MARS calculations for Test 1a Problem

• Problem description

$$R = 1.0, a = 0.1, \quad Circular\ \ cross\ \ section,$$

$$q = 1.1 + 1.8\psi^2_{\rm norm}, \qquad P \equiv 0.$$

Figure 1 shows the equilibrium profile for this test problem. The equilibrium was calculated by CHEASE code.

• MARS normalization

$$R_0 = 1, B_0 = 1, \rho_m \equiv 1, \tau_A = \frac{R_0}{v_A(0)}, \tau_R = \frac{a^2}{\eta}, S = \frac{\tau_R}{\tau_A}.$$

• MARS calculations

Figure 2 shows the dependence of tearing mode growth rate (γ) on S, for different number (N) of points in radial (s) direction. The values of γ at $N = \infty$ were obtained using extrapolation: $\gamma(N) = \gamma(\infty) + CN^{-2}$. The eigenvalues shown in figure are $\gamma(\infty)$.

The extrapolation property via number of radial points is shown in Fig. 3, for $S = 10^6$. Three points were calculated with $N = 129, 161, 257$ respectively. Two lines correspond to different packing parameters in CHEASE equilibrium code. Note that although eigenvalues calculation depends on mesh packing, the extrapolated eigenvalue for $N = \infty$ does not depend on packing.

The convergence of eigenvalues calculation with respect to the total number of poloidal harmonics shows that 7 Fourier harmonics is enough for $n = 1$ mode.

The mode structure is shown in Fig.4, where the S value is $S = 10^6$.

