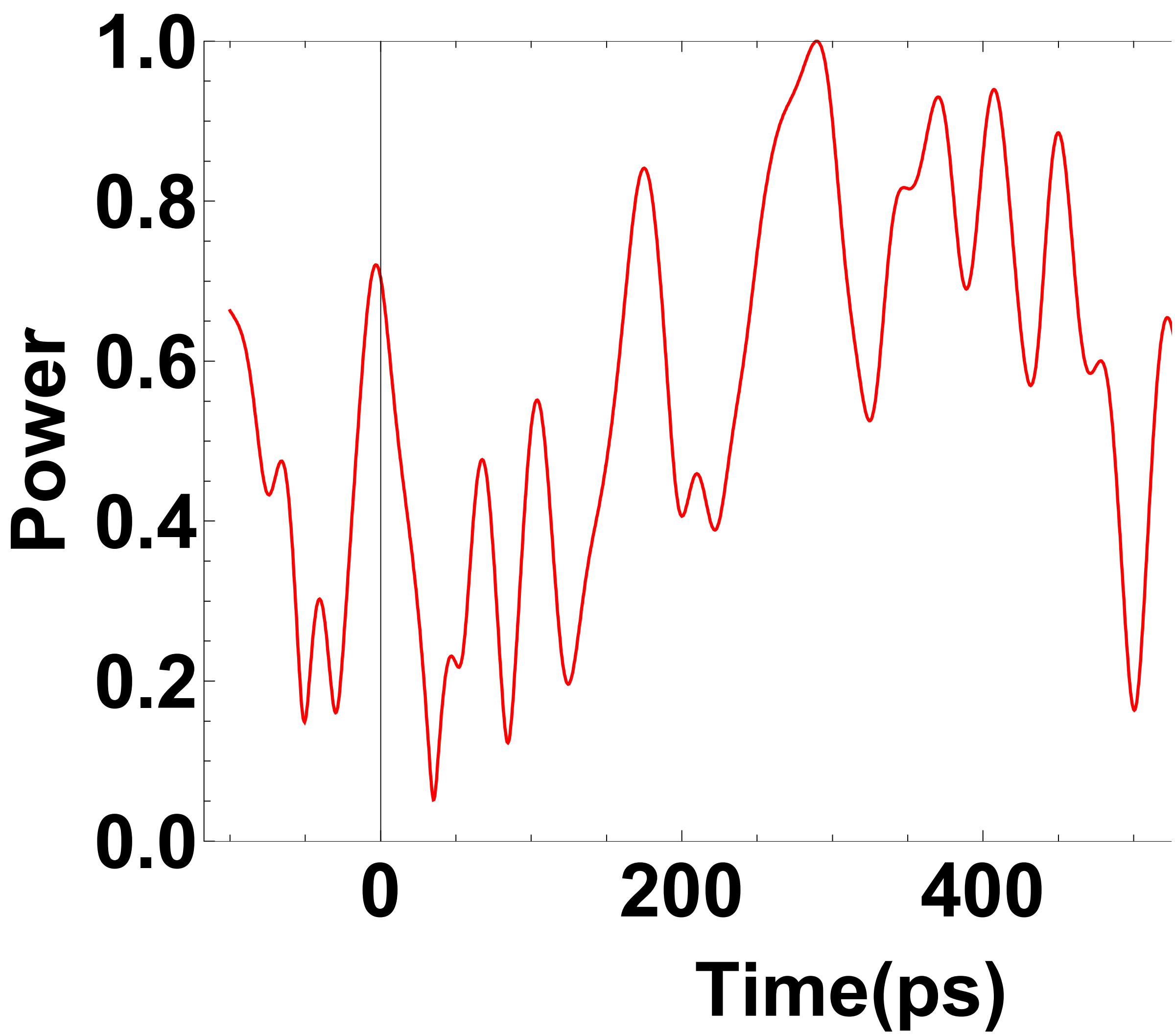
Out[ ]=



Eye Pattern

In[ ]:=
```
For[i = 0., i <= 25 * bit, i = i + samp, eyetime[i] = Mod[i, 50]]
繰返し評価                                         剰余
```

