Contents

Part I
Profiles NF2008

1 Normalized poloidal magnetic flux ψ_N

Normalized polidal magnetic flux ψ_N (1, Fig.1):

$$\psi_N(a_N) = \frac{\int\limits_0^{a_N} \mu(a')a'da'}{\int\limits_0^1 \mu(a')a'da'} \tag{1}$$

where $\mu = 1/q$, $q(a_N) = 1 + 3.6a_N^{5.6}$ is safety factor.

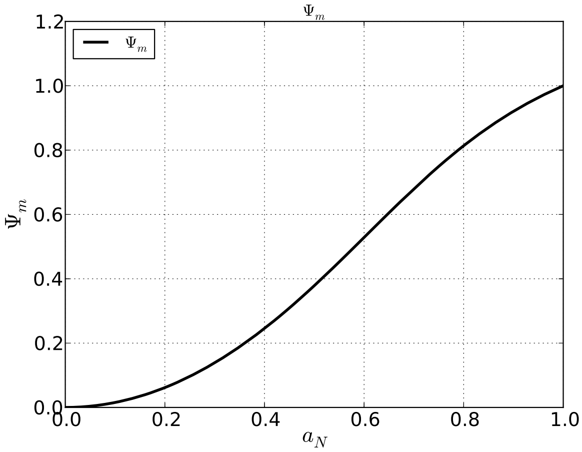

Figure 1: ψ_N - normalized poloidal magnetic flux (NF2008)

2 Density n_e and temperature $T_{e,i}$

Profiles of electron density $n_e(\psi_N)$ and electron and ion temperature $T_{e,i}(\psi_N)$ (2,3):

$$n_e(\psi_N) = n_{sep} + a_{n0}\left[tanh\left(2\frac{1-\psi_{mod}}{\Delta}\right) - tanh\left(2\frac{\psi_N - \psi_{mod}}{\Delta}\right)\right] + a_{n1}H\left(1 - \frac{\psi_N}{\psi_{ped}}\right)\left[1 - (\frac{\psi_N}{\psi_{ped}})^{\alpha_{n1}}\right]^{\alpha_{n2}}, \quad (2)$$

$$T_{e,i}(\psi_N) = T_{sep} + a_{T0}\left[tanh\left(2\frac{1-\psi_{mod}}{\Delta}\right) - tanh\left(2\frac{\psi_N - \psi_{mod}}{\Delta}\right)\right] + a_{T1}H\left(1 - \frac{\psi_N}{\psi_{ped}}\right)\left[1 - (\frac{\psi_N}{\psi_{ped}})^{\alpha_{T1}}\right]^{\alpha_{T2}}, \quad (3)$$

where Δ is pedestal width, $\psi_{ped} = 1 - \Delta, \psi_{mid} = 1 - \Delta/2$, parameters a_{n0}, a_{t0} and Δ affect the pedestal profiles, parameters $a_{n1}, a_{T1}, \alpha_{n1}, \alpha_{n2}, \alpha_{T1}$ and α_{T2} affect the core plasma profiles, $H(x)$ - Heaviside function. These profiles are shown as function of normalized radius at Fig.2 and Fig.3.

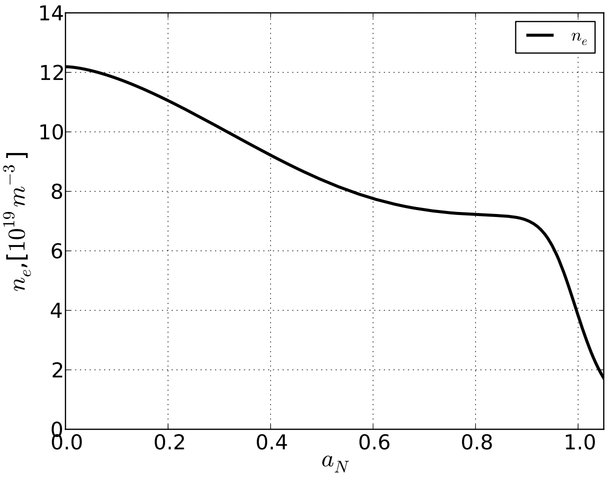

Figure 2: Electron density, $10^{19}m^{-3}$ (NF2008)