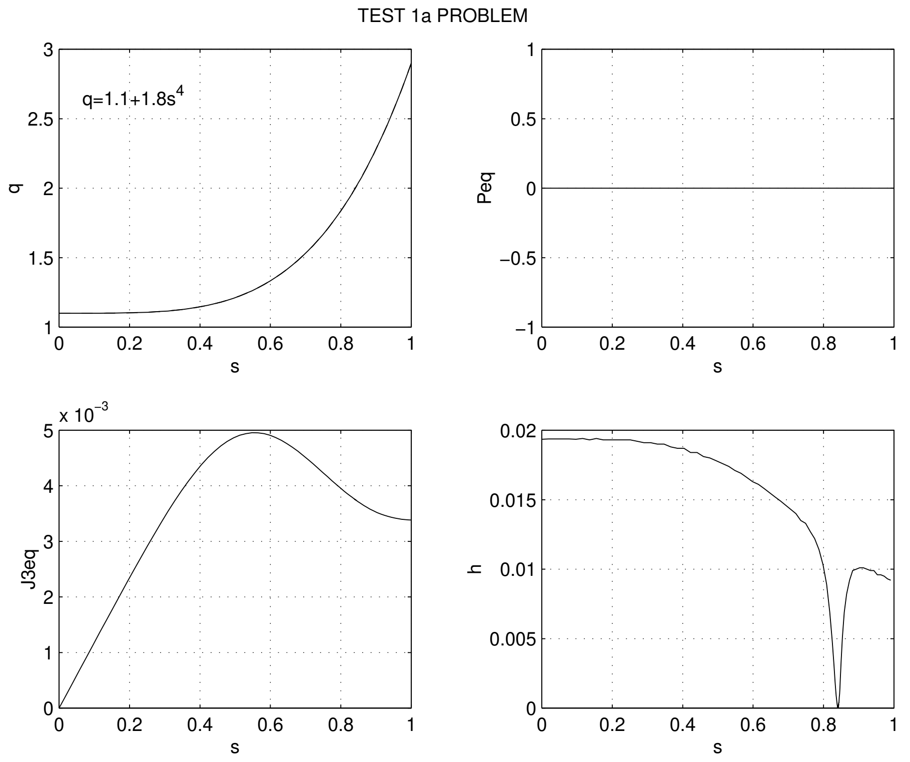

Figure 1: *Equilibrium for Test 1a.*

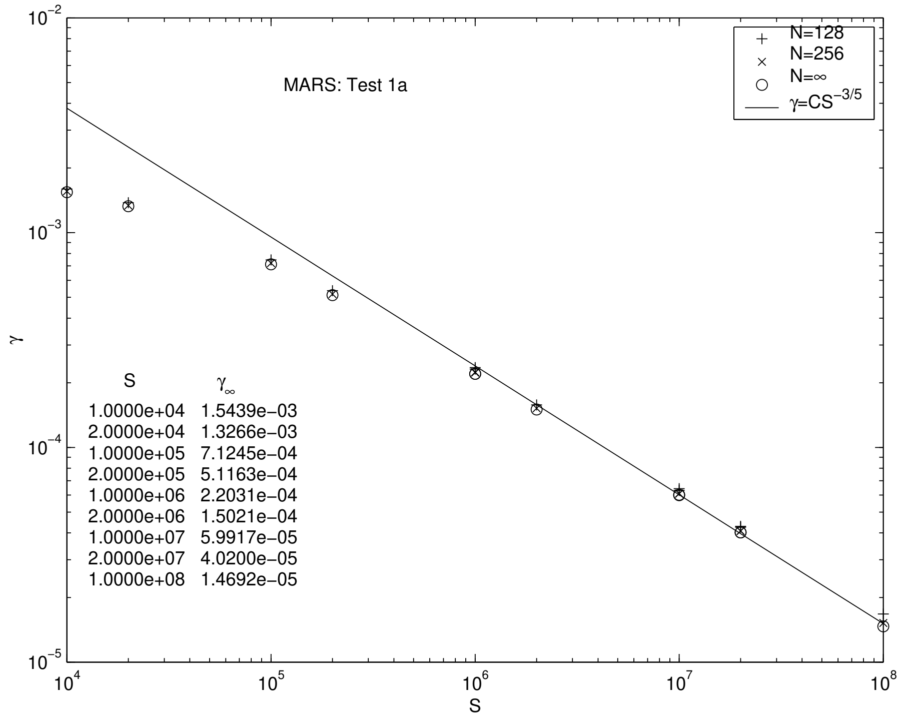

Figure 2: *Scaling test of tearing mode.*

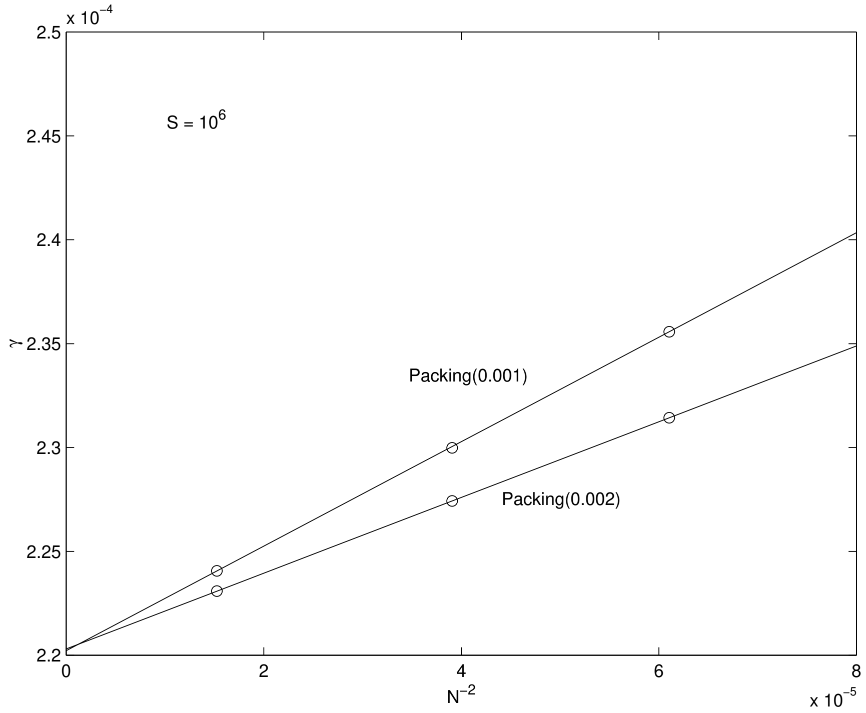

Figure 3: *Convergence with the number of radial points.*

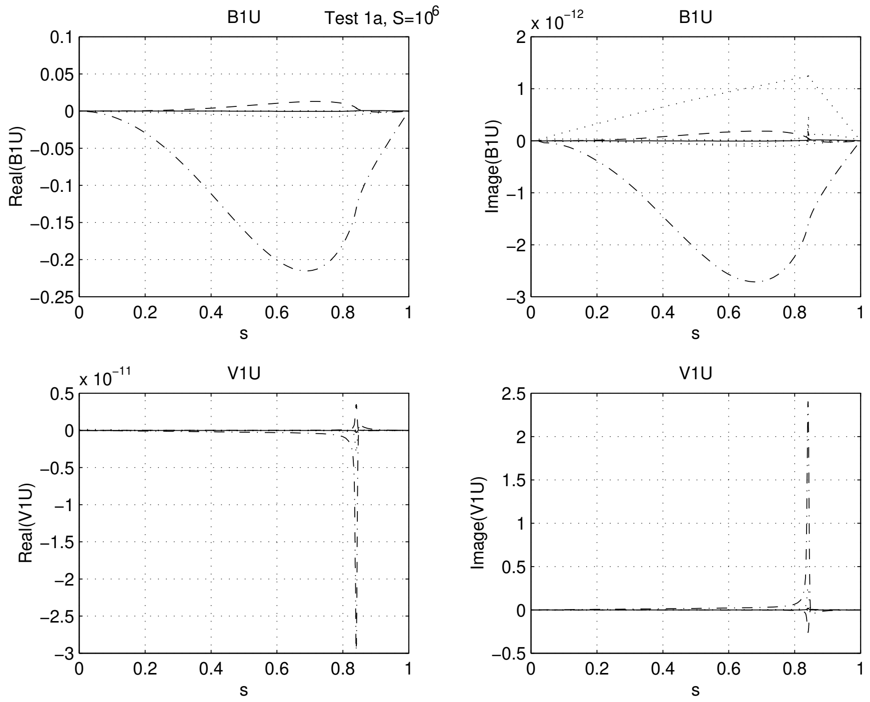

Figure 4: *Mode structure for $S = 10^6$.*

MARS calculations for Test 1b Problem

- **Problem description**

$$R = 1.7, a = 0.65, \kappa = 1.8, \delta = 0.3,$$
$$FF' = C(1.3 - 1.6\psi_{\text{norm}} + 0.3\psi_{\text{norm}}^2),$$
$$P \equiv 0, q_0 = 1.2.$$

- **q-profile from CHEASE equilibrium code**

$$q_{95} = 4.5, q_{\text{edge}} = 5.754, r_{s2/1} = 0.749, r_{s3/1} = 0.899, r_{s4/1} = 0.958.$$

- **MARS normalization**

$$R_0 = 1, B_0 = 1, \rho_m \equiv 1, \tau_A = \frac{R_0}{v_A(0)}, \tau_R = \frac{a^2}{\eta}, S = \frac{\tau_R}{\tau_A}.$$

- **MARS calculations**

Figure 2 shows the dependence of tearing mode growth rate (γ) on S, for different number (N) of points in radial (s) direction. The values of γ at $N = \infty$ were obtained using extrapolation: $\gamma(N) = \gamma(\infty) + CN^{-2}$. The eigenvalues shown in figure are $\gamma(\infty)$.

The extrapolation property via number of radial points is shown in Fig. 3, for $S = 10^8$. Three points were calculated with $N = 129, 161, 257$ respectively.

The convergence of eigenvalues calculation with respect to the total number of poloidal harmonics (Fig. 4) shows that 23 Fourier harmonics is enough for $n = 1$ mode.

The mode structure is shown in Fig.5 - 7, where the S values are $S = 10^5, 10^6, 2 \cdot 10^6$, respectively.

