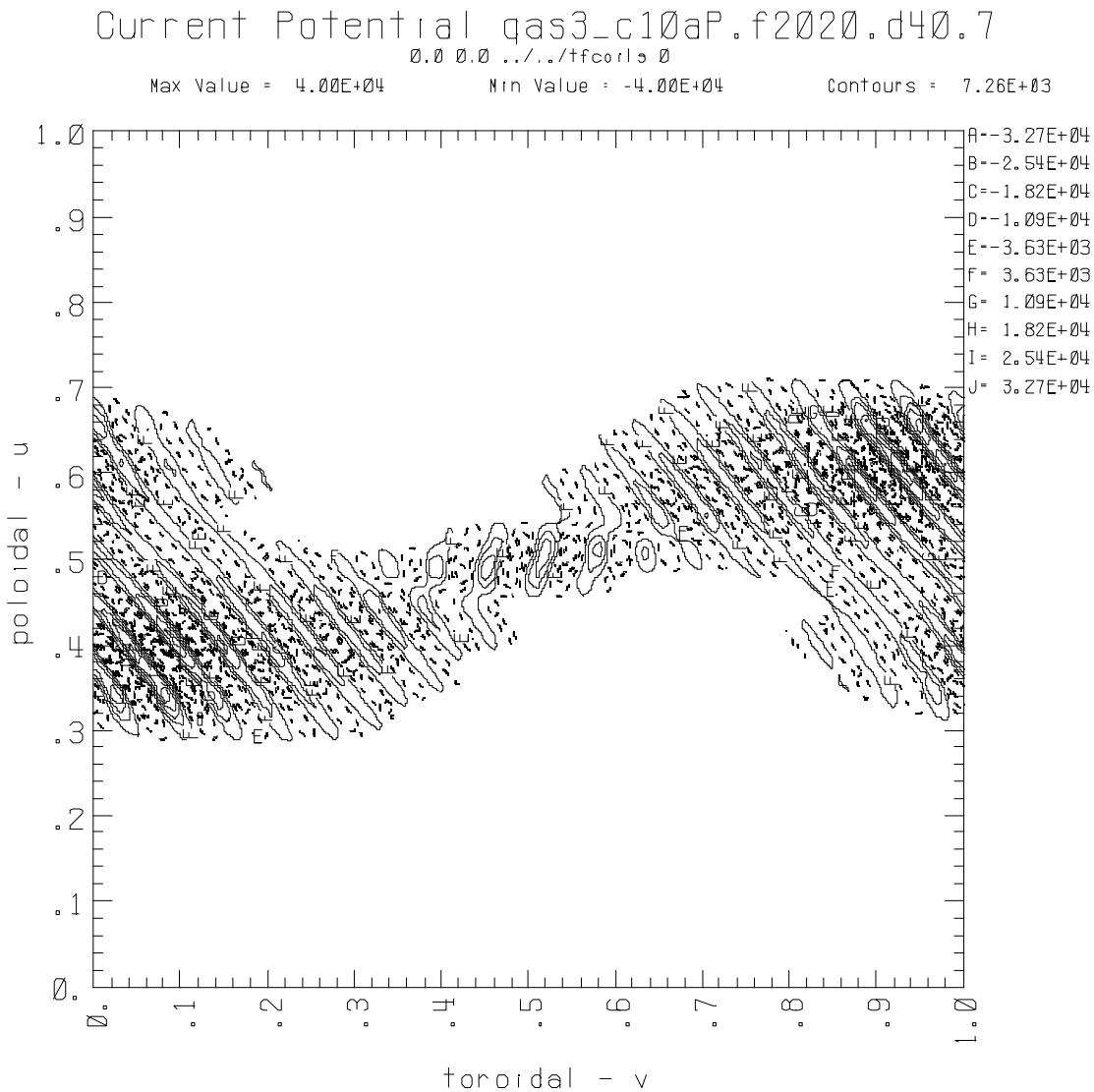
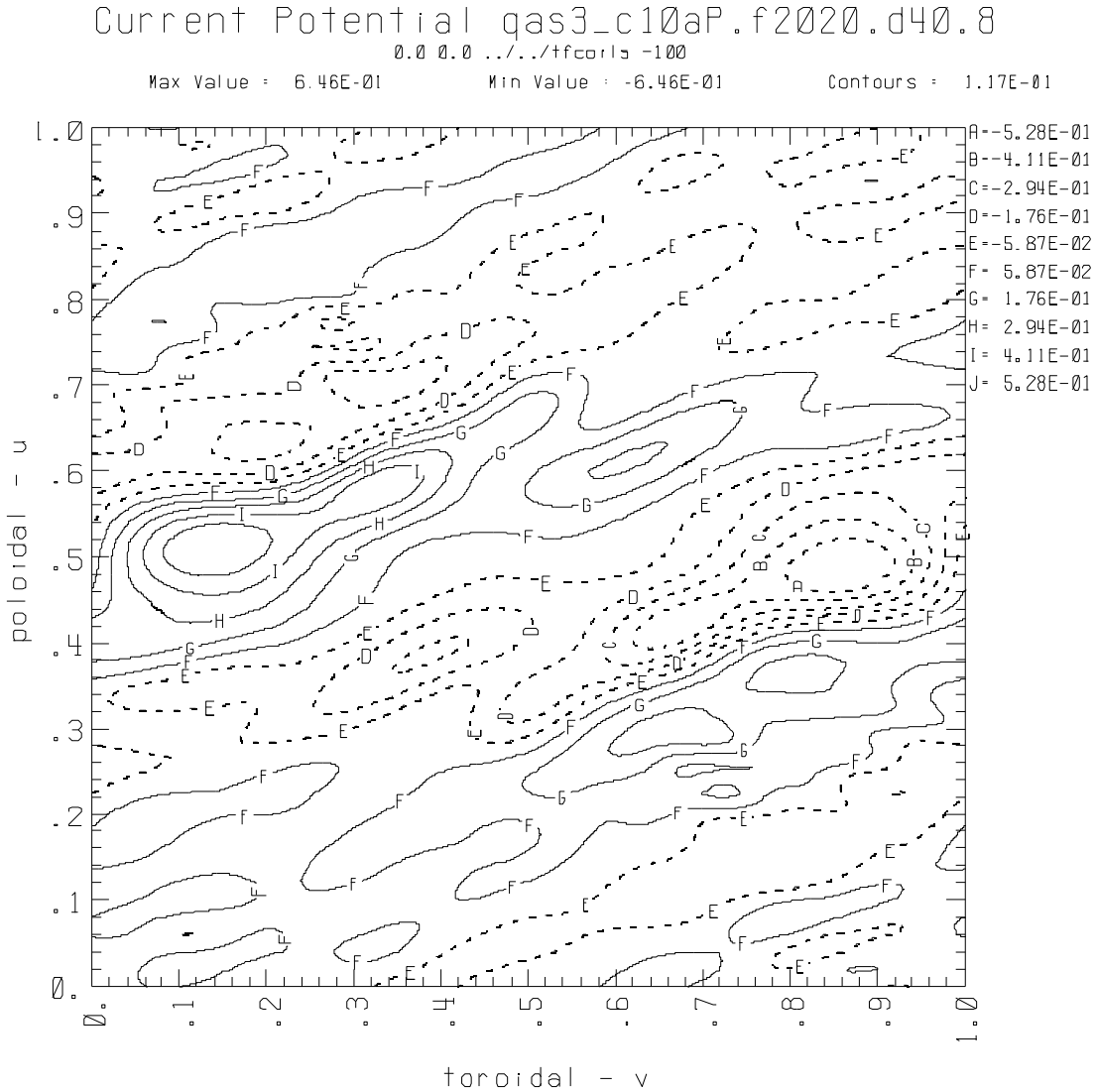
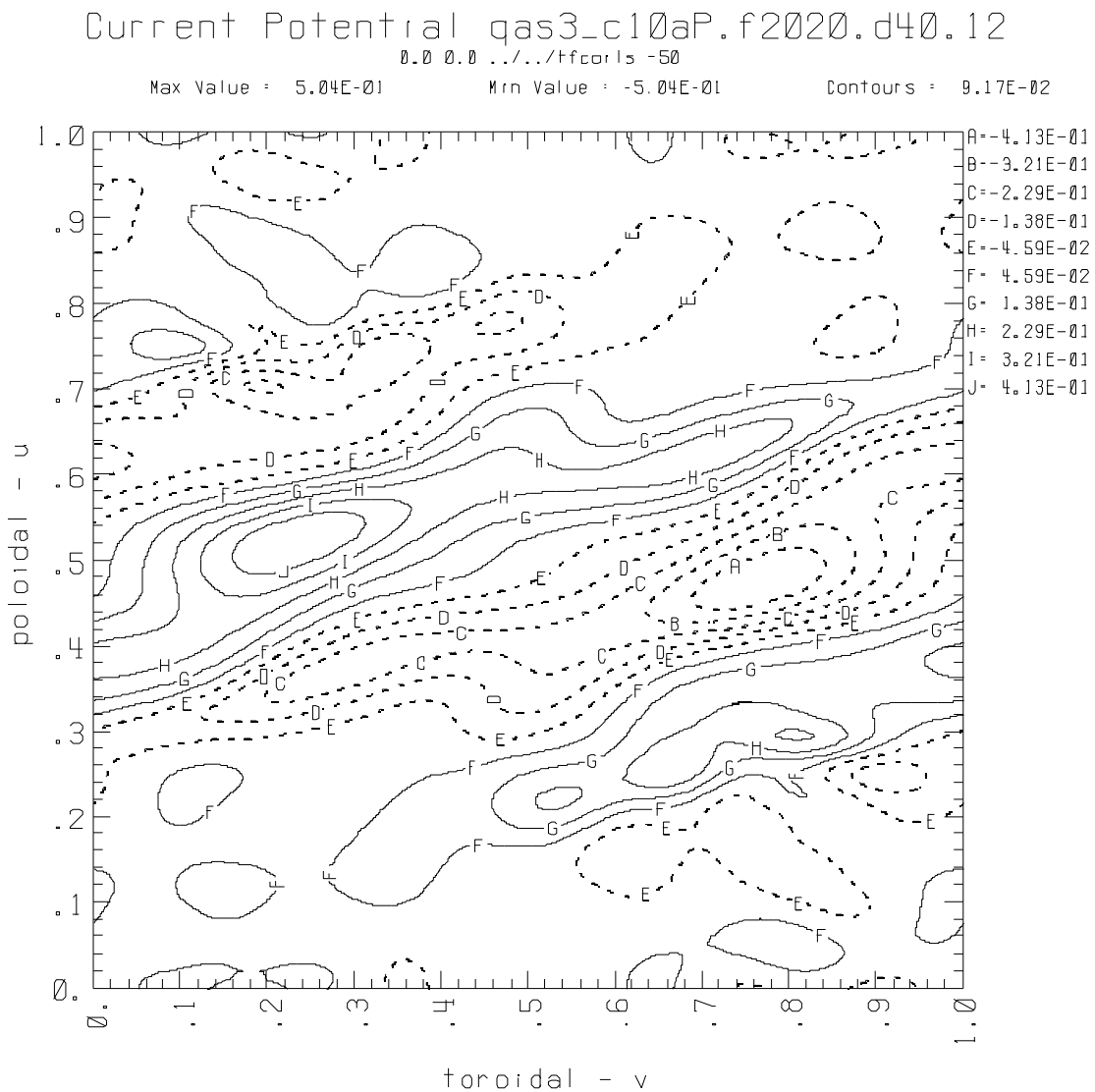


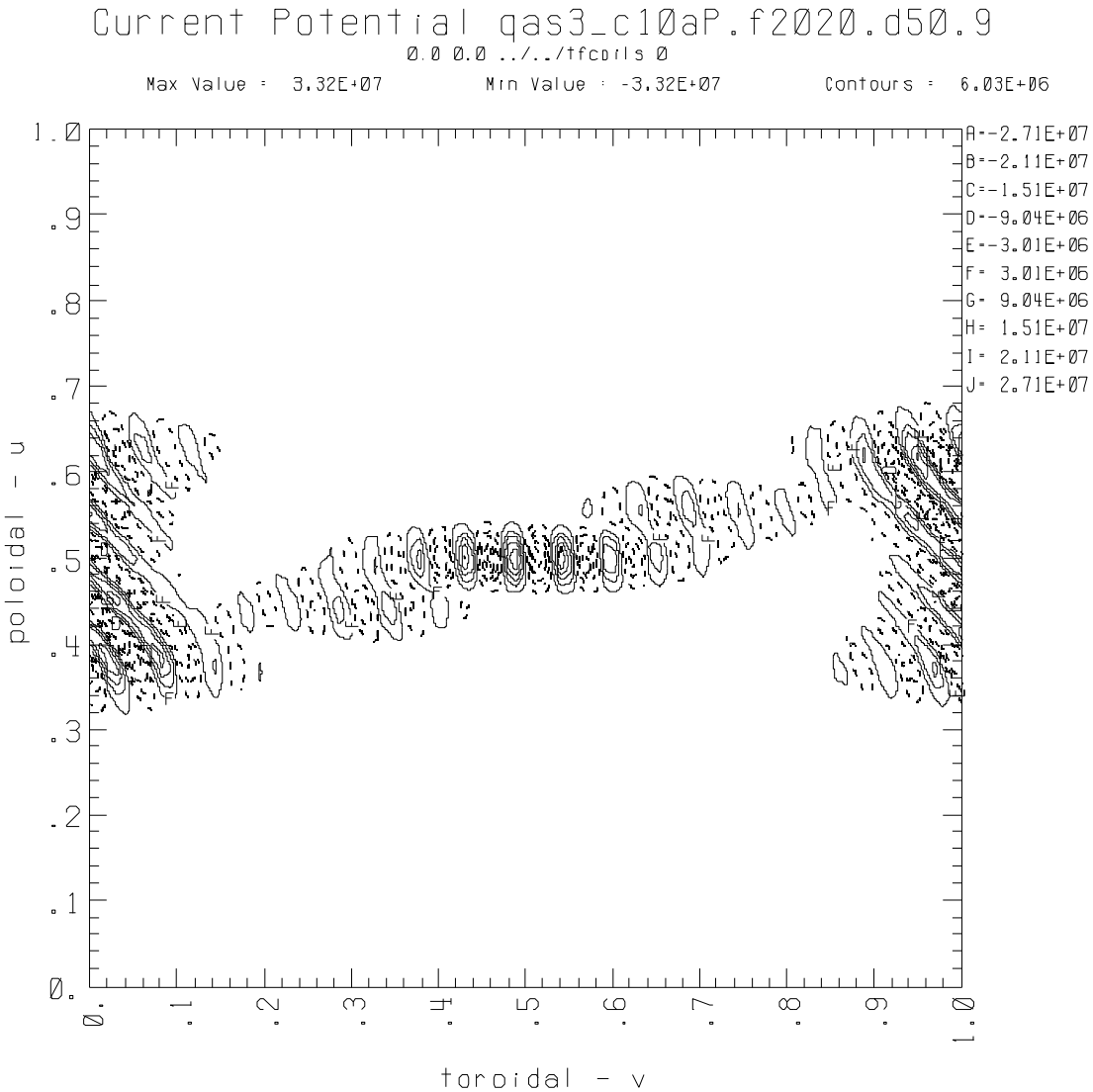