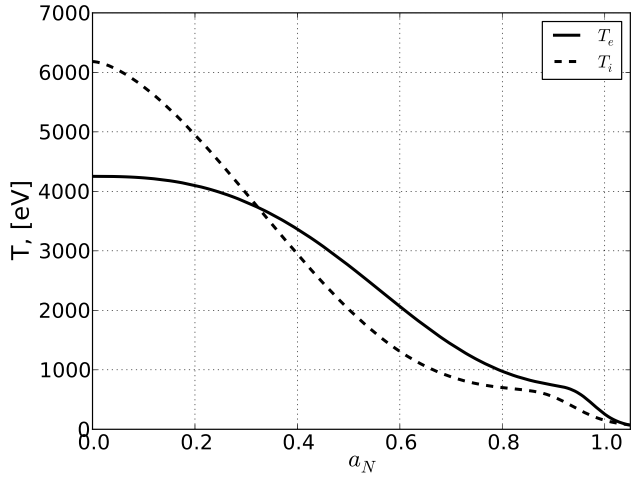

Figure 3: Electron and ion temperature, eV (NF2008)

3 Plasma pressure and pressure gradients

Electron, ion and total plasma pressure (Fig.4) are estimated as (4):

$$P_{e,i}[Pa] = 1.6 \times n_e[10^{19}m^{-3}] \times T_{e,i}[eV] \tag{4}$$

Pressure gradients are shown at Fig.5.

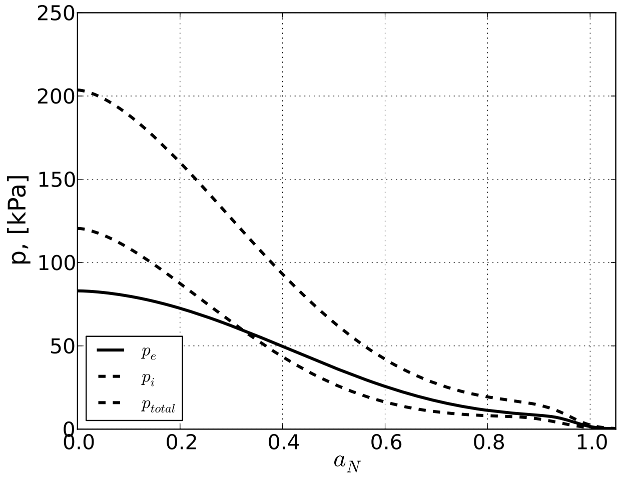

Figure 4: Electron, ion and total pressure, kPa (NF2008)

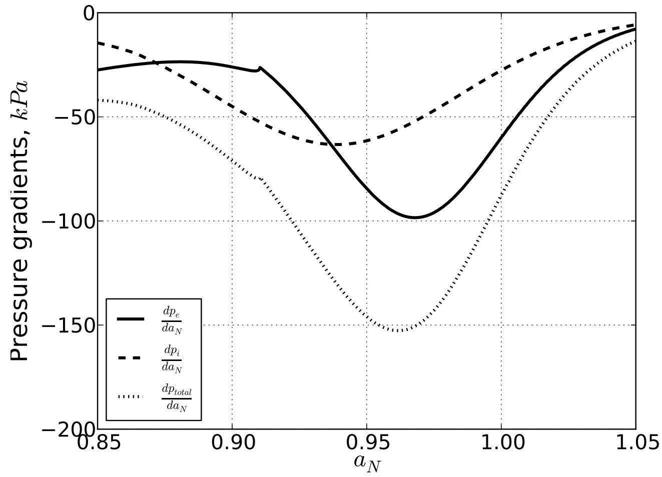

Figure 5: Pressure gradients, kPa (NF2008)

4 Radial electric field $E_{0r}(a_N)$

Radial electric field $E_{0r}(a_N)$ (Fig.6) is aproximated as (5):

$$E_{0r}(a_N) = d_1 + r_1 a_N\, exp\left(b_1 + c_1 a_N^{exp(-a_1 x^2)}\right)[\frac{V}{m}]. \tag{5}$$