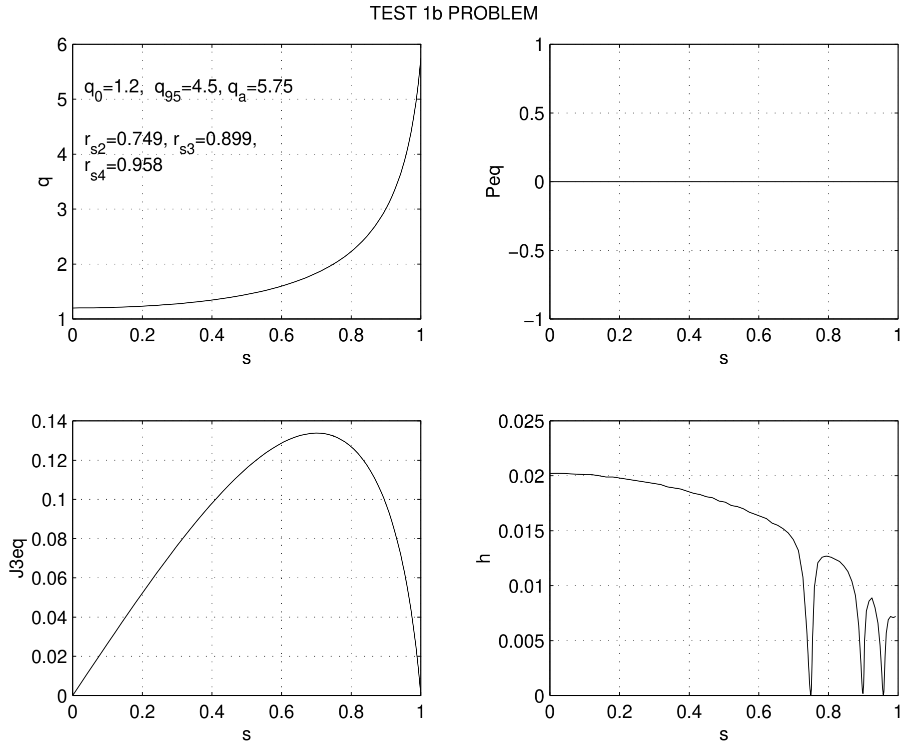

Figure 1: *Equilibrium for Test 1b.*

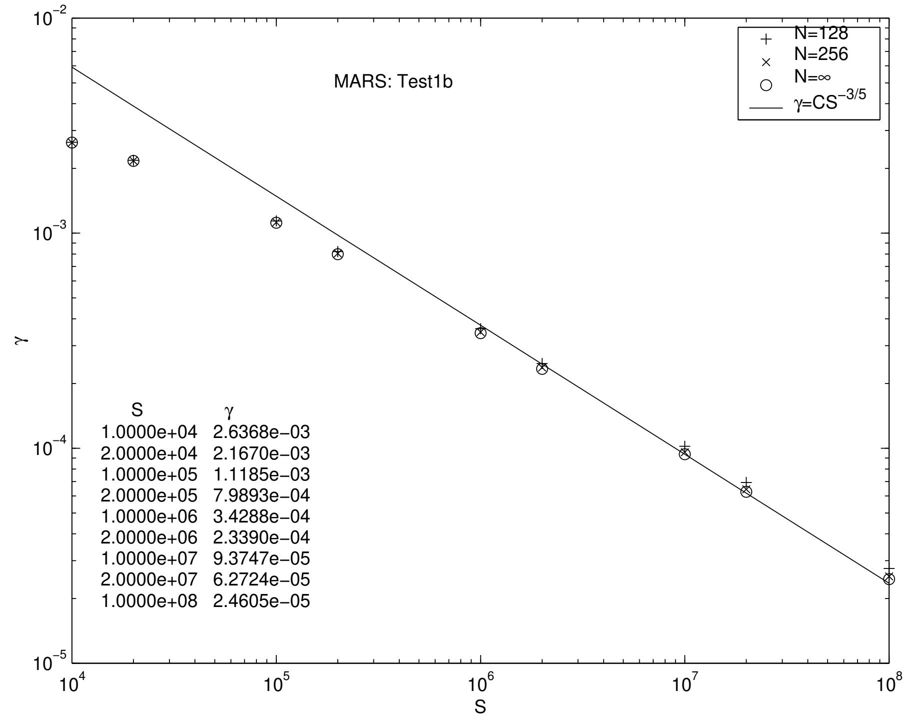

Figure 2: *Scaling test of tearing mode.*

