Derivation of the equations:

The vehicle is moving as shown in Figure 1:

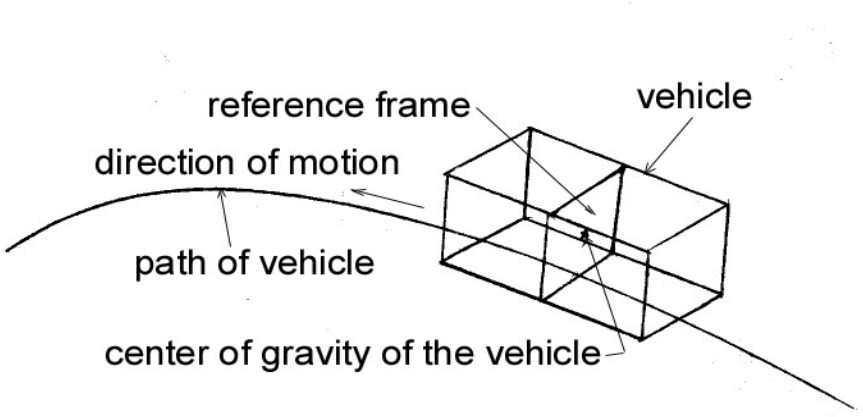

Figure 1

We consider a coordinate system fixed in the transverse plane, moving, but not rolling over with the vehicle (Figure 2):

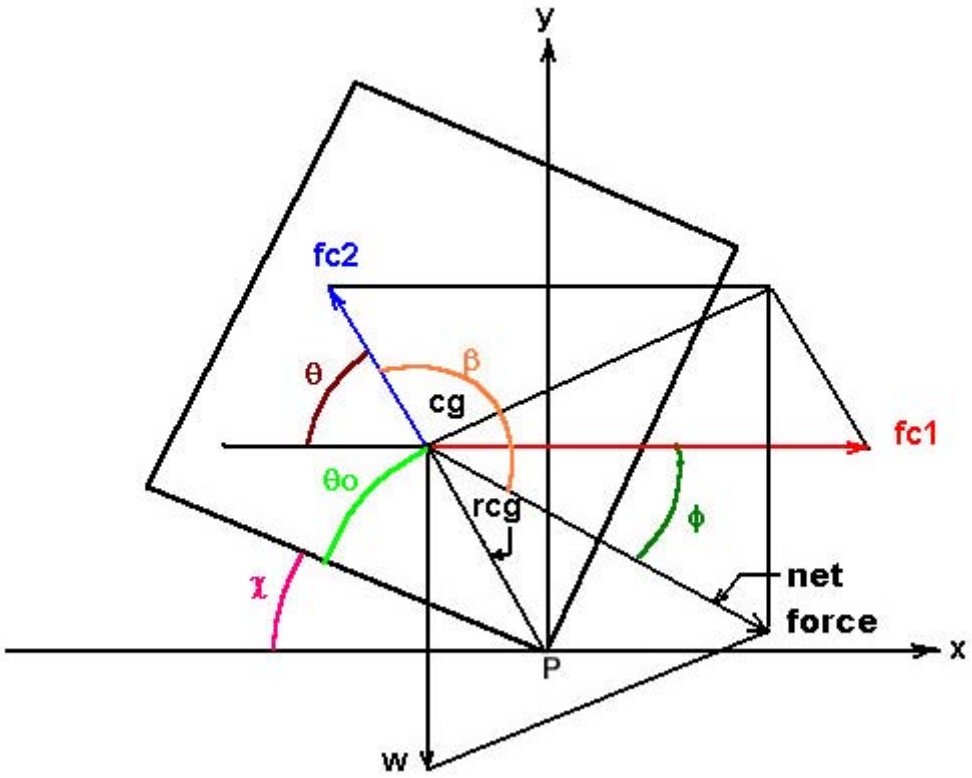

Figure 2

The vehicle is presumed to be traveling away from the viewer. The point P represents the bottom of the tires on the right side of the vehicle. The vehicle will be rolling over about an axis through the point P.

The vehicle is initially presumed to be traveling in a straight line at time t=0, with a velocity V_0, when the driver suddenly and sharply turns the wheel to the right or left. We will thus consider a steering induced rollover, which is the most common kind. For the purposes of the analysis we will assume that the driver turns the wheel to the left, but we could just as well have assumed that the driver turns the wheel to the right. The analysis is the same either way.

If the speed is sufficiently high and the radius of curvature of the path of the vehicle is sufficiently small, the vehicle will begin to roll over; that is, rotate about an axis through the point P.

Figure 2 shows the vehicle after it has begun to roll over. The vehicle will experience a centrifugal force fc1 due to the curvature of the path of the vehicle. In addition, the vehicle will experience a centrifugal force fc2 due to the roll, and a force W due to the weight of the vehicle. r_{cg} is the distance from the point P to the center of gravity (cg) of the vehicle. Theta (θ) is the angle between the radius vector r_{cg} and the x axis, thetao (θ_0) is the angle between the radius vector r_{cg} and the bottom of the vehicle and χ is the angle between the x axis and the bottom of the vehicle. Thus,

$$\chi = \theta - \theta_0$$

Newton's second law of motion may be may be expressed as

$$T = I\dot{\omega} \qquad (1)$$

where T is the torque, I the moment of inertia, and $\dot{\omega}$ the angular acceleration. Applying this equation to the rotation of the vehicle about the axis through the point P we get,

$$\overline{r^2}M\ddot{\theta} = \rho M\omega_c^2 r_{cg}\sin\theta - Wr_{cg}\cos\theta \qquad (2)$$

where $\sqrt{\overline{r^2}}$ is the radius of gyration, M the mass of the vehicle, $\ddot{\theta} = d^2\theta/dt^2$, ρ the radius of curvature of the path of the vehicle, ω_c the angular velocity of the vehicle about the center of curvature of the path, r_{cg} the distance from the point P to the center of gravity of the vehicle and W the weight of the vehicle.

We assume that the driver is turning the steering wheel so that the angle of the front wheels, w_a, varies linearly with t; i.e., w_a=ct. We have taken the proportionality constant c as 7^0 per second, based on our experience as to how fast the driver of a vehicle equipped with power steering can turn the steering wheel.

We assume the driving speed of the vehicle, V_0 to remain constant; that is, the rpm of the rear wheels is assumed to be constant with no longitudinal slip. In order to determine the actual path of the vehicle we have to take into account two other factors: slip and slide. Slip refers to the fact that in a turn the front wheels may not be traveling in the direction the wheels are pointed in due to the

distortion of the tires. Slide refers to the sideways motion of the wheels due to the centrifugal force. Szostek et al (1) identify three regimes: slip in the absence of slide, pure slide, and a transition region where both slip and slide are present. In the present case, the vehicle can be expected to pass through all three regions as the driver turns the steering wheel.

Slip depends on numerous factors, (tire design, tire pressure, camber, etc.) and is extremely difficult to predict. Experimental results show that the slip angle may vary from 3^0 to 8^0 (1,2,3,4) but 8^0 is likely to represent a very soft tire. Slip angle is of interest mainly in calculating the steering torque (the force needed to turn and hold the steering wheel) and even here, Hsu and Gerdes (2) suggest that good results may be obtained by assuming a uniform tire pressure distribution and a rigid tire carcass.

Szostek (1) suggests a formula for the coefficient of friction in the transition region,

$$\mu = \mu_0(1 - K_\mu \sin \alpha) \qquad (3)$$

in the absence of longitudinal slide (skid), where μ is the coefficient of friction and α is the slip angle. (Note: Szostek uses the traditional symbol for coefficient of friction, μ, in his equation but elsewhere in this paper we shall use μ (mu) to designate an angle of the path and c_f to designate the coefficient of friction.) Singh (4,5) suggests a value of 0.124 for K_μ. Thus it may be seen that the correction is very small.

Once the vehicle enters pure slide, slip ceases to be relevant. A vehicle will enter pure slide when the sideways force is sufficient to cause the tires to “break loose”; that is, when the sideways force exceeds μF_y, where μ is the coefficient of friction and F_y the normal force on the tire. As will be seen from the results of our calculations, this will be the case as soon as the vehicle begins to roll over. To be strictly accurate however, we need to define w_a as the effective wheel angle; that is, as the direction in which the tire is rolling as opposed to the direction in which the wheel is turned, prior to the onset of rollover.

The lateral coefficient of friction, c_f, may vary from 0.1 to 1.6 (3,4). 0.1 would represent an icy road and 1.6 would generally be encountered only on the finest kind of racing tires. For passenger car tires under normal conditions (dry pavement) the coefficient of friction will be in the range of 0.8 to 1.0 (2,3,4). Singh (4) suggests 0.85, Hsu and Gerdes (2) suggest 0.95, Smith (3) suggests 0.9. In our calculations we have assumed a value c_f = 0.9 but, like the other parameters in our computer program, c_f may be chosen by the user. In their analysis, as well as in their experimental results, Hsu and Gerdes (2) find that c_f is fairly constant once the vehicle enters the pure slide region (and even in the transition region).

Once the vehicle enters the pure slide region, the magnitude and direction of the velocity will be given by $\vec{V} = \vec{V}_o + \vec{v}_n$, where V_O is the wheel speed and v_n is the slide speed. V_o and v_n are assumed to be perpendicular. We define f_n as the net sideways force on the vehicle; that is,

$$f_n = fc1 - c_f f_y \quad (4)$$

where fc1 is the centrifugal force on the vehicle due to the curvature of the path of the vehicle, c_f is the lateral coefficient of friction, and f_y the normal force on the tires. In the present analysis we will assume that the vehicle is aligned in the direction of $V_{0.}$ Since this will not be exactly the case in practice, we need to consider this assumption more carefully.

For a wheel velocity of 73 fps we find a maximum v_n of 31 fps. The vehicle would thus be at an angle of 23^0 to the direction of the velocity. Since the cosine of 23^0 is 0.92, there would, briefly, be a maximum error of 8% in the component of the lateral force perpendicular to the velocity. Thus, the actual v_n would be less and the error would be less. This does not take into account understeer or oversteer, however. The typical SUV has a 55 : 45 weight distribution; that is, 55% of the weight is on the front wheels and 45% on the rear wheels. Other things being equal, this would lead to oversteer which would increase the centrifugal force on the vehicle and the occupants. Neglecting this factor would thus result in a lower force being predicted than would actually be the case.

If the lateral force on the vehicle is greater than $c_f f_y$ there will be a net outward force and hence a net outward acceleration: In accordance with Newton's second law of motion, $\vec{F}=m\vec{a}$, the outward acceleration would be given by

$$a_n = f_n/M \quad (5)$$

where M is the mass of the vehicle and f_n is given by equation (4). The normal (downward) force on the tires (before the vault) is given by

$$f_y = W \sin^2\theta - fc2 \sin\theta \quad (6)$$

(see Figure 2). The lateral velocity v_n is given by

$$v_n = \int_o^t a_n dt \quad (7)$$

The distance travelled by the vehicle in time dt will thus be

$$ds = [(V_0 dt)^2 + (v_n dt)^2]^{1/2} \quad (8)$$

The change in the direction of motion in time dt, in the absence of any change in the front wheel angle w_a and in the absence of slide, is given by

$$d\mu = w_a V_0 dt/w_b \quad (9)$$

where $d\mu$ represent the change in the direction of motion (not the change in viscosity) and w_b is the wheel base. To get the actual change in the direction of motion we have to add the change in the wheel angle, $dw_{a,}$ and the change in the direction of the outward velocity vector, v_n/V_0.

$$dw_a = 0.122dt \quad (10)$$

assuming a rate of change of the wheel angle of 7^0 per second. The change in the direction of motion, $d\nu$, in time dt, is thus given by,

$$d\nu = d\mu + dw_a - d[\arctan (v_n/V_0)] \quad (11)$$

The radius of curvature of the path is given by

$$\rho = ds/d\nu \quad (12)$$

The velocity of the vehicle is given by

$$V = [V_0^2 + v_n^2]^{1/2} \quad (13)$$

Equation (3) may be written in the form

$$\ddot{\theta} = \frac{r_{cg} V^2}{\overline{r^2}\rho} \sin\theta - \frac{g r_{cg}}{\overline{r^2}} \cos\theta \quad (14)$$

Given V_0, r_{cg}, and $\overline{r^2}$, we may thus integrate forward from the initial condititons t=0, $v_n = 0$, $\mu = 0$, $\nu = 0$, and $\dot{\theta} = 0$. Since, initially, the centrifugal force will not be enough to roll the vehicle, $\ddot{\theta}$ will initially be negative. We must thus step forward in time until $\ddot{\theta}$ is positive before we can generate a meaningful solution.

The suspension: In a real vehicle, the body will lean and the roll rate would already have some positive value before the wheels on the left (or right) side start to lift. That is, the springs and shock absorbers will extend on one side of the vehicle and compress on the other side. The extent of this lean and the initial angular velocity will depend on the suspension - less for a stiff suspension, more for a soft suspension. In the present analysis, we have ignored this effect; that is, we have assumed initial values of $\theta = \theta_0$ and $\dot{\theta} = 0$.

Referring to Figure 2, fc1 is given by

$$fc1 = MV^2/\rho \quad (15)$$

and fc2 is given by

$$fc2 = M\dot{\theta}^2 r_{cg} \quad (16)$$

where M is the mass of the vehicle and $\dot{\theta}$ is obtained by integrating equation (14). The vertical force on the wheels, f_y, will be given by

$$f_y = W \sin^2\theta - fc2 \sin\theta \quad (17)$$

where W is the weight of the vehicle, and hence the lateral force will be given by

$$f_n = fc1 - c_f f_y \quad (18)$$

where c_f is the lateral coefficient of friction of the tires. We define fnet2 as

$$fnet2 = W \sin\theta - fc2 \qquad (19)$$

Once fnet2 becomes negative, the center of gravity can no longer maintain a circular path. Strictly speaking, the tires will not actually lose contact with the ground until θ reaches 90^0 so that if fnet2 becomes negative before then there may be some slight further increase in $\dot{\theta}$. In practice the effect would be small so we have taken $\dot{\theta}$ constant from the moment fnet2 becomes negative.

The force on the child: The child may be sitting either on the inside or the outside of the rotation. We consider first the child sitting on the inside of the rotation; that is, to the right of the cg in Figure 2. Figure 3 shows the position of the child.

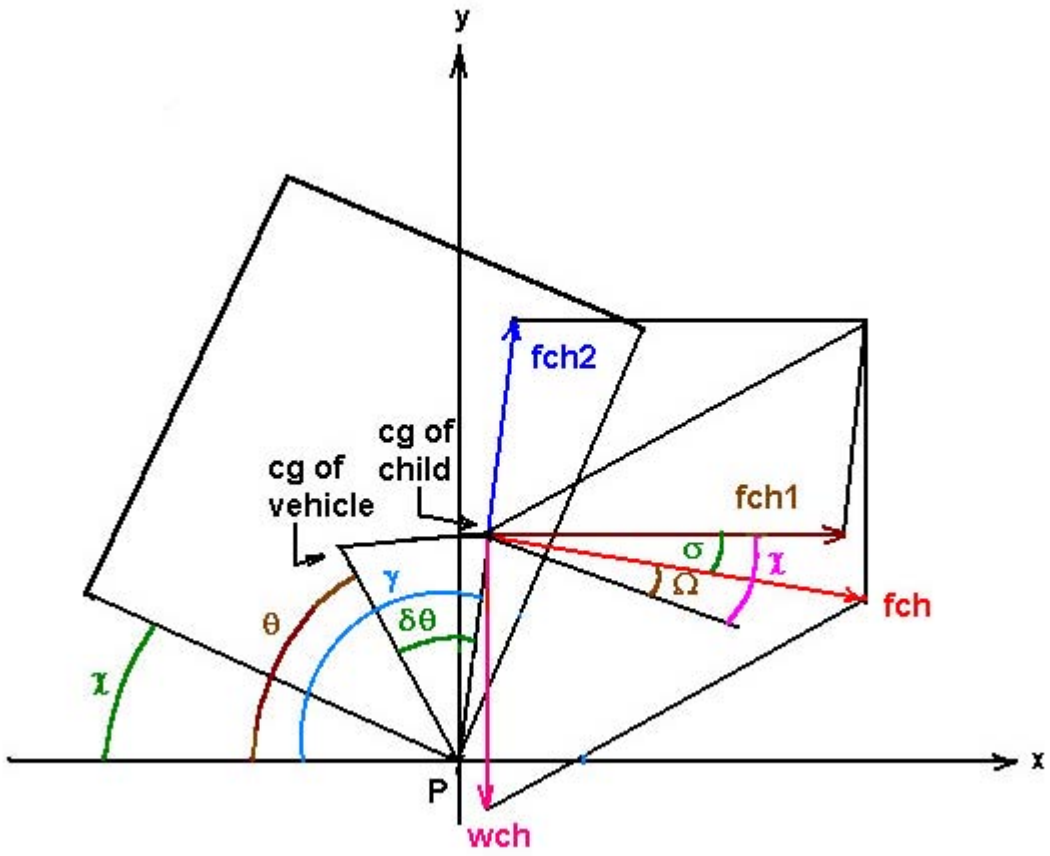

Figure 3

fch is the force on the child, fch2 is the centrifugal force component on the child due to the rotation of the vehicle, fch1 is the centrifugal force component on the child due to the curvature of the path of the vehicle, wch is the weight of the child, rchv is the distance between the center of gravity of the vehicle and the center of gravity of the child, rch is the distance from the center of gravity of the child to the point P, $\Delta\theta$ is the angle between r_{cg} and rch, fxch is the horizontal component of the force on the child, and fych is the vertical component of the force on the child. We define the angle σ as arctan(fych/fxch). Thus, σ may be either positive or negative. rchv is given by

$$rchv = [r_{cg} + rch^2 - 2r_{cg}rch\cos(\Delta\theta)]^{1/2} \quad (20)$$

Note that $\chi = \theta - \theta_0$ and $\gamma = \theta + \Delta\theta$ (21)

Ω is the angle between the perpendicular to the side of the car and the force vector on the child. This is important not only in helping us to determine the force against the booster seat straps but also in evaluating claims of ejection through a car window. Clearly, the child, or an adult occupant, cannot be ejected through a window unless a) the force vector is in the direction of the window, b) the force vector is of sufficient magnitude, and c) the force is of sufficient duration in that direction.

In addition to the forces shown in Figure 3, the child will also experience a force which is approximately in the direction of motion of the vehicle, the so-called Coriolis force, due to the rotation of the coordinate system. This force, however, is spread over the back of the child by the padded seat back and will, therefore, not be as harmful as the force on the straps. In the present case the Coriolis force is given by

$$2m\vec{\omega} \times \vec{V} = 2(mch)\omega_c V_r \vec{k} \quad (22)$$

where $\vec{k}$ is a unit vector perpendicular to the reference plane (moving coordinate system) and V_r the velocity of the center of gravity of the child in the moving coordinate system. Because the vehicle is sliding sideways, the vector $\vec{k}$ will not be exactly in the direction of motion.

Referring again to Figure 3,

$$fch2 = (mch)\dot{\theta}^2(rch) \quad (21)$$

$$fch1 = (fc1)(wch)/W \quad (22)$$

where mch is the mass of the child and rch is the distance from the center of gravity of the child to the point P. (Notice that we have ignored the fact that the center of gravity of the child does not coincide, exactly, with the center of gravity of the vehicle). The y component of the force on the child is given by

$$fych = (fch2)\sin(\gamma) - wch \quad (23)$$

The x component of the force on the child is given by

$$fxch = fch1 - (fch2)\cos(\gamma) \quad (24)$$

The total force on the child is given by

$$fch = [(fxch)^2 + (fych)^2]^{1/2} \quad (25)$$

For the child sitting on the outside of the rotation we define Ω as the direction of the force on the child relative to the outward perpendicular to the left side of the car (Figure 4). If Ω is between 0 and π, (Ω positive), the force component perpendicular to the seat is upward relative to the seat, while if Ω is between 0

and -π, (Ω negative) the force component perpendicular to the seat is downward on the seat. Here the situation is a little more complicated than for the child sitting on the inside of the rotation because Δθ can be either positive or negative. We need to define four cases:

1. Δθ positive, before the vault (rotation about P).
2. Δθ positive, during the vault (rotation about the cg).
3. Δθ negative, before the vault (rotation about the point P).
4. Δθ negative, during the vault (rotation about the cg).

