BC parameter sensitivity
+
μ-bunch (in)stability

BC1+3rd & BC2

SC effects after last BC

dog & BC1+3rd & BC2

dog+3rd & BC1+3rd & BC2

BC0+3rd & BC1+3rd & BC2

sign of new (induced) modulation

75A-Gun,BC0+3rd & BC1+3rd & BC2

compression with BC1 and BC2

$$\text{WRITEPRN}(\text{"setup.dat"}) := \text{BC\_S1}$$

$$BC\_S1 = \begin{pmatrix} 0 & -1 \times 10^{-5} & 1 \\ 5 \times 10^{8} & -0.103258 & 20 \\ 2 \times 10^{9} & -0.0173908 & 100 \end{pmatrix}$$

$$\frac{rf^{\langle 0 \rangle}}{MV} = \begin{pmatrix} 0 \\ 0 \\ 583.167 \\ 99.3 \\ 1.5 \times 10^{3} \end{pmatrix} \qquad \frac{rf^{\langle 1 \rangle}}{deg} = \begin{pmatrix} 0 \\ 0 \\ 0.54 \\ 146.853 \\ 2.134 \times 10^{-14} \end{pmatrix}$$

$$QT = \begin{pmatrix} 0 & 0 \\ 0.33 & 2.943 \end{pmatrix}$$

$$\frac{BC\_S1^{\langle 0 \rangle}}{MV} = \begin{pmatrix} 0 \\ 500 \\ 2 \times 10^{3} \end{pmatrix} \qquad \frac{BC\_S1^{\langle 1 \rangle}}{0.001} = \begin{pmatrix} -0.01 \\ -103.3 \\ -17.39 \end{pmatrix} \qquad BC\_S1^{\langle 2 \rangle} = \begin{pmatrix} 1 \\ 20 \\ 100 \end{pmatrix}$$

$\text{Imax1} = 50$

$\text{MV1} = 0 \qquad \text{deg1} = 0$

$\text{Imax2} = 50 \qquad \Delta e2 = 0$

$\frac{\text{Ene3}}{MV} = 1.75 \times 10^{4} \qquad \frac{r56\_3}{0.001} = 0.84 \qquad C3 = 0.9784$

$\text{MV2} = 0 \qquad \text{deg2} = 0$

$E_{rms} = 1 \times 10^{4}$

$\text{Imax3} = 1 \times 10^{3} \qquad \Delta e3 = -0.022$

$\text{Imax4} = 5000 \qquad \Delta e4 = -5.471 \times 10^{-3}$

$$MV3 = \begin{pmatrix} 0.198 & -1 \\ -0.161 & 1 \end{pmatrix} \qquad deg3 = \begin{pmatrix} 0.015 & 1 \\ -0.018 & -1 \end{pmatrix}$$

$$\frac{\Delta e4 \cdot BC\_S1_{2,0}}{MV} = -10.942$$

$$MV4 = \begin{pmatrix} 0.059 & 1 \\ -0.08 & -1 \end{pmatrix} \qquad deg4 = \begin{pmatrix} 0.055 & -1 \\ -0.044 & 1 \end{pmatrix}$$
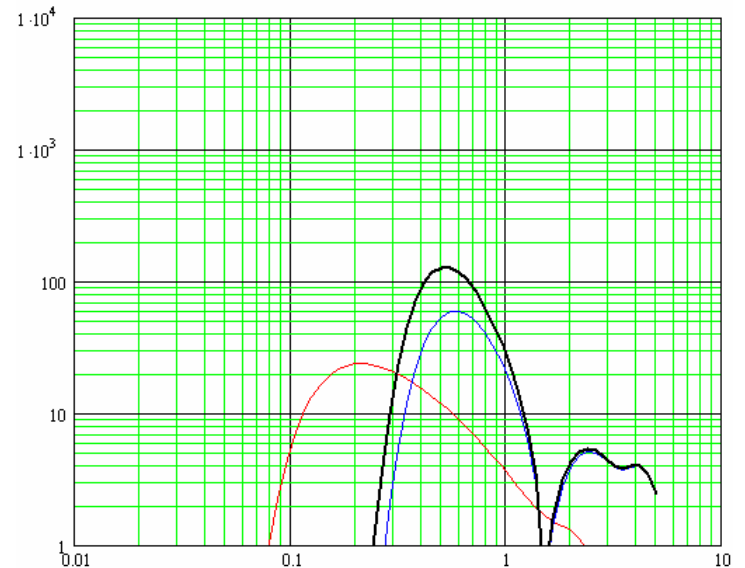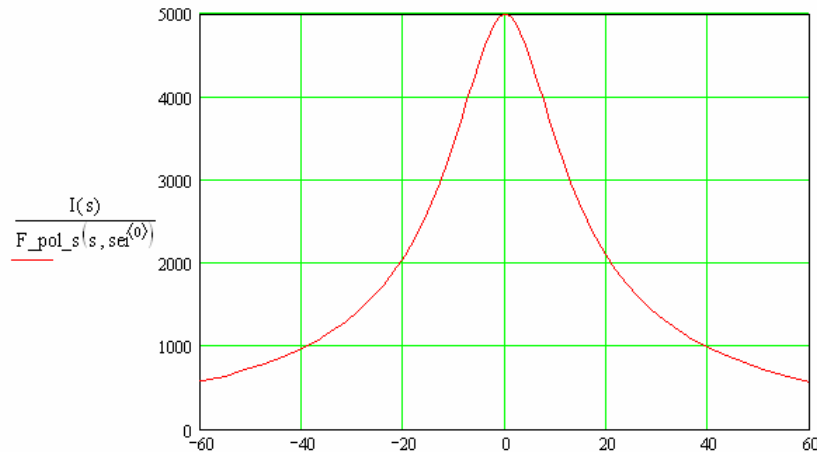
$$MV5 = \begin{pmatrix} 18.526 & -1 \\ -15.148 & 1 \end{pmatrix} \qquad deg5 = \begin{pmatrix} 2.613 & 1 \\ -4.406 & -1 \end{pmatrix}$$
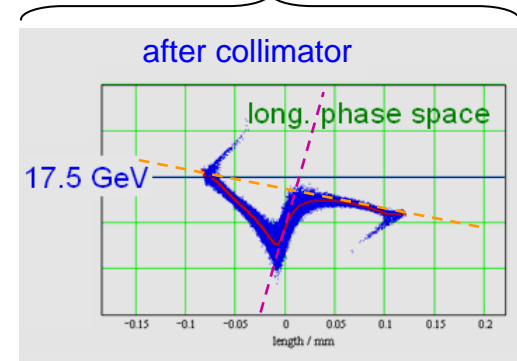
$$\min(\text{stack}(am,ph)) = 2.912 \times 10^{-4} \qquad \min(am) = 3.079 \times 10^{-4} \qquad \min(ph) = 2.912 \times 10^{-4}$$
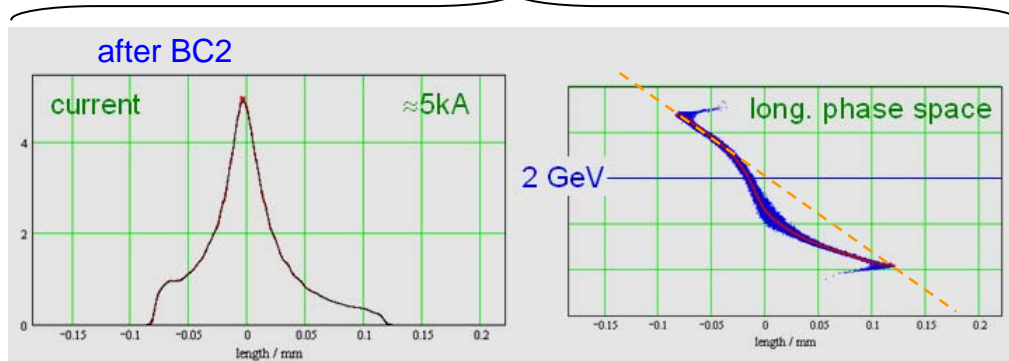
European XFEL:
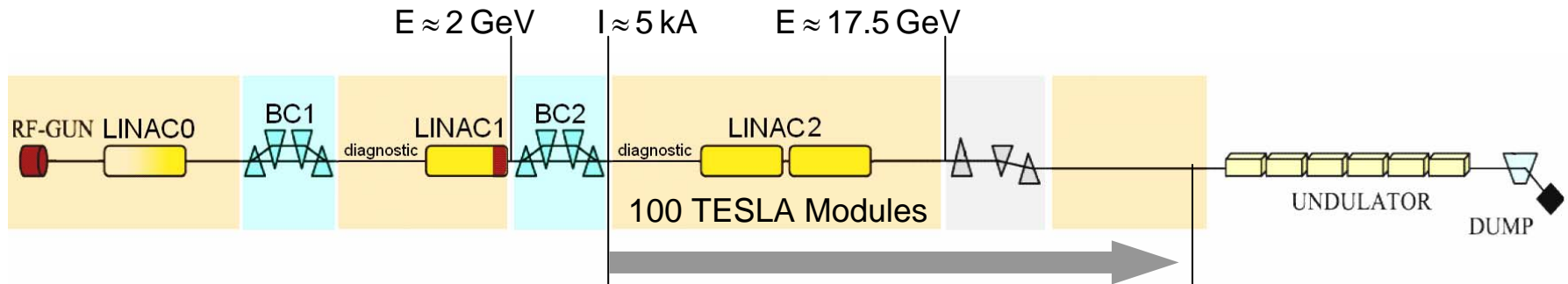
negative chirp compensated by LINAC wakes
positive chirp induced by space charge !