5 Plasma conductivity $\sigma(a_N)$

Plasma conductivity $\sigma(a_N)$ (7, Fig.7):

$$\sigma(a_N)[sec^{-1}] = 1.2 \times 10^{17}\left(\frac{T_e[keV]}{500}\right)^{3/2} \tag{6}$$

6 Equation

Our equation (7):

$$\frac{1}{a_N}\frac{d}{da_N}\left(a_N\frac{d}{da_N}(a_N B_m^a)\right) - \frac{m^2}{a_N^2}(a_N B_m^a) - \frac{m}{a_N^2}Q_m(a_N)(a_N B_m^a) - \frac{4\pi m^2}{cB_{0\zeta}}\frac{R}{a}\frac{dj_b}{da_N}Q_{1m}(a_N)(a_N B_m^a) = 0 \tag{7}$$

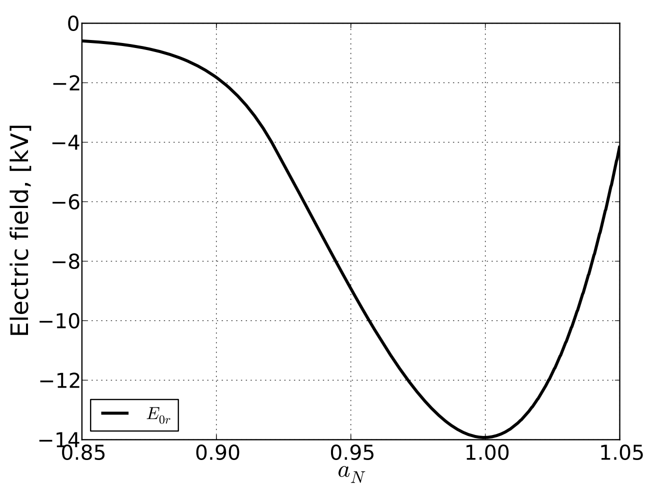

Figure 6: Radial electric field, kV (NF2008)

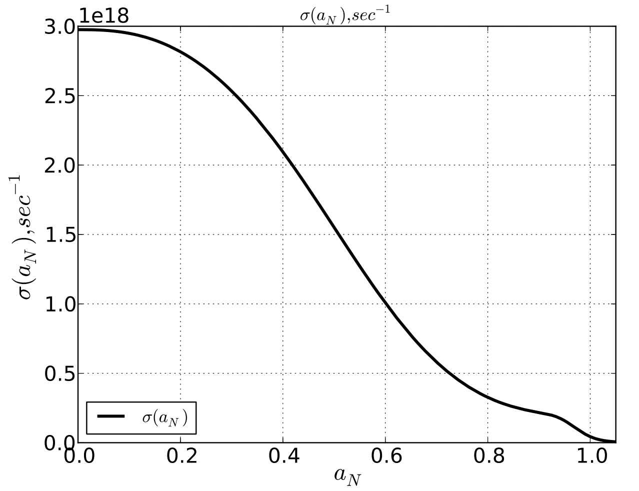

Figure 7: Plasma conductivity, sec^{-1} (NF2008)

7 $K_m(a_N), A(a_N)$

Quantities $K_m(a_N)$ (Eq.8, Fig.8) and $A(a_N)$ (Eq.8, Fig.9):

$$K_m(a_N) = F_m(a_N)\frac{a}{R}\frac{V_{0||}}{mc} + \frac{1}{B_0}\left(\frac{1}{p_{0i}}\frac{dp_{0i}}{da_N}\frac{T_i(a_N)}{ea_{pl}} - E_{0a}(a_N)\right) \tag{8}$$

$$A(a_N) = \frac{8\pi}{B_{0\zeta}^2}a_N\frac{dp_0}{da_N}m^2(\mu^2 - 1 - \frac{R}{a}S\xi'), \quad \boxed{-1 - \frac{R}{a}S\xi' \approx -9} \tag{9}$$