d=40 cm, SVD mf=nf=20, all weights kept, Ave err = 7.5874E-05, Max err = 8.572E-04 : Low



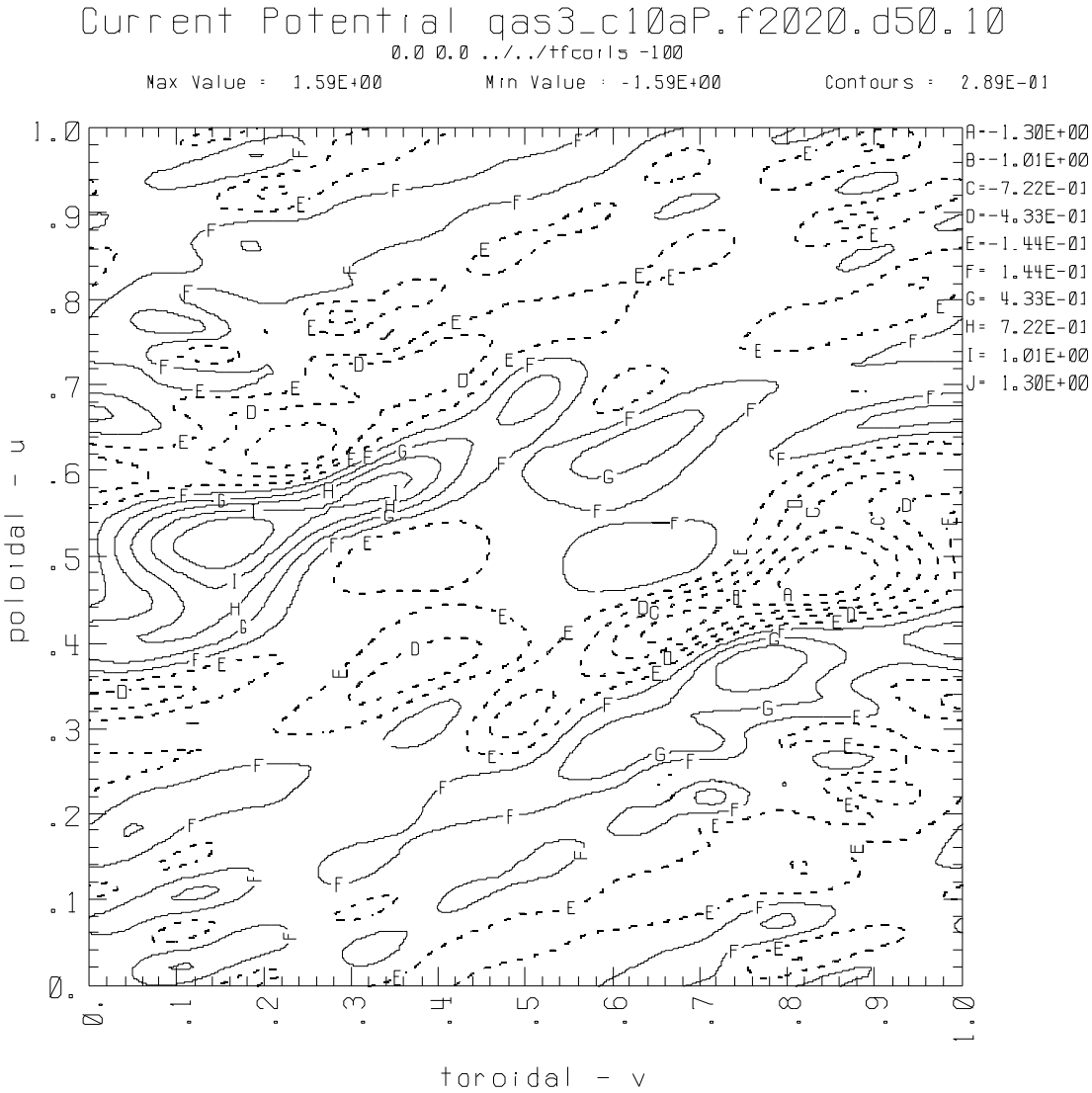