compression with BC1 and BC2

$\text{WRITEPRN}(\text{"setup.dat"}) := \text{BC\_S1}$

$$BC\_S1 = \begin{pmatrix} 0 & -1 \times 10^{-5} & 1 \\ 5 \times 10^8 & -0.103258 & 20 \\ 2 \times 10^9 & -0.0173908 & 100 \end{pmatrix}$$

$$\frac{\text{rf}^{\langle 0 \rangle}}{\text{MV}} = \begin{pmatrix} 0 \\ 0 \\ 808.877 \\ 256.814 \\ 1.5 \times 10^3 \end{pmatrix} \qquad \frac{\text{rf}^{\langle 1 \rangle}}{\text{deg}} = \begin{pmatrix} 0 \\ 0 \\ -43.869 \\ 108.889 \\ 2.134 \times 10^{-14} \end{pmatrix}$$

$$\frac{BC\_S1^{\langle 0 \rangle}}{\text{MV}} = \begin{pmatrix} 0 \\ 500 \\ 2 \times 10^3 \end{pmatrix} \qquad \frac{BC\_S1^{\langle 1 \rangle}}{0.001} = \begin{pmatrix} -0.01 \\ -103.3 \\ -17.39 \end{pmatrix} \qquad BC\_S1^{\langle 2 \rangle} = \begin{pmatrix} 1 \\ 20 \\ 100 \end{pmatrix}$$

$$QT = \begin{pmatrix} 0 & 0 \\ 0.33 & 12 \end{pmatrix}$$

$\dfrac{\text{Ene3}}{\text{MV}} = 1.75 \times 10^4$ 　　　 $\dfrac{\text{r56\_3}}{0.001} = 0.84$ 　　　 $C3 = 0.9784$

$\text{Imax1} = 50$ 　　　 $\text{MV1} = 0$ 　　　 $\text{deg1} = 0$ 　　　 $E_{\text{rms}} = 1 \times 10^4$

$\text{Imax2} = 50$ 　　 $\Delta e2 = 0$ 　　　 $\text{MV2} = 0$ 　　　 $\text{deg2} = 0$

$\text{Imax3} = 1 \times 10^3$ 　　 $\Delta e3 = -0.021$

$\text{Imax4} = 5000$ 　　 $\Delta e4 = -5.366 \times 10^{-3}$ 　　 $\text{MV3} = \begin{pmatrix} 0.138 & -1 \\ -0.111 & 1 \end{pmatrix}$ 　 $\text{deg3} = \begin{pmatrix} 0.222 & 1 \\ -0.229 & -1 \end{pmatrix}$

$\dfrac{\Delta e4 \cdot BC\_S1_{2,0}}{\text{MV}} = -10.732$ 　　 $\text{MV4} = \begin{pmatrix} 0.044 & 1 \\ -0.064 & -1 \end{pmatrix}$ 　 $\text{deg4} = \begin{pmatrix} 0.635 & -1 \\ -0.629 & 1 \end{pmatrix}$

$\text{MV5} = \begin{pmatrix} 18.526 & -1 \\ -15.149 & 1 \end{pmatrix}$ 　 $\text{deg5} = \begin{pmatrix} 2.613 & 1 \\ -4.406 & -1 \end{pmatrix}$

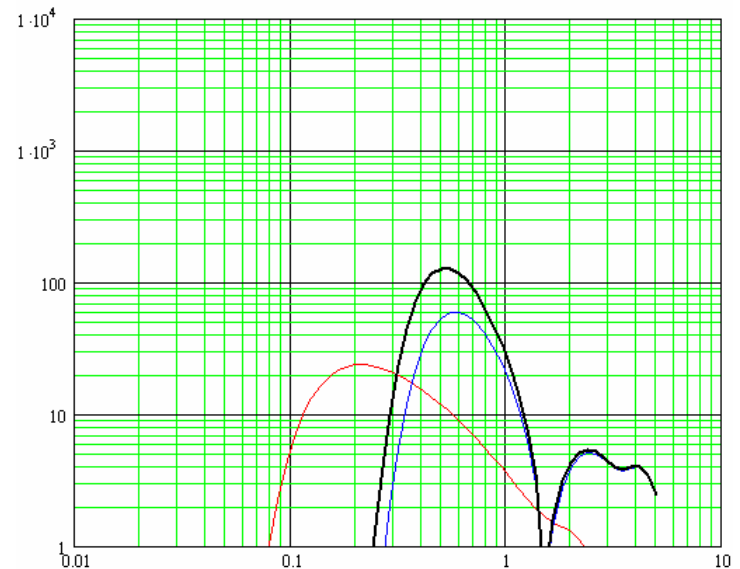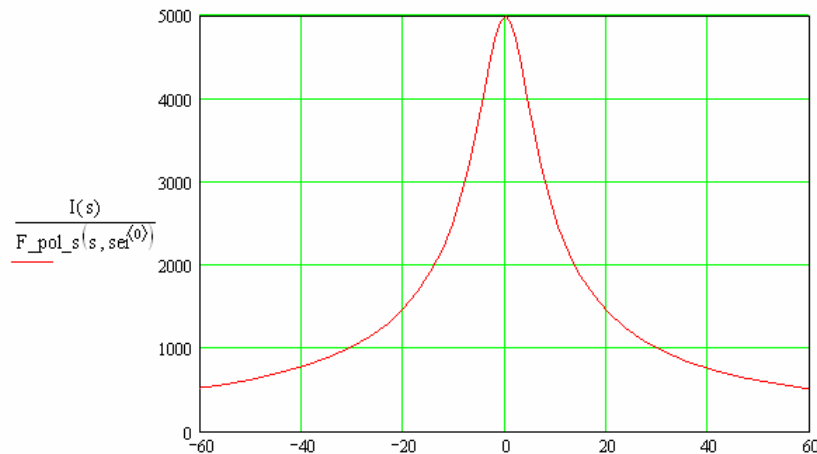$\min(\text{stack}(\text{am},\text{ph})) = 1.536 \times 10^{-4}$ 　　 $\min(\text{am}) = 1.536 \times 10^{-4}$ 　 $\min(\text{ph}) = 3.933 \times 10^{-3}$

$\dfrac{I(s)}{\text{F\_pol\_s}(s, \text{set}^{\langle 0 \rangle})}$

compression with BC1 and BC2

$$\mathrm{WRITEPRN}(\text{"setup.dat"}) := \mathrm{BC\_S1}$$

$$\mathrm{BC\_S1} = \begin{pmatrix} 0 & -1 \times 10^{-5} & 1 \\ 5 \times 10^{8} & -0.07 & 8 \\ 2 \times 10^{9} & -0.020857 & 66.6666667 \end{pmatrix}$$

$$\frac{\mathrm{rf}^{\langle 0 \rangle}}{\mathrm{MV}} = \begin{pmatrix} 0 \\ 0 \\ 605.358 \\ 113.398 \\ 1.958 \times 10^{3} \end{pmatrix} \qquad \frac{\mathrm{rf}^{\langle 1 \rangle}}{\deg} = \begin{pmatrix} 0 \\ 0 \\ 6.969 \\ 152.831 \\ 40 \end{pmatrix}$$

$$\mathrm{QT} = \begin{pmatrix} 0 & 0 \\ 0.614 & 2.943 \end{pmatrix}$$

$$\frac{\mathrm{BC\_S1}^{\langle 0 \rangle}}{\mathrm{MV}} = \begin{pmatrix} 0 \\ 500 \\ 2 \times 10^{3} \end{pmatrix} \qquad \frac{\mathrm{BC\_S1}^{\langle 1 \rangle}}{0.001} = \begin{pmatrix} -0.01 \\ -70 \\ -20.86 \end{pmatrix} \qquad \mathrm{BC\_S1}^{\langle 2 \rangle} = \begin{pmatrix} 1 \\ 8 \\ 66.67 \end{pmatrix}$$

$$\frac{\mathrm{Ene3}}{\mathrm{MV}} = 1.75 \times 10^{4} \qquad \frac{\mathrm{r56\_3}}{0.001} = 0.84 \qquad \mathrm{C3} = 0.96735$$

$$\mathrm{E_{rms}} = 1 \times 10^{4}$$
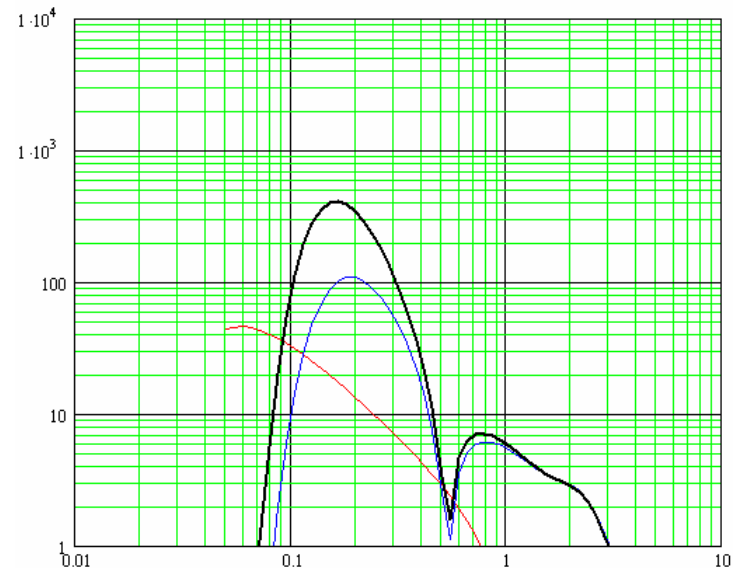
$\mathrm{Imax1} = 75$