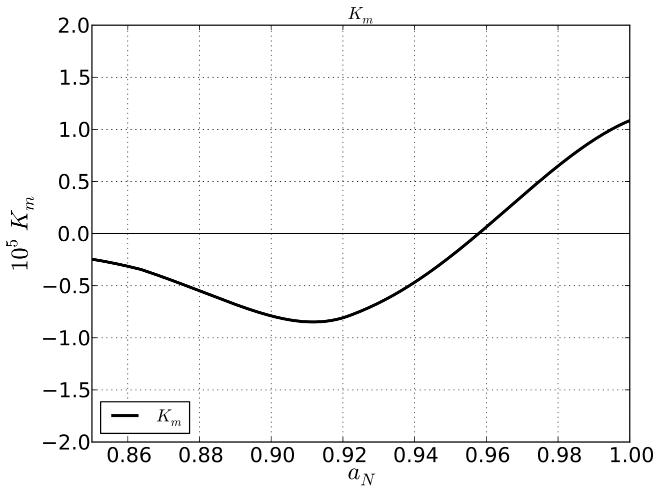

Figure 8: $K_m(a_N)$ (NF2008)

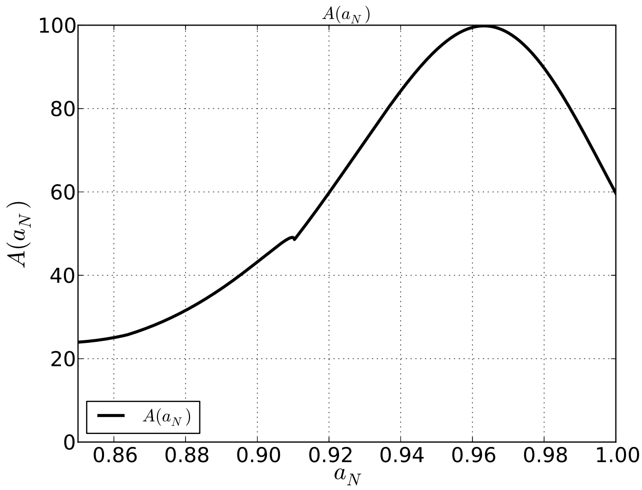

Figure 9: $A(a_N)$ (NF2008)

8 $Q_m(a_N)$

Real (10) and imaginary (11) part of $Q_m(a_N)$ (Fig.10):

$$\mathrm{Re}Q_m = \frac{mK_m^2(a_N)F_m^2(a_N)A(a_N)}{\left(mK_m(a_N)F_m^2(a_N)\right)^2 + \left(A_m(a_N)\frac{c}{4\pi\sigma(a_N)a}\right)^2} \tag{10}$$

$$\mathrm{Im}Q_m = \frac{K_m(a_N)A^2(a_N)\frac{c}{4\pi\sigma(a_N)a}}{\left(mK_m(a_N)F_m^2(a_N)\right)^2 + \left(A_m(a_N)\frac{c}{4\pi\sigma(a_N)a}\right)^2} \tag{11}$$

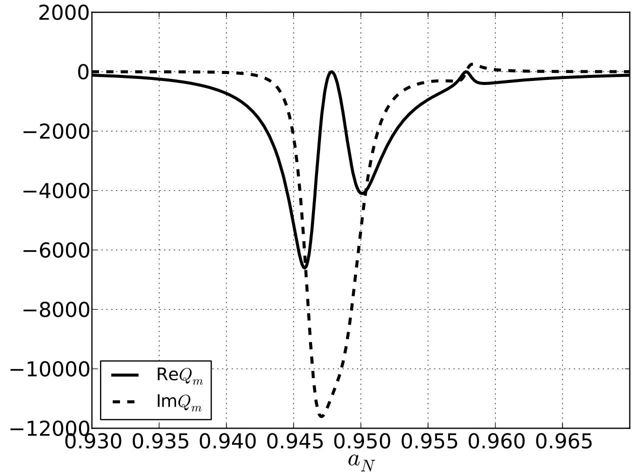

Figure 10: $Q(a_N)$: $m = -11, V_0 = 0km/sec$ (NF2008)