d=40 cm, SVD mf=nf=20, 100 weights kept, Ave err = 6.6233E-03, Max err = 3.659E-02 : OK



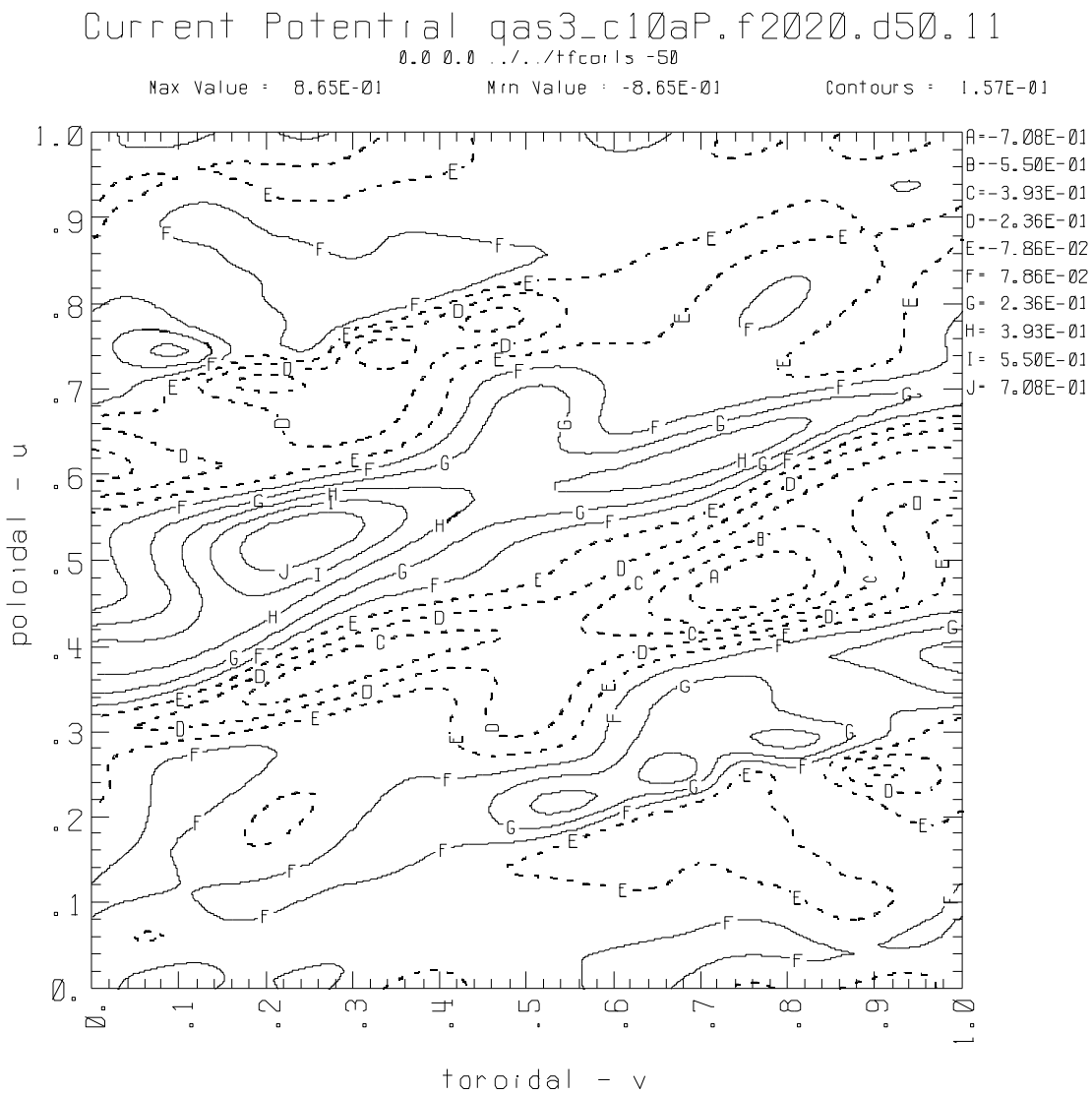