In[ ]:=
```
Print["Eye is ", bit * 25 / 50]
出力表示
```

Eye is $\frac{25}{2}$

In[•]:=
```
Table[eyetime[m], {m, 0, 25 * bit, samp}];
リストを作成
```

In[•]:=
```
eyebf = Table[{eyetime[m], nrzsig2[m + 12.5]}, {m, 0, 25 * bit - 12.5, samp}];
        リストを作成
eyeaf = Table[{eyetime[m], Abs[after[m + 12.5]] / maxsig}, {m, 0, 25 * bit - 12.5, samp}];
        リストを作成              絶対値
```

In[•]:=
```
ListLinePlot[eyebf, Frame → True, FrameLabel → {"Time(ps)", "Power"},
折れ線グラフ(点を繋いでプ…  枠      真     枠ラベル                  ベキ
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              グレーレベル    太字   縦横比              画像サイズ
```
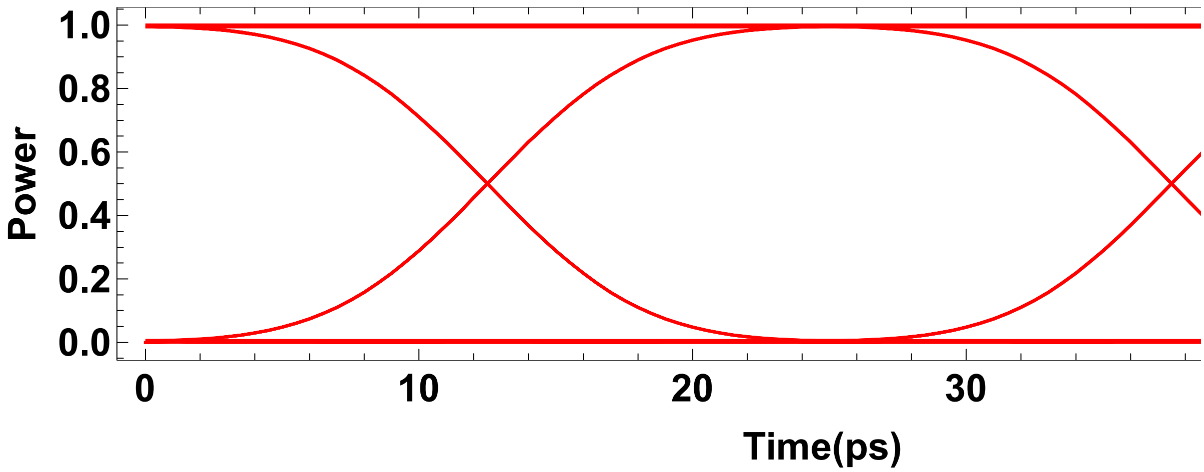