Case 1. Referring to Figure 4,

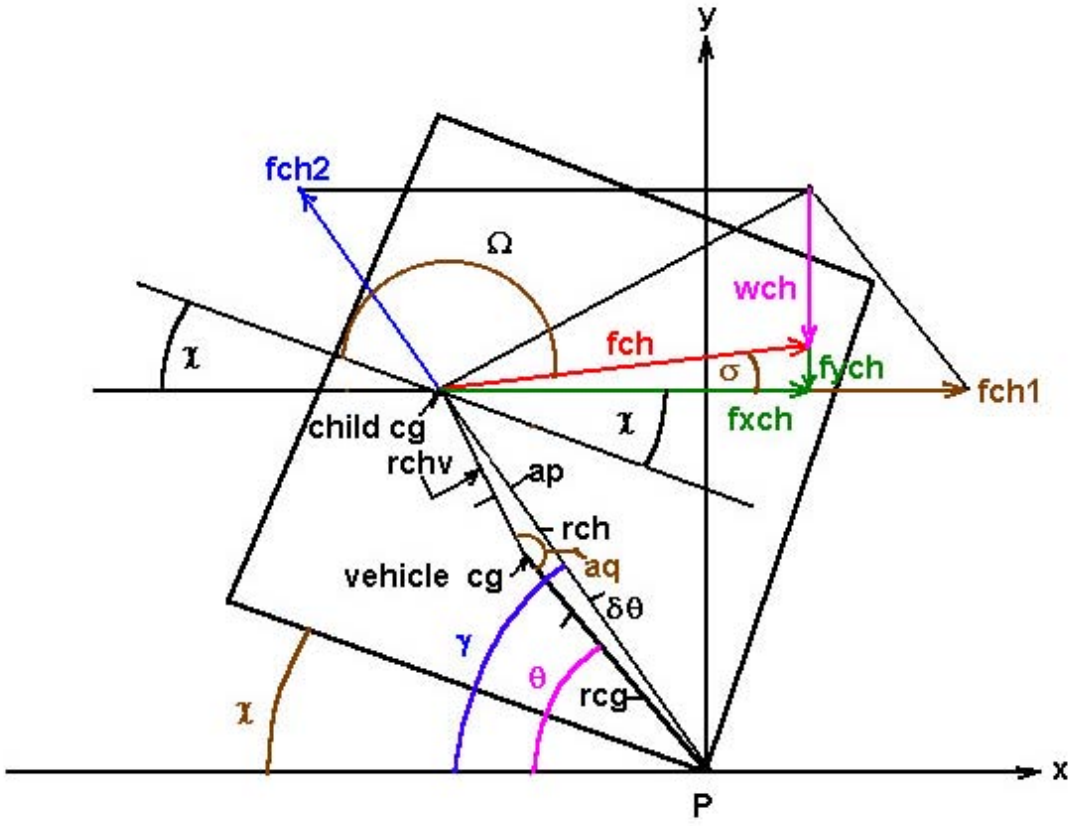

Figure 4

we see that

$$\Omega = \pi - (\chi + \sigma) \qquad (26)$$

Case 2. Referring to Figure 5,

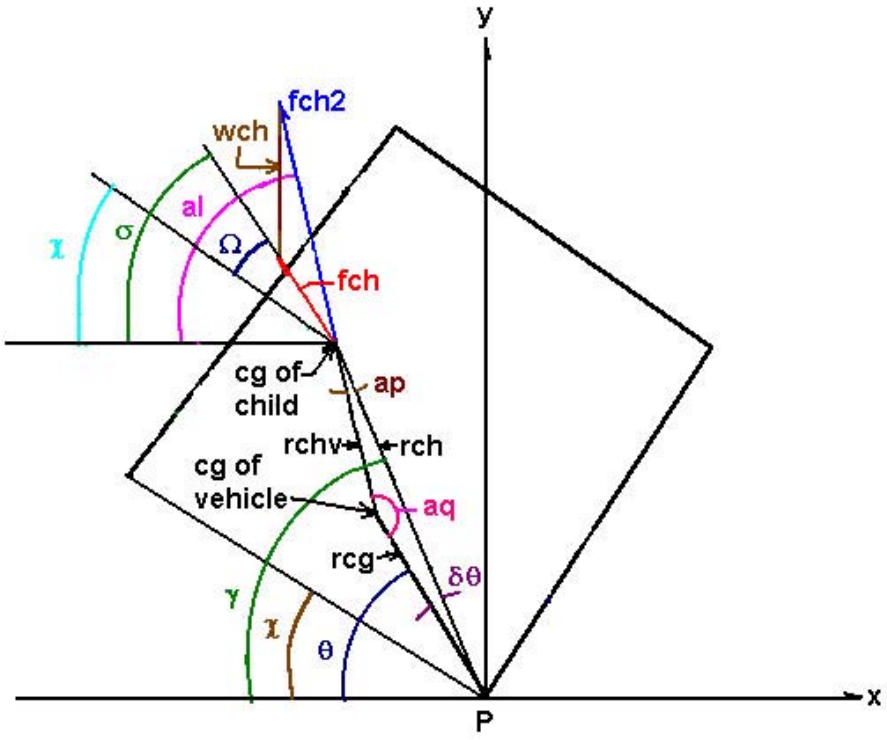

Figure 5

we see that if al < 90^0, $\Omega = -(\sigma + \chi)$. Notice that σ is negative while χ is positive so that Ω is positive upwards.
Referring to Figure 6,

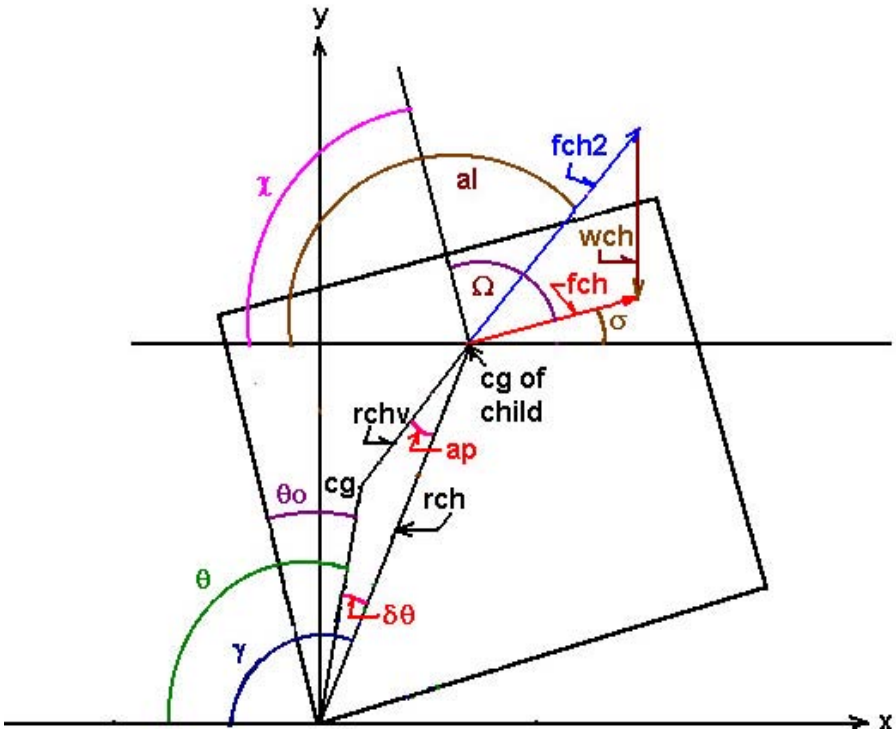

Figure 6

we see that if al > 90^0, $\Omega = \pi - (\sigma + \chi)$. In practice, the vault usually occurs when al is at, or close to 90^0. Notice that σ may be positive or negative.

Case 3. $\Delta\theta < 0$. Referring to Figure 7

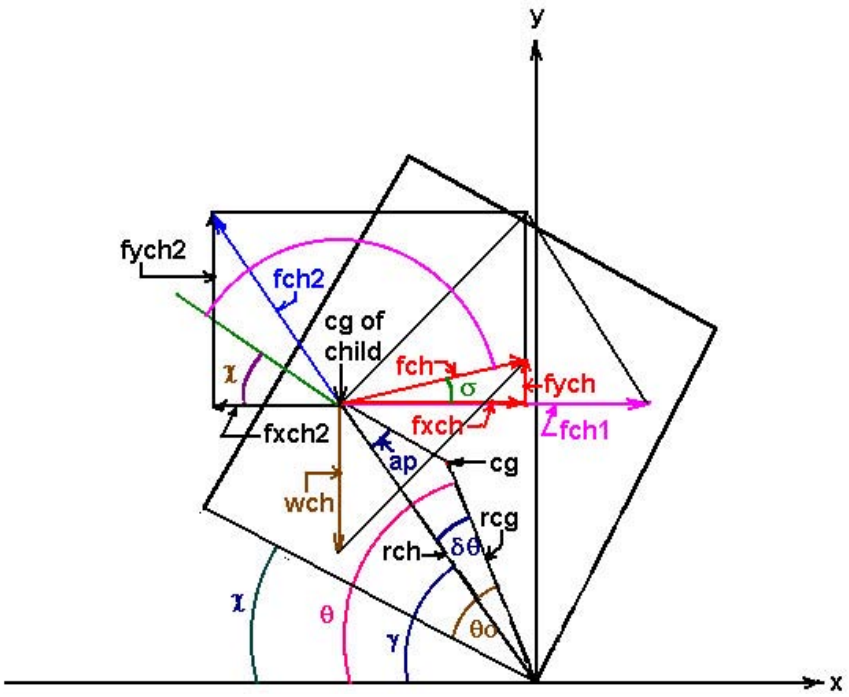

Figure 7

we see that $\Omega = \pi - (\sigma + \chi)$, as in the previous case.

Case 4. Referring to Figure 8,

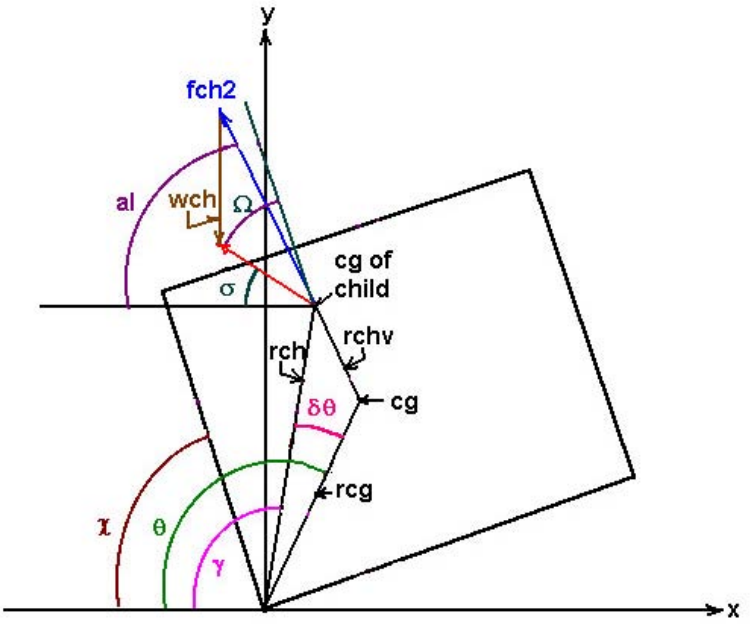

Figure 8

we see that when $\Delta\theta < 0$, al must be defined as al = γ - ap, where ap is always taken as positive. Here, al < $\pi/2$. Hence, $\sigma < 0$ (fych >0, fxch <0) and hence $\Omega = -(\sigma + \chi)$.

Integration of the equations and the computer programs.

The integration of the equations can perhaps be best understood by referring to the computer programs (appendixes 1, 2, and 3, p23 et. seq.). The computer programs are written in Fortran 77 and can be run on any computer with a Fortran 77 compiler. We present three different versions of the computer program. sideslip1 (appendix 1) is the full program with the child on the inside of the rotation. The program prints the solution for all the principal parameters at each step of the intergration. This results in approximately 22 pages of output for step size of 0.01. (appendix 4).

mensai (appendix 2)is the same as sideslip1 except that it prints out t, x, y, fch, Ω, θ, and $\dot{\theta}$ in tabular form which can readily be transferred to a spread sheet program such as Lotus 123 or Excel. mensao (appendix 3) is the same as mansai except that the program has been modified to generate the solution for the child sitting on the outside of the rotation. (sideslip1 can easily be modified the same way.)

Getting the solutions.
The first step is to select and enter the input parameters. In order to gernerate the path of the vehicle we have arbitrarily chosen the initial values of x and y as x=0, y=82. y=82 was chosen because it corresponded to the radius of curvature on some of our initial test runs. Other input and initial parameters which must be chosen are fnet2, V_0, a_n, f_n, w_a, w_b, v_n, M, W, w_{ch}, m_{ch}, t, c_f, y_{cg}, r_{cg}, $\Delta\theta$, μ, ν, θ_0, δt, θ, and θ_1. Since Fortran 77 does not permit subscripts or greek letters, the following nomenclature has been used in the computer programs:

V_0 = Vo	r_{ch} = rch	ρ = rho	f_{ch}=fch
a_n = an	m_{ch} = mch	$\ddot{\theta}$ = thetadd	σ = sigma
f_n= fn	c_f = cf	$\dddot{\theta}$ = theta3d	χ = chi
w_a = wa	$\overline{r^2}$ = rsqbar	f_y = fy	Ω = omega
w_b = wb	y_{cg} = ycg	f_x = fx	r_{chv} = rchv
v_n = vn	r_{cg} = rcg	f_{ycg} = fycg	r_{ch} = rch
μ = mu	θ_o = thetao	ϕ = phi	
ν = nu	δt = deltat	β = beta	
W = w	θ = theta	γ = gamma	
$\Delta\theta$ = dtheta	$\dot{\theta}$ = thetad	f_{ych} = fych	
w_{ch} = wch	θ_1 = theta1	f_{xch} = fxch	

Since the vehicle is asssumed to be travelling in a straight line at time t = 0, the initital values of t, fnet2, an, fn, wa, vn, mu, nu, and thetad are all zero. wb is the wheel base and was taken as ten feet, which is the average wheel base of common SUVs. M is the mass of the vehicle which was chosen as 124.22 slugs (4000 pounds) for convenience. Full size SUVs tend to be slightly heavier while compact SUVs may be slightly lighter.

The location of the center of gravity of the child is specified in polar coordinates by the distance from the point P, rch, and the angle $\Delta\theta$ (dtheta) from the center of gravity of the vehicle (Figure 2). For our example we have taken rch = 4.24 feet and dtheta = 0.436 radians. The weight of the child is assumed to be 40 pounds, the average weight for a four year old child (8).

The moment of inertia about the point P is given by

$$I_p = \int_M r^2 dm = \overline{r^2} M \qquad (27)$$

where $\sqrt{\overline{r^2}}$ is the radius of gyration. In the sample calculation we have taken $\sqrt{\overline{r^2}}$ as 4.9, giving a moment of inertia about P of 2981 slug-ft^2 for the assumed mass 124.22 slugs (4000 pounds). Yamaguchi (6) gives a moment of inertia of 2079.6 for a Toyota pickup truck where most of the mass would be concentrated lower down since the truck lacks an upper body except for the cab. For the distance of the center of gravity of the vehicle from the point P we have taken 4.24 feet. These figures are estimates. The actual values will depend on the particular vehicle. For a base width of six feet, θ_o (thetao), the polar coordinate of the center of gravity of the vehicle works out to 0.785 radians (Figure 2) in the present case. Since the vehicle is initially level, the initial value of θ is θ_o.

Since we are concerned with the first 90^0 of the roll in the present case, we set the final value of theta, theta1, as the initial value plus 90^0. Thus,

$$\text{theta1} = \text{thetao} + 1.57 \qquad (28)$$

This will be the point where the iteration stops but we could just as well have chosen some other value; for example, if the roof is narrower than the base, the vehicle would roll past 90^0 before the first roof edge strike and we could choose an appropriate higher value, based on the dimensions of the vehicle.

Finally, we have to choose a step size, deltat, for the numerical integration. We chose an initial step size of 0.01 seconds. This turned out to give good results except near the discontinuity at the vault. This problem was overcome by using a smaller step size.

The equations were intergrated using the Euler method. The accuracy of the results may be tested by using the convergence method. This involves repeating the integration using progressively smaller step sizes and noting the change in the solution. If one plots the results one finds that the solution usually approaches an asymptote as the step size approaches zero. In this way it is possible to get quite accurate solutions as well as a good idea of the error involved for a particular step size. In the present case we found a maximum error of approximately 5.5% for a step size of 0.01.

The results.

The computer programs were used to find the solutions for a typical SUV rollover at speeds ranging from 40 to 65 mph. Since the number of solutions the program

can generate is essentially unlimited, we present this sample solution and publish the program itself so that the reader may generate his own solutions. The program can be run on any computer with a Fortran 77 compiler. No special skill is required. Anyone not having a Fortran compiler can obtain one free of charge from http://www.geocities.com/Athens/Olympus/5564 or http://kkourakis.tripod.com .

Sample numerical outputs of sideslip1.for, mensai.for and mensao.for are given in appendixes 4, 5, and 6 (pp. 31 et. seq.). To save space, and for clarity, the remainder of the results are presented in graphical form. (To present the full results of our sample calculations in numerical form would run to over 400 pages.) If you look carefully you will note a few blips and wiggles in the in the solutions for the larger step sizes. These have been smoothed out in the charts to show the overall trend line. These blips and wiggles tend to disappear when one goes to smaller step sizes.

Looking at Figure 9, (page 15) we see the force on the child sitting on the inside of the rotation. The results are presented for both a 0.01 second and a 0.005 second step size. As may be seen, it makes little difference. The curves show the results for speeds of 59, 66, 73, 81, 88, and 95 feet per second (40, 45, 50, 55, 60 and 65 miles per hour). As may be seen, the maximum force on the child ranges from 80 to 93 pounds just prior to the vault. The solution clearly shows the sudden drop when the vehicle vaults.

Figure 10 shows the direction of the force. The angle omega is the angle is the angle the force vector makes with the outward perpendicular to the vehicle (see Figure 3). A positive value indicates an upward component away from the seat, a negative value indicates a downward component into the seat. Thus it may be seen that during the period of highest force, the force is upward and outward - that is, against the harness. The child would thus suffer severe, and probably fatal injuries even prior to the first roof edge strike.

Figures 11 and 12 show the magnitude and direction of the force on the child sitting on the outside of the rotation. Here we see that the maximum force ranges between 70 and 80 pounds. The direction of the force, omega, is defined in Figures 4 and 5. A value greater than π (3.1416) indicates a downward component of the force (into the seat) and a value of less than π indicates an upward component of the force; i.e., away from the seat and into the harness. Again we see that the maximum force occurs just before the vault and is directed against the straps. These results also enable one to calculate the distribution of the force between the hip and the neck (see the solution to puzzle no. 2, elsewhere on this web site).

Figure 13 show the path of the vehicle for the different speeds considered. The rate of change of the angle of the front wheels is the same in each case but the curvature needed for a vault is less at the higher speeds, as might be expected. Once the vehicle vaults, the wheels lose contact with the ground and hence the path becomes a straight line.

Figures 14(a) and (b) show the variation of θ (theta) with time. Once the vehicle vaults, $\dot{\theta}$ (thetad) becomes constant and hence the variation of theta with time

must be a straight line of constant slope. Although it appears from the graphs that the value of θ at the vault, θ_v, may be independent of velocity, a closer look shows that this is not the case, at least based on the numerical solutions of the equations, as we may see when we consider the variation in angular velocity.

Figures 15 (a) and (b) show the angular velocity of the roll as a function of time. The results for the 0.01 step size appear to be somewhat erratic and even the results for the 0.005 step size did not seem satisfactory so we went to a 0.001 step size (Figures 15b). While the variation in the final angular velocity decreases with step size it is not a priori evident that it has to converge to zero. While the graphs show little difference, the numbers still reveal considerable variation:

	59	66	73	81	88	95
$\dot{\theta}_v$	2.7517	2.7488	2.7435	2.7308	2.7280	2.7165
θ_v	1.4616 (83.75^0)	1.4365 (82.31^0)	1.4101 (80.80^0)	1.3785 (78.99^0)	1.3541 (77.59^0)	1.3286 (76.13^0)

The critereon for the vault is

$$g \sin\theta = r_{cg}\dot{\theta}^2 \tag{29}$$

For an r_{cg} of 4.24, as chosen in our sample calculation,

$$\sin\theta_v = 0.1317\dot{\theta}_v^2 \tag{30}$$

Since $\sin\theta$ cannot exceed 1, $\dot{\theta}_v$ must be $\leq$ 2.755. The value of θ_v may be calculated from equation (30) for a given $\dot{\theta}_v$. Thus we find,

	59	66	73	81	88	95
θ_v from program:	83.75^0	82.31^0	80.80^0	78.99^0	77.59^0	76.13^0
θ_v from equation 30:	85.72^0	84.33^0	82.42^0	79.15^0	78.55^0	76.37^0

Because the values of the sine are so close to 1.0 above 82^0, it is likely that some round-off error is involved. These variations have no significant effect on the order of magnitude of the force on the child, however.