d=40 cm, SVD mf=nf=20, 50 weights kept, Ave err = 1.8495E-02, Max err = 8.402E-02 Too high



d=50 cm, SVD mf=nf=20, all weights kept, Ave err = 1.0432E-04, Max err = 1.579E-03

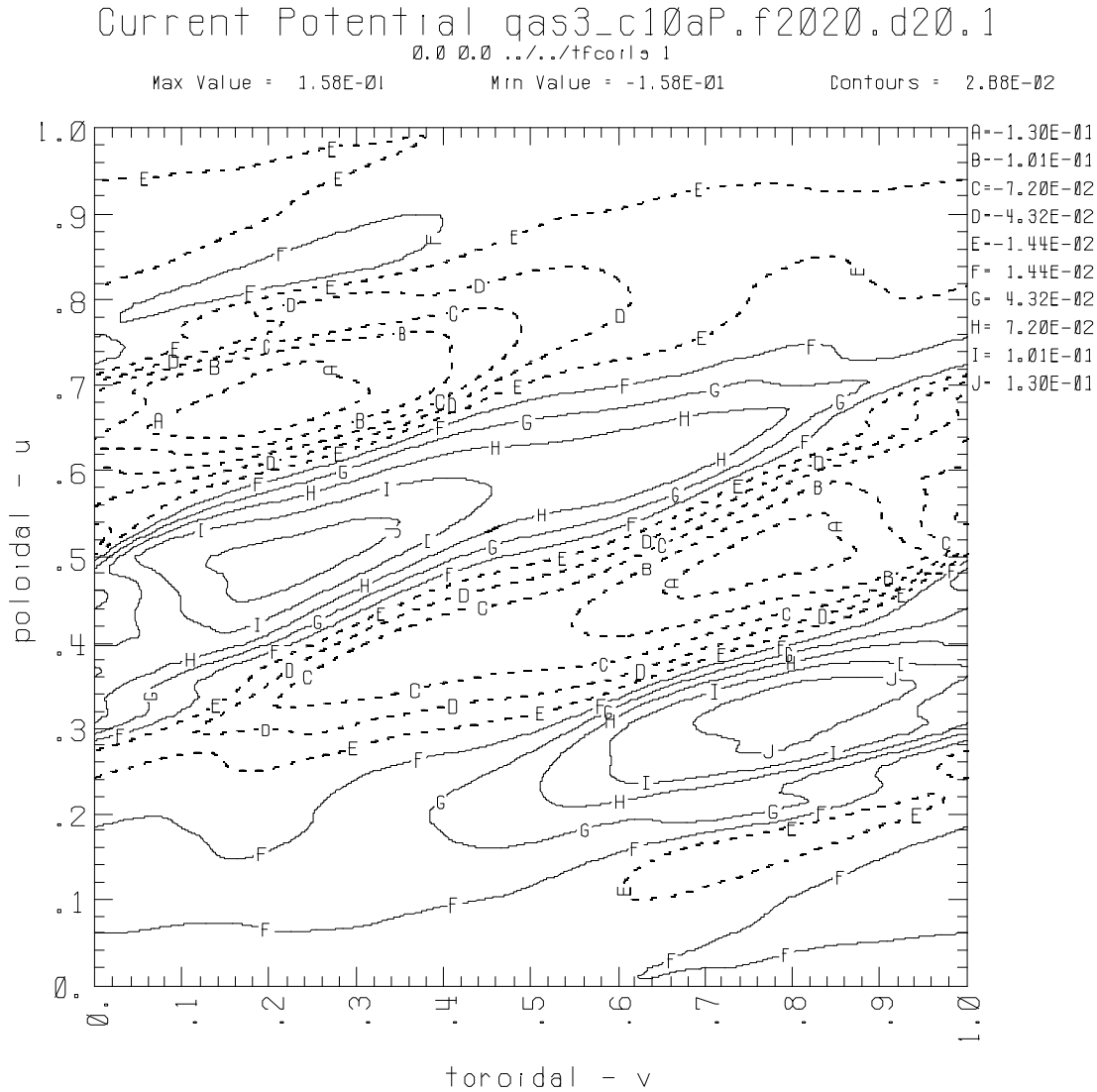


d=50 cm, SVD mf=nf=20, 100 weights kept, 8.5670E-03, Max err = 5.271E-02