$\mathrm{Imax2} = 75 \qquad \Delta e2 = 0$

$\mathrm{Imax3} = 600.022 \qquad \Delta e3 = -0.02$

$\mathrm{Imax4} = 5000 \qquad \Delta e4 = -8.496 \times 10^{-3}$

$$\frac{\Delta e4 \cdot \mathrm{BC\_S1}_{2,0}}{\mathrm{MV}} = -16.993$$

$\mathrm{MV1} = 0 \qquad \deg 1 = 0$

$\mathrm{MV2} = 0 \qquad \deg 2 = 0$

$$\mathrm{MV3} = \begin{pmatrix} 0.769 & -1 \\ -0.621 & 1 \end{pmatrix} \qquad \deg 3 = \begin{pmatrix} 0.043 & 1 \\ -0.052 & -1 \end{pmatrix}$$

$$\mathrm{MV4} = \begin{pmatrix} 0.226 & 1 \\ -0.279 & -1 \end{pmatrix} \qquad \deg 4 = \begin{pmatrix} 0.137 & -1 \\ -0.112 & 1 \end{pmatrix}$$
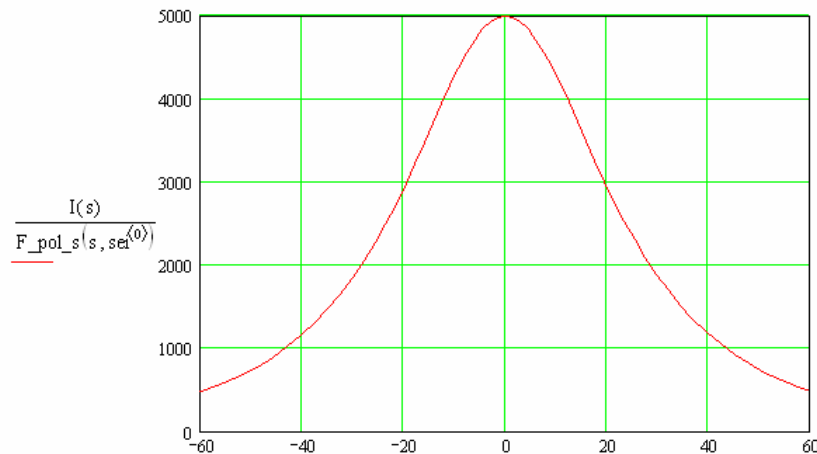
$$\mathrm{MV5} = \begin{pmatrix} 16.05 & -1 \\ -13.202 & 1 \end{pmatrix} \qquad \deg 5 = \begin{pmatrix} 0.277 & 1 \\ -0.381 & -1 \end{pmatrix}$$

$\min(\mathrm{stack(am,ph)}) = 8.274 \times 10^{-4} \qquad \min(\mathrm{am}) = 1.148 \times 10^{-3} \qquad \min(\mathrm{ph}) = 8.274 \times 10^{-4}$

$$\frac{I(s)}{\mathrm{F\_pol\_s}(s,\mathrm{set}^{\langle 0 \rangle})}$$

ccompression with dog, BC1, BC2 (t566_dog=1.0m)

$\text{WRITEPRN}("setup.dat") := BC\_S1$

$$BC\_S1 = \begin{pmatrix} 1.3 \times 10^8 & 0.02 & 1.1 \\ 5 \times 10^8 & -0.1 & 13.6363636 \\ 2 \times 10^9 & -0.021768 & 100 \end{pmatrix}$$

$$\frac{rf^{\langle 0 \rangle}}{MV} = \begin{pmatrix} 131.787 \\ 0 \\ 455.246 \\ 98.192 \\ 1.596 \times 10^3 \end{pmatrix} \qquad \frac{rf^{\langle 1 \rangle}}{deg} = \begin{pmatrix} -9.447 \\ 0 \\ 4.892 \\ 148.35 \\ 20 \end{pmatrix}$$

$$QT = \begin{pmatrix} 0 & 0 \\ 0.597 & 2.86 \end{pmatrix}$$

$Imax1 = 50$

$Imax2 = 55.118 \qquad \Delta e2 = 0.011$

$Imax3 = 752.086 \qquad \Delta e3 = -0.021$

$Imax4 = 5000 \qquad \Delta e4 = -6.411 \times 10^{-3}$

$$\frac{\Delta e4 \cdot BC\_S1_{2,0}}{MV} = -12.821$$

$$MV1 = \begin{pmatrix} 0.118 & -1 \\ -0.087 & 1 \end{pmatrix} \qquad deg1 = \begin{pmatrix} 0.104 & 1 \\ -0.133 & -1 \end{pmatrix}$$

$$MV2 = 0 \qquad deg2 = 0$$

$$MV3 = \begin{pmatrix} 0.318 & -1 \\ -0.257 & 1 \end{pmatrix} \qquad deg3 = \begin{pmatrix} 0.024 & 1 \\ -0.029 & -1 \end{pmatrix}$$
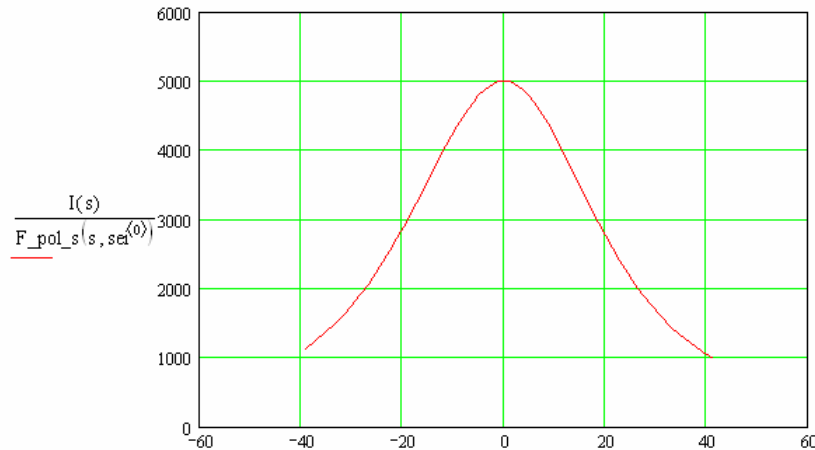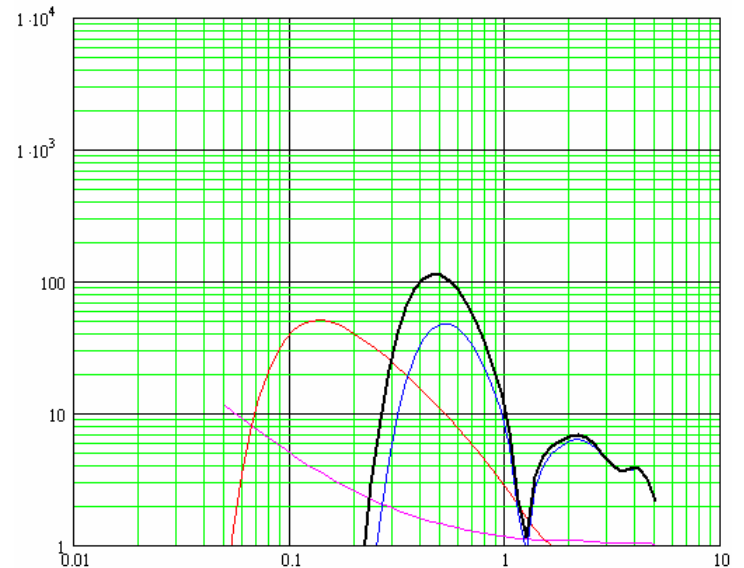
$$MV4 = \begin{pmatrix} 0.087 & 1 \\ -0.109 & -1 \end{pmatrix} \qquad deg4 = \begin{pmatrix} 0.07 & -1 \\ -0.057 & 1 \end{pmatrix}$$

$$MV5 = \begin{pmatrix} 15.18 & -1 \\ -12.444 & 1 \end{pmatrix} \qquad deg5 = \begin{pmatrix} 0.666 & 1 \\ -0.857 & -1 \end{pmatrix}$$