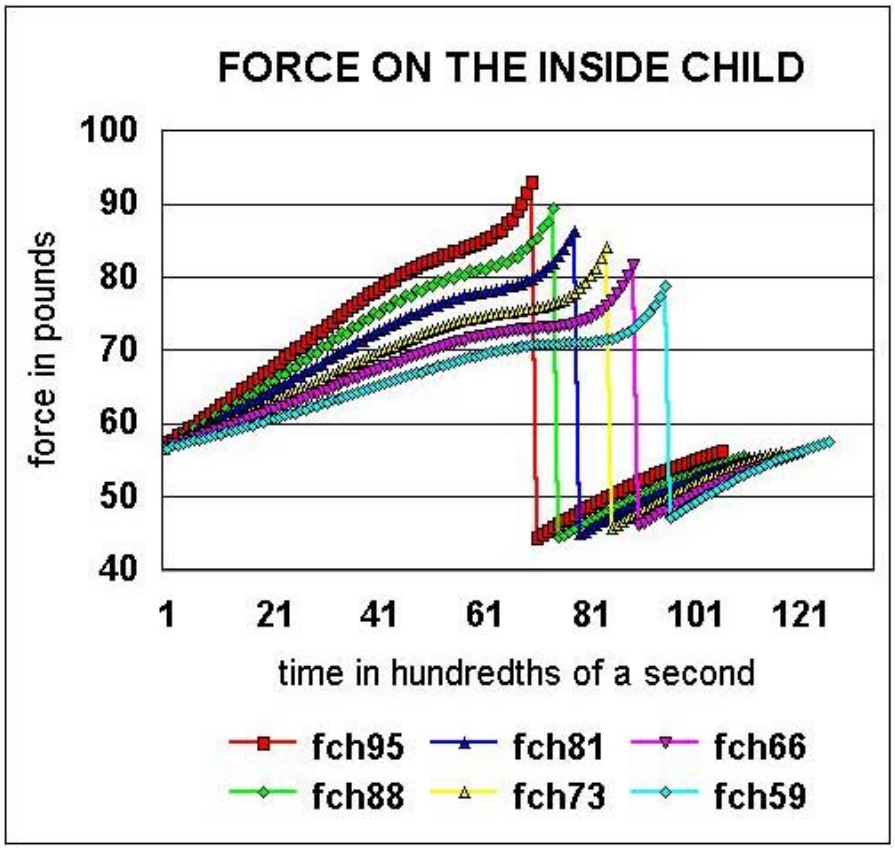

Figure 9a

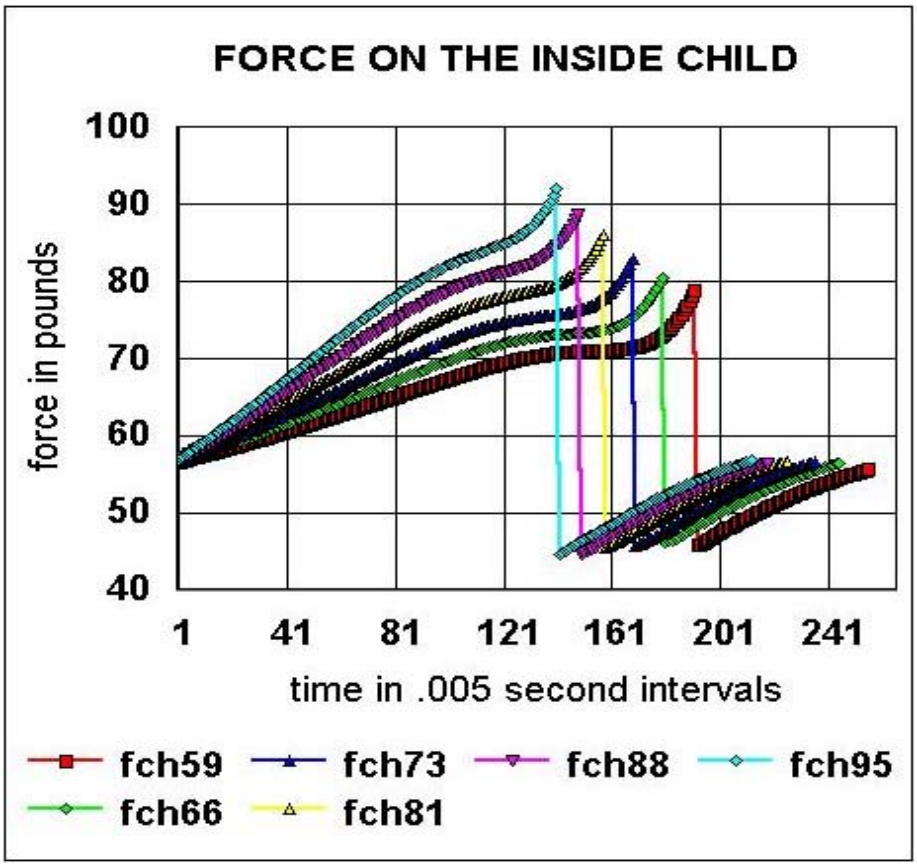

Figure 9b

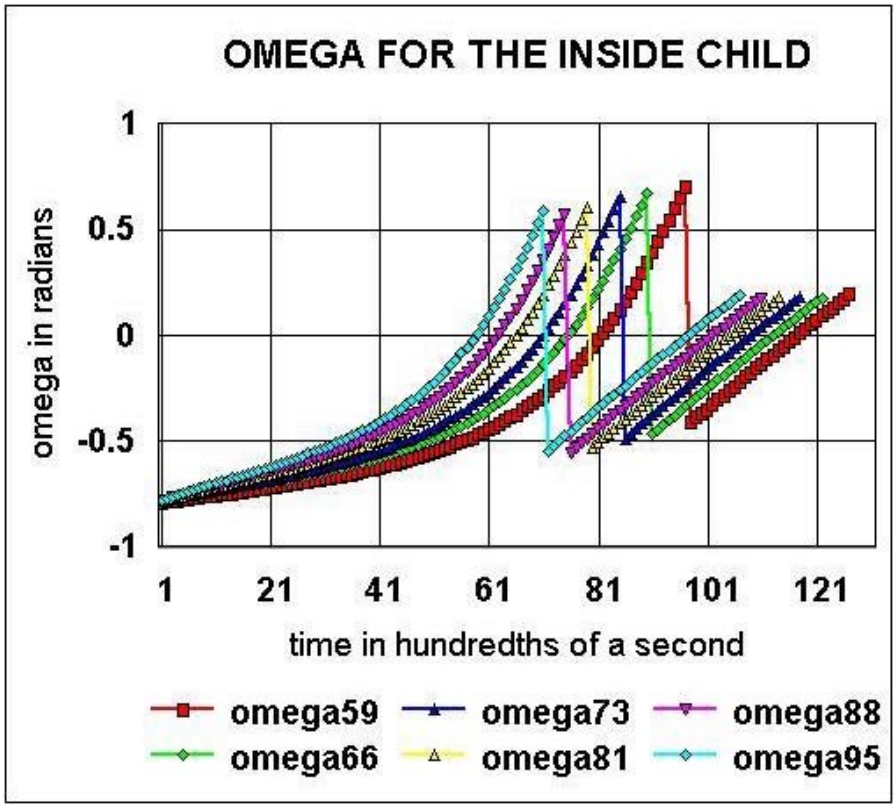

Figure 10a

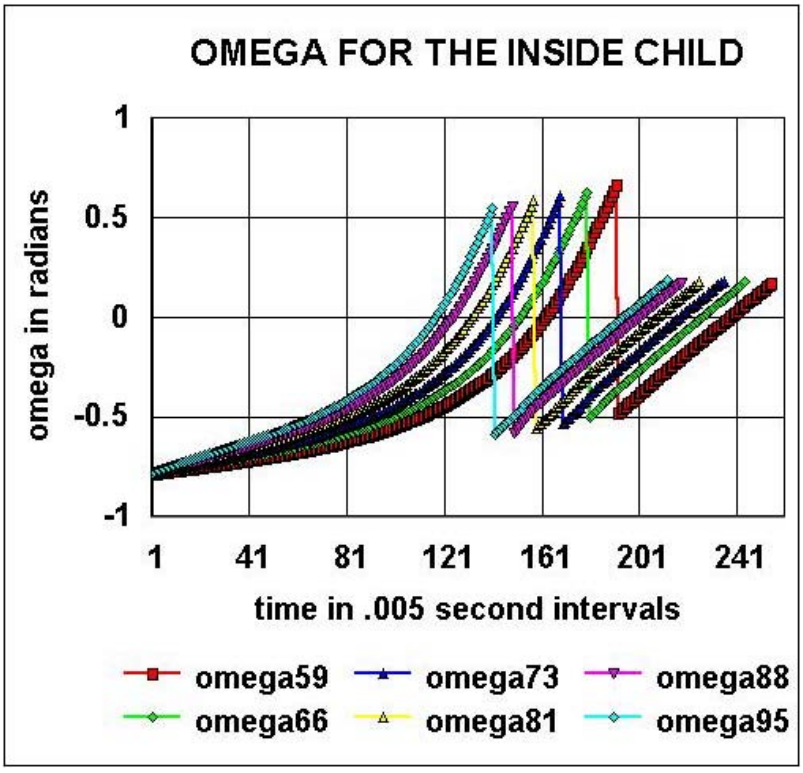

Figure 10b

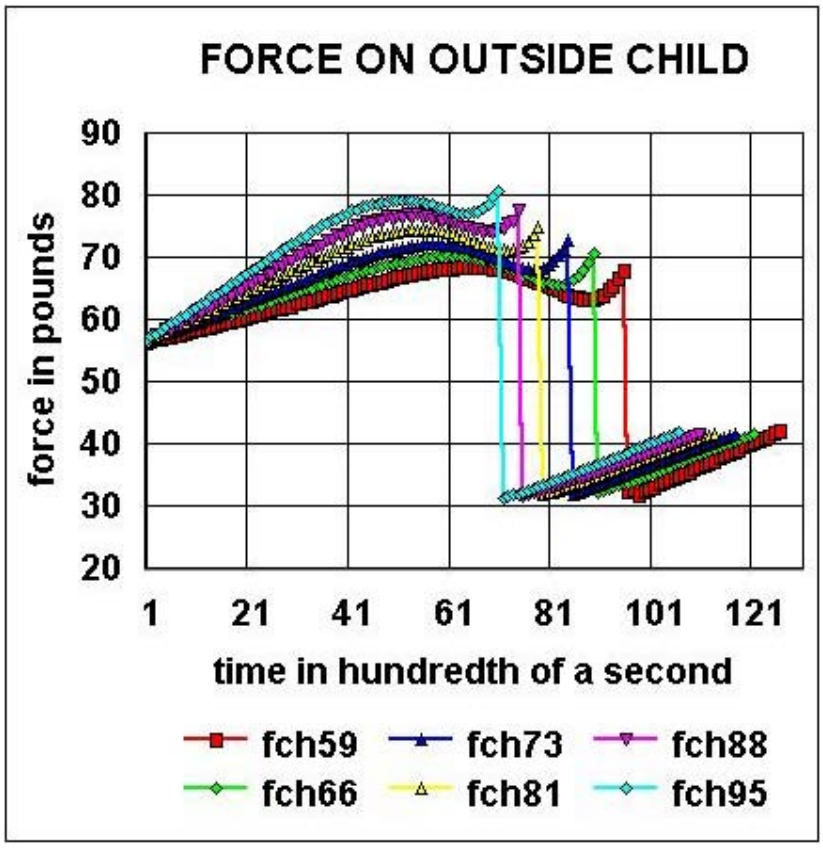

Figure 11a

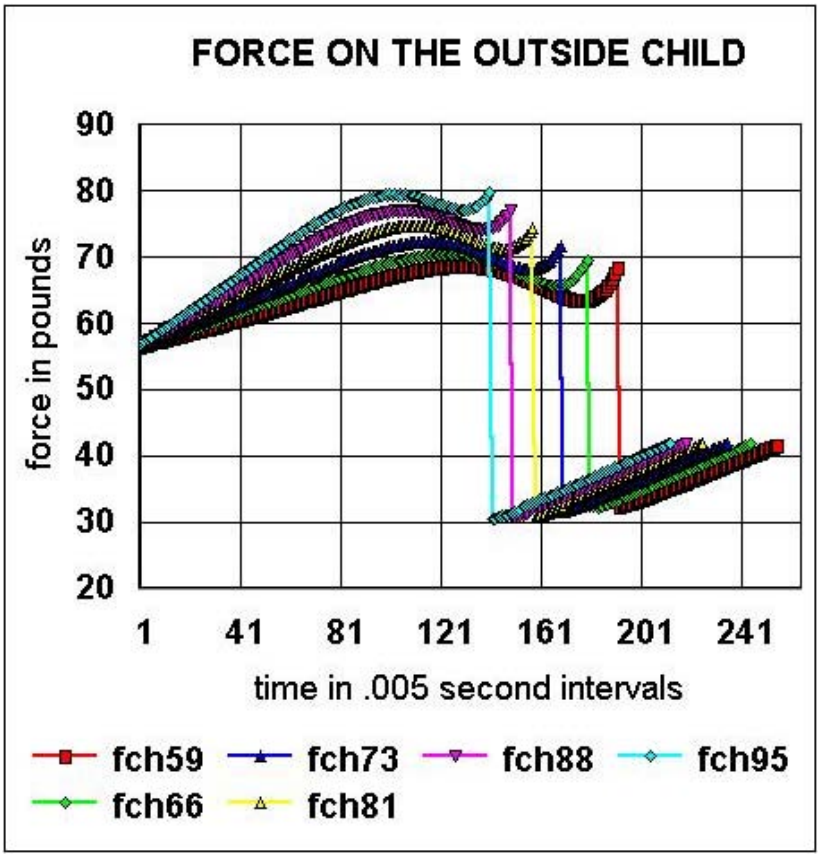

Figure 11b

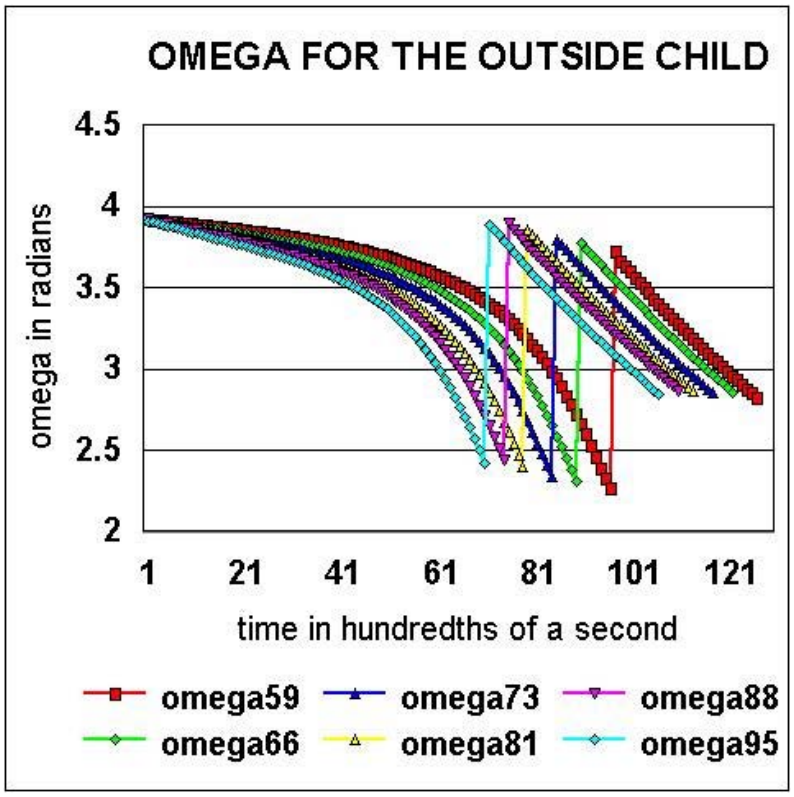

Figure 12a

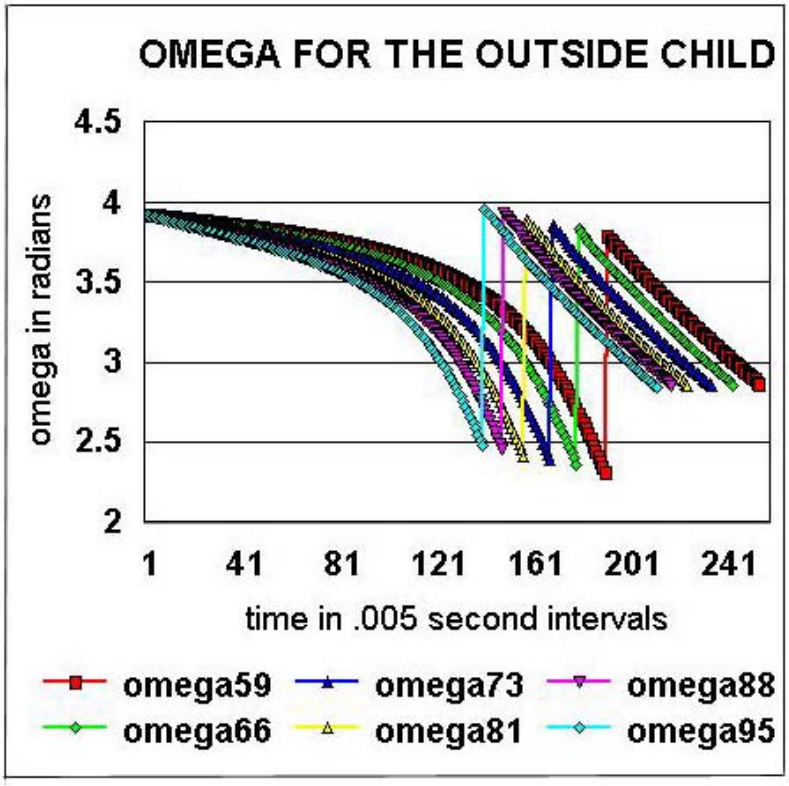

Figure 12b

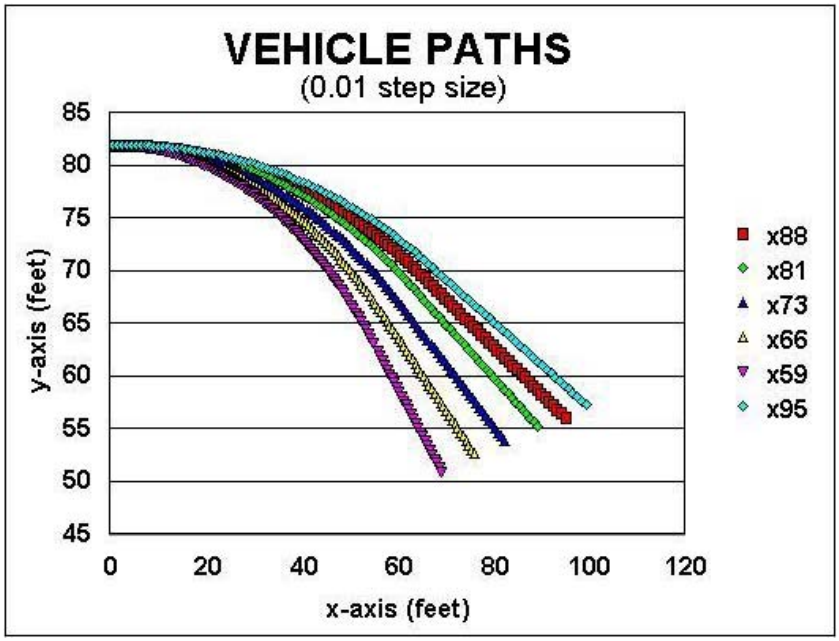

Figure 13a

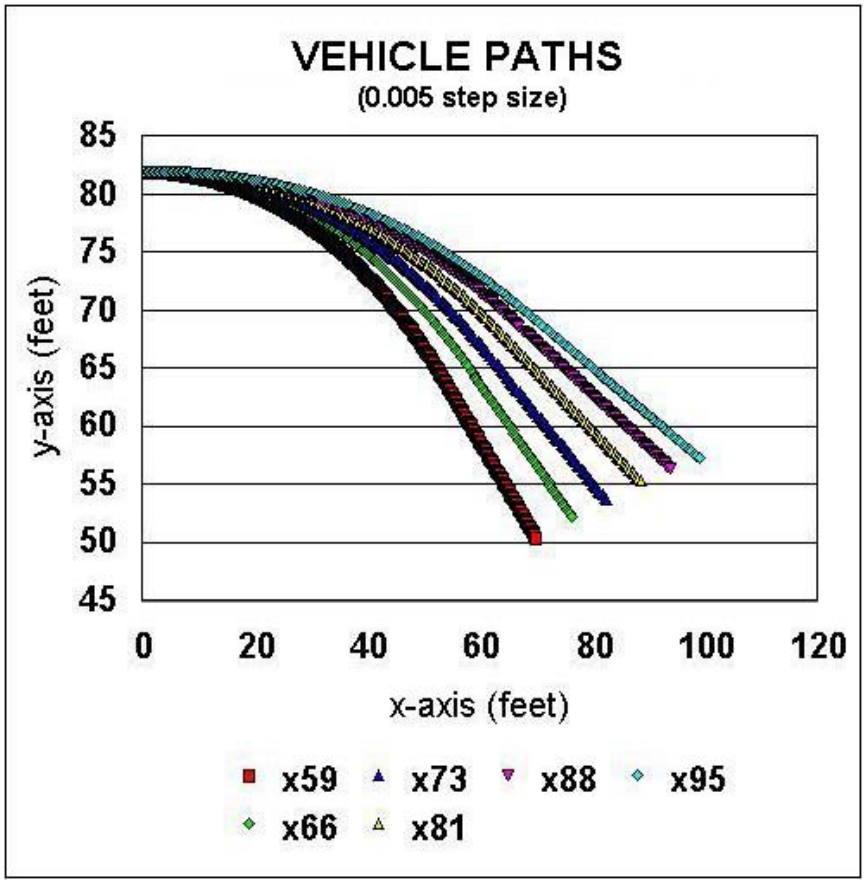

Figure 13b

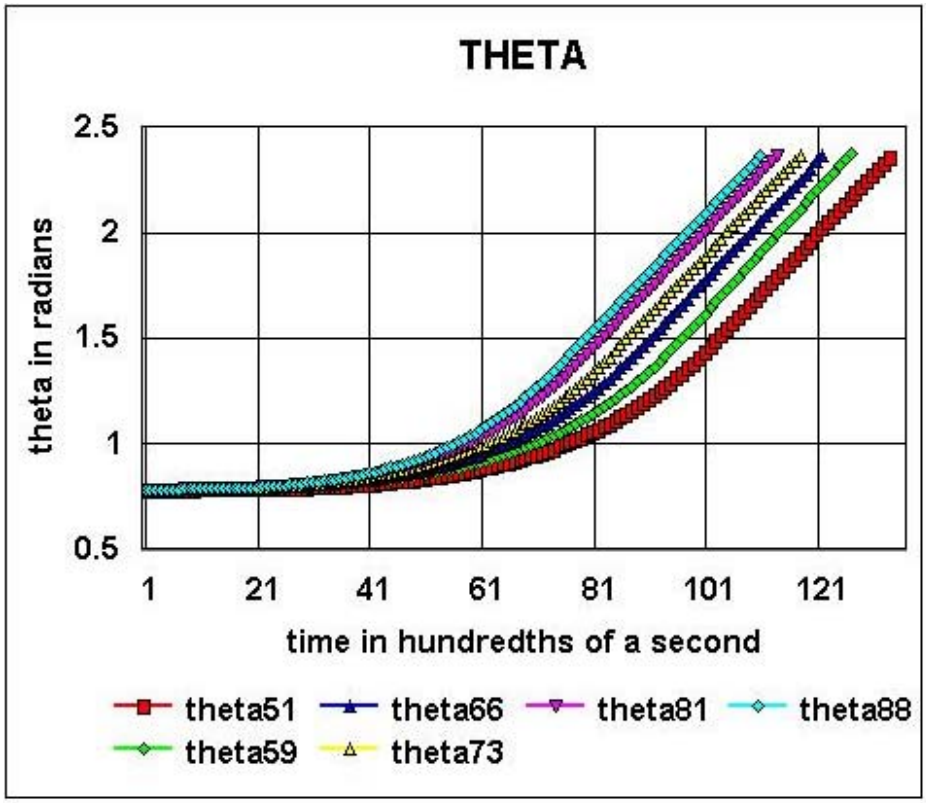

Figure 14a

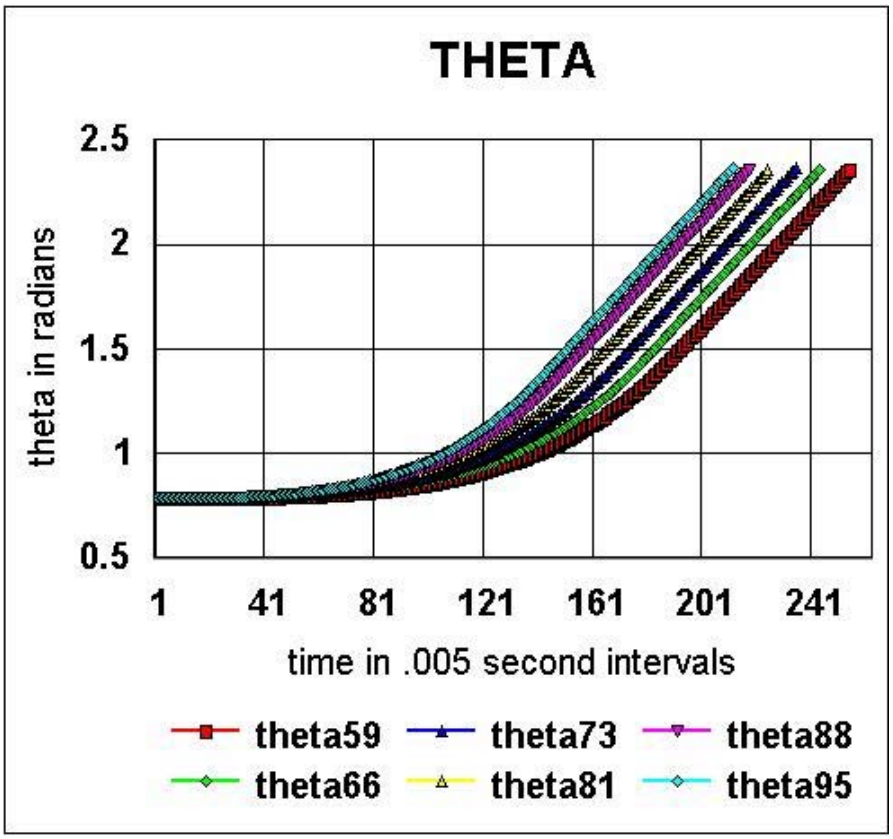

Figure 14b

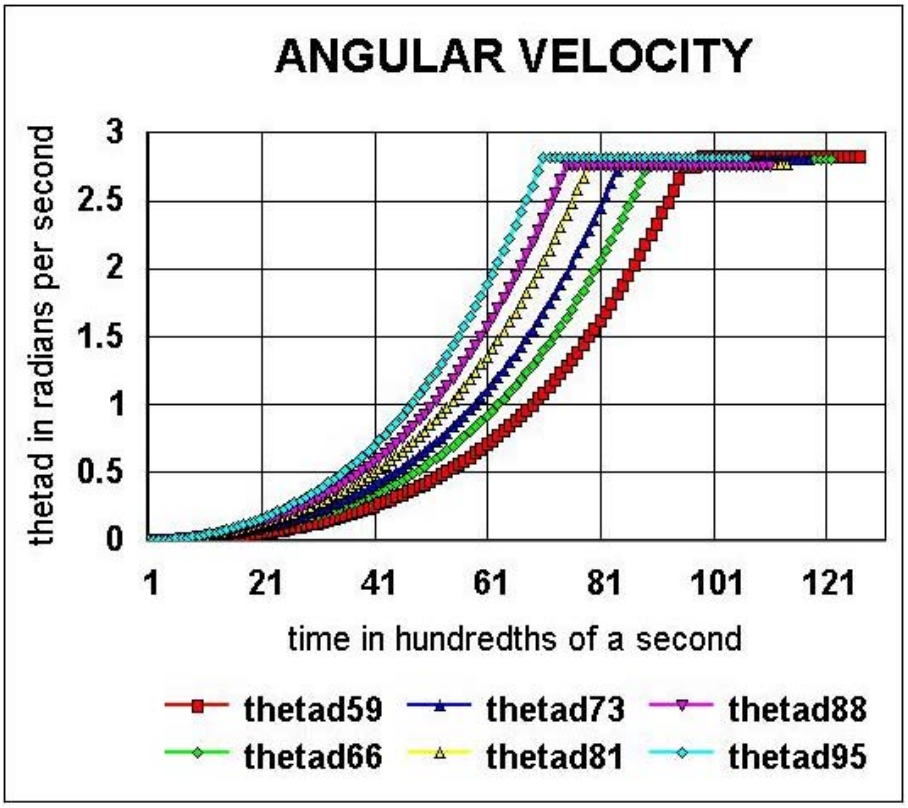

Figure 15a

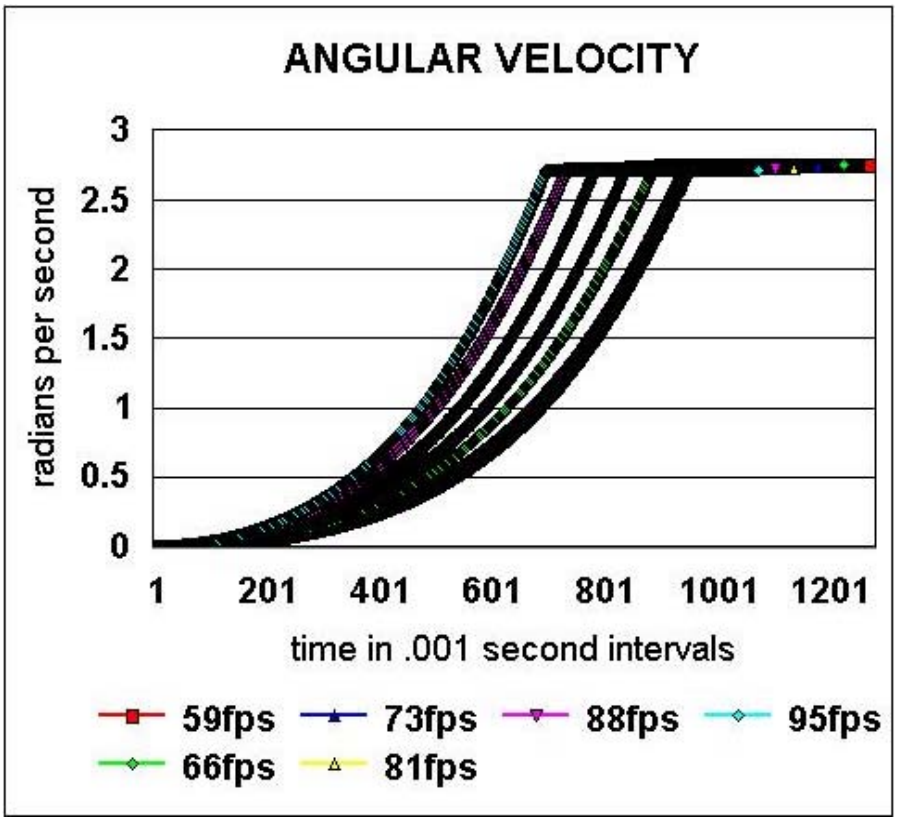

Figure 15b

References:

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5. Telephone conversation with Professor Singh.

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7. Larsen, R. E., et. al., Vehicle Rollover Testing. Methodologies in Recreating Rollover Collisions. SAE Technical Paper Series 2000-01-1641. Proceedings of the Automotive Dynamics Conference, Troy, Michigan, May, 2000.

8. United States Center for Disease Control (CDC): Weights and Dimensions of Children. http://www.cdc.gov

APPENDIX 1

```
      program sideslip1
      real M, rsqbar, rcg, theta, thetad, thetadd, theta3d, theta1, x,
     + y, rho, V, t, thetao, deltat, kone, ktwo, alpha, a, ycg, fycg,
     + fc1,fc2,fy,fn,fx, beta, phi, nu, mu, muav, dmu, dnu, dr,rchv,
     + gamma,sigma, fch1, fch2, wch, fych, fxch, dtheta, w, fch, omega
     + r, wa, vn, an, wb, vn1, ds, dwa, vnav, fnet2, cf, chi,rch,mch,
     + q, al, aq, Vo
      fnet2=0.0
      Vo=73.0
      x=0.0
      y=82.0
      an=0.0
      fn=0.0
      fnet2=0.0
      wa=0.0
      wb=10.0
      vn=0.0
      mu=0.0
      nu=0.0
      M=124.22
      w=32.2*M
      dtheta=0.436
      wch=40.0
      rch=4.24
      mch=wch/32.2
      t=0
      alpha=0.0
      a=6.0
      cf=0.9
      rsqbar=(a**2)*((2.0-1.33*alpha)/(3.0-alpha))
      ycg=a*(1.0-alpha)/(2.0-alpha)
      rcg=SQRT(ycg**2+a**2/4.0)
      thetao=ATAN(2.0*ycg/a)
      deltat=0.01
      theta=thetao
      thetad=0.0
      theta1=thetao+1.57
      PRINT 5, M, rsqbar, rcg, Vo, deltat
    5  FORMAT(1X,'M=',F6.2,3X,'rsqbar=',F4.1,3X,'rcg=',F4.2,3X,
     + 'Vo=',F5.1,3X,'deltat=',F4.2)
      PRINT 6, thetao, a, ycg, alpha
    6  FORMAT(1X, 'thetao=', F5.3, 3X, 'a=', F3.1, 3X, 'ycg=',
     + F5.3, 3X, 'alpha=', F3.1)
   10  IF(theta.LE.theta1) THEN
      IF(fnet2.GE.0.0) THEN
      an=fn/M
      wa=wa+0.122*deltat
      r=wb/wa
      dr=0.8197/(1+t)**2
```

```
   vn1=vn+an*deltat
   ds=SQRT((Vo*deltat)**2+(vn1*deltat-dr)**2)
   dmu=wa*Vo*deltat/wb
   dwa=0.122*deltat
   dnu=dmu+dwa-ATAN(vn1/Vo)+ATAN(vn/Vo)
   rho=ds/dnu
   V=SQRT(Vo**2+vn1**2)
   kone=rcg*(V**2)/(rsqbar*rho)
   ktwo=32.2*rcg/rsqbar
   thetadd=kone*sin(theta)-ktwo*cos(theta)
   IF (thetadd.LT.0.0) THEN
   t=t+deltat
   GO TO 10
   ELSE
   ENDIF
   theta3d=thetad*(kone*cos(theta)+ktwo*sin(theta))
   thetad=thetad+thetadd*deltat+(theta3d/2.0)*(deltat**2)
   theta=theta+thetad*deltat+(thetdd/2.0)*(deltat**2)
   fc1=M*(V**2)/rho
   fc2=M*(thetad**2)*rcg
   fy=w*(sin(theta))**2-fc2*sin(theta)
   fn=fc1-cf*fy
   fnet2=w*sin(theta)-fc2
   fx=fc1-fc2*cos(theta)
   fycg=fc2*sin(theta)-w
   phi=ATAN(fycg/fx)
   beta=(3.1416-theta)-phi
   gamma=(theta+dtheta)
   fch2=mch*(thetad**2)*rch
   fch1=fc1*(wch/w)
   fych=fch2*sin(gamma)-wch
   fxch=-fch2*cos(gamma)+fch1
   fch=SQRT(fxch**2+fych**2)
   sigma=ATAN(fych/fxch)
   chi=theta-thetao
   omega=chi+sigma
   t=t+deltat
   muav=mu+dmu/2.0
   vnav=(vn1+vn)/2.0
   dx=ds*cos(nu)
   dy=-ds*sin(nu)
   x=x+dx
   y=y+dy
   vn=vn1
   mu=mu+dmu
   nu=nu+dnu
   PRINT 20, t, theta, thetad, thetadd
20  FORMAT(// 1X,'t=',F6.4, 2X,'theta=',F6.4, 2X,'thetad=',
  + F6.4, 2X,'thetadd=',F7.4)
   PRINT 25, theta3d, rho, nu
25  FORMAT(' ',1X,'theta3d=',F8.4,2X,'rho=',F7.3,2X,'nu=',F6.3)
   PRINT 30, fc1, fc2, fy, fn, mu
```

```
 30  FORMAT(' ',1X,'FC1=',F7.1,2X,'FC2=',F8.2,2X,'FY=',F9.2,
  + 2x,'FN=',F8.2,2X,'mu=',F6.3)
     PRINT 40, fx, phi, beta, x, y
 40  FORMAT(' ',1X,'FX=',F9.2,2X,'PHI=',F7.4,2X,'BETA=',F6.4,
  + 2X,'x=',F8.5,2X,'y=',F8.5)
     PRINT 50, fch, omega, fch1, fch2, fnet2
 50  FORMAT(",1X,'FCH=',F6.1,2X,'OMEGA=',F6.4,2X,'FCH1=',
  + F6.1,2X,'FCH2=',F6.1,2X,'fnet2=',F8.2)
     PRINT 60, r,wa,vn,an,dnu,dmu
 60  FORMAT(' ',1X,'r=',F7.2,2X,'wa=',F6.4,2X,'vn=',F5.2,2X,
  + 'an=',F6.2,2X,'dnu=',F6.4,2X,'dmu=',F6.4)
     PRINT 65, sigma, gamma, chi, fych, fxch
 65  FORMAT(' ',1X,'sigma=',F7.4,2X,'gamma=',F6.4,2X,'chi=',
  + F6.4,2X,'fych=',F6.2,2X,'fxch=',F6.2)
     GO TO 10
     ELSE
     theta=theta+thetad*deltat
     fc1=0.0
     gamma=(theta+dtheta)
     rchv=SQRT(rcg**2+rch**2-2.0*rcg*rch*COS(dtheta))
     q=((rchv**2+rcg**2-rch**2)/(2.0*rch*rchv))
     aq=ACOS(q)
     al=aq-theta
     fch1=0.0
     fch2=mch*(thetad**2)*rchv
     fych=fch2*SIN(al)-wch
     fxch=fch2*COS(al)
     fch=SQRT(fxch**2+fych**2)
     sigma=ATAN(fych/fxch)
     chi=theta-thetao
     omega=chi+sigma
     t=t+deltat
     ds=V*deltat
     dx=ds*cos(nu)
     dy=-ds*sin(nu)
     x=x+dx
     y=y+dy
     PRINT 70, t, theta, thetad, nu
 70  FORMAT(// 1X,'t=',F6.4,2X,'theta=',F6.4,2X,'thetad=',F6.4,
  + 2X,'nu=',F6.3)
     PRINT 90, x, y
 90  FORMAT(' ',1X, 'x=',F8.5,2X,'y=',F8.5)
     PRINT 95, fch, omega, fch1, fch2
 95  FORMAT(",1X,'FCH=',F6.1,2X,'OMEGA=',F6.4,2X,'FCH1=',
  + F6.1,2X,'FCH2=',F6.1)
     PRINT 100, sigma, gamma, chi, fych, fxch
100  FORMAT(' ',1X,'sigma=',F7.4,2X,'gamma=',F6.4,2X,'chi=',
  + F6.4,2X,'fych=',F6.2,2X,'fxch=',F6.2)
     ENDIF
     GO TO 10
     ELSE
     ENDIF
```

```
   STOP
   END
```

APPENDIX 2

```
   program mensai
   real M, rsqbar, rcg, theta, thetad, thetadd, theta3d, theta1, x,
  + y, rho, V, t, thetao, deltat, kone, ktwo, alpha, a, ycg, fycg,
  + fc1,fc2,fy,fn,fx, beta, phi, nu, mu, muav, dmu, dnu, dr,rchv,
  + gamma,sigma, fch1, fch2, wch, fych, fxch, dtheta, w, fch, omega
  + r, wa, vn, an, wb, vn1, ds, dwa, vnav, fnet2, cf, chi,rch,mch,
  + q, al, aq, Vo
   fnet2=0.0
   Vo=59.0
   x=0.0
   y=82.0
   an=0.0
   fn=0.0
   fnet2=0.0
   wa=0.0
   wb=10.0
   vn=0.0
   mu=0.0
   nu=0.0
   M=124.22
   w=32.2*M
   dtheta=0.436
   wch=40.0
   rch=4.24
   mch=wch/32.2
   t=0
   alpha=0.0
   a=6.0
   cf=0.9