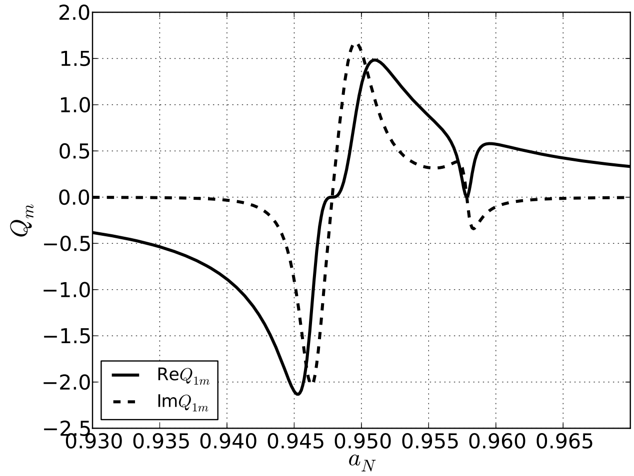

Figure 11: Q_{1m} : $m = -11, V_0 = 0km/sec$ (NF2008)

9 $Q_{1m}(a_N)$

Real (12) and imaginary (13) part of Q_{1m} (Fig.11):

$$\mathrm{Re}Q_{1m} = \frac{mK_m^2(a_N)F_m^3(a_N)}{\left(mK_m(a_N)F_m^2(a_N)\right)^2 + \left(A_m(a_N)\frac{c}{4\pi\sigma(a_N)a}\right)^2} \tag{12}$$

$$\mathrm{Im}Q_{1m} = \frac{K_m(a_N)F_m(a_N)A(a_N)\frac{c}{4\pi\sigma(a_N)a}}{\left(mK_m(a_N)F_m^2(a_N)\right)^2 + \left(A_m(a_N)\frac{c}{4\pi\sigma(a_N)a}\right)^2} \tag{13}$$

10 Pressure perturbation P_m

Real and imaginary part of pressure perturbations (14,15):

$$\mathrm{Re}P_m = -a_N\frac{dp_0}{da_N}\frac{R}{a}\frac{mK_m(a_N)F_m(a_N)A(a_N)\frac{c}{4\pi\sigma(a_N)a}}{\left(mK_m(a_N)F_m^2(a_N)\right)^2 + \left(A(a_N)\frac{c}{4\pi\sigma(a_N)a}\right)^2}\frac{B_m^a}{B_0} \tag{14}$$

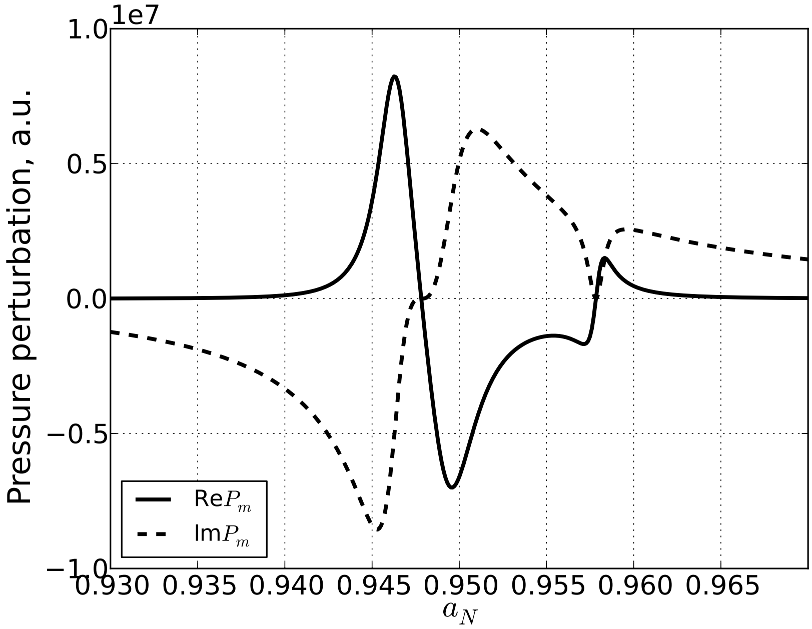

Figure 12: Plasma pressure perturbation (NF2008)

$$\mathrm{Im}P_m = a_N \frac{dp_0}{da_N} \frac{R}{a} \frac{m^2 K_m^2(a_N) F_m^3(a_N) \dfrac{B_{0\varsigma}}{B_0}}{\left(mK_m(a_N)F_m^2(a_N)\right)^2 + \left(A(a_N)\dfrac{c}{4\pi\sigma(a_N)a}\right)^2} \frac{B_m^a}{B_0} \tag{15}$$

Part II
Profiles NF2013

11 Density n_e and temperature $T_{e,i}$

All subsequent profiles correspond 60^o phase.