$\min(stack(am,ph)) = 4.666 \times 10^{-4} \qquad \min(am) = 6.317 \times 10^{-4} \qquad \min(ph) = 4.666 \times 10^{-4}$

$$\frac{BC\_S1^{\langle 0 \rangle}}{MV} = \begin{pmatrix} 130 \\ 500 \\ 2 \times 10^3 \end{pmatrix} \qquad \frac{BC\_S1^{\langle 1 \rangle}}{0.001} = \begin{pmatrix} 20 \\ -100 \\ -21.77 \end{pmatrix} \qquad BC\_S1^{\langle 2 \rangle} = \begin{pmatrix} 1.1 \\ 13.64 \\ 100 \end{pmatrix}$$

$$\frac{Ene4}{MV} = 1.75 \times 10^4 \qquad \frac{r56\_4}{0.001} = 0.84 \qquad C4 = 0.97563$$

$$E_{rms} = 1 \times 10^4$$

$\dfrac{I(s)}{F\_pol\_s\left(s, set^{\langle 0 \rangle}\right)}$

ccompression with dog, BC1, BC2 (t566_dog=1.0m)

$\text{WRITEPRN}(\text{"setup.dat"}) := BC\_S1$

$$BC\_S1 = \begin{pmatrix} 1.3 \times 10^8 & 0.04 & 1.2 \\ 5 \times 10^8 & -0.1 & 10 \\ 2 \times 10^9 & -0.0293752 & 100 \end{pmatrix}$$

$$\frac{rf^{\langle 0 \rangle}}{MV} = \begin{pmatrix} 131.503 \\ 0 \\ 460.377 \\ 101.175 \\ 1.596 \times 10^3 \end{pmatrix} \qquad \frac{rf^{\langle 1 \rangle}}{deg} = \begin{pmatrix} -8.672 \\ 0 \\ 5.167 \\ 151.02 \\ 20 \end{pmatrix}$$

$$QT = \begin{pmatrix} 0 & 0 \\ 0.676 & 2.73 \end{pmatrix}$$

$$\frac{BC\_S1^{\langle 0 \rangle}}{MV} = \begin{pmatrix} 130 \\ 500 \\ 2 \times 10^3 \end{pmatrix} \qquad \frac{BC\_S1^{\langle 1 \rangle}}{0.001} = \begin{pmatrix} 40 \\ -100 \\ -29.38 \end{pmatrix} \qquad BC\_S1^{\langle 2 \rangle} = \begin{pmatrix} 1.2 \\ 10 \\ 100 \end{pmatrix}$$

$Imax1 = 50$

$Imax2 = 60.005 \qquad \Delta e2 = 9.966 \times 10^{-3}$

$Imax3 = 600.24 \qquad \Delta e3 = -0.018$
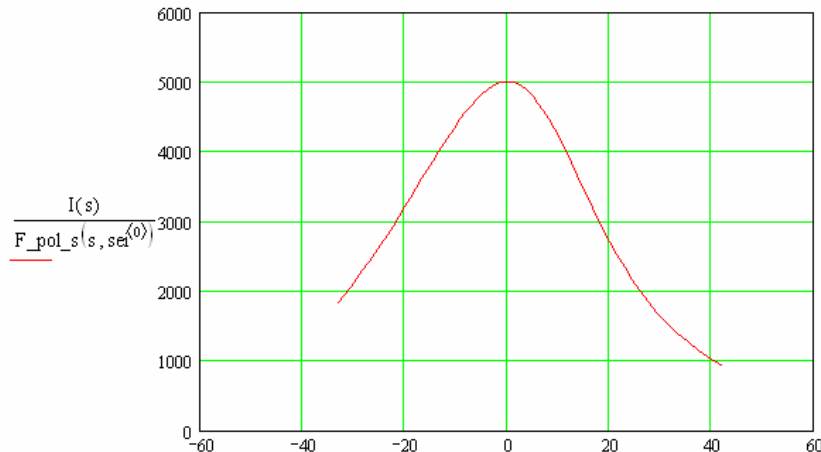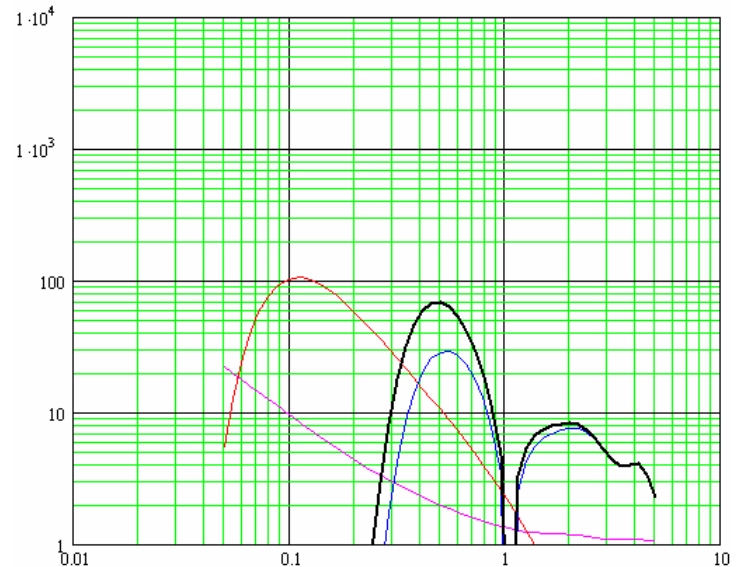
$Imax4 = 5000 \qquad \Delta e4 = -6.132 \times 10^{-3}$

$$\frac{\Delta e4 \cdot BC\_S1_{2,0}}{MV} = -12.265$$

$$MV1 = \begin{pmatrix} 0.323 & -1 \\ -0.158 & 1 \end{pmatrix} \qquad deg1 = \begin{pmatrix} 0.081 & 1 \\ -0.101 & -1 \end{pmatrix}$$

$MV2 = 0 \qquad deg2 = 0$

$$MV3 = \begin{pmatrix} 0.42 & -1 \\ -0.34 & 1 \end{pmatrix} \qquad deg3 = \begin{pmatrix} 0.027 & 1 \\ -0.033 & -1 \end{pmatrix}$$

$$MV4 = \begin{pmatrix} 0.109 & 1 \\ -0.136 & -1 \end{pmatrix} \qquad deg4 = \begin{pmatrix} 0.072 & -1 \\ -0.059 & 1 \end{pmatrix}$$

$$MV5 = \begin{pmatrix} 12.064 & -1 \\ -9.886 & 1 \end{pmatrix} \qquad deg5 = \begin{pmatrix} 0.465 & 1 \\ -0.59 & -1 \end{pmatrix}$$

$\min(\text{stack}(am, ph)) = 5.292 \times 10^{-4} \qquad \min(am) = 8.251 \times 10^{-4} \qquad \min(ph) = 5.292 \times 10^{-4}$

$\frac{Ene4}{MV} = 1.75 \times 10^4 \qquad \frac{r56\_4}{0.001} = 0.84 \qquad C4 = 0.9766$

$E_{rms} = 1 \times 10^4$

compression with dog, BC1, BC2 (t566_dog=1.0m)

$\text{WRITEPRN}(\text{"setup.dat"}) := \text{BC\_S1}$

$$BC\_S1 = \begin{pmatrix} 1.3 \times 10^8 & 0.04 & 1.2 \\ 4 \times 10^8 & -0.1 & 8.3333333 \\ 2 \times 10^9 & -0.0272687 & 100 \end{pmatrix}$$

$$QT = \begin{pmatrix} 0 & 0 \\ 0.772 & 4.55 \end{pmatrix}$$

$$\frac{rf^{\langle 0 \rangle}}{MV} = \begin{pmatrix} 131.503 \\ 0 \\ 346.869 \\ 100.309 \\ 2.089 \times 10^3 \end{pmatrix} \qquad \frac{rf^{\langle 1 \rangle}}{deg} = \begin{pmatrix} -8.672 \\ 0 \\ -9.253 \\ 136.164 \\ 40 \end{pmatrix}$$

$\text{Imax1} = 50$

$\text{Imax2} = 60.005 \qquad \Delta e2 = 9.966 \times 10^{-3}$

$\text{Imax3} = 500.003 \qquad \Delta e3 = -0.018$

$\text{Imax4} = 5000 \qquad \Delta e4 = -8.198 \times 10^{-3}$

$$\frac{\Delta e4 \cdot BC\_S1_{2,0}}{MV} = -16.397$$

$$MV1 = \begin{pmatrix} 1.08 & 1 \\ -0.277 & 1 \end{pmatrix} \qquad deg1 = \begin{pmatrix} 0.095 & 1 \\ -0.118 & -1 \end{pmatrix}$$