   rsqbar=(a**2)*((2.0-1.33*alpha)/(3.0-alpha))
   ycg=a*(1.0-alpha)/(2.0-alpha)
   rcg=SQRT(ycg**2+a**2/4.0)
   thetao=ATAN(2.0*ycg/a)
   deltat=0.001
   theta=thetao
   thetad=0.0
   theta1=thetao+1.57
   PRINT 5
 5  FORMAT(' ',T6,'t',T15,'x',T23,'y',T31,'fch',T39,
  + 'omega',T47,'theta',T54,'thetad')
10  IF(theta.LE.theta1) THEN
   IF(fnet2.GE.0.0) THEN
   an=fn/M
   wa=wa+0.122*deltat
```

```
      vn1=vn+an*deltat
      ds=SQRT((Vo*deltat)**2+(vn1*deltat)**2)
      dmu=wa*Vo*deltat/wb
      dwa=0.122*deltat
      dnu=dmu+dwa-ATAN(vn1/Vo)+ATAN(vn/Vo)
      rho=ds/dnu
      V=SQRT(Vo**2+vn1**2)
      kone=rcg*(V**2)/(rsqbar*rho)
      ktwo=32.2*rcg/rsqbar
      thetadd=kone*sin(theta)-ktwo*cos(theta)
      IF (thetadd.LT.0.0) THEN
      t=t+deltat
      GO TO 10
      ELSE
      ENDIF
      theta3d=thetad*(kone*cos(theta)+ktwo*sin(theta))
      thetad=thetad+thetadd*deltat+(theta3d/2.0)*(deltat**2)
      theta=theta+thetad*deltat+(thetdd/2.0)*(deltat**2)
      fc1=M*(V**2)/rho
      fc2=M*(thetad**2)*rcg
      fy=w*(sin(theta))**2-fc2*sin(theta)
      fn=fc1-cf*fy
      fnet2=w*sin(theta)-fc2
      fx=fc1-fc2*cos(theta)
      fycg=fc2*sin(theta)-w
      phi=ATAN(fycg/fx)
      beta=(3.1416-theta)+phi
      gamma=(theta+dtheta)
      fch2=mch*(thetad**2)*rch
      fch1=fc1*(wch/w)
      fych=fch2*sin(gamma)-wch
      fxch=-fch2*cos(gamma)+fch1
      fch=SQRT(fxch**2+fych**2)
      sigma=ATAN(fych/fxch)
      chi=theta-thetao
      omega=chi+sigma
      t=t+deltat
      muav=mu+dmu/2.0
      vnav=(vn1+vn)/2.0
      dx=ds*cos(nu)
      dy=-ds*sin(nu)
      x=x+dx
      y=y+dy
      vn=vn1
      mu=mu+dmu
      nu=nu+dnu
      PRINT 60, t, x, y, fch, omega, theta, thetad
   60  FORMAT(' ', 1X, F6.4, 2X, F7.3, 2X, F7.3, 2X, F7.3,
     + 2X, F6.4, 2X, F6.4, 2X, F6.4)
      GO TO 10
      ELSE
      theta=theta+thetad*deltat
```

```
      fc1=0.0
      gamma=(theta+dtheta)
      rchv=SQRT(rcg**2+rch**2-2.0*rcg*rch*COS(dtheta))
      q=((rchv**2+rcg**2-rch**2)/(2.0*rch*rchv))
      aq=ACOS(q)
      al=aq-theta
      fch1=0.0
      fch2=mch*(thetad**2)*rchv
      fych=fch2*SIN(al)-wch
      fxch=fch2*COS(al)
      sigma=ATAN(fych/fxch)
      chi=theta-thetao
      omega=chi+sigma
      fch=SQRT(fxch**2+fych**2)
      t=t+deltat
      ds=V*deltat
      dx=ds*cos(nu)
      dy=-ds*sin(nu)
      x=x+dx
      y=y+dy
      PRINT 70, t, x, y, fch, omega, theta, thetad
   70  FORMAT(' ', 1X, F6.4, 2X, F7.3, 2X, F7.3, 2X, F7.3,
     + 2X, F6.4, 2X, F6.4, 2X, F6.4)
      ENDIF
      GO TO 10
      ELSE
      ENDIF
      STOP
      END
```

APPENDIX 3

```
      program mensao
      real M, rsqbar, rcg, theta, thetad, thetadd, theta3d, theta1, x,
     + y, rho, V, t, thetao, deltat, kone, ktwo, alpha, a, ycg, fycg,
     + fc1,fc2,fy,fn,fx, beta, phi, nu, mu, muav, dmu, dnu, dr,rchv,
     + gamma,sigma, fch1, fch2, wch, fych, fxch, dtheta, w, fch, omega
     + r, wa, vn, an, wb, vn1, ds, dwa, vnav, fnet2, cf, chi,rch,mch,
     + q, al, aq, Vo, p, ap
      fnet2=0.0
      Vo=95.0
      x=0.0
      y=82.0
      an=0.0
      fn=0.0
      fnet2=0.0
      wa=0.0
      wb=10.0
      vn=0.0
```

```
      mu=0.0
      nu=0.0
      M=124.22
      w=32.2*M
      dtheta=0.14
      wch=40.0
      rch=5.20
      mch=wch/32.2
      t=0
      alpha=0.0
      a=6.0
      cf=0.9
      rsqbar=(a**2)*((2.0-1.33*alpha)/(3.0-alpha))
      ycg=a*(1.0-alpha)/(2.0-alpha)
      rcg=SQRT(ycg**2+a**2/4.0)
      thetao=ATAN(2.0*ycg/a)
      deltat=0.01
      theta=thetao
      thetad=0.0
      theta1=thetao+1.57
      PRINT 5
    5 FORMAT(' ',T6,'t',T15,'x',T23,'y',T31,'fch',T39,
     + 'omega',T47,'theta',T54,'thetad')
   10 IF(theta.LE.theta1) THEN
      IF(fnet2.GE.0.0) THEN
      an=fn/M
      wa=wa+0.122*deltat
      vn1=vn+an*deltat
      ds=SQRT((Vo*deltat)**2+(vn1*deltat)**2)
      dmu=wa*Vo*deltat/wb
      dwa=0.122*deltat
      dnu=dmu+dwa-ATAN(vn1/Vo)+ATAN(vn/Vo)
      rho=ds/dnu
      V=SQRT(Vo**2+vn1**2)
      kone=rcg*(V**2)/(rsqbar*rho)
      ktwo=32.2*rcg/rsqbar
      thetadd=kone*sin(theta)-ktwo*cos(theta)
      IF (thetadd.LT.0.0) THEN
      t=t+deltat
      GO TO 10
      ELSE
      ENDIF
      theta3d=thetad*(kone*cos(theta)+ktwo*sin(theta))
      thetad=thetad+thetadd*deltat+(theta3d/2.0)*(deltat**2)
      theta=theta+thetad*deltat+(thetdd/2.0)*(deltat**2)
      fc1=M*(V**2)/rho
      fc2=M*(thetad**2)*rcg
      fy=w*(sin(theta))**2-fc2*sin(theta)
      fn=fc1-cf*fy
      fnet2=w*sin(theta)-fc2
      fx=fc1-fc2*cos(theta)
      fycg=fc2*sin(theta)-w
```

```
      phi=ATAN(fycg/fx)
      beta=(3.1416-theta)+phi
      gamma=(theta+dtheta)
      fch2=mch*(thetad**2)*rch
      fch1=fc1*(wch/w)
      fych=fch2*sin(gamma)-wch
      fxch=fch1-fch2*cos(gamma)
      fch=SQRT(fxch**2+fych**2)
      sigma=ATAN(fych/fxch)
      chi=theta-thetao
      omega=3.1416-(chi+sigma)
      t=t+deltat
      muav=mu+dmu/2.0
      vnav=(vn1+vn)/2.0
      dx=ds*cos(nu)
      dy=-ds*sin(nu)
      x=x+dx
      y=y+dy
      vn=vn1
      mu=mu+dmu
      nu=nu+dnu
      PRINT 60, t, x, y, fch, omega, theta, thetad
   60  FORMAT(' ', 1X, F6.4, 2X, F7.3, 2X, F7.3, 2X, F7.3,
     + 2X, F6.4, 2X, F6.4, 2X, F6.4)
      GO TO 10
      ELSE
      theta=theta+thetad*deltat
      fc1=0.0
      fc2=M*(thetad**2)*rcg
      fy=w*(sin(theta))**2-fc2*sin(theta)
      fn=fc1-fy
      fnet2=w*sin(theta)-fc2
      fx=fc1-fc2*cos(theta)
      phi=ATAN(fy/fx)
      beta=(3.1416-theta)+phi
      gamma=(theta+dtheta)
      rchv=SQRT(rcg**2+rch**2-2.0*rcg*rch*COS(dtheta))
      q=((rchv**2+rcg**2-rch**2)/(2.0*rch*rchv))
      aq=ACOS(q)
      p=(rch**2+rchv**2-rcg**2)/(2.0*rch*rchv)
      ap=COS(p)
      fch1=0.0
      fch2=mch*(thetad**2)*rchv
      chi=theta-thetao
      IF(dtheta.LE.0.0) THEN
      al=gamma-ap
      ELSE
      al=gamma+ap
      ENDIF
      fych=fch2*SIN(al)-wch
      fxch=-fch2*COS(al)
      sigma=ATAN(fych/fxch)
```

```
      IF(al.LE.1.571) THEN
      omega=-(sigma+chi)
      ELSE
      omega=3.1416-(sigma+chi)
      ENDIF
      fch=SQRT(fxch**2+fych**2)
      t=t+deltat
      ds=V*deltat
      dx=ds*cos(nu)
      dy=-ds*sin(nu)
      x=x+dx
      y=y+dy
      PRINT 70, t, x, y, fch, omega, theta, thetad
   70  FORMAT(' ', 1X, F6.4, 2X, F7.3, 2X, F7.3, 2X, F7.3,
     + 2X, F6.4, 2X, F6.4, 2X, F6.4)
      ENDIF
      GO TO 10
      ELSE
      ENDIF
      STOP
      END
```