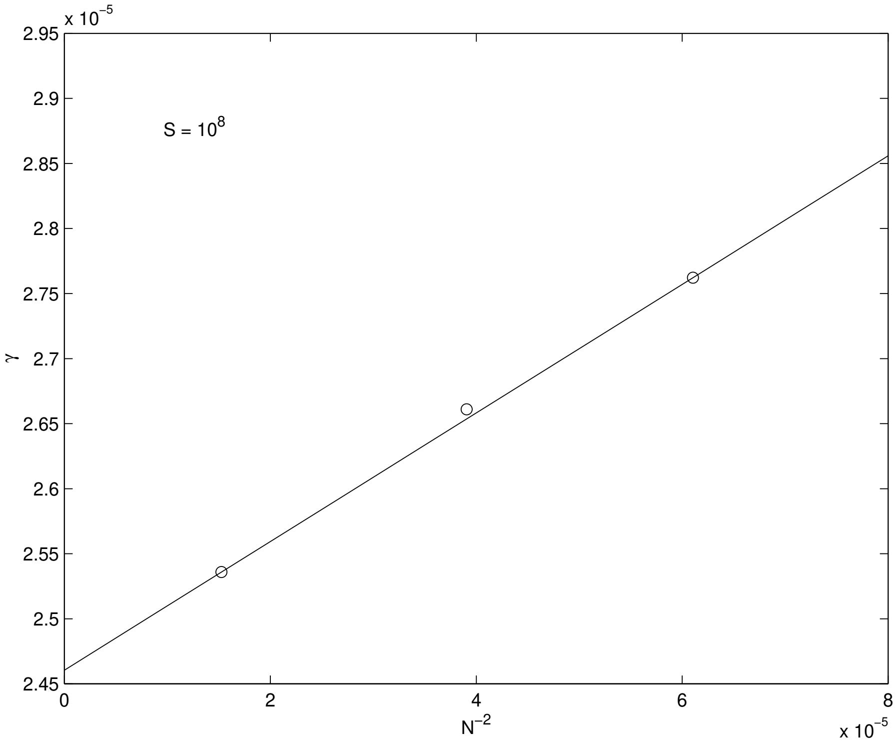

Figure 3: *Convergence with the number of radial points.*

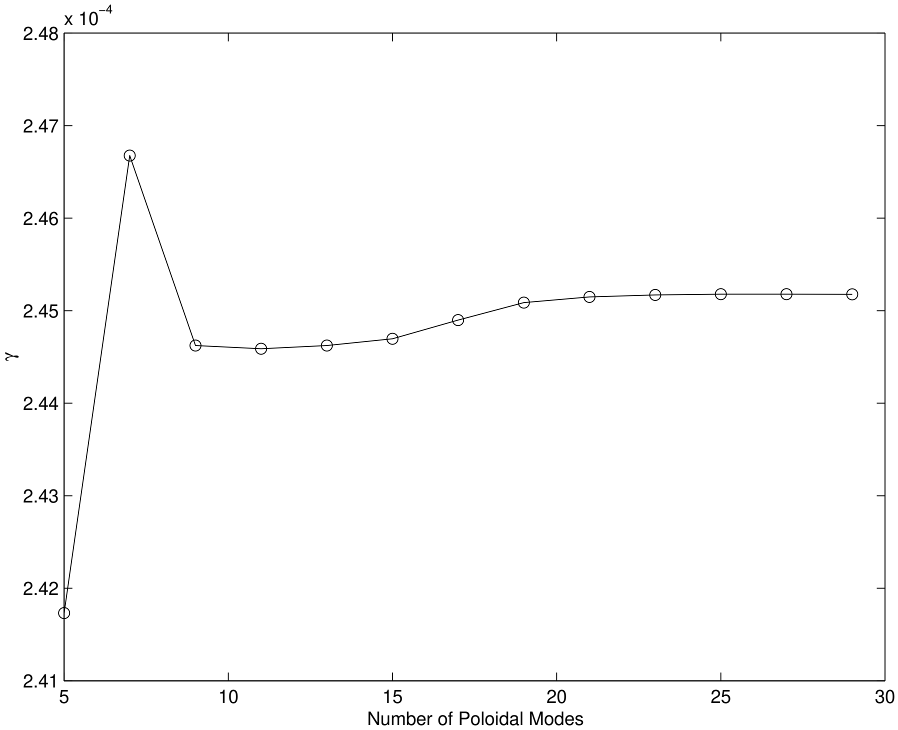