$MV2 = 0 \qquad deg2 = 0$

$$MV3 = \begin{pmatrix} 0.661 & -1 \\ -0.513 & 1 \end{pmatrix} \qquad deg3 = \begin{pmatrix} 0.052 & 1 \\ -0.063 & -1 \end{pmatrix}$$

$$MV4 = \begin{pmatrix} 0.12 & 1 \\ -0.151 & -1 \end{pmatrix} \qquad deg4 = \begin{pmatrix} 0.106 & -1 \\ -0.087 & 1 \end{pmatrix}$$
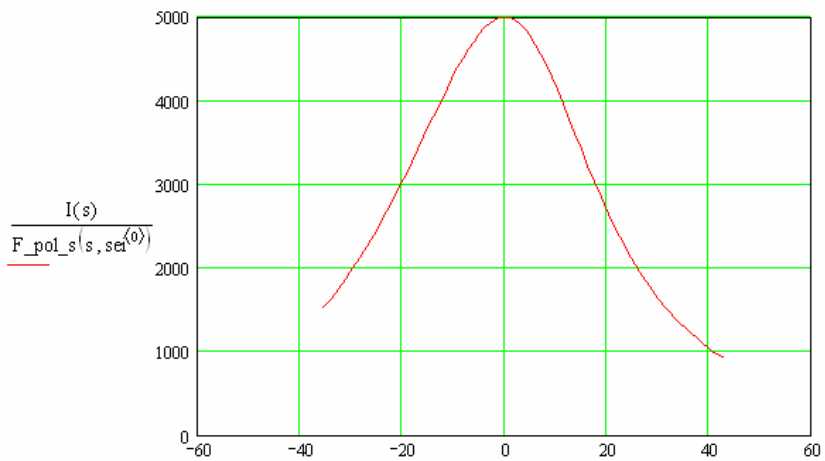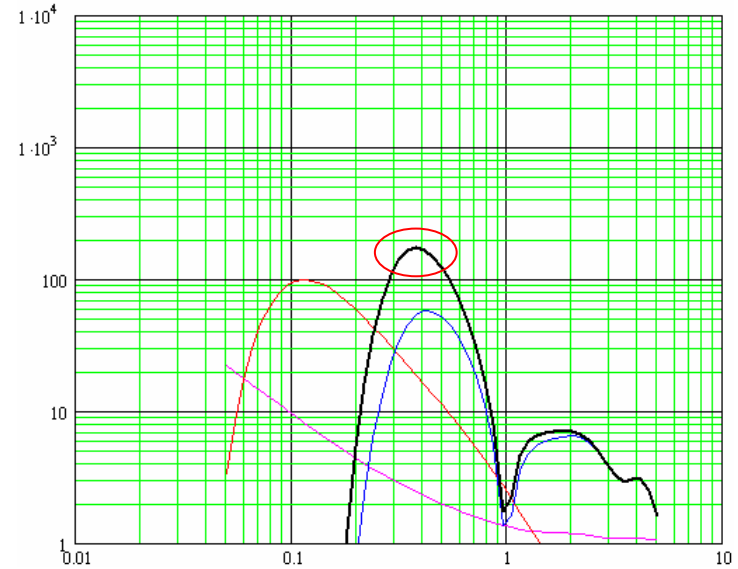
$$MV5 = \begin{pmatrix} 13.929 & -1 \\ -11.473 & 1 \end{pmatrix} \qquad deg5 = \begin{pmatrix} 0.186 & 1 \\ -0.29 & -1 \end{pmatrix}$$

$\min(\text{stack}(am,ph)) = 9.988 \times 10^{-4} \qquad \min(am) = 1.354 \times 10^{-3} \qquad \min(ph) = 9.988 \times 10^{-4}$

$$\frac{BC\_S1^{\langle 0 \rangle}}{MV} = \begin{pmatrix} 130 \\ 400 \\ 2 \times 10^3 \end{pmatrix} \qquad \frac{BC\_S1^{\langle 1 \rangle}}{0.001} = \begin{pmatrix} 40 \\ -100 \\ -27.27 \end{pmatrix} \qquad BC\_S1^{\langle 2 \rangle} = \begin{pmatrix} 1.2 \\ 8.333 \\ 100 \end{pmatrix}$$

$\frac{Ene4}{MV} = 1.75 \times 10^4 \qquad \frac{r56\_4}{0.001} = 0.84 \qquad C4 = 0.96929$

$E_{rms} = 1 \times 10^4$

$$\frac{I(s)}{F\_pol\_s(s, set^{\langle 0 \rangle})}$$

compression with dog, BC1, BC2 (t566_dog=1.0m)

WRITEPRN("setup.dat") := BC_S1

$$BC\_S1 = \begin{pmatrix} 1.3 \times 10^8 & 0.05 & 1.25 \\ 5 \times 10^8 & -0.1 & 8 \\ 2 \times 10^9 & -0.0360617 & 100 \end{pmatrix}$$

$$\frac{rf^{\langle 0 \rangle}}{MV} = \begin{pmatrix} 131.386 \\ 0 \\ 462.386 \\ 103.417 \\ 1.596 \times 10^3 \end{pmatrix} \qquad \frac{rf^{\langle 1 \rangle}}{deg} = \begin{pmatrix} -8.33 \\ 0 \\ 4.504 \\ 151.586 \\ 20 \end{pmatrix}$$

$$QT = \begin{pmatrix} 0 & 0 \\ 0.715 & 2.73 \end{pmatrix}$$

$$\frac{BC\_S1^{\langle 0 \rangle}}{MV} = \begin{pmatrix} 130 \\ 500 \\ 2 \times 10^3 \end{pmatrix} \qquad \frac{BC\_S1^{\langle 1 \rangle}}{0.001} = \begin{pmatrix} 50 \\ -100 \\ -36.06 \end{pmatrix} \qquad BC\_S1^{\langle 2 \rangle} = \begin{pmatrix} 1.25 \\ 8 \\ 100 \end{pmatrix}$$

$Imax1 = 50$

$$MV1 = \begin{pmatrix} 0.713 & 1 \\ -0.291 & 1 \end{pmatrix} \qquad deg1 = \begin{pmatrix} 0.075 & 1 \\ -0.092 & -1 \end{pmatrix}$$

$\frac{Ene4}{MV} = 1.75 \times 10^4$

$\frac{r56\_4}{0.001} = 0.84$

$C4 = 0.9766$

$Imax2 = 62.507 \qquad \Delta e2 = 9.568 \times 10^{-3}$

$MV2 = 0 \qquad deg2 = 0$

$E_{rms} = 1 \times 10^4$

$Imax3 = 500 \qquad \Delta e3 = -0.017$

$$MV3 = \begin{pmatrix} 0.53 & -1 \\ -0.428 & 1 \end{pmatrix} \qquad deg3 = \begin{pmatrix} 0.03 & 1 \\ -0.037 & -1 \end{pmatrix}$$
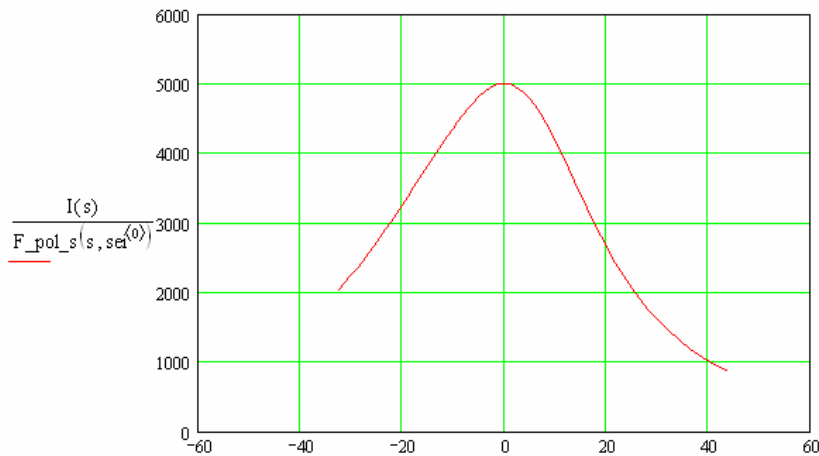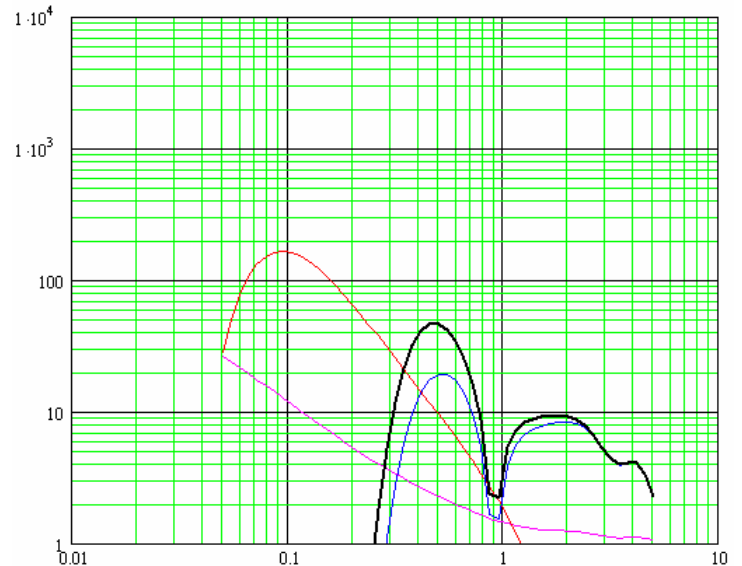
$Imax4 = 5000 \qquad \Delta e4 = -6.129 \times 10^{-3}$

$$MV4 = \begin{pmatrix} 0.124 & 1 \\ -0.156 & -1 \end{pmatrix} \qquad deg4 = \begin{pmatrix} 0.074 & -1 \\ -0.06 & 1 \end{pmatrix}$$

$$\frac{\Delta e4 \cdot BC\_S1_{2,0}}{MV} = -12.258$$

$$MV5 = \begin{pmatrix} 10.098 & -1 \\ -8.259 & 1 \end{pmatrix} \qquad deg5 = \begin{pmatrix} 0.335 & 1 \\ -0.442 & -1 \end{pmatrix}$$

$min(stack(am, ph)) = 5.805 \times 10^{-4} \qquad min(am) = 1.036 \times 10^{-3} \qquad min(ph) = 5.805 \times 10^{-4}$

$$\frac{I(s)}{F\_pol\_s(s, set^{\langle 0 \rangle})}$$

compression with dog, BC1, BC2 (t566_dog=1.0m)