APPENDIX 4

```
M=124.22   rsqbar=24.0   rcg=4.24   Vo= 73.0   deltat=0.01
 thetao=0.785   a=6.0   ycg=3.000   alpha=0.0


 t=0.4300  theta=0.7844  thetad=0.0000  thetadd= 0.0006
  theta3d=  0.0000  rho=165.471  nu= 0.005
  FC1= 4000.5  FC2=    0.00  FY=  1995.91  FN= 2204.20  mu= 0.004
  FX=  4000.52  PHI=-0.7853  BETA=3.1425  x= 0.83556  y=82.00000
 FCH=  56.6  OMEGA=-.7863  FCH1=  40.0  FCH2=   0.0  fnet2= 2825.50
  r= 190.62  wa=0.0525  vn= 0.00  an=  0.00  dnu=0.0050  dmu=0.0038
  sigma=-0.7853  gamma=1.2204  chi=-.0010  fych=-40.00  fxch= 40.01


 t=0.6800  theta=0.7834  thetad=0.0007  thetadd= 0.0717
  theta3d=  0.0001  rho=162.276  nu= 0.010
  FC1= 4079.3  FC2=    0.00  FY=  1991.91  FN= 2286.57  mu= 0.010
  FX=  4079.30  PHI=-0.7756  BETA=3.1338  x= 1.62183  y=81.99603
 FCH=  57.1  OMEGA=-.7776  FCH1=  40.8  FCH2=   0.0  fnet2= 2822.66
  r= 120.54  wa=0.0830  vn= 0.18  an= 17.74  dnu=0.0048  dmu=0.0061
  sigma=-0.7756  gamma=1.2194  chi=-.0020  fych=-40.00  fxch= 40.79


 t=0.6900  theta=0.7824  thetad=0.0014  thetadd= 0.0724
  theta3d=  0.0059  rho=161.929  nu= 0.015
  FC1= 4088.1  FC2=    0.00  FY=  1987.94  FN= 2298.96  mu= 0.016
```

FX= 4088.11 PHI=-0.7745 BETA=3.1337 x= 2.40612 y=81.98827
FCH= 57.2 OMEGA=-.7775 FCH1= 40.9 FCH2= 0.0 fnet2= 2819.85
r= 118.79 wa=0.0842 vn= 0.36 an= 18.41 dnu=0.0048 dmu=0.0061
sigma=-0.7745 gamma=1.2184 chi=-.0030 fych=-40.00 fxch= 40.88

t=0.7000 theta=0.7814 thetad=0.0028 thetadd= 0.1386
theta3d= 0.0119 rho=159.056 nu= 0.020
FC1= 4162.1 FC2= 0.00 FY= 1984.03 FN= 2376.47 mu= 0.022
FX= 4162.09 PHI=-0.7655 BETA=3.1257 x= 3.18844 y=81.97675
FCH= 57.7 OMEGA=-.7695 FCH1= 41.6 FCH2= 0.0 fnet2= 2817.07
r= 117.10 wa=0.0854 vn= 0.55 an= 18.51 dnu=0.0049 dmu=0.0062
sigma=-0.7655 gamma=1.2174 chi=-.0040 fych=-40.00 fxch= 41.62

t=0.7100 theta=0.7805 thetad=0.0043 thetadd= 0.1440
theta3d= 0.0233 rho=158.554 nu= 0.025
FC1= 4175.5 FC2= 0.01 FY= 1980.16 FN= 2393.32 mu= 0.029
FX= 4175.46 PHI=-0.7639 BETA=3.1251 x= 3.96881 y=81.96140
FCH= 57.8 OMEGA=-.7689 FCH1= 41.8 FCH2= 0.0 fnet2= 2814.32
r= 115.45 wa=0.0866 vn= 0.74 an= 19.13 dnu=0.0049 dmu=0.0063
sigma=-0.7639 gamma=1.2165 chi=-.0049 fych=-40.00 fxch= 41.76

t=0.7200 theta=0.7795 thetad=0.0063 thetadd= 0.2063
theta3d= 0.0355 rho=155.943 nu= 0.030
FC1= 4245.6 FC2= 0.02 FY= 1976.38 FN= 2466.87 mu= 0.035
FX= 4245.60 PHI=-0.7556 BETA=3.1177 x= 4.74726 y=81.94226
FCH= 58.3 OMEGA=-.7615 FCH1= 42.5 FCH2= 0.0 fnet2= 2811.63
r= 113.84 wa=0.0878 vn= 0.93 an= 19.27 dnu=0.0050 dmu=0.0064
sigma=-0.7556 gamma=1.2155 chi=-.0059 fych=-40.00 fxch= 42.46

t=0.7300 theta=0.7786 thetad=0.0085 thetadd= 0.2156
theta3d= 0.0527 rho=155.328 nu= 0.035
FC1= 4262.8 FC2= 0.04 FY= 1972.68 FN= 2487.34 mu= 0.042
FX= 4262.73 PHI=-0.7536 BETA=3.1166 x= 5.52380 y=81.91929
FCH= 58.5 OMEGA=-.7604 FCH1= 42.6 FCH2= 0.0 fnet2= 2808.98
r= 112.28 wa=0.0891 vn= 1.13 an= 19.86 dnu=0.0050 dmu=0.0065
sigma=-0.7536 gamma=1.2146 chi=-.0068 fych=-40.00 fxch= 42.63

t=0.7400 theta=0.7777 thetad=0.0113 thetadd= 0.2750
theta3d= 0.0713 rho=152.936 nu= 0.040
FC1= 4329.8 FC2= 0.07 FY= 1969.08 FN= 2557.67 mu= 0.048
FX= 4329.80 PHI=-0.7458 BETA=3.1097 x= 6.29846 y=81.89249
FCH= 58.9 OMEGA=-.7535 FCH1= 43.3 FCH2= 0.0 fnet2= 2806.41
r= 110.77 wa=0.0903 vn= 1.33 an= 20.02 dnu=0.0051 dmu=0.0066
sigma=-0.7458 gamma=1.2137 chi=-.0077 fych=-40.00 fxch= 43.30

t=0.7500 theta=0.7768 thetad=0.0141 thetadd= 0.2877

theta3d= 0.0946 rho=152.239 nu= 0.045
FC1= 4350.1 FC2= 0.11 FY= 1965.59 FN= 2581.10 mu= 0.055
FX= 4350.06 PHI=-0.7435 BETA=3.1082 x= 7.07123 y=81.86184
FCH= 59.1 OMEGA=-.7520 FCH1= 43.5 FCH2= 0.0 fnet2= 2803.90
r= 109.29 wa=0.0915 vn= 1.54 an= 20.59 dnu=0.0051 dmu=0.0067
sigma=-0.7435 gamma=1.2128 chi=-.0086 fych=-40.00 fxch= 43.50

t=0.7600 theta=0.7760 thetad=0.0176 thetadd= 0.3449
theta3d= 0.1197 rho=150.029 nu= 0.050
FC1= 4414.8 FC2= 0.16 FY= 1962.23 FN= 2648.77 mu= 0.062
FX= 4414.66 PHI=-0.7361 BETA=3.1017 x= 7.84216 y=81.82734
FCH= 59.6 OMEGA=-.7455 FCH1= 44.1 FCH2= 0.0 fnet2= 2801.47
r= 107.85 wa=0.0927 vn= 1.74 an= 20.78 dnu=0.0051 dmu=0.0068
sigma=-0.7361 gamma=1.2120 chi=-.0094 fych=-40.00 fxch= 44.15

t=0.7700 theta=0.7752 thetad=0.0212 thetadd= 0.3608
theta3d= 0.1494 rho=149.275 nu= 0.055
FC1= 4437.7 FC2= 0.24 FY= 1959.00 FN= 2674.65 mu= 0.068
FX= 4437.58 PHI=-0.7335 BETA=3.0999 x= 8.61123 y=81.78896
FCH= 59.7 OMEGA=-.7437 FCH1= 44.4 FCH2= 0.0 fnet2= 2799.12
r= 106.45 wa=0.0939 vn= 1.96 an= 21.32 dnu=0.0052 dmu=0.0069
sigma=-0.7335 gamma=1.2112 chi=-.0102 fych=-40.00 fxch= 44.38

t=0.7800 theta=0.7744 thetad=0.0254 thetadd= 0.4165
theta3d= 0.1815 rho=147.220 nu= 0.060
FC1= 4500.4 FC2= 0.34 FY= 1955.91 FN= 2740.12 mu= 0.075
FX= 4500.19 PHI=-0.7266 BETA=3.0937 x= 9.37849 y=81.74670
FCH= 60.2 OMEGA=-.7375 FCH1= 45.0 FCH2= 0.0 fnet2= 2796.87
r= 105.09 wa=0.0952 vn= 2.17 an= 21.53 dnu=0.0052 dmu=0.0069
sigma=-0.7266 gamma=1.2104 chi=-.0109 fych=-40.00 fxch= 45.00

t=0.7900 theta=0.7737 thetad=0.0297 thetadd= 0.4351
theta3d= 0.2178 rho=146.426 nu= 0.065
FC1= 4525.7 FC2= 0.47 FY= 1952.99 FN= 2768.01 mu= 0.082
FX= 4525.36 PHI=-0.7238 BETA=3.0917 x=10.14392 y=81.70052
FCH= 60.4 OMEGA=-.7354 FCH1= 45.3 FCH2= 0.0 fnet2= 2794.71
r= 103.76 wa=0.0964 vn= 2.39 an= 22.06 dnu=0.0052 dmu=0.0070
sigma=-0.7238 gamma=1.2097 chi=-.0117 fych=-40.00 fxch= 45.26

t=0.8000 theta=0.7731 thetad=0.0347 thetadd= 0.4899
theta3d= 0.2572 rho=144.504 nu= 0.071
FC1= 4586.9 FC2= 0.63 FY= 1950.23 FN= 2831.65 mu= 0.090
FX= 4586.41 PHI=-0.7171 BETA=3.0857 x=10.90756 y=81.65044
FCH= 60.9 OMEGA=-.7294 FCH1= 45.9 FCH2= 0.0 fnet2= 2792.65
r= 102.46 wa=0.0976 vn= 2.62 an= 22.28 dnu=0.0053 dmu=0.0071
sigma=-0.7171 gamma=1.2091 chi=-.0123 fych=-39.99 fxch= 45.87

t=0.8100 theta=0.7725 thetad=0.0398 thetadd= 0.5112
theta3d= 0.3006 rho=143.684 nu= 0.076
FC1= 4614.1 FC2= 0.83 FY= 1947.65 FN= 2861.22 mu= 0.097
FX= 4613.51 PHI=-0.7142 BETA=3.0833 x=11.66941 y=81.59643
FCH= 61.1 OMEGA=-.7271 FCH1= 46.1 FCH2= 0.0 fnet2= 2790.71
r= 101.19 wa=0.0988 vn= 2.84 an= 22.80 dnu=0.0053 dmu=0.0072
sigma=-0.7141 gamma=1.2085 chi=-.0129 fych=-39.99 fxch= 46.14

t=0.8200 theta=0.7719 thetad=0.0455 thetadd= 0.5655
theta3d= 0.3475 rho=141.876 nu= 0.081
FC1= 4674.1 FC2= 1.09 FY= 1945.26 FN= 2923.34 mu= 0.104
FX= 4673.30 PHI=-0.7078 BETA=3.0775 x=12.42948 y=81.53848
FCH= 61.5 OMEGA=-.7212 FCH1= 46.7 FCH2= 0.0 fnet2= 2788.87
r= 99.96 wa=0.1000 vn= 3.07 an= 23.03 dnu=0.0054 dmu=0.0073
sigma=-0.7077 gamma=1.2079 chi=-.0135 fych=-39.99 fxch= 46.74

t=0.8300 theta=0.7714 thetad=0.0514 thetadd= 0.5895
theta3d= 0.3984 rho=141.041 nu= 0.087
FC1= 4703.1 FC2= 1.39 FY= 1943.08 FN= 2954.31 mu= 0.111
FX= 4702.08 PHI=-0.7048 BETA=3.0749 x=13.18779 y=81.47657
FCH= 61.7 OMEGA=-.7186 FCH1= 47.0 FCH2= 0.0 fnet2= 2787.15
r= 98.76 wa=0.1013 vn= 3.31 an= 23.53 dnu=0.0054 dmu=0.0074
sigma=-0.7047 gamma=1.2074 chi=-.0140 fych=-39.99 fxch= 47.03

t=0.8400 theta=0.7710 thetad=0.0578 thetadd= 0.6438
theta3d= 0.4534 rho=139.334 nu= 0.092
FC1= 4762.1 FC2= 1.76 FY= 1941.11 FN= 3015.15 mu= 0.119
FX= 4760.88 PHI=-0.6986 BETA=3.0692 x=13.94434 y=81.41069
FCH= 62.2 OMEGA=-.7129 FCH1= 47.6 FCH2= 0.0 fnet2= 2785.55
r= 97.58 wa=0.1025 vn= 3.55 an= 23.78 dnu=0.0055 dmu=0.0075
sigma=-0.6985 gamma=1.2070 chi=-.0144 fych=-39.98 fxch= 47.62

t=0.8500 theta=0.7706 thetad=0.0646 thetadd= 0.6703
theta3d= 0.5122 rho=138.492 nu= 0.098
FC1= 4792.7 FC2= 2.20 FY= 1939.36 FN= 3047.30 mu= 0.126
FX= 4791.15 PHI=-0.6954 BETA=3.0664 x=14.69914 y=81.34081
FCH= 62.4 OMEGA=-.7101 FCH1= 47.9 FCH2= 0.0 fnet2= 2784.08
r= 96.43 wa=0.1037 vn= 3.79 an= 24.27 dnu=0.0055 dmu=0.0076
sigma=-0.6953 gamma=1.2066 chi=-.0148 fych=-39.98 fxch= 47.92

t=0.8600 theta=0.7703 thetad=0.0718 thetadd= 0.7250
theta3d= 0.5757 rho=136.874 nu= 0.103
FC1= 4851.1 FC2= 2.72 FY= 1937.84 FN= 3107.07 mu= 0.134
FX= 4849.17 PHI=-0.6895 BETA=3.0607 x=15.45220 y=81.26694
FCH= 62.9 OMEGA=-.7044 FCH1= 48.5 FCH2= 0.0 fnet2= 2782.73
r= 95.31 wa=0.1049 vn= 4.03 an= 24.53 dnu=0.0055 dmu=0.0077

sigma=-0.6893 gamma=1.2063 chi=-.0151 fych=-39.97 fxch= 48.50

t=0.8700 theta=0.7701 thetad=0.0794 thetadd= 0.7541
theta3d= 0.6430 rho=136.029 nu= 0.109
FC1= 4883.1 FC2= 3.32 FY= 1936.57 FN= 3140.22 mu= 0.142
FX= 4880.75 PHI=-0.6862 BETA=3.0577 x=16.20354 y=81.18904
FCH= 63.1 OMEGA=-.7013 FCH1= 48.8 FCH2= 0.0 fnet2= 2781.51
r= 94.22 wa=0.1061 vn= 4.28 an= 25.01 dnu=0.0056 dmu=0.0077
sigma=-0.6860 gamma=1.2061 chi=-.0153 fych=-39.97 fxch= 48.82

t=0.8800 theta=0.7700 thetad=0.0875 thetadd= 0.8096
theta3d= 0.7155 rho=134.490 nu= 0.114
FC1= 4941.1 FC2= 4.04 FY= 1935.54 FN= 3199.09 mu= 0.150
FX= 4938.18 PHI=-0.6805 BETA=3.0521 x=16.95315 y=81.10711
FCH= 63.5 OMEGA=-.6956 FCH1= 49.4 FCH2= 0.0 fnet2= 2780.42
r= 93.14 wa=0.1074 vn= 4.54 an= 25.28 dnu=0.0056 dmu=0.0078
sigma=-0.6802 gamma=1.2060 chi=-.0154 fych=-39.96 fxch= 49.40

t=0.8900 theta=0.7700 thetad=0.0960 thetadd= 0.8415
theta3d= 0.7918 rho=133.649 nu= 0.120
FC1= 4974.4 FC2= 4.86 FY= 1934.79 FN= 3233.09 mu= 0.158
FX= 4970.91 PHI=-0.6772 BETA=3.0488 x=17.70105 y=81.02112
FCH= 63.8 OMEGA=-.6923 FCH1= 49.7 FCH2= 0.0 fnet2= 2779.46
r= 92.10 wa=0.1086 vn= 4.79 an= 25.75 dnu=0.0056 dmu=0.0079
sigma=-0.6768 gamma=1.2060 chi=-.0154 fych=-39.95 fxch= 49.73

t=0.9000 theta=0.7700 thetad=0.1050 thetadd= 0.8982
theta3d= 0.8739 rho=132.181 nu= 0.126
FC1= 5032.1 FC2= 5.81 FY= 1934.29 FN= 3291.21 mu= 0.166
FX= 5027.90 PHI=-0.6715 BETA=3.0431 x=18.44724 y=80.93106
FCH= 64.2 OMEGA=-.6866 FCH1= 50.3 FCH2= 0.1 fnet2= 2778.63
r= 91.07 wa=0.1098 vn= 5.06 an= 26.03 dnu=0.0057 dmu=0.0080
sigma=-0.6711 gamma=1.2060 chi=-.0154 fych=-39.95 fxch= 50.30

t=0.9100 theta=0.7701 thetad=0.1144 thetadd= 0.9328
theta3d= 0.9598 rho=131.347 nu= 0.132
FC1= 5066.6 FC2= 6.90 FY= 1934.08 FN= 3325.95 mu= 0.174
FX= 5061.67 PHI=-0.6682 BETA=3.0396 x=19.19173 y=80.83691
FCH= 64.5 OMEGA=-.6830 FCH1= 50.7 FCH2= 0.1 fnet2= 2777.94
r= 90.07 wa=0.1110 vn= 5.32 an= 26.49 dnu=0.0057 dmu=0.0081
sigma=-0.6677 gamma=1.2061 chi=-.0153 fych=-39.94 fxch= 50.64

t=0.9200 theta=0.7704 thetad=0.1244 thetadd= 0.9911
theta3d= 1.0521 rho=129.942 nu= 0.137
FC1= 5124.2 FC2= 8.15 FY= 1934.15 FN= 3383.44 mu= 0.182
FX= 5118.33 PHI=-0.6627 BETA=3.0339 x=19.93453 y=80.73866

FCH= 64.9 OMEGA=-.6772 FCH1= 51.2 FCH2= 0.1 fnet2= 2777.36
r= 89.09 wa=0.1122 vn= 5.59 an= 26.77 dnu=0.0058 dmu=0.0082
sigma=-0.6621 gamma=1.2064 chi=-.0150 fych=-39.92 fxch= 51.21

t=0.9300 theta=0.7707 thetad=0.1347 thetadd= 1.0286
theta3d= 1.1483 rho=129.118 nu= 0.143
FC1= 5159.9 FC2= 9.56 FY= 1934.53 FN= 3418.80 mu= 0.190
FX= 5153.02 PHI=-0.6593 BETA=3.0302 x=20.67563 y=80.63628
FCH= 65.2 OMEGA=-.6734 FCH1= 51.6 FCH2= 0.1 fnet2= 2776.93
r= 88.14 wa=0.1135 vn= 5.86 an= 27.24 dnu=0.0058 dmu=0.0083
sigma=-0.6587 gamma=1.2067 chi=-.0147 fych=-39.91 fxch= 51.57

t=0.9400 theta=0.7712 thetad=0.1457 thetadd= 1.0888
theta3d= 1.2517 rho=127.772 nu= 0.149
FC1= 5217.5 FC2= 11.18 FY= 1935.19 FN= 3475.79 mu= 0.199
FX= 5209.45 PHI=-0.6539 BETA=3.0243 x=21.41505 y=80.52977
FCH= 65.6 OMEGA=-.6674 FCH1= 52.2 FCH2= 0.1 fnet2= 2776.60
r= 87.20 wa=0.1147 vn= 6.14 an= 27.52 dnu=0.0058 dmu=0.0084
sigma=-0.6532 gamma=1.2072 chi=-.0142 fych=-39.90 fxch= 52.14

t=0.9500 theta=0.7717 thetad=0.1570 thetadd= 1.1295
theta3d= 1.3588 rho=126.960 nu= 0.155
FC1= 5254.3 FC2= 12.99 FY= 1936.18 FN= 3511.71 mu= 0.207
FX= 5244.96 PHI=-0.6504 BETA=3.0203 x=22.15279 y=80.41909
FCH= 65.9 OMEGA=-.6633 FCH1= 52.5 FCH2= 0.1 fnet2= 2776.40
r= 86.28 wa=0.1159 vn= 6.42 an= 27.98 dnu=0.0059 dmu=0.0085
sigma=-0.6496 gamma=1.2077 chi=-.0137 fych=-39.88 fxch= 52.50

t=0.9600 theta=0.7724 thetad=0.1690 thetadd= 1.1921
theta3d= 1.4740 rho=125.666 nu= 0.161
FC1= 5312.0 FC2= 15.05 FY= 1937.46 FN= 3568.30 mu= 0.216
FX= 5301.23 PHI=-0.6451 BETA=3.0143 x=22.88885 y=80.30424
FCH= 66.4 OMEGA=-.6572 FCH1= 53.1 FCH2= 0.2 fnet2= 2776.30
r= 85.38 wa=0.1171 vn= 6.70 an= 28.27 dnu=0.0059 dmu=0.0085
sigma=-0.6442 gamma=1.2084 chi=-.0130 fych=-39.86 fxch= 53.07

t=0.9700 theta=0.7732 thetad=0.1814 thetadd= 1.2361
theta3d= 1.5930 rho=124.868 nu= 0.167
FC1= 5349.9 FC2= 17.35 FY= 1939.08 FN= 3604.70 mu= 0.224
FX= 5337.45 PHI=-0.6417 BETA=3.0101 x=23.62324 y=80.18518
FCH= 66.7 OMEGA=-.6528 FCH1= 53.5 FCH2= 0.2 fnet2= 2776.31
r= 84.50 wa=0.1183 vn= 6.99 an= 28.73 dnu=0.0060 dmu=0.0086
sigma=-0.6406 gamma=1.2092 chi=-.0122 fych=-39.84 fxch= 53.44

t=0.9800 theta=0.7741 thetad=0.1945 thetadd= 1.3014
theta3d= 1.7208 rho=123.624 nu= 0.173