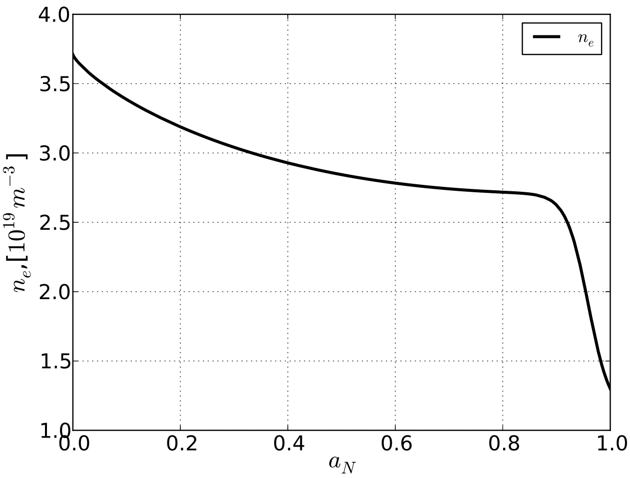

Figure 13: Electron density, $10^{19}m^{-3}$ (NF2013)

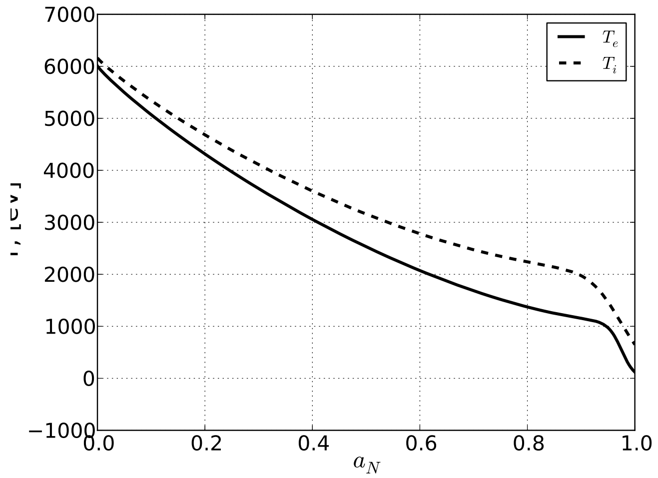

Figure 14: Electron and ion temperature, eV (NF2013)

12 Plasma pressure and pressure gradients

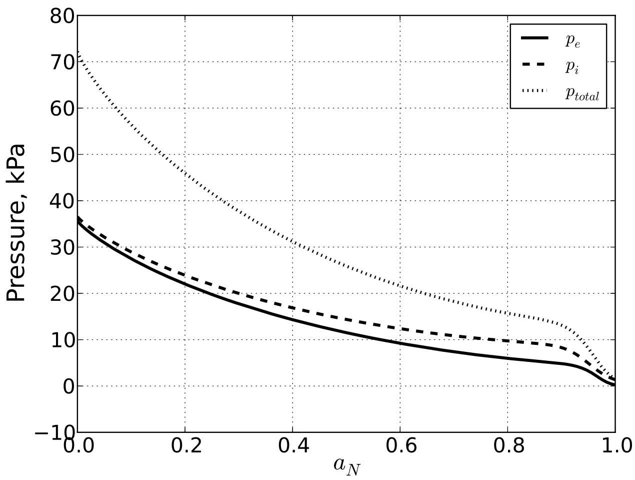

Figure 15: Electron, ion and total pressure, kPa (NF2013)

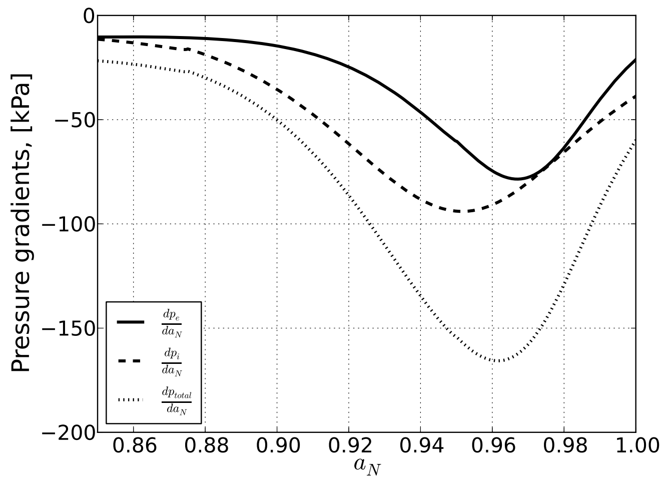

Figure 16: Pressure gradients, kPa (NF2013)