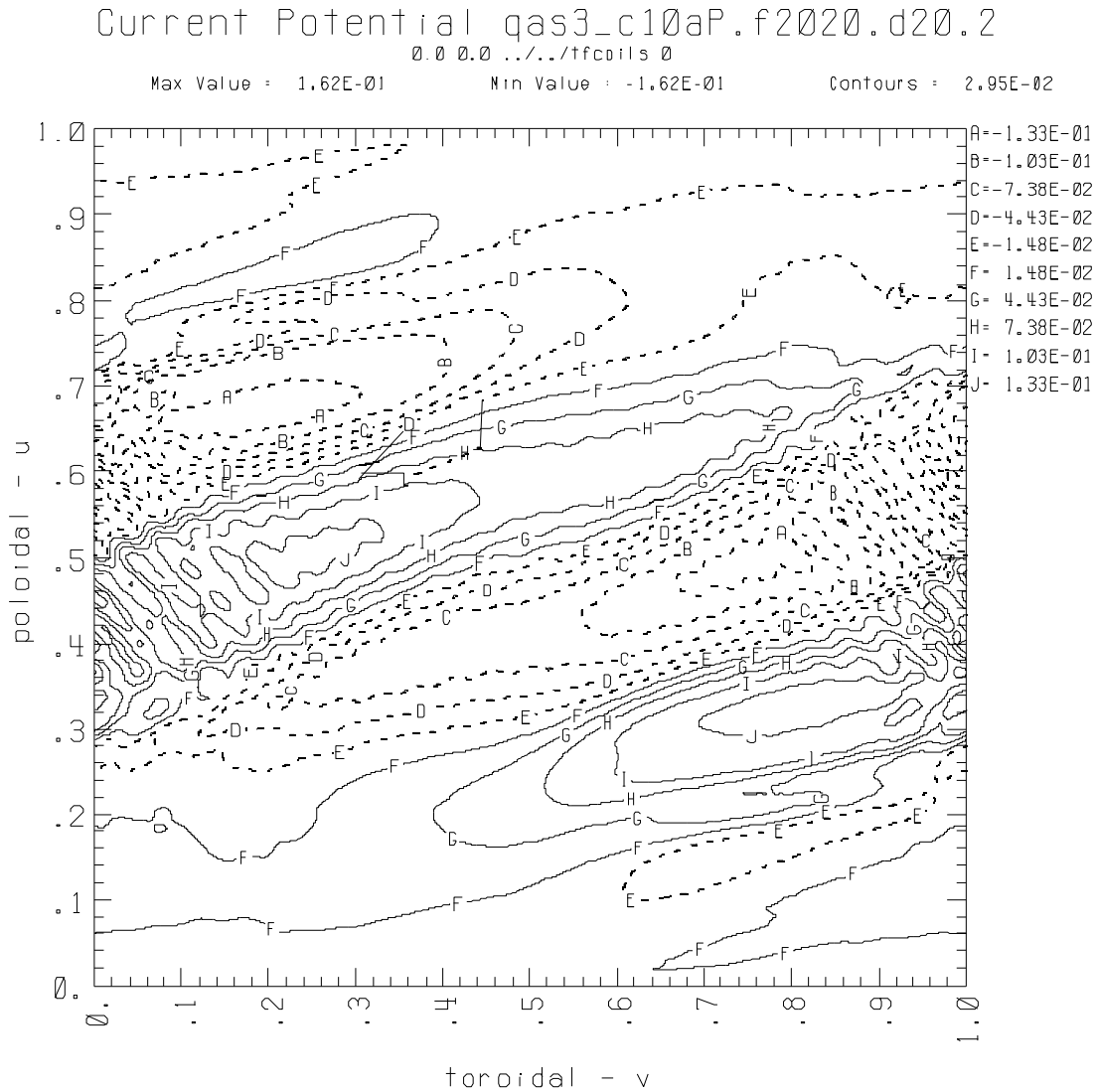


d=50 cm, SVD mf=nf=20, 50 weights kept, Ave err = 2.1820E-02, Max err = 1.039E-01

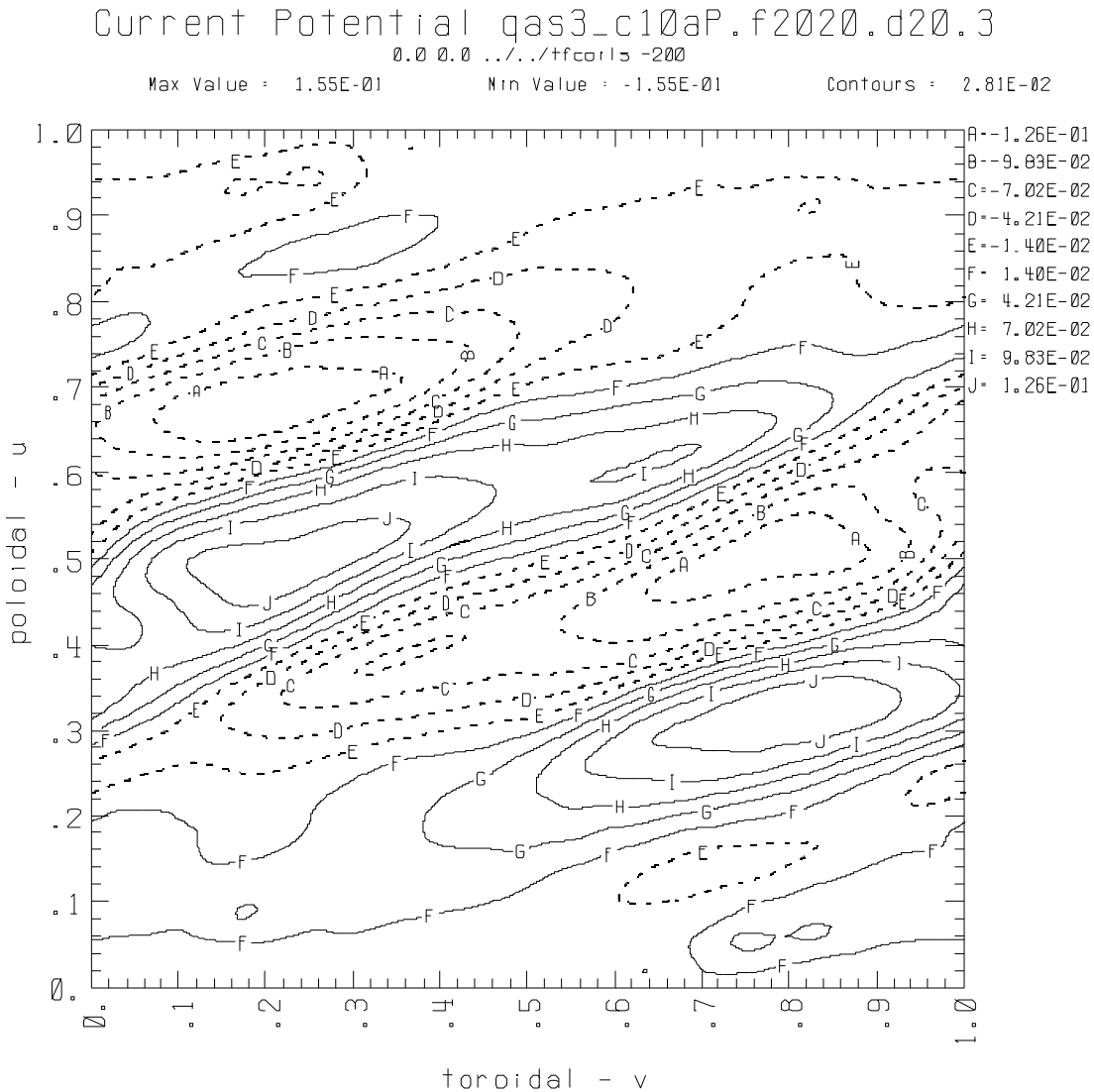