FC1= 5407.9 FC2= 19.95 FY= 1941.00 FN= 3661.00 mu= 0.233
FX= 5393.64 PHI=-0.6364 BETA=3.0039 x=24.35595 y=80.06191
FCH= 67.1 OMEGA=-.6465 FCH1= 54.1 FCH2= 0.2 fnet2= 2776.40
r= 83.64 wa=0.1196 vn= 7.28 an= 29.02 dnu=0.0060 dmu=0.0087
sigma=-0.6352 gamma=1.2101 chi=-.0113 fych=-39.81 fxch= 54.01

t=0.9900 theta=0.7752 thetad=0.2081 thetadd= 1.3489
theta3d= 1.8525 rho=122.841 nu= 0.179
FC1= 5446.8 FC2= 22.83 FY= 1943.26 FN= 3697.83 mu= 0.242
FX= 5430.46 PHI=-0.6329 BETA=2.9993 x=25.08700 y=79.93440
FCH= 67.4 OMEGA=-.6417 FCH1= 54.5 FCH2= 0.2 fnet2= 2776.59
r= 82.80 wa=0.1208 vn= 7.57 an= 29.47 dnu=0.0060 dmu=0.0088
sigma=-0.6316 gamma=1.2112 chi=-.0102 fych=-39.79 fxch= 54.39

t=1.0000 theta=0.7764 thetad=0.2224 thetadd= 1.4173
theta3d= 1.9938 rho=121.641 nu= 0.185
FC1= 5505.2 FC2= 26.07 FY= 1945.84 FN= 3753.92 mu= 0.251
FX= 5486.58 PHI=-0.6278 BETA=2.9929 x=25.81639 y=79.80264
FCH= 67.8 OMEGA=-.6352 FCH1= 55.1 FCH2= 0.3 fnet2= 2776.82
r= 81.97 wa=0.1220 vn= 7.87 an= 29.77 dnu=0.0061 dmu=0.0089
sigma=-0.6262 gamma=1.2124 chi=-.0090 fych=-39.76 fxch= 54.96

t=1.0100 theta=0.7778 thetad=0.2372 thetadd= 1.4688
theta3d= 2.1392 rho=120.875 nu= 0.191
FC1= 5545.0 FC2= 29.65 FY= 1948.76 FN= 3791.16 mu= 0.260
FX= 5523.92 PHI=-0.6242 BETA=2.9880 x=26.54410 y=79.66659
FCH= 68.1 OMEGA=-.6301 FCH1= 55.5 FCH2= 0.3 fnet2= 2777.13
r= 81.16 wa=0.1232 vn= 8.17 an= 30.22 dnu=0.0061 dmu=0.0090
sigma=-0.6225 gamma=1.2138 chi=-.0076 fych=-39.72 fxch= 55.35

t=1.0200 theta=0.7793 thetad=0.2527 thetadd= 1.5407
theta3d= 2.2952 rho=119.718 nu= 0.197
FC1= 5603.9 FC2= 33.66 FY= 1951.99 FN= 3847.14 mu= 0.269
FX= 5579.98 PHI=-0.6191 BETA=2.9814 x=27.27016 y=79.52625
FCH= 68.6 OMEGA=-.6232 FCH1= 56.0 FCH2= 0.3 fnet2= 2777.45
r= 80.36 wa=0.1244 vn= 8.48 an= 30.52 dnu=0.0062 dmu=0.0091
sigma=-0.6172 gamma=1.2153 chi=-.0061 fych=-39.68 fxch= 55.92

t=1.0300 theta=0.7810 thetad=0.2688 thetadd= 1.5962
theta3d= 2.4552 rho=118.970 nu= 0.203
FC1= 5644.8 FC2= 38.08 FY= 1955.56 FN= 3884.76 mu= 0.278
FX= 5617.72 PHI=-0.6156 BETA=2.9762 x=27.99455 y=79.38158
FCH= 68.9 OMEGA=-.6177 FCH1= 56.4 FCH2= 0.4 fnet2= 2777.81
r= 79.58 wa=0.1257 vn= 8.79 an= 30.97 dnu=0.0062 dmu=0.0092
sigma=-0.6134 gamma=1.2170 chi=-.0044 fych=-39.64 fxch= 56.32

t=1.0400 theta=0.7829 thetad=0.2857 thetadd= 1.6721
theta3d= 2.6269 rho=117.852 nu= 0.210
FC1= 5704.2 FC2= 43.01 FY= 1959.43 FN= 3940.71 mu= 0.287
FX= 5673.72 PHI=-0.6105 BETA=2.9692 x=28.71729 y=79.23257
FCH= 69.3 OMEGA=-.6105 FCH1= 57.0 FCH2= 0.4 fnet2= 2778.14
r= 78.81 wa=0.1269 vn= 9.10 an= 31.27 dnu=0.0063 dmu=0.0093
sigma=-0.6080 gamma=1.2189 chi=-.0025 fych=-39.60 fxch= 56.90

t=1.0500 theta=0.7849 thetad=0.3031 thetadd= 1.7321
theta3d= 2.8027 rho=117.121 nu= 0.216
FC1= 5746.0 FC2= 48.42 FY= 1963.64 FN= 3978.73 mu= 0.297
FX= 5711.74 PHI=-0.6069 BETA=2.9636 x=29.43836 y=79.07919
FCH= 69.6 OMEGA=-.6046 FCH1= 57.5 FCH2= 0.5 fnet2= 2778.45
r= 78.06 wa=0.1281 vn= 9.41 an= 31.72 dnu=0.0063 dmu=0.0094
sigma=-0.6041 gamma=1.2209 chi=-.0005 fych=-39.55 fxch= 57.30

t=1.0600 theta=0.7871 thetad=0.3214 thetadd= 1.8124
theta3d= 2.9913 rho=116.041 nu= 0.222
FC1= 5806.1 FC2= 54.44 FY= 1968.13 FN= 4034.74 mu= 0.306
FX= 5767.63 PHI=-0.6018 BETA=2.9563 x=30.15777 y=78.92142
FCH= 70.1 OMEGA=-.5971 FCH1= 58.1 FCH2= 0.5 fnet2= 2778.67
r= 77.33 wa=0.1293 vn= 9.74 an= 32.03 dnu=0.0063 dmu=0.0094
sigma=-0.5987 gamma=1.2231 chi=0.0017 fych=-39.49 fxch= 57.88

t=1.0700 theta=0.7895 thetad=0.3403 thetadd= 1.8772
theta3d= 3.1842 rho=115.330 nu= 0.229
FC1= 5848.8 FC2= 61.04 FY= 1972.94 FN= 4073.15 mu= 0.316
FX= 5805.81 PHI=-0.5982 BETA=2.9503 x=30.87552 y=78.75923
FCH= 70.4 OMEGA=-.5907 FCH1= 58.5 FCH2= 0.6 fnet2= 2778.83
r= 76.60 wa=0.1305 vn=10.06 an= 32.48 dnu=0.0064 dmu=0.0095
sigma=-0.5947 gamma=1.2255 chi=0.0041 fych=-39.43 fxch= 58.28

t=1.0800 theta=0.7921 thetad=0.3601 thetadd= 1.9623
theta3d= 3.3909 rho=114.285 nu= 0.235
FC1= 5909.5 FC2= 68.35 FY= 1978.00 FN= 4129.33 mu= 0.325
FX= 5861.53 PHI=-0.5931 BETA=2.9427 x=31.59161 y=78.59261
FCH= 70.8 OMEGA=-.5826 FCH1= 59.1 FCH2= 0.7 fnet2= 2778.82
r= 75.90 wa=0.1318 vn=10.39 an= 32.79 dnu=0.0064 dmu=0.0096
sigma=-0.5893 gamma=1.2281 chi=0.0067 fych=-39.36 fxch= 58.87

t=1.0900 theta=0.7949 thetad=0.3806 thetadd= 2.0324
theta3d= 3.6020 rho=113.594 nu= 0.242
FC1= 5953.2 FC2= 76.35 FY= 1983.34 FN= 4168.17 mu= 0.335
FX= 5899.71 PHI=-0.5894 BETA=2.9362 x=32.30603 y=78.42153
FCH= 71.1 OMEGA=-.5757 FCH1= 59.5 FCH2= 0.8 fnet2= 2778.67
r= 75.20 wa=0.1330 vn=10.72 an= 33.24 dnu=0.0065 dmu=0.0097
sigma=-0.5852 gamma=1.2309 chi=0.0095 fych=-39.28 fxch= 59.28

t=1.1000 theta=0.7979 thetad=0.4020 thetadd= 2.1228
theta3d= 3.8282 rho=112.584 nu= 0.248
FC1= 6014.6 FC2= 85.19 FY= 1988.91 FN= 4224.63 mu= 0.345
FX= 5955.16 PHI=-0.5844 BETA=2.9281 x=33.01879 y=78.24596
FCH= 71.6 OMEGA=-.5672 FCH1= 60.1 FCH2= 0.9 fnet2= 2778.26
r= 74.52 wa=0.1342 vn=11.06 an= 33.55 dnu=0.0065 dmu=0.0098
sigma=-0.5797 gamma=1.2339 chi=0.0125 fych=-39.20 fxch= 59.87

t=1.1100 theta=0.8011 thetad=0.4242 thetadd= 2.1985
theta3d= 4.0588 rho=111.913 nu= 0.255
FC1= 6059.2 FC2= 94.85 FY= 1994.71 FN= 4263.94 mu= 0.355
FX= 5993.17 PHI=-0.5806 BETA=2.9211 x=33.72987 y=78.06588
FCH= 71.9 OMEGA=-.5597 FCH1= 60.6 FCH2= 0.9 fnet2= 2777.62
r= 73.84 wa=0.1354 vn=11.40 an= 34.01 dnu=0.0066 dmu=0.0099
sigma=-0.5754 gamma=1.2371 chi=0.0157 fych=-39.10 fxch= 60.28

t=1.1200 theta=0.8046 thetad=0.4474 thetadd= 2.2947
theta3d= 4.3059 rho=110.936 nu= 0.261
FC1= 6121.4 FC2= 105.49 FY= 2000.68 FN= 4320.81 mu= 0.365
FX= 6048.27 PHI=-0.5755 BETA=2.9125 x=34.43929 y=77.88126
FCH= 72.3 OMEGA=-.5506 FCH1= 61.2 FCH2= 1.1 fnet2= 2776.61
r= 73.18 wa=0.1366 vn=11.74 an= 34.33 dnu=0.0066 dmu=0.0100
sigma=-0.5698 gamma=1.2406 chi=0.0192 fych=-39.00 fxch= 60.87

t=1.1300 theta=0.8083 thetad=0.4714 thetadd= 2.3764
theta3d= 4.5575 rho=110.287 nu= 0.268
FC1= 6166.8 FC2= 117.11 FY= 2006.82 FN= 4360.65 mu= 0.375
FX= 6085.89 PHI=-0.5717 BETA=2.9050 x=35.14703 y=77.69209
FCH= 72.6 OMEGA=-.5425 FCH1= 61.7 FCH2= 1.2 fnet2= 2775.26
r= 72.54 wa=0.1379 vn=12.09 an= 34.78 dnu=0.0066 dmu=0.0101
sigma=-0.5654 gamma=1.2443 chi=0.0229 fych=-38.89 fxch= 61.29

t=1.1400 theta=0.8123 thetad=0.4964 thetadd= 2.4790
theta3d= 4.8269 rho=109.343 nu= 0.275
FC1= 6229.8 FC2= 129.87 FY= 2013.04 FN= 4418.05 mu= 0.385
FX= 6140.45 PHI=-0.5665 BETA=2.8959 x=35.85309 y=77.49832
FCH= 73.0 OMEGA=-.5328 FCH1= 62.3 FCH2= 1.3 fnet2= 2773.40
r= 71.90 wa=0.1391 vn=12.44 an= 35.10 dnu=0.0067 dmu=0.0102
sigma=-0.5596 gamma=1.2483 chi=0.0269 fych=-38.77 fxch= 61.89

t=1.1500 theta=0.8165 thetad=0.5223 thetadd= 2.5672
theta3d= 5.1007 rho=108.716 nu= 0.281
FC1= 6276.0 FC2= 143.79 FY= 2019.36 FN= 4458.55 mu= 0.395
FX= 6177.50 PHI=-0.5626 BETA=2.8877 x=36.55747 y=77.29993
FCH= 73.3 OMEGA=-.5239 FCH1= 62.8 FCH2= 1.4 fnet2= 2771.05

r= 71.28 wa=0.1403 vn=12.79 an= 35.57 dnu=0.0067 dmu=0.0102
sigma=-0.5550 gamma=1.2525 chi=0.0311 fych=-38.64 fxch= 62.31

t=1.1600 theta=0.8210 thetad=0.5494 thetadd= 2.6766
theta3d= 5.3939 rho=107.806 nu= 0.288
FC1= 6339.7 FC2= 159.06 FY= 2025.65 FN= 4516.63 mu= 0.405
FX= 6231.31 PHI=-0.5573 BETA=2.8780 x=37.26017 y=77.09691
FCH= 73.7 OMEGA=-.5135 FCH1= 63.4 FCH2= 1.6 fnet2= 2768.04
r= 70.66 wa=0.1415 vn=13.15 an= 35.89 dnu=0.0068 dmu=0.0103
sigma=-0.5491 gamma=1.2570 chi=0.0356 fych=-38.49 fxch= 62.91

t=1.1700 theta=0.8257 thetad=0.5774 thetadd= 2.7718
theta3d= 5.6914 rho=107.202 nu= 0.295
FC1= 6386.7 FC2= 175.69 FY= 2031.92 FN= 4557.93 mu= 0.416
FX= 6267.53 PHI=-0.5533 BETA=2.8691 x=37.96117 y=76.88921
FCH= 74.0 OMEGA=-.5039 FCH1= 63.9 FCH2= 1.8 fnet2= 2764.37
r= 70.06 wa=0.1427 vn=13.52 an= 36.36 dnu=0.0068 dmu=0.0104
sigma=-0.5442 gamma=1.2617 chi=0.0403 fych=-38.33 fxch= 63.33

t=1.1800 theta=0.8308 thetad=0.6066 thetadd= 2.8886
theta3d= 6.0097 rho=106.325 nu= 0.302
FC1= 6451.1 FC2= 193.90 FY= 2038.03 FN= 4616.87 mu= 0.426
FX= 6320.35 PHI=-0.5479 BETA=2.8587 x=38.66047 y=76.67681
FCH= 74.5 OMEGA=-.4926 FCH1= 64.5 FCH2= 1.9 fnet2= 2759.84
r= 69.46 wa=0.1440 vn=13.88 an= 36.69 dnu=0.0069 dmu=0.0105
sigma=-0.5380 gamma=1.2668 chi=0.0454 fych=-38.15 fxch= 63.93

t=1.1900 theta=0.8361 thetad=0.6368 thetadd= 2.9912
theta3d= 6.3323 rho=105.746 nu= 0.309
FC1= 6498.7 FC2= 213.71 FY= 2043.97 FN= 4659.13 mu= 0.437
FX= 6355.45 PHI=-0.5437 BETA=2.8491 x=39.35808 y=76.45969
FCH= 74.7 OMEGA=-.4821 FCH1= 65.0 FCH2= 2.1 fnet2= 2754.45
r= 68.88 wa=0.1452 vn=14.25 an= 37.17 dnu=0.0069 dmu=0.0106
sigma=-0.5329 gamma=1.2721 chi=0.0507 fych=-37.96 fxch= 64.36

t=1.2000 theta=0.8418 thetad=0.6683 thetadd= 3.1158
theta3d= 6.6771 rho=104.903 nu= 0.316
FC1= 6563.8 FC2= 235.37 FY= 2049.58 FN= 4719.14 mu= 0.448
FX= 6406.98 PHI=-0.5381 BETA=2.8379 x=40.05397 y=76.23780
FCH= 75.1 OMEGA=-.4700 FCH1= 65.6 FCH2= 2.4 fnet2= 2747.96
r= 68.31 wa=0.1464 vn=14.63 an= 37.51 dnu=0.0070 dmu=0.0107
sigma=-0.5264 gamma=1.2778 chi=0.0564 fych=-37.75 fxch= 64.96

t=1.2100 theta=0.8478 thetad=0.7009 thetadd= 3.2264
theta3d= 7.0259 rho=104.350 nu= 0.323
FC1= 6611.9 FC2= 258.91 FY= 2054.83 FN= 4762.60 mu= 0.458

FX= 6440.65 PHI=-0.5337 BETA=2.8275 x=40.74816 y=76.01113
FCH= 75.4 OMEGA=-.4585 FCH1= 66.1 FCH2= 2.6 fnet2= 2740.36
r= 67.74 wa=0.1476 vn=15.01 an= 37.99 dnu=0.0070 dmu=0.0108
sigma=-0.5209 gamma=1.2838 chi=0.0624 fych=-37.52 fxch= 65.39

t=1.2200 theta=0.8542 thetad=0.7349 thetadd= 3.3594
theta3d= 7.3983 rho=103.542 nu= 0.330
FC1= 6677.5 FC2= 284.61 FY= 2059.52 FN= 4823.96 mu= 0.469
FX= 6490.58 PHI=-0.5280 BETA=2.8154 x=41.44062 y=75.77965
FCH= 75.8 OMEGA=-.4453 FCH1= 66.8 FCH2= 2.8 fnet2= 2731.38
r= 67.19 wa=0.1488 vn=15.39 an= 38.34 dnu=0.0071 dmu=0.0109
sigma=-0.5141 gamma=1.2902 chi=0.0688 fych=-37.27 fxch= 65.99

t=1.2300 theta=0.8609 thetad=0.7700 thetadd= 3.4785
theta3d= 7.7744 rho=103.017 nu= 0.337
FC1= 6726.1 FC2= 312.50 FY= 2063.61 FN= 4868.86 mu= 0.480
FX= 6522.42 PHI=-0.5233 BETA=2.8040 x=42.13136 y=75.54331
FCH= 76.0 OMEGA=-.4327 FCH1= 67.3 FCH2= 3.1 fnet2= 2721.01
r= 66.64 wa=0.1501 vn=15.78 an= 38.83 dnu=0.0071 dmu=0.0110
sigma=-0.5082 gamma=1.2969 chi=0.0755 fych=-36.99 fxch= 66.42

t=1.2400 theta=0.8679 thetad=0.8067 thetadd= 3.6203
theta3d= 8.1755 rho=102.247 nu= 0.344
FC1= 6792.0 FC2= 342.93 FY= 2066.85 FN= 4931.87 mu= 0.491
FX= 6570.36 PHI=-0.5173 BETA=2.7910 x=42.82036 y=75.30210
FCH= 76.4 OMEGA=-.4184 FCH1= 67.9 FCH2= 3.4 fnet2= 2708.91
r= 66.10 wa=0.1513 vn=16.17 an= 39.20 dnu=0.0071 dmu=0.0110
sigma=-0.5009 gamma=1.3039 chi=0.0825 fych=-36.69 fxch= 67.02

t=1.2500 theta=0.8754 thetad=0.8446 thetadd= 3.7482
theta3d= 8.5796 rho=101.753 nu= 0.351
FC1= 6840.9 FC2= 375.92 FY= 2069.19 FN= 4978.58 mu= 0.502
FX= 6599.99 PHI=-0.5122 BETA=2.7785 x=43.50763 y=75.05598
FCH= 76.6 OMEGA=-.4046 FCH1= 68.4 FCH2= 3.8 fnet2= 2695.07
r= 65.57 wa=0.1525 vn=16.57 an= 39.70 dnu=0.0072 dmu=0.0111
sigma=-0.4945 gamma=1.3114 chi=0.0900 fych=-36.37 fxch= 67.45

t=1.2600 theta=0.8832 thetad=0.8840 thetadd= 3.8994
theta3d= 9.0099 rho=101.021 nu= 0.358
FC1= 6906.9 FC2= 411.85 FY= 2070.32 FN= 5043.63 mu= 0.514
FX= 6645.52 PHI=-0.5059 BETA=2.7643 x=44.19314 y=74.80492
FCH= 77.0 OMEGA=-.3890 FCH1= 69.1 FCH2= 4.1 fnet2= 2679.12
r= 65.05 wa=0.1537 vn=16.97 an= 40.08 dnu=0.0072 dmu=0.0112
sigma=-0.4868 gamma=1.3192 chi=0.0978 fych=-36.01 fxch= 68.05

t=1.2700 theta=0.8914 thetad=0.9248 thetadd= 4.0365

theta3d= 9.4424 rho=100.562 nu= 0.366
FC1= 6955.7 FC2= 450.78 FY= 2070.18 FN= 5092.52 mu= 0.525
FX= 6672.45 PHI=-0.5005 BETA=2.7506 x=44.87690 y=74.54888
FCH= 77.2 OMEGA=-.3737 FCH1= 69.6 FCH2= 4.5 fnet2= 2661.00
r= 64.54 wa=0.1549 vn=17.38 an= 40.60 dnu=0.0073 dmu=0.0113
sigma=-0.4798 gamma=1.3274 chi=0.1060 fych=-35.63 fxch= 68.47

t=1.2800 theta=0.9001 thetad=0.9673 thetadd= 4.1974
theta3d= 9.9020 rho= 99.873 nu= 0.373
FC1= 7021.7 FC2= 493.13 FY= 2068.38 FN= 5160.11 mu= 0.536
FX= 6715.15 PHI=-0.4937 BETA=2.7352 x=45.55889 y=74.28784
FCH= 77.5 OMEGA=-.3567 FCH1= 70.2 FCH2= 4.9 fnet2= 2640.31
r= 64.04 wa=0.1562 vn=17.79 an= 41.00 dnu=0.0073 dmu=0.0114
sigma=-0.4714 gamma=1.3361 chi=0.1147 fych=-35.21 fxch= 69.07

t=1.2900 theta=0.9092 thetad=1.0113 thetadd= 4.3439
theta3d= 10.3625 rho= 99.452 nu= 0.380
FC1= 7070.0 FC2= 538.97 FY= 2064.83 FN= 5211.68 mu= 0.548
FX= 6738.89 PHI=-0.4877 BETA=2.7201 x=46.23911 y=74.02177
FCH= 77.7 OMEGA=-.3399 FCH1= 70.7 FCH2= 5.4 fnet2= 2616.98
r= 63.54 wa=0.1574 vn=18.20 an= 41.54 dnu=0.0073 dmu=0.0115
sigma=-0.4637 gamma=1.3452 chi=0.1238 fych=-34.75 fxch= 69.50

t=1.3000 theta=0.9188 thetad=1.0570 thetadd= 4.5149
theta3d= 10.8509 rho= 98.807 nu= 0.388
FC1= 7135.6 FC2= 588.77 FY= 2059.08 FN= 5282.39 mu= 0.559
FX= 6778.30 PHI=-0.4804 BETA=2.7032 x=46.91754 y=73.75063
FCH= 78.0 OMEGA=-.3212 FCH1= 71.4 FCH2= 5.9 fnet2= 2590.53
r= 63.05 wa=0.1586 vn=18.62 an= 41.96 dnu=0.0074 dmu=0.0116
sigma=-0.4545 gamma=1.3548 chi=0.1334 fych=-34.25 fxch= 70.10

t=1.3100 theta=0.9288 thetad=1.1042 thetadd= 4.6711
theta3d= 11.3384 rho= 98.430 nu= 0.395
FC1= 7183.1 FC2= 642.62 FY= 2051.01 FN= 5337.21 mu= 0.571
FX= 6798.31 PHI=-0.4737 BETA=2.6865 x=47.59419 y=73.47438
FCH= 78.2 OMEGA=-.3026 FCH1= 71.8 FCH2= 6.4 fnet2= 2560.88
r= 62.57 wa=0.1598 vn=19.05 an= 42.52 dnu=0.0074 dmu=0.0117
sigma=-0.4460 gamma=1.3648 chi=0.1434 fych=-33.71 fxch= 70.52

t=1.3200 theta=0.9393 thetad=1.1534 thetadd= 4.8523
theta3d= 11.8541 rho= 97.835 nu= 0.403
FC1= 7247.8 FC2= 701.06 FY= 2040.07 FN= 5411.77 mu= 0.583
FX= 6833.98 PHI=-0.4656 BETA=2.6679 x=48.26904 y=73.19301
FCH= 78.5 OMEGA=-.2820 FCH1= 72.5 FCH2= 7.0 fnet2= 2527.48
r= 62.10 wa=0.1610 vn=19.48 an= 42.97 dnu=0.0075 dmu=0.0118
sigma=-0.4359 gamma=1.3753 chi=0.1539 fych=-33.13 fxch= 71.12