Out[•]=



In[•]:=
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折れ線グラフ(点を繋いでプ…  枠      真     枠ラベル                  ベキ
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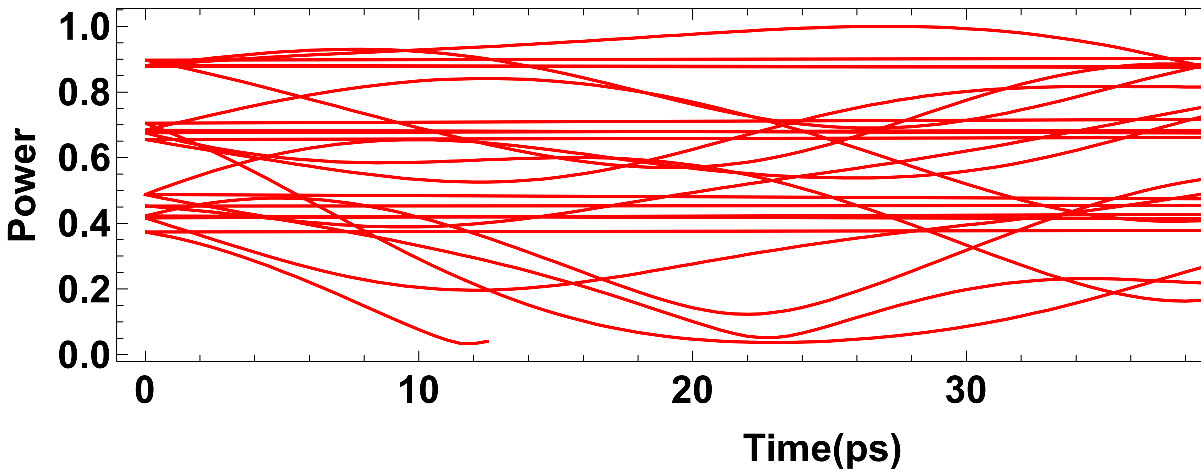
Out[•]=



Bit Error Rate

In[ ]:=
```
For[m = 22.5, m ≤ 27.5, m = m + samp, For[i = m * 2 + 1;
繰返し評価                                繰返し評価
  j = 1, i <= (bit * 25 - 12.5) * 1/samp, i = i + 50 * 1/samp;
  j++, list_m[j] = Part[eyeaf[[All, 2]], i]]]
                   部分         すべて
```

In[ ]:=
```
For[j = 22.5;
繰返し評価
 m = 1;
 n = 1;
 l0 = 0;
 l1 = 0, j ≤ 27.5, j = j + samp, For[i = 1, i ≤ bit * 25/50, i++,
                                 繰返し評価
  If[list_j[i] > 0.5, eye1[m] = list_j[i]; m++; l1 = l1 + 1];
  If文
  If[list_j[i] < 0.5, eye0[n] = list_j[i];
  If文
   n++;
   l0 = l0 + 1]]]
```

In[ ]:=
```
Print["1 is ", l1, " point"]
出力表示
Print["0 is ", l0, " point"]
出力表示
```

1 is 81 point

0 is 51 point

In[ ]:=
```
Table[eye1[m], {m, 1, l1, 1}];
リストを作成
Table[eye0[m], {m, 1, l0, 1}];
リストを作成
ave1 = Sum[eye1[i], {i, 1, l1}] / l1;
ave0 = Sum[eye0[i], {i, 1, l0}] / l0;
```

In[ ]:=
```
Print["Average of 1 is ", ave1]
出力表示
Print["Average of 0 is ", ave0]
出力表示
```

Average of 1 is 0.680821

Average of 0 is 0.202646

In[∘]:= $$\text{disp1} = \sqrt{\frac{\text{Sum}\left[(\text{eye1}[i]-\text{ave1})^2, \{i, 1, \text{l1}\}\right]}{\text{l1}}};$$

$$\text{disp0} = \sqrt{\frac{\text{Sum}\left[(\text{eye0}[i]-\text{ave0})^2, \{i, 1, \text{l0}\}\right]}{\text{l0}}};$$

In[∘]:=
```
Print["A Standard Deviation of 1 is ", disp1]
```
出力表示
```
Print["A Standard Deviation of 0 is ", disp0]
```
出力表示