13 Radial electric field $E_{0r}(a_N)$

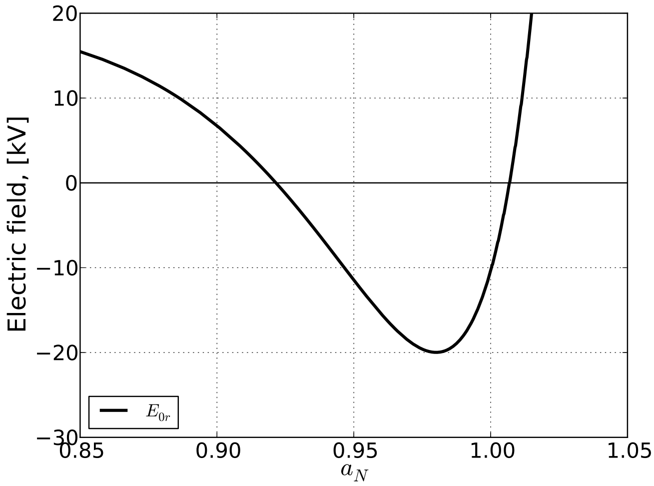

Figure 17: Radial electric field, kV (NF2013)

14 $K_m(a_N)$, $A(a_N)$

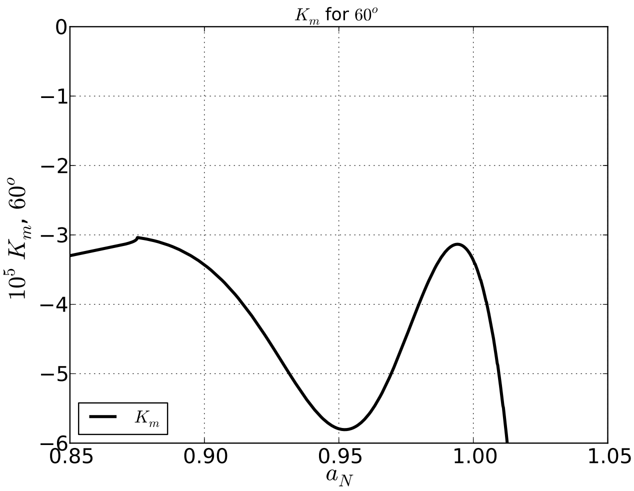

Figure 18: $K_m(a_N)$ (NF2013)

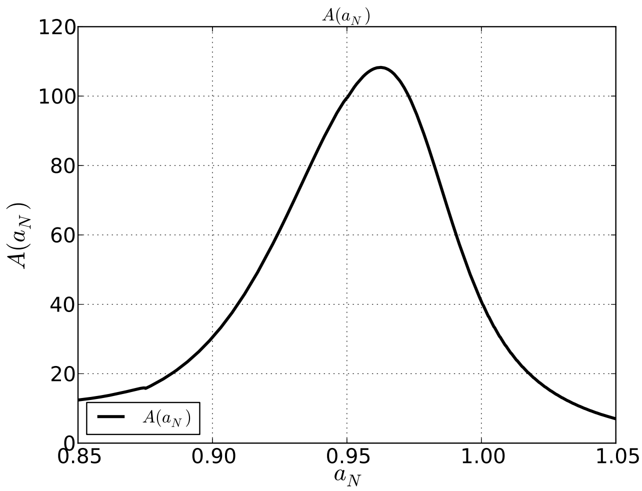

Figure 19: $A(a_N)$ (NF2013)