$\text{WRITEPRN}(\text{"setup.dat"}) := BC\_S1$

$$BC\_S1 = \begin{pmatrix} 1.3 \times 10^8 & 0.05 & 1.4 \\ 5 \times 10^8 & -0.1 & 8.5714286 \\ 2 \times 10^9 & -0.0333512 & 100 \end{pmatrix}$$

$$QT = \begin{pmatrix} -0.4 & 0 \\ 0.25 & 4.16 \end{pmatrix}$$

$\text{Imax1} = 50$

$\text{Imax2} = 70.952 \qquad \Delta e2 = 0.014$

$\text{Imax3} = 606.485 \qquad \Delta e3 = -0.015$

$\text{Imax4} = 5000.424 \qquad \Delta e4 = -5.379 \times 10^{-3}$

$$\frac{\Delta e4 \cdot BC\_S1_{2,0}}{MV} = -10.758$$

$$\min(\text{stack}(am, ph)) = 3.672 \times 10^{-4}$$

$$\frac{rf^{\langle 0 \rangle}}{MV} = \begin{pmatrix} 143.059 \\ 9.816 \\ 433.314 \\ 99.831 \\ 1.596 \times 10^3 \end{pmatrix} \qquad \frac{rf^{\langle 1 \rangle}}{\deg} = \begin{pmatrix} -12.348 \\ 173.371 \\ -4.671 \\ 128.301 \\ 20 \end{pmatrix}$$

$$MV1 = \begin{pmatrix} 0.063 & -1 \\ -0.042 & 1 \end{pmatrix} \qquad \deg1 = \begin{pmatrix} 0.151 & 1 \\ -0.221 & -1 \end{pmatrix}$$

$$MV2 = \begin{pmatrix} 0.045 & 1 \\ -0.056 & -1 \end{pmatrix} \qquad \deg2 = \begin{pmatrix} 0.393 & -1 \\ -0.319 & 1 \end{pmatrix}$$

$$MV3 = \begin{pmatrix} 0.436 & -1 \\ -0.352 & 1 \end{pmatrix} \qquad \deg3 = \begin{pmatrix} 0.039 & 1 \\ -0.048 & -1 \end{pmatrix}$$

$$MV4 = \begin{pmatrix} 0.1 & 1 \\ -0.124 & -1 \end{pmatrix} \qquad \deg4 = \begin{pmatrix} 0.15 & -1 \\ -0.123 & 1 \end{pmatrix}$$

$$MV5 = \begin{pmatrix} 12.303 & -1 \\ -10.067 & 1 \end{pmatrix} \qquad \deg5 = \begin{pmatrix} 0.436 & 1 \\ -0.555 & -1 \end{pmatrix}$$

$$\min(am) = 3.672 \times 10^{-4} \qquad \min(ph) = 7.63 \times 10^{-4}$$

$$\frac{BC\_S1^{\langle 0 \rangle}}{MV} = \begin{pmatrix} 130 \\ 500 \\ 2 \times 10^3 \end{pmatrix} \qquad \frac{BC\_S1^{\langle 1 \rangle}}{0.001} = \begin{pmatrix} 50 \\ -100 \\ -33.35 \end{pmatrix} \qquad BC\_S1^{\langle 2 \rangle} = \begin{pmatrix} 1.4 \\ 8.571 \\ 100 \end{pmatrix}$$
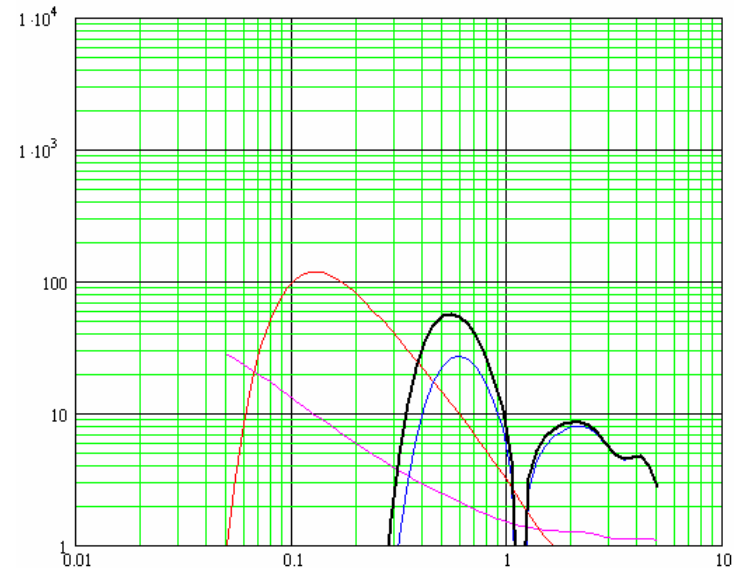
$$\frac{Ene4}{MV} = 1.75 \times 10^4 \qquad \frac{r56\_4}{0.001} = 0.84 \qquad C4 = 0.97933$$

$$E_{rms} = 1 \times 10^4$$

compression with BC1 ... BC3

$$\text{WRITEPRN}(\text{"setup.dat"}) := \text{BC\_S1}$$

$$\text{BC\_S1} = \begin{pmatrix} 1.2 \times 10^8 & -0.15 & 2 \\ 5 \times 10^8 & -0.05 & 5 \\ 2 \times 10^9 & -0.0241987 & 100 \end{pmatrix}$$

$$\frac{\text{rf}^{\langle 0 \rangle}}{\text{MV}} = \begin{pmatrix} 137.155 \\ 16.174 \\ 505.965 \\ 111.35 \\ 1.958 \times 10^3 \end{pmatrix} \qquad \frac{\text{rf}^{\langle 1 \rangle}}{\text{deg}} = \begin{pmatrix} 6.898 \\ -177.838 \\ 16.831 \\ 159.488 \\ 40 \end{pmatrix}$$

$$\text{QT} = \begin{pmatrix} 0.078 & 0 \\ 0.909 & 2.4 \end{pmatrix}$$

$$\frac{\text{BC\_S1}^{\langle 0 \rangle}}{\text{MV}} = \begin{pmatrix} 120 \\ 500 \\ 2 \times 10^3 \end{pmatrix} \qquad \frac{\text{BC\_S1}^{\langle 1 \rangle}}{0.001} = \begin{pmatrix} -150 \\ -50 \\ -24.2 \end{pmatrix} \qquad \text{BC\_S1}^{\langle 2 \rangle} = \begin{pmatrix} 2 \\ 5 \\ 100 \end{pmatrix}$$

$$\text{Imax1} = 50$$

$$\frac{\text{Ene4}}{\text{MV}} = 1.75 \times 10^4 \qquad \frac{\text{r56\_4}}{0.001} = 0.84 \qquad \text{C4} = 0.96553$$

$$\text{Imax2} = 100.015 \qquad \Delta e2 = -7.979 \times 10^{-3}$$

$$E_{\text{rms}} = 1 \times 10^4$$

$$\text{Imax3} = 500.049 \qquad \Delta e3 = -0.019$$

$$\text{MV1} = \begin{pmatrix} 0.808 & -1 \\ -1.024 & -1 \end{pmatrix} \qquad \text{deg1} = \begin{pmatrix} 0.082 & 1 \\ -0.101 & -1 \end{pmatrix}$$

$$\text{Imax4} = 5000 \qquad \Delta e4 = -8.94 \times 10^{-3}$$

$$\text{MV2} = \begin{pmatrix} 0.917 & -1 \\ -0.725 & -1 \end{pmatrix} \qquad \text{deg2} = \begin{pmatrix} 0.289 & -1 \\ -0.236 & 1 \end{pmatrix}$$

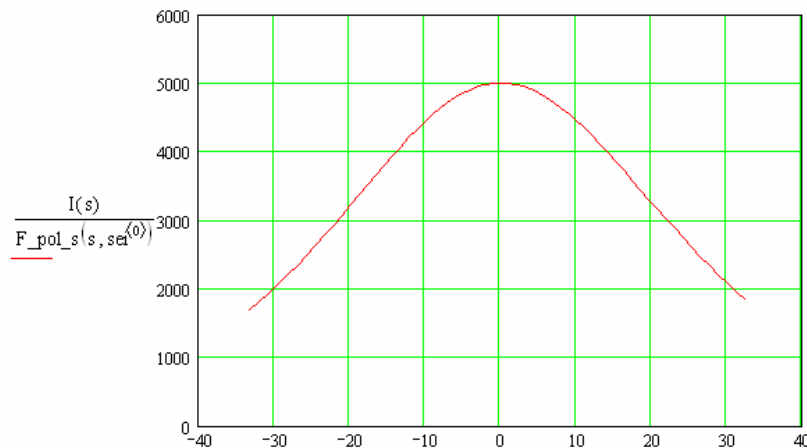$$\frac{\Delta e4 \cdot \text{BC\_S1}_{2,0}}{\text{MV}} = -17.88$$

$$\text{MV3} = \begin{pmatrix} 1.822 & -1 \\ -1.455 & 1 \end{pmatrix} \qquad \text{deg3} = \begin{pmatrix} 0.086 & 1 \\ -0.106 & -1 \end{pmatrix}$$