Figure 4: *Convergence with the number of poloidal Fourier harmonics.*

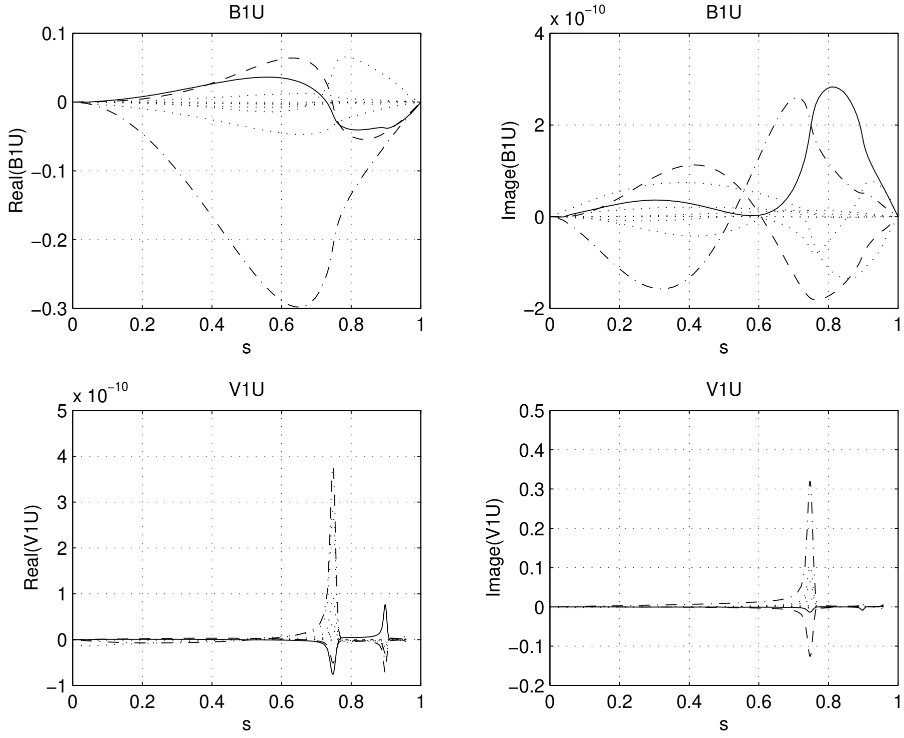

Figure 5: *Mode structure for* $S = 10^5$.