15 $Q_m(a_N)$, $Q_{1m}(a_N)$

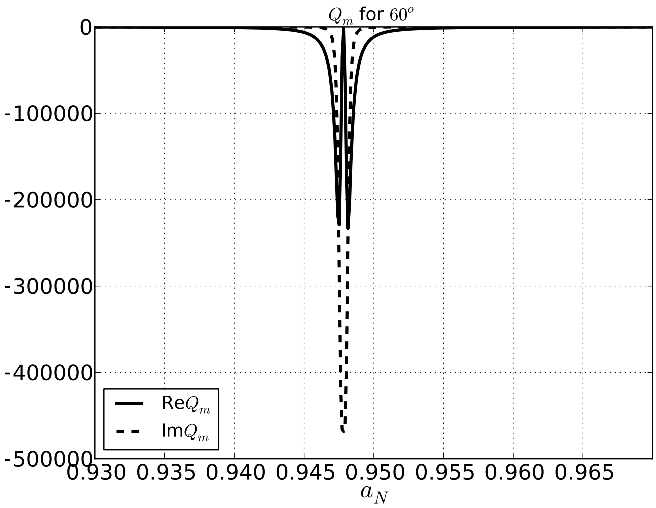

Figure 20: $Q(a_N)$: $m = -11, V_0 = 0km/sec$ (NF2013)

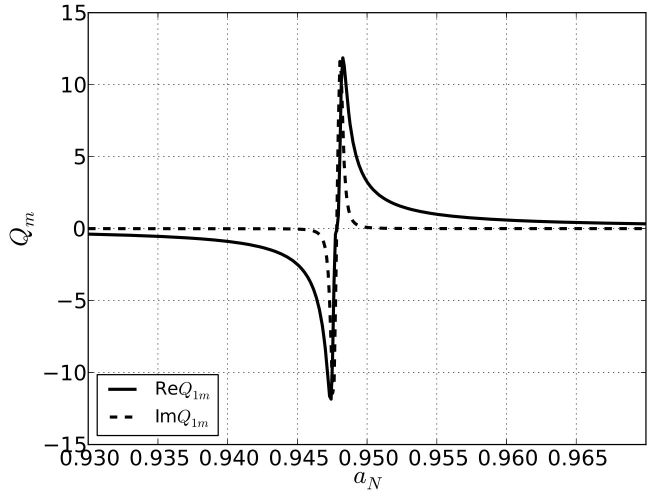

Figure 21: Q_{1m} : $m = -11, V_0 = 0km/sec$ (NF2013)

16 Plasma pressure perturbation P_m

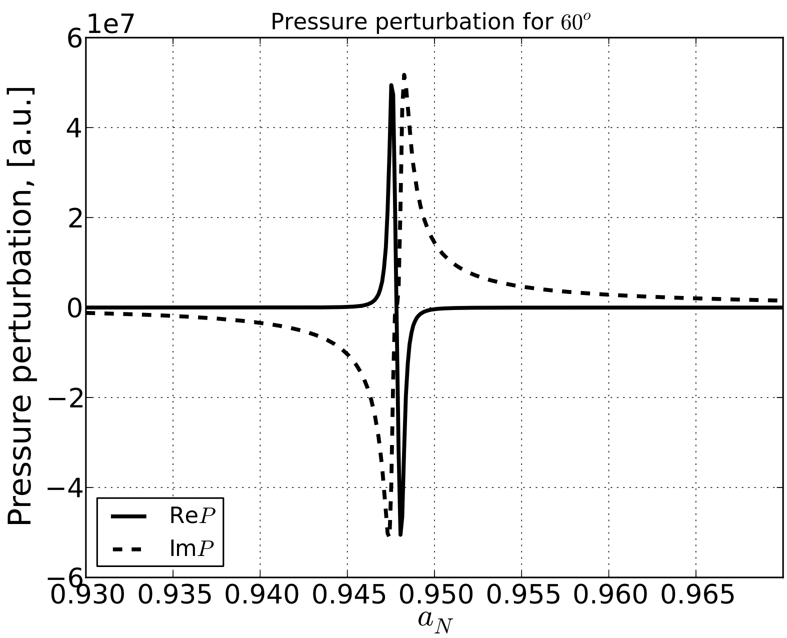

Figure 22: Plasma pressure perturbation (NF2013)

Part III
Bootstrap current

In progress ....