$$\text{MV4} = \begin{pmatrix} 0.479 & 1 \\ -0.591 & -1 \end{pmatrix} \qquad \text{deg4} = \begin{pmatrix} 0.24 & -1 \\ -0.197 & 1 \end{pmatrix}$$

$$\text{MV5} = \begin{pmatrix} 13.485 & -1 \\ -11.083 & 1 \end{pmatrix} \qquad \text{deg5} = \begin{pmatrix} 0.209 & 1 \\ -0.313 & -1 \end{pmatrix}$$

$$\min(\text{stack}(\text{am},\text{ph})) = 1.597 \times 10^{-3} \qquad \min(\text{am}) = 3.239 \times 10^{-3} \qquad \min(\text{ph}) = 1.597 \times 10^{-3}$$

different r56 in collimator

Top right:

$$\frac{BC\_S1^{\langle 0\rangle}}{MV} = \begin{pmatrix} 120 \\ 500 \\ 2\times 10^3 \end{pmatrix} \qquad \frac{BC\_S1^{\langle 1\rangle}}{0.001} = \begin{pmatrix} -150 \\ -50 \\ -24.2 \end{pmatrix} \qquad BC\_S1^{\langle 2\rangle} = \begin{pmatrix} 2 \\ 5 \\ 100 \end{pmatrix}$$
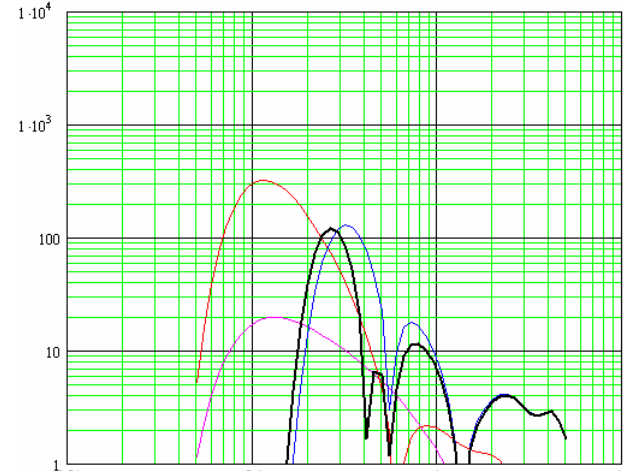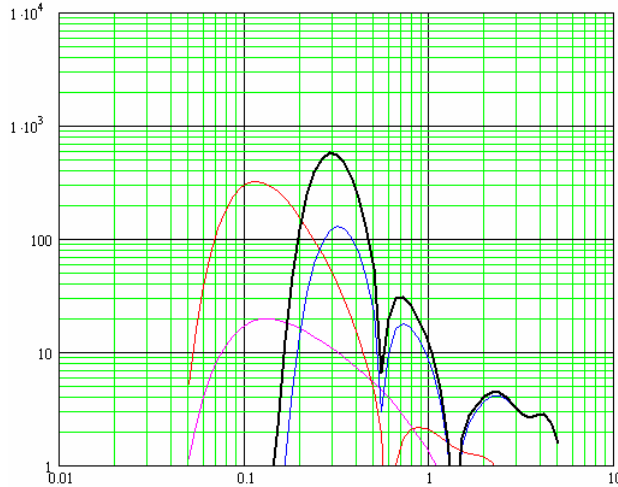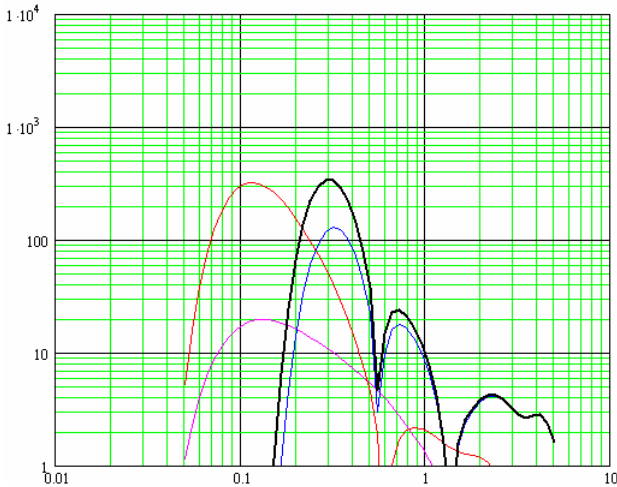
$$\frac{Ene4}{MV} = 1.75\times 10^4 \qquad \frac{r56\_4}{0.001} = -0.4 \qquad C4 = 1.0173$$

$$E_{rms} = 1\times 10^4$$

Left:

$$\frac{BC\_S1^{\langle 0\rangle}}{MV} = \begin{pmatrix} 120 \\ 500 \\ 2\times 10^3 \end{pmatrix} \qquad \frac{BC\_S1^{\langle 1\rangle}}{0.001} = \begin{pmatrix} -150 \\ -50 \\ -24.2 \end{pmatrix} \qquad BC\_S1^{\langle 2\rangle} = \begin{pmatrix} 2 \\ 5 \\ 100 \end{pmatrix}$$

$$\frac{Ene4}{MV} = 1.75\times 10^4 \qquad \frac{r56\_4}{0.001} = 0.4 \qquad C4 = 0.98328$$

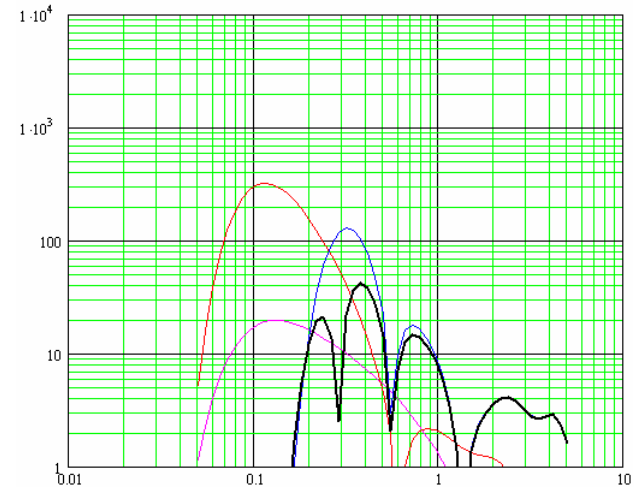$$E_{rms} = 1\times 10^4$$

Middle:

$$\frac{BC\_S1^{\langle 0\rangle}}{MV} = \begin{pmatrix} 120 \\ 500 \\ 2\times 10^3 \end{pmatrix} \qquad \frac{BC\_S1^{\langle 1\rangle}}{0.001} = \begin{pmatrix} -150 \\ -50 \\ -24.2 \end{pmatrix} \qquad BC\_S1^{\langle 2\rangle} = \begin{pmatrix} 2 \\ 5 \\ 100 \end{pmatrix}$$

$$\frac{Ene4}{MV} = 1.75\times 10^4 \qquad \frac{r56\_4}{0.001} = 0.84 \qquad C4 = 0.96553$$

$$E_{rms} = 1\times 10^4$$

Bottom right:

$$\frac{BC\_S1^{\langle 0\rangle}}{MV} = \begin{pmatrix} 120 \\ 500 \\ 2\times 10^3 \end{pmatrix} \qquad \frac{BC\_S1^{\langle 1\rangle}}{0.001} = \begin{pmatrix} -150 \\ -50 \\ -24.2 \end{pmatrix} \qquad BC\_S1^{\langle 2\rangle} = \begin{pmatrix} 2 \\ 5 \\ 100 \end{pmatrix}$$