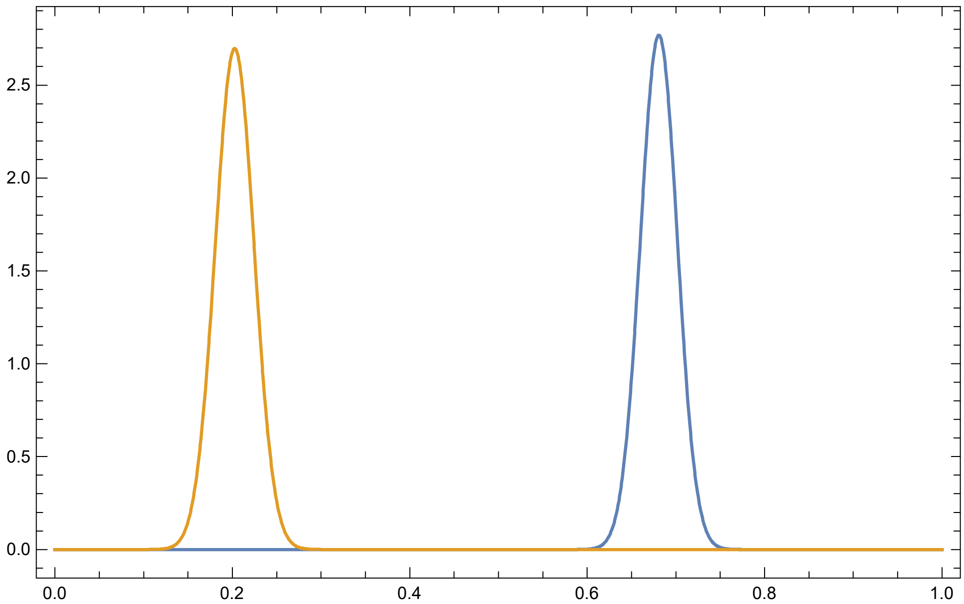
A Standard Deviation of 1 is 0.144097

A Standard Deviation of 0 is 0.147935

In[∘]:= $$\text{gauss1}[x\_] := \frac{1}{\sqrt{2 * \text{Pi} * \text{disp1}^2}} * \text{Exp}\left[\frac{-1}{2} * \left(\frac{x - \text{ave1}}{\text{disp1}^2}\right)^2\right];$$
指数関数

$$\text{gauss0}[x\_] := \frac{1}{\sqrt{2 * \text{Pi} * \text{disp0}^2}} * \text{Exp}\left[\frac{-1}{2} * \left(\frac{x - \text{ave0}}{\text{disp0}^2}\right)^2\right];$$
指数関数

In[∘]:=
```
Plot[{gauss1[x], gauss0[x]}, {x, 0, 1}, PlotRange → All, Frame → True, ImageSize → 500]
```
プロット　プロット範囲　すべて　枠　真　画像サイズ

Out[∘]=


In[∘]:= $$Q = \frac{\text{ave1} - \text{ave0}}{\text{disp1} + \text{disp0}};$$

```
Qdb = 20 Log10[Q];
```
底が10の対数
```
Print["Q-factor is ", Q]
```
出力表示
```
Print["Q-dB is ", Qdb, " dB"]
```
出力表示

```
Q-factor is 1.6374

Q-dB is 4.28311 dB
```

In[ ]:=

$$ber[x\_] := \frac{1}{2} * Erfc\left[\frac{x}{\sqrt{2}}\right];$$

相補誤差関数

$$Eyeopening = \frac{(ave1 - disp1) - (ave0 + disp0)}{ave1 - ave0};$$

```
Print["Bit Error Rate is ", ber[Q]]
出力表示
Print["Eye Opening is ", Eyeopening]
オープニング処理
```

```
Bit Error Rate is 0.0507731

Eye Opening is 0.389277
```

In[ ]:=

```
LogPlot[ber[z], {z, 1, 100}, PlotRange → {{1, 12}, {10^-20, 1}},
対数プロット                  プロット範囲
 Frame → True, FrameLabel → {"Q-factor", "Bit Error Rate"},
 枠      真     枠ラベル
 BaseStyle → {FontSize → 20, Red, FontWeight → Bold},
              フォントサイズ   赤   フォントの太さ  太字
 LabelStyle → {GrayLevel[0], Bold}, ImageSize → 500]
               グレーレベル   太字   画像サイズ
```

Out[ ]=