t=1.3300 theta=0.9504 thetad=1.2042 thetadd= 5.0181
theta3d= 12.3666 rho= 97.507 nu= 0.410
FC1= 7294.1 FC2= 764.17 FY= 2026.10 FN= 5470.57 mu= 0.595
FX= 6849.77 PHI=-0.4582 BETA=2.6494 x=48.94208 y=72.90646
FCH= 78.6 OMEGA=-.2614 FCH1= 72.9 FCH2= 7.6 fnet2= 2490.22
r= 61.63 wa=0.1623 vn=19.91 an= 43.57 dnu=0.0075 dmu=0.0118
sigma=-0.4263 gamma=1.3864 chi=0.1650 fych=-32.49 fxch= 71.54

t=1.3400 theta=0.9619 thetad=1.2569 thetadd= 5.2093
theta3d= 12.9068 rho= 96.968 nu= 0.418
FC1= 7357.3 FC2= 832.58 FY= 2008.47 FN= 5549.70 mu= 0.606
FX= 6881.13 PHI=-0.4492 BETA=2.6289 x=49.61331 y=72.61472
FCH= 78.8 OMEGA=-.2387 FCH1= 73.6 FCH2= 8.3 fnet2= 2448.49
r= 61.17 wa=0.1635 vn=20.35 an= 44.04 dnu=0.0075 dmu=0.0119
sigma=-0.4152 gamma=1.3979 chi=0.1765 fych=-31.80 fxch= 72.14

t=1.3500 theta=0.9740 thetad=1.3114 thetadd= 5.3848
theta3d= 13.4410 rho= 96.695 nu= 0.425
FC1= 7401.7 FC2= 906.37 FY= 1986.95 FN= 5613.49 mu= 0.619
FX= 6892.39 PHI=-0.4406 BETA=2.6082 x=50.28272 y=72.31775
FCH= 78.9 OMEGA=-.2158 FCH1= 74.0 FCH2= 9.1 fnet2= 2402.15
r= 60.72 wa=0.1647 vn=20.80 an= 44.68 dnu=0.0076 dmu=0.0120
sigma=-0.4044 gamma=1.4100 chi=0.1886 fych=-31.06 fxch= 72.57

t=1.3600 theta=0.9867 thetad=1.3680 thetadd= 5.5858
theta3d= 14.0016 rho= 96.220 nu= 0.433
FC1= 7462.9 FC2= 986.24 FY= 1960.81 FN= 5698.12 mu= 0.631
FX= 6918.99 PHI=-0.4305 BETA=2.5854 x=50.95030 y=72.01551
FCH= 79.2 OMEGA=-.1907 FCH1= 74.6 FCH2= 9.9 fnet2= 2350.50
r= 60.27 wa=0.1659 vn=21.25 an= 45.19 dnu=0.0076 dmu=0.0121
sigma=-0.3920 gamma=1.4227 chi=0.2013 fych=-30.25 fxch= 73.18

t=1.3700 theta=1.0000 thetad=1.4264 thetadd= 5.7703
theta3d= 14.5524 rho= 96.009 nu= 0.440
FC1= 7504.7 FC2= 1072.29 FY= 1929.77 FN= 5767.93 mu= 0.643
FX= 6925.32 PHI=-0.4206 BETA=2.5622 x=51.61604 y=71.70798
FCH= 79.3 OMEGA=-.1652 FCH1= 75.0 FCH2= 10.7 fnet2= 2293.40
r= 59.83 wa=0.1671 vn=21.71 an= 45.87 dnu=0.0076 dmu=0.0122
sigma=-0.3798 gamma=1.4360 chi=0.2146 fych=-29.38 fxch= 73.61

t=1.3800 theta=1.0138 thetad=1.4870 thetadd= 5.9805
theta3d= 15.1273 rho= 95.605 nu= 0.448
FC1= 7562.9 FC2= 1165.27 FY= 1892.99 FN= 5859.23 mu= 0.655
FX= 6946.93 PHI=-0.4090 BETA=2.5367 x=52.27994 y=71.39512
FCH= 79.5 OMEGA=-.1375 FCH1= 75.6 FCH2= 11.6 fnet2= 2230.05
r= 59.40 wa=0.1684 vn=22.18 an= 46.43 dnu=0.0077 dmu=0.0123

sigma=-0.3659 gamma=1.4498 chi=0.2284 fych=-28.44 fxch= 74.23

t=1.3900 theta=1.0283 thetad=1.5495 thetadd= 6.1735
theta3d= 15.6879 rho= 95.466 nu= 0.456
FC1= 7601.4 FC2= 1265.32 FY= 1850.11 FN= 5936.32 mu= 0.668
FX= 6948.17 PHI=-0.3974 BETA=2.5107 x=52.94200 y=71.07690
FCH= 79.5 OMEGA=-.1091 FCH1= 76.0 FCH2= 12.6 fnet2= 2160.28
r= 58.97 wa=0.1696 vn=22.65 an= 47.17 dnu=0.0077 dmu=0.0124
sigma=-0.3520 gamma=1.4643 chi=0.2429 fych=-27.43 fxch= 74.67

t=1.4000 theta=1.0434 thetad=1.6142 thetadd= 6.3919
theta3d= 16.2690 rho= 95.143 nu= 0.463
FC1= 7655.8 FC2= 1373.25 FY= 1800.18 FN= 6035.60 mu= 0.680
FX= 6964.67 PHI=-0.3839 BETA=2.4820 x=53.60220 y=70.75328
FCH= 79.8 OMEGA=-.0783 FCH1= 76.6 FCH2= 13.7 fnet2= 2083.21
r= 58.55 wa=0.1708 vn=23.12 an= 47.79 dnu=0.0077 dmu=0.0125
sigma=-0.3364 gamma=1.4794 chi=0.2580 fych=-26.33 fxch= 75.31

t=1.4100 theta=1.0592 thetad=1.6810 thetadd= 6.5920
theta3d= 16.8301 rho= 95.088 nu= 0.471
FC1= 7689.9 FC2= 1489.19 FY= 1742.79 FN= 6121.38 mu= 0.693
FX= 6960.87 PHI=-0.3702 BETA=2.4525 x=54.26056 y=70.42424
FCH= 79.8 OMEGA=-.0467 FCH1= 76.9 FCH2= 14.9 fnet2= 1998.64
r= 58.13 wa=0.1720 vn=23.61 an= 48.59 dnu=0.0077 dmu=0.0126
sigma=-0.3206 gamma=1.4952 chi=0.2738 fych=-25.16 fxch= 75.78

t=1.4200 theta=1.0757 thetad=1.7500 thetadd= 6.8173
theta3d= 17.4068 rho= 94.858 nu= 0.479
FC1= 7739.3 FC2= 1614.04 FY= 1676.83 FN= 6230.19 mu= 0.705
FX= 6972.53 PHI=-0.3544 BETA=2.4202 x=54.91706 y=70.08975
FCH= 80.1 OMEGA=-.0127 FCH1= 77.4 FCH2= 16.1 fnet2= 1905.62
r= 57.72 wa=0.1732 vn=24.10 an= 49.28 dnu=0.0078 dmu=0.0126
sigma=-0.3030 gamma=1.5117 chi=0.2903 fych=-23.90 fxch= 76.44

t=1.4300 theta=1.0929 thetad=1.8211 thetadd= 7.0231
theta3d= 17.9564 rho= 94.899 nu= 0.487
FC1= 7768.0 FC2= 1747.91 FY= 1601.85 FN= 6326.33 mu= 0.718
FX= 6964.17 PHI=-0.3380 BETA=2.3867 x=55.57172 y=69.74978
FCH= 80.2 OMEGA=0.0225 FCH1= 77.7 FCH2= 17.5 fnet2= 1803.92
r= 57.32 wa=0.1745 vn=24.60 an= 50.15 dnu=0.0078 dmu=0.0127
sigma=-0.2850 gamma=1.5289 chi=0.3075 fych=-22.55 fxch= 76.95

t=1.4400 theta=1.1109 thetad=1.8946 thetadd= 7.2533
theta3d= 18.5151 rho= 94.774 nu= 0.495
FC1= 7811.3 FC2= 1891.76 FY= 1516.62 FN= 6446.39 mu= 0.731
FX= 6971.64 PHI=-0.3193 BETA=2.3500 x=56.22452 y=69.40429

FCH= 80.5 OMEGA=0.0602 FCH1= 78.1 FCH2= 18.9 fnet2= 1692.49
r= 56.92 wa=0.1757 vn=25.11 an= 50.93 dnu=0.0078 dmu=0.0128
sigma=-0.2653 gamma=1.5469 chi=0.3255 fych=-21.10 fxch= 77.66

t=1.4500 theta=1.1296 thetad=1.9702 thetadd= 7.4626
theta3d= 19.0387 rho= 94.926 nu= 0.502
FC1= 7833.4 FC2= 2045.70 FY= 1420.65 FN= 6554.77 mu= 0.744
FX= 6959.74 PHI=-0.2996 BETA=2.3117 x=56.87548 y=69.05325
FCH= 80.6 OMEGA=0.0992 FCH1= 78.3 FCH2= 20.4 fnet2= 1571.11
r= 56.53 wa=0.1769 vn=25.63 an= 51.89 dnu=0.0078 dmu=0.0129
sigma=-0.2450 gamma=1.5656 chi=0.3442 fych=-19.56 fxch= 78.23

t=1.4600 theta=1.1490 thetad=2.0481 thetadd= 7.6954
theta3d= 19.5628 rho= 94.924 nu= 0.510
FC1= 7869.3 FC2= 2210.74 FY= 1312.59 FN= 6687.94 mu= 0.757
FX= 6964.28 PHI=-0.2774 BETA=2.2699 x=57.52462 y=68.69666
FCH= 81.0 OMEGA=0.1408 FCH1= 78.7 FCH2= 22.1 fnet2= 1438.65
r= 56.14 wa=0.1781 vn=26.16 an= 52.77 dnu=0.0078 dmu=0.0130
sigma=-0.2229 gamma=1.5850 chi=0.3636 fych=-17.91 fxch= 79.01

t=1.4700 theta=1.1693 thetad=2.1282 thetadd= 7.9055
theta3d= 20.0427 rho= 95.203 nu= 0.518
FC1= 7883.4 FC2= 2386.94 FY= 1191.93 FN= 6810.62 mu= 0.770
FX= 6950.59 PHI=-0.2538 BETA=2.2261 x=58.17193 y=68.33445
FCH= 81.3 OMEGA=0.1838 FCH1= 78.8 FCH2= 23.9 fnet2= 1294.89
r= 55.76 wa=0.1793 vn=26.70 an= 53.84 dnu=0.0078 dmu=0.0131
sigma=-0.2001 gamma=1.6053 chi=0.3839 fych=-16.16 fxch= 79.66

t=1.4800 theta=1.1904 thetad=2.2106 thetadd= 8.1378
theta3d= 20.5128 rho= 95.341 nu= 0.526
FC1= 7910.5 FC2= 2575.37 FY= 1057.24 FN= 6958.95 mu= 0.783
FX= 6954.30 PHI=-0.2273 BETA=2.1785 x=58.81744 y=67.96662
FCH= 81.8 OMEGA=0.2293 FCH1= 79.1 FCH2= 25.7 fnet2= 1138.62
r= 55.38 wa=0.1806 vn=27.25 an= 54.83 dnu=0.0078 dmu=0.0132
sigma=-0.1757 gamma=1.6264 chi=0.4050 fych=-14.30 fxch= 80.54

t=1.4900 theta=1.2124 thetad=2.2951 thetadd= 8.3458
theta3d= 20.9285 rho= 95.766 nu= 0.534
FC1= 7915.3 FC2= 2776.03 FY= 908.03 FN= 7098.12 mu= 0.796
FX= 6941.49 PHI=-0.1991 BETA=2.1283 x=59.46116 y=67.59314
FCH= 82.2 OMEGA=0.2763 FCH1= 79.2 FCH2= 27.7 fnet2= 969.65
r= 55.01 wa=0.1818 vn=27.81 an= 56.02 dnu=0.0078 dmu=0.0133
sigma=-0.1506 gamma=1.6484 chi=0.4270 fych=-12.34 fxch= 81.31

t=1.5000 theta=1.2352 thetad=2.3819 thetadd= 8.5741
theta3d= 21.3225 rho= 96.064 nu= 0.541

FC1= 7932.3 FC2= 2990.00 FY= 742.82 FN= 7263.77 mu= 0.810
FX= 6947.53 PHI=-0.1678 BETA=2.0742 x=60.10312 y=67.21398
FCH= 83.0 OMEGA=0.3257 FCH1= 79.3 FCH2= 29.9 fnet2= 786.71
r= 54.64 wa=0.1830 vn=28.38 an= 57.14 dnu=0.0078 dmu=0.0134
sigma=-0.1241 gamma=1.6712 chi=0.4498 fych=-10.27 fxch= 82.32

t=1.5100 theta=1.2589 thetad=2.4707 thetadd= 8.7763
theta3d= 21.6511 rho= 96.658 nu= 0.549
FC1= 7926.7 FC2= 3217.22 FY= 561.20 FN= 7421.59 mu= 0.823
FX= 6939.35 PHI=-0.1343 BETA=2.0171 x=60.74335 y=66.82911
FCH= 83.6 OMEGA=0.3766 FCH1= 79.3 FCH2= 32.2 fnet2= 589.66
r= 54.28 wa=0.1842 vn=28.96 an= 58.48 dnu=0.0077 dmu=0.0134
sigma=-0.0969 gamma=1.6949 chi=0.4735 fych= -8.09 fxch= 83.25

t=1.5200 theta=1.2835 thetad=2.5618 thetadd= 8.9968
theta3d= 21.9446 rho= 97.137 nu= 0.557
FC1= 7932.3 FC2= 3458.74 FY= 361.72 FN= 7606.75 mu= 0.837
FX= 6952.18 PHI=-0.0979 BETA=1.9560 x=61.38188 y=66.43851
FCH= 84.6 OMEGA=0.4293 FCH1= 79.3 FCH2= 34.6 fnet2= 377.18
r= 53.93 wa=0.1854 vn=29.56 an= 59.75 dnu=0.0077 dmu=0.0135
sigma=-0.0687 gamma=1.7195 chi=0.4981 fych= -5.81 fxch= 84.45

t=1.5300 theta=1.3090 thetad=2.6548 thetadd= 9.1892
theta3d= 22.1616 rho= 97.922 nu= 0.564
FC1= 7915.1 FC2= 3714.43 FY= 144.11 FN= 7785.38 mu= 0.850
FX= 6953.83 PHI=-0.0592 BETA=1.8918 x=62.01875 y=66.04214
FCH= 85.7 OMEGA=0.4835 FCH1= 79.2 FCH2= 37.1 fnet2= 149.20
r= 53.57 wa=0.1867 vn=30.17 an= 61.24 dnu=0.0077 dmu=0.0136
sigma=-0.0402 gamma=1.7450 chi=0.5236 fych= -3.44 fxch= 85.59

t=1.5400 theta=1.3355 thetad=2.7499 thetadd= 9.3979
theta3d= 22.3290 rho= 98.606 nu= 0.572
FC1= 7908.4 FC2= 3985.29 FY= -92.97 FN= 7992.04 mu= 0.864
FX= 6979.34 PHI=-0.0178 BETA=1.8239 x=62.65401 y=65.64000
FCH= 87.0 OMEGA=0.5390 FCH1= 79.1 FCH2= 39.8 fnet2= -95.61
r= 53.23 wa=0.1879 vn=30.80 an= 62.67 dnu=0.0076 dmu=0.0137
sigma=-0.0111 gamma=1.7715 chi=0.5501 fych= -0.97 fxch= 87.03

t=1.5500 theta=1.3630 thetad=2.7499 nu= 0.572
x=63.32021 y=65.21112
FCH= 43.7 OMEGA=-.5882 FCH1= 0.0 FCH2= 17.2
sigma=-1.1658 gamma=1.7990 chi=0.5776 fych=-40.20 fxch= 17.23

t=1.5600 theta=1.3905 thetad=2.7499 nu= 0.572
x=63.98642 y=64.78224
FCH= 44.2 OMEGA=-.5652 FCH1= 0.0 FCH2= 17.2

sigma=-1.1703 gamma=1.8265 chi=0.6051 fych=-40.68 fxch= 17.22

t=1.5700 theta=1.4180 thetad=2.7499 nu= 0.572
x=64.65262 y=64.35336
FCH= 44.6 OMEGA=-.5424 FCH1= 0.0 FCH2= 17.2
sigma=-1.1750 gamma=1.8540 chi=0.6326 fych=-41.15 fxch= 17.20

t=1.5800 theta=1.4455 thetad=2.7499 nu= 0.572
x=65.31882 y=63.92448
FCH= 45.0 OMEGA=-.5197 FCH1= 0.0 FCH2= 17.2
sigma=-1.1798 gamma=1.8815 chi=0.6601 fych=-41.62 fxch= 17.16

t=1.5900 theta=1.4730 thetad=2.7499 nu= 0.572
x=65.98503 y=63.49560
FCH= 45.4 OMEGA=-.4972 FCH1= 0.0 FCH2= 17.2
sigma=-1.1848 gamma=1.9090 chi=0.6876 fych=-42.09 fxch= 17.11

t=1.6000 theta=1.5005 thetad=2.7499 nu= 0.572
x=66.65124 y=63.06672
FCH= 45.8 OMEGA=-.4748 FCH1= 0.0 FCH2= 17.2
sigma=-1.1899 gamma=1.9365 chi=0.7151 fych=-42.56 fxch= 17.04

t=1.6100 theta=1.5280 thetad=2.7499 nu= 0.572
x=67.31744 y=62.63783
FCH= 46.3 OMEGA=-.4526 FCH1= 0.0 FCH2= 17.2
sigma=-1.1952 gamma=1.9640 chi=0.7426 fych=-43.03 fxch= 16.97

t=1.6200 theta=1.5555 thetad=2.7499 nu= 0.572
x=67.98365 y=62.20895
FCH= 46.7 OMEGA=-.4306 FCH1= 0.0 FCH2= 17.2
sigma=-1.2007 gamma=1.9915 chi=0.7701 fych=-43.50 fxch= 16.88

t=1.6300 theta=1.5830 thetad=2.7499 nu= 0.572
x=68.64986 y=61.78007
FCH= 47.0 OMEGA=-.4087 FCH1= 0.0 FCH2= 17.2
sigma=-1.2063 gamma=2.0190 chi=0.7976 fych=-43.96 fxch= 16.77

t=1.6400 theta=1.6105 thetad=2.7499 nu= 0.572
x=69.31606 y=61.35118
FCH= 47.4 OMEGA=-.3869 FCH1= 0.0 FCH2= 17.2
sigma=-1.2120 gamma=2.0465 chi=0.8251 fych=-44.42 fxch= 16.66

t=1.6500 theta=1.6380 thetad=2.7499 nu= 0.572

x=69.98227 y=60.92230
FCH= 47.8 OMEGA=-.3652 FCH1= 0.0 FCH2= 17.2
sigma=-1.2179 gamma=2.0740 chi=0.8526 fych=-44.87 fxch= 16.53

t=1.6600 theta=1.6655 thetad=2.7499 nu= 0.572
x=70.64848 y=60.49342
FCH= 48.2 OMEGA=-.3437 FCH1= 0.0 FCH2= 17.2
sigma=-1.2238 gamma=2.1015 chi=0.8801 fych=-45.33 fxch= 16.39

t=1.6700 theta=1.6930 thetad=2.7499 nu= 0.572
x=71.31468 y=60.06454
FCH= 48.6 OMEGA=-.3223 FCH1= 0.0 FCH2= 17.2
sigma=-1.2299 gamma=2.1290 chi=0.9076 fych=-45.78 fxch= 16.24

t=1.6800 theta=1.7205 thetad=2.7499 nu= 0.572
x=71.98089 y=59.63565
FCH= 48.9 OMEGA=-.3010 FCH1= 0.0 FCH2= 17.2
sigma=-1.2361 gamma=2.1565 chi=0.9351 fych=-46.22 fxch= 16.07

t=1.6900 theta=1.7480 thetad=2.7499 nu= 0.572
x=72.64709 y=59.20677
FCH= 49.3 OMEGA=-.2799 FCH1= 0.0 FCH2= 17.2
sigma=-1.2425 gamma=2.1840 chi=0.9626 fych=-46.66 fxch= 15.90

t=1.7000 theta=1.7755 thetad=2.7499 nu= 0.572
x=73.31330 y=58.77789
FCH= 49.6 OMEGA=-.2588 FCH1= 0.0 FCH2= 17.2
sigma=-1.2489 gamma=2.2115 chi=0.9901 fych=-47.09 fxch= 15.71

t=1.7100 theta=1.8030 thetad=2.7499 nu= 0.572
x=73.97951 y=58.34901
FCH= 50.0 OMEGA=-.2378 FCH1= 0.0 FCH2= 17.2
sigma=-1.2554 gamma=2.2390 chi=1.0176 fych=-47.52 fxch= 15.50

t=1.7200 theta=1.8305 thetad=2.7499 nu= 0.572
x=74.64571 y=57.92012
FCH= 50.3 OMEGA=-.2170 FCH1= 0.0 FCH2= 17.2
sigma=-1.2621 gamma=2.2665 chi=1.0451 fych=-47.95 fxch= 15.29

t=1.7300 theta=1.8580 thetad=2.7499 nu= 0.572
x=75.31192 y=57.49124
FCH= 50.7 OMEGA=-.1962 FCH1= 0.0 FCH2= 17.2
sigma=-1.2688 gamma=2.2940 chi=1.0726 fych=-48.36 fxch= 15.07

t=1.7400 theta=1.8855 thetad=2.7499 nu= 0.572
x=75.97813 y=57.06236
FCH= 51.0 OMEGA=-.1755 FCH1= 0.0 FCH2= 17.2
sigma=-1.2756 gamma=2.3215 chi=1.1001 fych=-48.78 fxch= 14.83

t=1.7500 theta=1.9130 thetad=2.7499 nu= 0.572
x=76.64433 y=56.63348
FCH= 51.3 OMEGA=-.1549 FCH1= 0.0 FCH2= 17.2
sigma=-1.2825 gamma=2.3490 chi=1.1276 fych=-49.18 fxch= 14.59

t=1.7600 theta=1.9405 thetad=2.7499 nu= 0.572
x=77.31054 y=56.20459
FCH= 51.6 OMEGA=-.1344 FCH1= 0.0 FCH2= 17.2
sigma=-1.2895 gamma=2.3765 chi=1.1551 fych=-49.58 fxch= 14.33

t=1.7700 theta=1.9680 thetad=2.7499 nu= 0.572
x=77.97675 y=55.77571
FCH= 51.9 OMEGA=-.1139 FCH1= 0.0 FCH2= 17.2
sigma=-1.2965 gamma=2.4040 chi=1.1826 fych=-49.97 fxch= 14.06