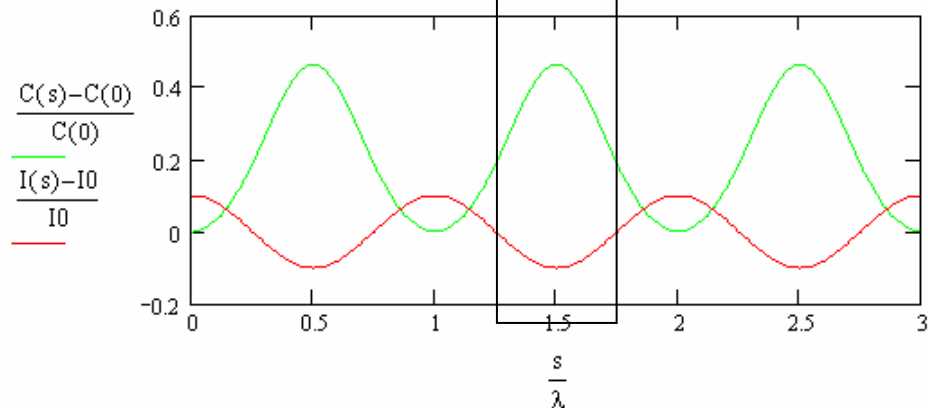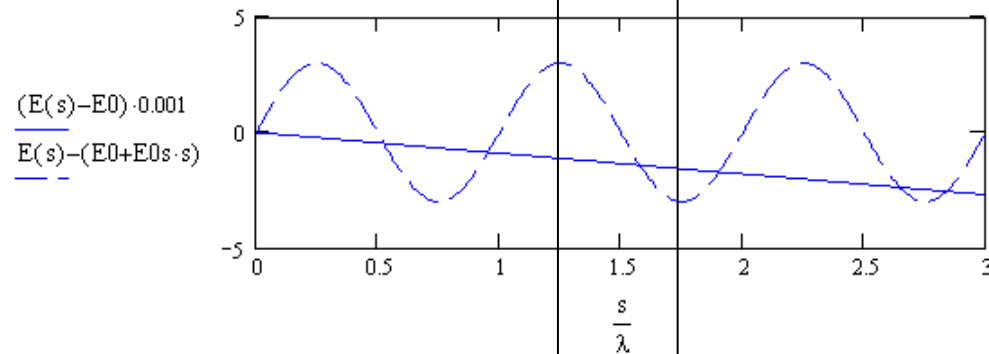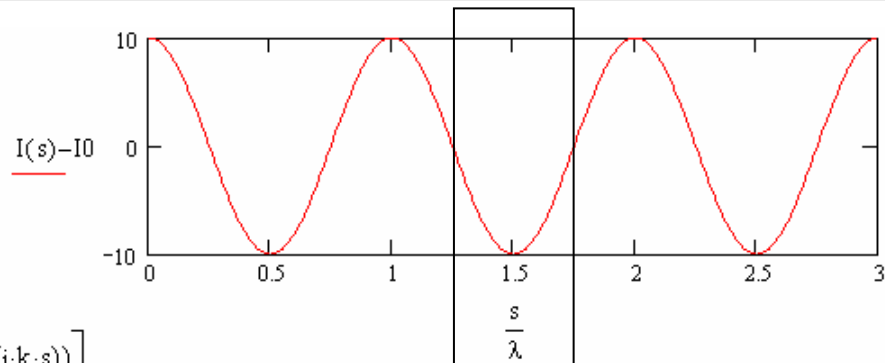$$\frac{Ene4}{MV} = 1.75\times 10^4 \qquad \frac{r56\_4}{0.001} = -0.2 \qquad C4 = 1.00857$$

$$E_{rms} = 1\times 10^4$$

$$E(s) := E0 + E0s \cdot s + Re\left[\overline{Z(k)} \cdot (I1 \cdot \exp(i \cdot k \cdot s))\right]$$

$$C(s) := \frac{1}{1 - \frac{r56}{E0} \cdot \frac{d}{ds}E(s)}$$

compression with BC1 ... BC3

$$\text{WRITEPRN}(\text{"setup.dat"}) := BC\_S1$$

$$BC\_S1 = \begin{pmatrix} 1.2 \times 10^8 & -0.15 & 2 \\ 5 \times 10^8 & -0.05 & 5 \\ 2 \times 10^9 & -0.0228544 & 66.6666667 \end{pmatrix}$$

$$\frac{rf^{\langle 0 \rangle}}{MV} = \begin{pmatrix} 137.194 \\ 16.213 \\ 505.292 \\ 110.691 \\ 1.958 \times 10^3 \end{pmatrix} \qquad \frac{rf^{\langle 1 \rangle}}{deg} = \begin{pmatrix} 6.896 \\ -177.843 \\ 16.855 \\ 159.36 \\ 40 \end{pmatrix}$$

$$QT = \begin{pmatrix} 0.08 & 0 \\ 0.897 & 2.4 \end{pmatrix}$$

$$\frac{BC\_S1^{\langle 0 \rangle}}{MV} = \begin{pmatrix} 120 \\ 500 \\ 2 \times 10^3 \end{pmatrix} \qquad \frac{BC\_S1^{\langle 1 \rangle}}{0.001} = \begin{pmatrix} -150 \\ -50 \\ -22.85 \end{pmatrix} \qquad BC\_S1^{\langle 2 \rangle} = \begin{pmatrix} 2 \\ 5 \\ 66.67 \end{pmatrix}$$

$$\frac{Ene4}{MV} = 1.75 \times 10^4 \qquad \frac{r56\_4}{0.001} = 0.84 \qquad C4 = 0.97674$$

$$Imax1 = 75$$

$$E_{rms} = 1.5 \times 10^4 \qquad E_{rms}*C_{tot} = 1MeV = const$$

$$MV1 = \begin{pmatrix} 0.942 & -1 \\ -1.111 & -1 \end{pmatrix} \qquad deg1 = \begin{pmatrix} 0.113 & 1 \\ -0.138 & -1 \end{pmatrix}$$

$$Imax2 = 150.012 \qquad \Delta e2 = -5.319 \times 10^{-3}$$

$$MV2 = \begin{pmatrix} 1.075 & -1 \\ -0.897 & -1 \end{pmatrix} \qquad deg2 = \begin{pmatrix} 0.395 & -1 \\ -0.323 & 1 \end{pmatrix}$$

$$Imax3 = 750.034 \qquad \Delta e3 = -0.013$$

$$MV3 = \begin{pmatrix} 2.45 & -1 \\ -1.96 & 1 \end{pmatrix} \qquad deg3 = \begin{pmatrix} 0.124 & 1 \\ -0.153 & -1 \end{pmatrix}$$

$$Imax4 = 5000 \qquad \Delta e4 = -5.946 \times 10^{-3}$$

$$\frac{\Delta e4 \cdot BC\_S1_{2,0}}{MV} = -11.892$$

$$MV4 = \begin{pmatrix} 0.68 & 1 \\ -0.841 & -1 \end{pmatrix} \qquad deg4 = \begin{pmatrix} 0.357 & -1 \\ -0.294 & 1 \end{pmatrix}$$

$$MV5 = \begin{pmatrix} 21.345 & -1 \\ -17.659 & 1 \end{pmatrix} \qquad deg5 = \begin{pmatrix} 0.362 & 1 \\ -0.467 & -1 \end{pmatrix}$$

$$min(stack(am,ph)) = 2.188 \times 10^{-3} \qquad min(am) = 4.364 \times 10^{-3} \qquad min(ph) = 2.188 \times 10^{-3}$$

$$\frac{BC\_S1^{\langle 0 \rangle}}{MV} = \begin{pmatrix} 120 \\ 500 \\ 2 \times 10^3 \end{pmatrix} \qquad \frac{BC\_S1^{\langle 1 \rangle}}{0.001} = \begin{pmatrix} -150 \\ -50 \\ -22.85 \end{pmatrix} \qquad BC\_S1^{\langle 2 \rangle} = \begin{pmatrix} 2 \\ 5 \\ 66.67 \end{pmatrix}$$
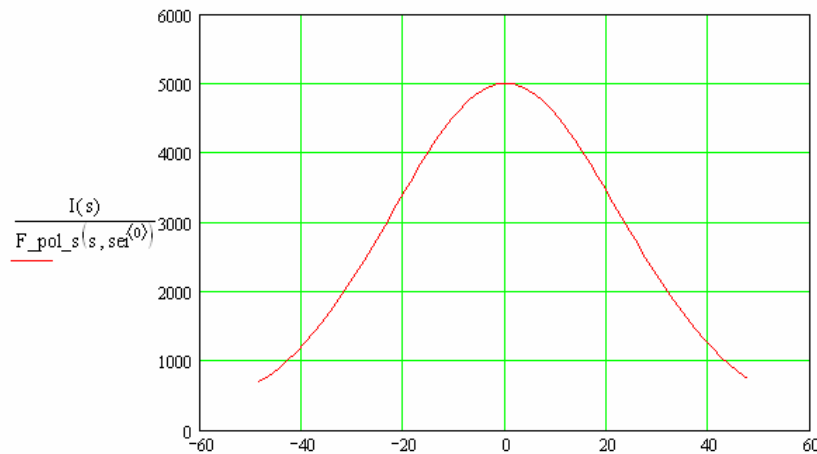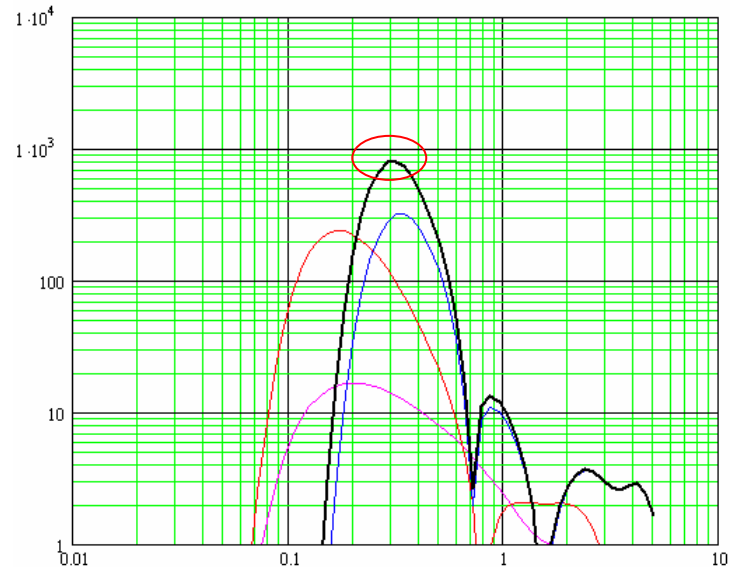
$$\frac{Ene4}{MV} = 1.75 \times 10^4 \qquad\qquad \frac{r56\_4}{0.001} = 0.84 \qquad\qquad C4 = 0.97674$$

$$E_{rms} = 2.25 \times 10^4 \qquad E_{rms} * C_{tot} = 1.5 MeV$$