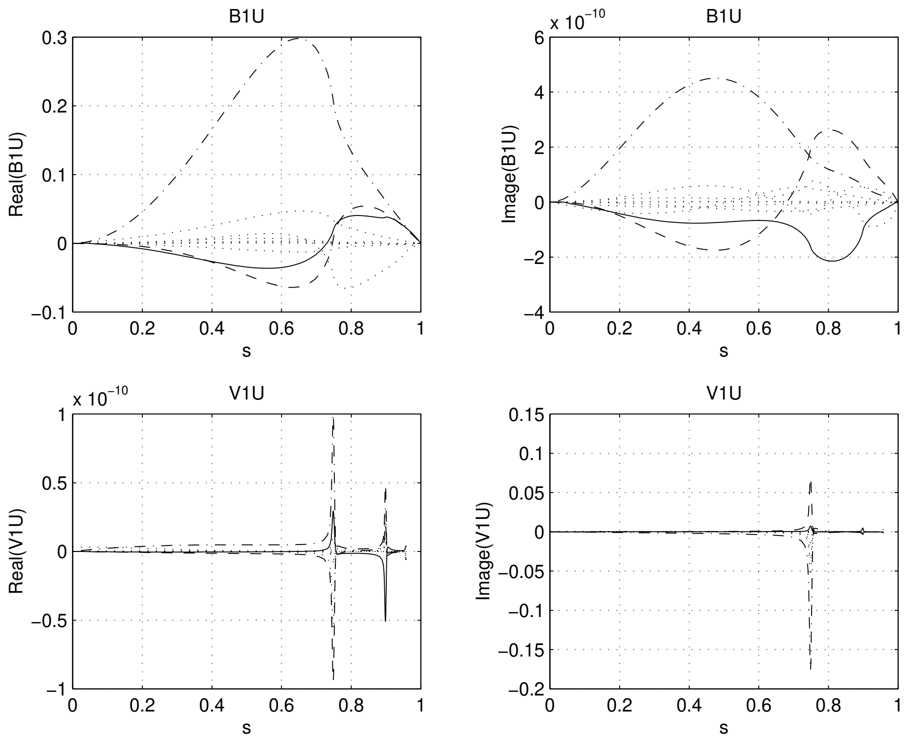

Figure 6: *Mode structure for* $S = 10^6$.

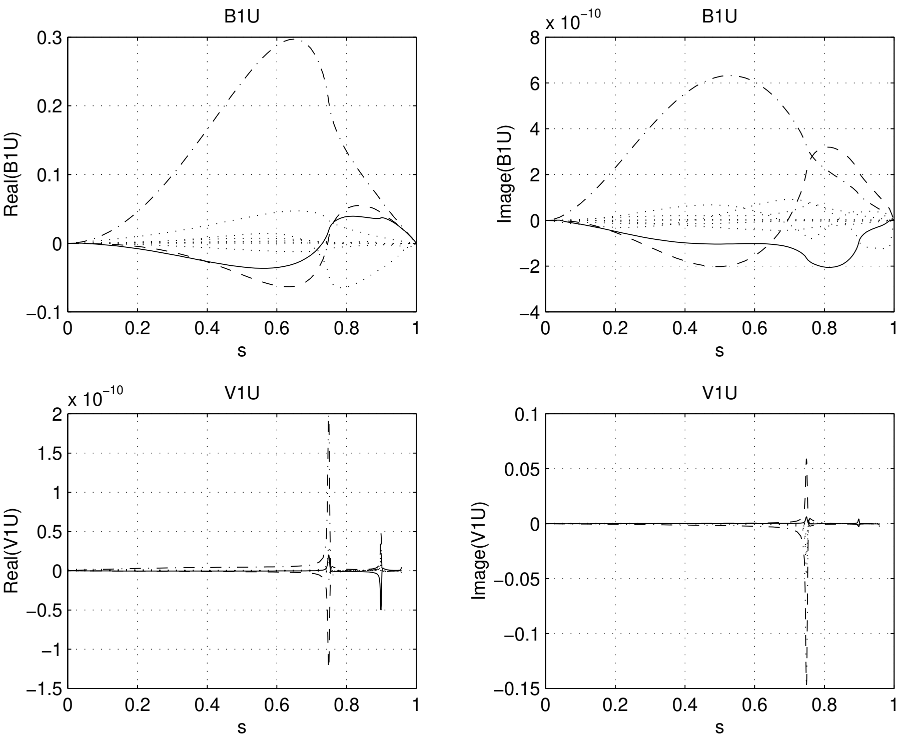

Figure 7: *Mode structure for* $S = 2 \cdot 10^6$.