t=1.7800 theta=1.9955 thetad=2.7499 nu= 0.572
x=78.64295 y=55.34683
FCH= 52.2 OMEGA=-.0936 FCH1= 0.0 FCH2= 17.2
sigma=-1.3037 gamma=2.4315 chi=1.2101 fych=-50.35 fxch= 13.78

t=1.7900 theta=2.0230 thetad=2.7499 nu= 0.572
x=79.30916 y=54.91795
FCH= 52.5 OMEGA=-.0733 FCH1= 0.0 FCH2= 17.2
sigma=-1.3109 gamma=2.4590 chi=1.2376 fych=-50.73 fxch= 13.49

t=1.8000 theta=2.0505 thetad=2.7499 nu= 0.572
x=79.97536 y=54.48906
FCH= 52.8 OMEGA=-.0531 FCH1= 0.0 FCH2= 17.2
sigma=-1.3182 gamma=2.4865 chi=1.2651 fych=-51.09 fxch= 13.19

t=1.8100 theta=2.0780 thetad=2.7499 nu= 0.572
x=80.64157 y=54.06018
FCH= 53.0 OMEGA=-.0329 FCH1= 0.0 FCH2= 17.2
sigma=-1.3255 gamma=2.5140 chi=1.2926 fych=-51.45 fxch= 12.88

t=1.8200 theta=2.1055 thetad=2.7499 nu= 0.572
x=81.30778 y=53.63130
FCH= 53.3 OMEGA=-.0128 FCH1= 0.0 FCH2= 17.2

sigma=-1.3329 gamma=2.5415 chi=1.3201 fych=-51.80 fxch= 12.56

t=1.8300 theta=2.1330 thetad=2.7499 nu= 0.572
x=81.97398 y=53.20242
FCH= 53.6 OMEGA=0.0072 FCH1= 0.0 FCH2= 17.2
sigma=-1.3404 gamma=2.5690 chi=1.3476 fych=-52.14 fxch= 12.23

t=1.8400 theta=2.1605 thetad=2.7499 nu= 0.572
x=82.64019 y=52.77353
FCH= 53.8 OMEGA=0.0272 FCH1= 0.0 FCH2= 17.2
sigma=-1.3479 gamma=2.5965 chi=1.3751 fych=-52.47 fxch= 11.89

t=1.8500 theta=2.1880 thetad=2.7499 nu= 0.572
x=83.30640 y=52.34465
FCH= 54.0 OMEGA=0.0471 FCH1= 0.0 FCH2= 17.2
sigma=-1.3555 gamma=2.6240 chi=1.4026 fych=-52.80 fxch= 11.54

t=1.8600 theta=2.2155 thetad=2.7499 nu= 0.572
x=83.97260 y=51.91577
FCH= 54.3 OMEGA=0.0669 FCH1= 0.0 FCH2= 17.2
sigma=-1.3632 gamma=2.6515 chi=1.4301 fych=-53.11 fxch= 11.19

t=1.8700 theta=2.2430 thetad=2.7499 nu= 0.572
x=84.63881 y=51.48689
FCH= 54.5 OMEGA=0.0867 FCH1= 0.0 FCH2= 17.2
sigma=-1.3708 gamma=2.6790 chi=1.4576 fych=-53.41 fxch= 10.82

t=1.8800 theta=2.2705 thetad=2.7499 nu= 0.572
x=85.30502 y=51.05800
FCH= 54.7 OMEGA=0.1065 FCH1= 0.0 FCH2= 17.2
sigma=-1.3786 gamma=2.7065 chi=1.4851 fych=-53.70 fxch= 10.45

t=1.8900 theta=2.2980 thetad=2.7499 nu= 0.572
x=85.97122 y=50.62912
FCH= 54.9 OMEGA=0.1262 FCH1= 0.0 FCH2= 17.2
sigma=-1.3864 gamma=2.7340 chi=1.5126 fych=-53.99 fxch= 10.07

t=1.9000 theta=2.3255 thetad=2.7499 nu= 0.572
x=86.63743 y=50.20024
FCH= 55.1 OMEGA=0.1459 FCH1= 0.0 FCH2= 17.2
sigma=-1.3942 gamma=2.7615 chi=1.5401 fych=-54.26 fxch= 9.68

t=1.9100 theta=2.3530 thetad=2.7499 nu= 0.572

x=87.30363 y=49.77135
FCH= 55.3 OMEGA=0.1655 FCH1= 0.0 FCH2= 17.2
sigma=-1.4021 gamma=2.7890 chi=1.5676 fych=-54.52 fxch= 9.29

t=1.9200 theta=2.3805 thetad=2.7499 nu= 0.572
x=87.96984 y=49.34247
FCH= 55.5 OMEGA=0.1851 FCH1= 0.0 FCH2= 17.2
sigma=-1.4100 gamma=2.8165 chi=1.5951 fych=-54.77 fxch= 8.88

APPENDIX 5

t	x	y	fch	omega	theta	thetad
0.6300	0.730	82.000	56.666	-.7837	0.7854	0.0001
0.6400	1.460	81.997	57.004	-.7778	0.7854	0.0008
0.6500	2.190	81.990	57.242	-.7737	0.7854	0.0017
0.6600	2.920	81.980	57.584	-.7679	0.7855	0.0031
0.6700	3.650	81.967	57.824	-.7638	0.7855	0.0049
0.6800	4.380	81.951	58.170	-.7580	0.7856	0.0072
0.6900	5.110	81.931	58.414	-.7540	0.7857	0.0098
0.7000	5.839	81.908	58.764	-.7483	0.7858	0.0129
0.7100	6.569	81.881	59.011	-.7442	0.7860	0.0163
0.7200	7.299	81.851	59.366	-.7385	0.7862	0.0203
0.7300	8.028	81.817	59.616	-.7344	0.7864	0.0246
0.7400	8.757	81.779	59.975	-.7287	0.7867	0.0294
0.7500	9.487	81.738	60.229	-.7245	0.7871	0.0346
0.7600	10.216	81.694	60.592	-.7188	0.7875	0.0403
0.7700	10.945	81.646	60.849	-.7146	0.7879	0.0464
0.7800	11.673	81.594	61.216	-.7087	0.7885	0.0530
0.7900	12.402	81.538	61.477	-.7044	0.7891	0.0601
0.8000	13.130	81.479	61.849	-.6985	0.7897	0.0677
0.8100	13.859	81.415	62.113	-.6940	0.7905	0.0757
0.8200	14.587	81.348	62.488	-.6880	0.7913	0.0843
0.8300	15.314	81.277	62.756	-.6833	0.7923	0.0933
0.8400	16.042	81.203	63.135	-.6772	0.7933	0.1029
0.8500	16.769	81.124	63.406	-.6723	0.7944	0.1130
0.8600	17.496	81.041	63.788	-.6660	0.7957	0.1237
0.8700	18.223	80.955	64.062	-.6609	0.7970	0.1349
0.8800	18.949	80.864	64.448	-.6544	0.7985	0.1467
0.8900	19.675	80.769	64.724	-.6491	0.8001	0.1591
0.9000	20.401	80.670	65.112	-.6423	0.8018	0.1721
0.9100	21.126	80.567	65.390	-.6367	0.8036	0.1857
0.9200	21.851	80.460	65.780	-.6296	0.8056	0.2000
0.9300	22.576	80.348	66.060	-.6236	0.8078	0.2149
0.9400	23.300	80.233	66.451	-.6162	0.8101	0.2305
0.9500	24.024	80.113	66.732	-.6099	0.8126	0.2468
0.9600	24.747	79.989	67.122	-.6022	0.8152	0.2639
0.9700	25.470	79.860	67.403	-.5954	0.8180	0.2816
0.9800	26.193	79.727	67.793	-.5872	0.8210	0.3001

0.9900	26.914	79.590	68.073	-.5800	0.8242	0.3194
1.0000	27.636	79.448	68.461	-.5714	0.8276	0.3396
1.0100	28.357	79.301	68.738	-.5636	0.8312	0.3605
1.0200	29.077	79.150	69.122	-.5545	0.8350	0.3823
1.0300	29.797	78.995	69.396	-.5461	0.8391	0.4050
1.0400	30.516	78.835	69.774	-.5364	0.8434	0.4287
1.0500	31.235	78.670	70.042	-.5274	0.8479	0.4532
1.0600	31.952	78.500	70.413	-.5170	0.8527	0.4788
1.0700	32.670	78.326	70.674	-.5072	0.8578	0.5054
1.0800	33.386	78.147	71.035	-.4961	0.8631	0.5330
1.0900	34.102	77.964	71.286	-.4855	0.8687	0.5617
1.1000	34.817	77.775	71.635	-.4735	0.8746	0.5916
1.1100	35.532	77.581	71.874	-.4620	0.8808	0.6225
1.1200	36.245	77.383	72.208	-.4491	0.8874	0.6547
1.1300	36.958	77.180	72.431	-.4366	0.8943	0.6881
1.1400	37.670	76.971	72.748	-.4226	0.9015	0.7228
1.1500	38.381	76.758	72.954	-.4089	0.9091	0.7588
1.1600	39.092	76.539	73.250	-.3938	0.9170	0.7961
1.1700	39.801	76.315	73.437	-.3788	0.9254	0.8348
1.1800	40.510	76.087	73.709	-.3623	0.9341	0.8750
1.1900	41.217	75.853	73.873	-.3458	0.9433	0.9166
1.2000	41.924	75.613	74.119	-.3278	0.9529	0.9598
1.2100	42.629	75.369	74.259	-.3096	0.9630	1.0044
1.2200	43.334	75.119	74.478	-.2899	0.9735	1.0508
1.2300	44.037	74.864	74.593	-.2699	0.9844	1.0987
1.2400	44.740	74.603	74.784	-.2483	0.9959	1.1484
1.2500	45.441	74.337	74.874	-.2262	1.0079	1.1997
1.2600	46.141	74.065	75.039	-.2023	1.0205	1.2529
1.2700	46.840	73.788	75.108	-.1779	1.0335	1.3078
1.2800	47.538	73.506	75.252	-.1516	1.0472	1.3646
1.2900	48.235	73.218	75.307	-.1245	1.0614	1.4233
1.3000	48.930	72.924	75.438	-.0954	1.0763	1.4839
1.3100	49.624	72.624	75.490	-.0654	1.0917	1.5464
1.3200	50.317	72.319	75.624	-.0333	1.1078	1.6109
1.3300	51.009	72.008	75.690	0.0000	1.1246	1.6773
1.3400	51.699	71.692	75.848	0.0354	1.1421	1.7458
1.3500	52.388	71.369	75.956	0.0723	1.1602	1.8162
1.3600	53.076	71.041	76.169	0.1112	1.1791	1.8887
1.3700	53.762	70.707	76.355	0.1518	1.1987	1.9631
1.3800	54.447	70.367	76.663	0.1945	1.2191	2.0396
1.3900	55.131	70.022	76.974	0.2388	1.2403	2.1181
1.4000	55.813	69.670	77.430	0.2852	1.2623	2.1985
1.4100	56.494	69.313	77.925	0.3333	1.2851	2.2808
1.4200	57.174	68.949	78.593	0.3831	1.3088	2.3650
1.4300	57.853	68.580	79.337	0.4344	1.3333	2.4510
1.4400	58.530	68.204	80.288	0.4872	1.3587	2.5387
1.4500	59.206	67.823	81.355	0.5411	1.3849	2.6282
1.4600	59.880	67.436	82.661	0.5960	1.4121	2.7193
1.4700	60.554	67.042	84.125	0.6515	1.4402	2.8119
1.4800	61.225	66.644	45.751	-.4859	1.4684	2.8119
1.4900	61.895	66.245	46.188	-.4634	1.4965	2.8119
1.5000	62.566	65.847	46.619	-.4410	1.5246	2.8119

1.5100	63.237	65.449	47.045	-.4188	1.5527	2.8119
1.5200	63.907	65.050	47.464	-.3967	1.5808	2.8119
1.5300	64.578	64.652	47.876	-.3747	1.6090	2.8119
1.5400	65.248	64.253	48.282	-.3529	1.6371	2.8119
1.5500	65.919	63.855	48.682	-.3312	1.6652	2.8119
1.5600	66.590	63.457	49.074	-.3097	1.6933	2.8119
1.5700	67.260	63.058	49.460	-.2882	1.7214	2.8119
1.5800	67.931	62.660	49.838	-.2669	1.7496	2.8119
1.5900	68.602	62.261	50.209	-.2457	1.7777	2.8119
1.6000	69.272	61.863	50.573	-.2245	1.8058	2.8119
1.6100	69.943	61.465	50.929	-.2035	1.8339	2.8119
1.6200	70.613	61.066	51.278	-.1826	1.8620	2.8119
1.6300	71.284	60.668	51.619	-.1618	1.8902	2.8119
1.6400	71.955	60.270	51.952	-.1410	1.9183	2.8119
1.6500	72.625	59.871	52.277	-.1203	1.9464	2.8119
1.6600	73.296	59.473	52.594	-.0998	1.9745	2.8119
1.6700	73.967	59.074	52.903	-.0793	2.0026	2.8119
1.6800	74.637	58.676	53.203	-.0588	2.0307	2.8119
1.6900	75.308	58.278	53.496	-.0385	2.0589	2.8119
1.7000	75.979	57.879	53.779	-.0182	2.0870	2.8119
1.7100	76.649	57.481	54.054	0.0020	2.1151	2.8119
1.7200	77.320	57.082	54.321	0.0222	2.1432	2.8119
1.7300	77.990	56.684	54.578	0.0423	2.1713	2.8119
1.7400	78.661	56.286	54.827	0.0624	2.1995	2.8119
1.7500	79.332	55.887	55.067	0.0824	2.2276	2.8119
1.7600	80.002	55.489	55.298	0.1023	2.2557	2.8119
1.7700	80.673	55.090	55.520	0.1222	2.2838	2.8119
1.7800	81.344	54.692	55.733	0.1421	2.3119	2.8119
1.7900	82.014	54.294	55.937	0.1619	2.3401	2.8119
1.8000	82.685	53.895	56.132	0.1817	2.3682	2.8119

APPENDIX 6

t	x	y	fch	omega	theta	thetad
0.6300	0.730	82.000	56.666	3.9253	0.7854	0.0001
0.6400	1.460	81.997	57.004	3.9194	0.7854	0.0008
0.6500	2.190	81.990	57.242	3.9153	0.7854	0.0017
0.6600	2.920	81.980	57.584	3.9095	0.7855	0.0031
0.6700	3.650	81.967	57.824	3.9054	0.7855	0.0049
0.6800	4.380	81.951	58.170	3.8996	0.7856	0.0072
0.6900	5.110	81.931	58.414	3.8956	0.7857	0.0098
0.7000	5.839	81.908	58.764	3.8899	0.7858	0.0129
0.7100	6.569	81.881	59.011	3.8858	0.7860	0.0163
0.7200	7.299	81.851	59.365	3.8801	0.7862	0.0203
0.7300	8.028	81.817	59.615	3.8760	0.7864	0.0246
0.7400	8.757	81.779	59.973	3.8703	0.7867	0.0294
0.7500	9.487	81.738	60.227	3.8662	0.7871	0.0346
0.7600	10.216	81.694	60.589	3.8604	0.7875	0.0403
0.7700	10.945	81.646	60.846	3.8562	0.7879	0.0464

0.7800	11.673	81.594	61.212	3.8504	0.7885	0.0530
0.7900	12.402	81.538	61.471	3.8461	0.7891	0.0601
0.8000	13.130	81.479	61.841	3.8402	0.7897	0.0677
0.8100	13.859	81.415	62.103	3.8357	0.7905	0.0757
0.8200	14.587	81.348	62.476	3.8297	0.7913	0.0843
0.8300	15.314	81.277	62.741	3.8251	0.7923	0.0933
0.8400	16.042	81.203	63.117	3.8190	0.7933	0.1029
0.8500	16.769	81.124	63.384	3.8142	0.7944	0.1130
0.8600	17.496	81.041	63.761	3.8079	0.7957	0.1237
0.8700	18.223	80.955	64.030	3.8029	0.7970	0.1349
0.8800	18.949	80.864	64.409	3.7964	0.7985	0.1467
0.8900	19.675	80.769	64.679	3.7911	0.8001	0.1591
0.9000	20.401	80.670	65.059	3.7844	0.8018	0.1721
0.9100	21.126	80.567	65.328	3.7788	0.8036	0.1857
0.9200	21.851	80.460	65.708	3.7718	0.8056	0.2000
0.9300	22.576	80.348	65.976	3.7660	0.8078	0.2149
0.9400	23.300	80.233	66.354	3.7587	0.8101	0.2305
0.9500	24.024	80.113	66.620	3.7524	0.8126	0.2468
0.9600	24.747	79.989	66.995	3.7448	0.8152	0.2639
0.9700	25.470	79.860	67.257	3.7382	0.8180	0.2816
0.9800	26.193	79.727	67.627	3.7302	0.8210	0.3001
0.9900	26.914	79.590	67.884	3.7231	0.8242	0.3194
1.0000	27.636	79.448	68.246	3.7146	0.8276	0.3396
1.0100	28.357	79.301	68.495	3.7070	0.8312	0.3605
1.0200	29.077	79.150	68.847	3.6980	0.8350	0.3823
1.0300	29.797	78.995	69.086	3.6899	0.8391	0.4050
1.0400	30.516	78.835	69.425	3.6803	0.8434	0.4287
1.0500	31.235	78.670	69.651	3.6715	0.8479	0.4532
1.0600	31.952	78.500	69.974	3.6614	0.8527	0.4788
1.0700	32.670	78.326	70.183	3.6518	0.8578	0.5054
1.0800	33.386	78.147	70.486	3.6409	0.8631	0.5330
1.0900	34.102	77.964	70.674	3.6306	0.8687	0.5617
1.1000	34.817	77.775	70.953	3.6189	0.8746	0.5916
1.1100	35.532	77.581	71.115	3.6077	0.8808	0.6225
1.1200	36.245	77.383	71.365	3.5950	0.8874	0.6547
1.1300	36.958	77.180	71.496	3.5827	0.8943	0.6881
1.1400	37.670	76.971	71.711	3.5690	0.9015	0.7228
1.1500	38.381	76.758	71.807	3.5556	0.9091	0.7588
1.1600	39.092	76.539	71.981	3.5407	0.9170	0.7961
1.1700	39.801	76.315	72.035	3.5259	0.9254	0.8348
1.1800	40.510	76.087	72.162	3.5096	0.9341	0.8750
1.1900	41.217	75.853	72.168	3.4933	0.9433	0.9166
1.2000	41.924	75.613	72.241	3.4754	0.9529	0.9598
1.2100	42.629	75.369	72.194	3.4573	0.9630	1.0044
1.2200	43.334	75.119	72.209	3.4375	0.9735	1.0508
1.2300	44.037	74.864	72.103	3.4174	0.9844	1.0987
1.2400	44.740	74.603	72.054	3.3955	0.9959	1.1484
1.2500	45.441	74.337	71.886	3.3730	1.0079	1.1997
1.2600	46.141	74.065	71.771	3.3486	1.0205	1.2529
1.2700	46.840	73.788	71.539	3.3233	1.0335	1.3078
1.2800	47.538	73.506	71.359	3.2959	1.0472	1.3646
1.2900	48.235	73.218	71.068	3.2674	1.0614	1.4233

1.3000	48.930	72.924	70.829	3.2367	1.0763	1.4839
1.3100	49.624	72.624	70.488	3.2044	1.0917	1.5464
1.3200	50.317	72.319	70.205	3.1696	1.1078	1.6109
1.3300	51.009	72.008	69.834	3.1330	1.1246	1.6773
1.3400	51.699	71.692	69.533	3.0937	1.1421	1.7458
1.3500	52.388	71.369	69.165	3.0521	1.1602	1.8162
1.3600	53.076	71.041	68.888	3.0075	1.1791	1.8887
1.3700	53.762	70.707	68.574	2.9603	1.1987	1.9631
1.3800	54.447	70.367	68.380	2.9100	1.2191	2.0396
1.3900	55.131	70.022	68.194	2.8568	1.2403	2.1181
1.4000	55.813	69.670	68.166	2.8004	1.2623	2.1985
1.4100	56.494	69.313	68.202	2.7411	1.2851	2.2808
1.4200	57.174	68.949	68.449	2.6788	1.3088	2.3650
1.4300	57.853	68.580	68.824	2.6138	1.3333	2.4510
1.4400	58.530	68.204	69.470	2.5464	1.3587	2.5387
1.4500	59.206	67.823	70.314	2.4770	1.3849	2.6282
1.4600	59.880	67.436	71.489	2.4061	1.4121	2.7193
1.4700	60.554	67.042	72.929	2.3343	1.4402	2.8119
1.4800	61.225	66.644	32.036	3.8009	1.4684	2.8119
1.4900	61.895	66.245	32.294	3.7668	1.4965	2.8119
1.5000	62.566	65.847	32.558	3.7331	1.5246	2.8119
1.5100	63.237	65.449	32.829	3.6997	1.5527	2.8119
1.5200	63.907	65.050	33.104	3.6667	1.5808	2.8119
1.5300	64.578	64.652	33.386	3.6339	1.6090	2.8119
1.5400	65.248	64.253	33.672	3.6015	1.6371	2.8119
1.5500	65.919	63.855	33.962	3.5693	1.6652	2.8119
1.5600	66.590	63.457	34.257	3.5375	1.6933	2.8119
1.5700	67.260	63.058	34.556	3.5060	1.7214	2.8119
1.5800	67.931	62.660	34.858	3.4748	1.7496	2.8119
1.5900	68.602	62.261	35.163	3.4438	1.7777	2.8119
1.6000	69.272	61.863	35.471	3.4132	1.8058	2.8119
1.6100	69.943	61.465	35.782	3.3829	1.8339	2.8119
1.6200	70.613	61.066	36.095	3.3528	1.8620	2.8119
1.6300	71.284	60.668	36.410	3.3230	1.8902	2.8119
1.6400	71.955	60.270	36.726	3.2935	1.9183	2.8119
1.6500	72.625	59.871	37.044	3.2643	1.9464	2.8119
1.6600	73.296	59.473	37.363	3.2353	1.9745	2.8119
1.6700	73.967	59.074	37.683	3.2065	2.0026	2.8119
1.6800	74.637	58.676	38.004	3.1780	2.0307	2.8119
1.6900	75.308	58.278	38.324	3.1498	2.0589	2.8119
1.7000	75.979	57.879	38.645	3.1218	2.0870	2.8119
1.7100	76.649	57.481	38.965	3.0940	2.1151	2.8119
1.7200	77.320	57.082	39.285	3.0664	2.1432	2.8119
1.7300	77.990	56.684	39.605	3.0391	2.1713	2.8119
1.7400	78.661	56.286	39.923	3.0120	2.1995	2.8119
1.7500	79.332	55.887	40.240	2.9850	2.2276	2.8119
1.7600	80.002	55.489	40.556	2.9583	2.2557	2.8119
1.7700	80.673	55.090	40.870	2.9318	2.2838	2.8119
1.7800	81.344	54.692	41.182	2.9055	2.3119	2.8119
1.7900	82.014	54.294	41.492	2.8793	2.3401	2.8119
1.8000	82.685	53.895	41.800	2.8533	2.3682	2.8119