1P. Base SQR case, No SVD, Ave err = 5.2681E-05, Max err = 2.616E-03



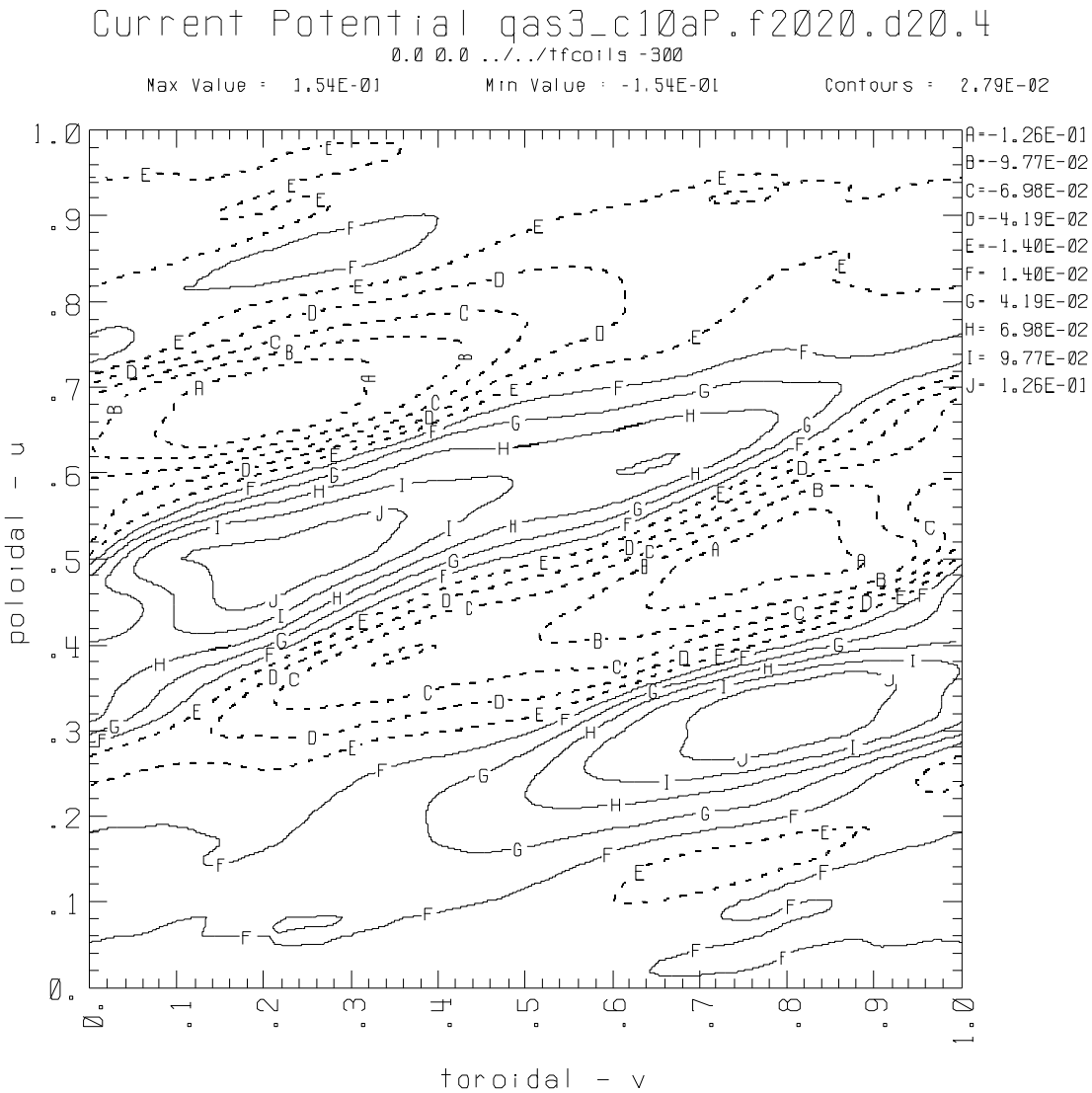
2P. Base SVD with all weights, Ave err = 8.2044E-05, Max err = 1.125E-03



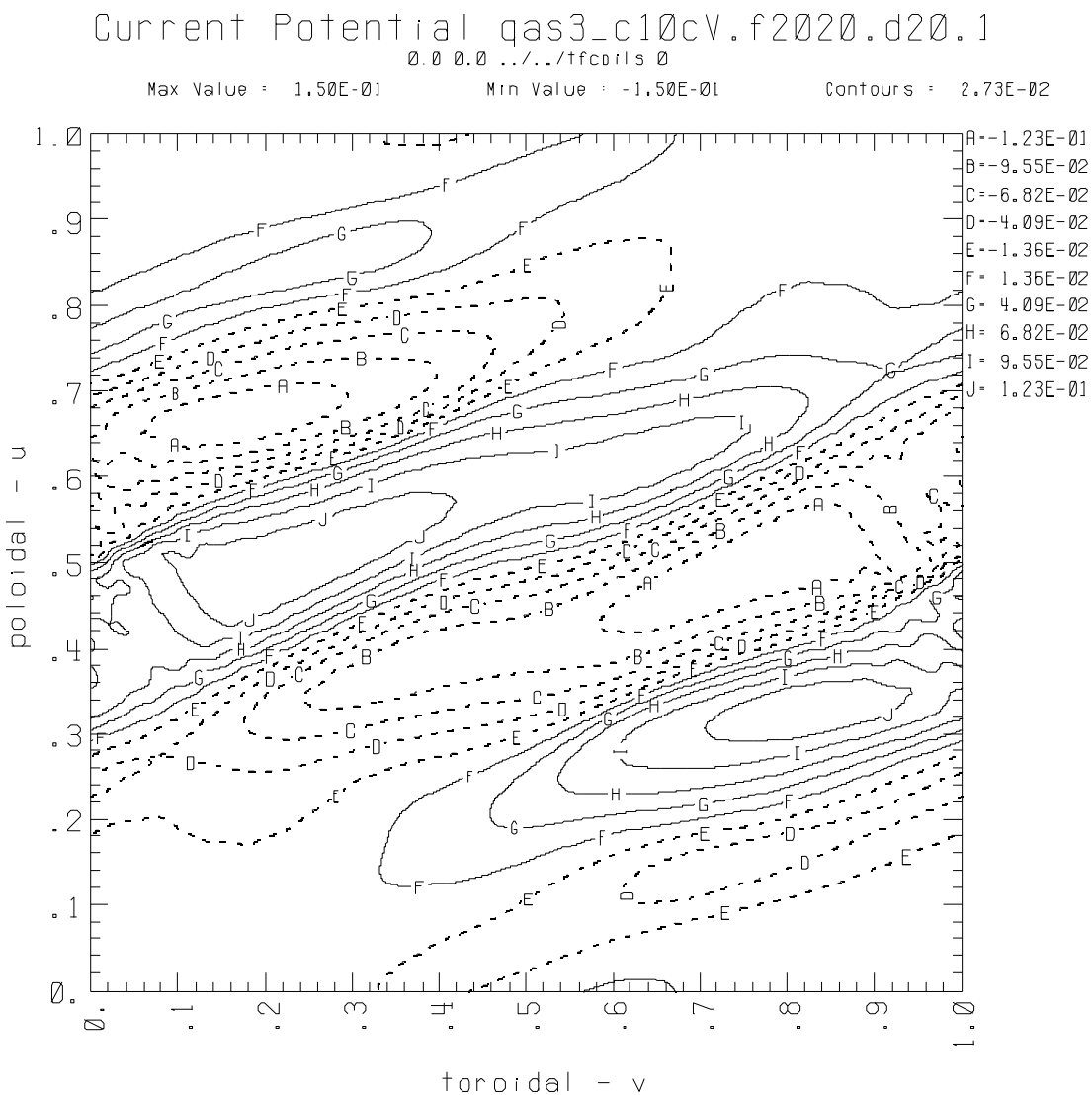
3P. SVD with 200 weights, Ave err = 1.3668E-03, Max err = 8.513E-03



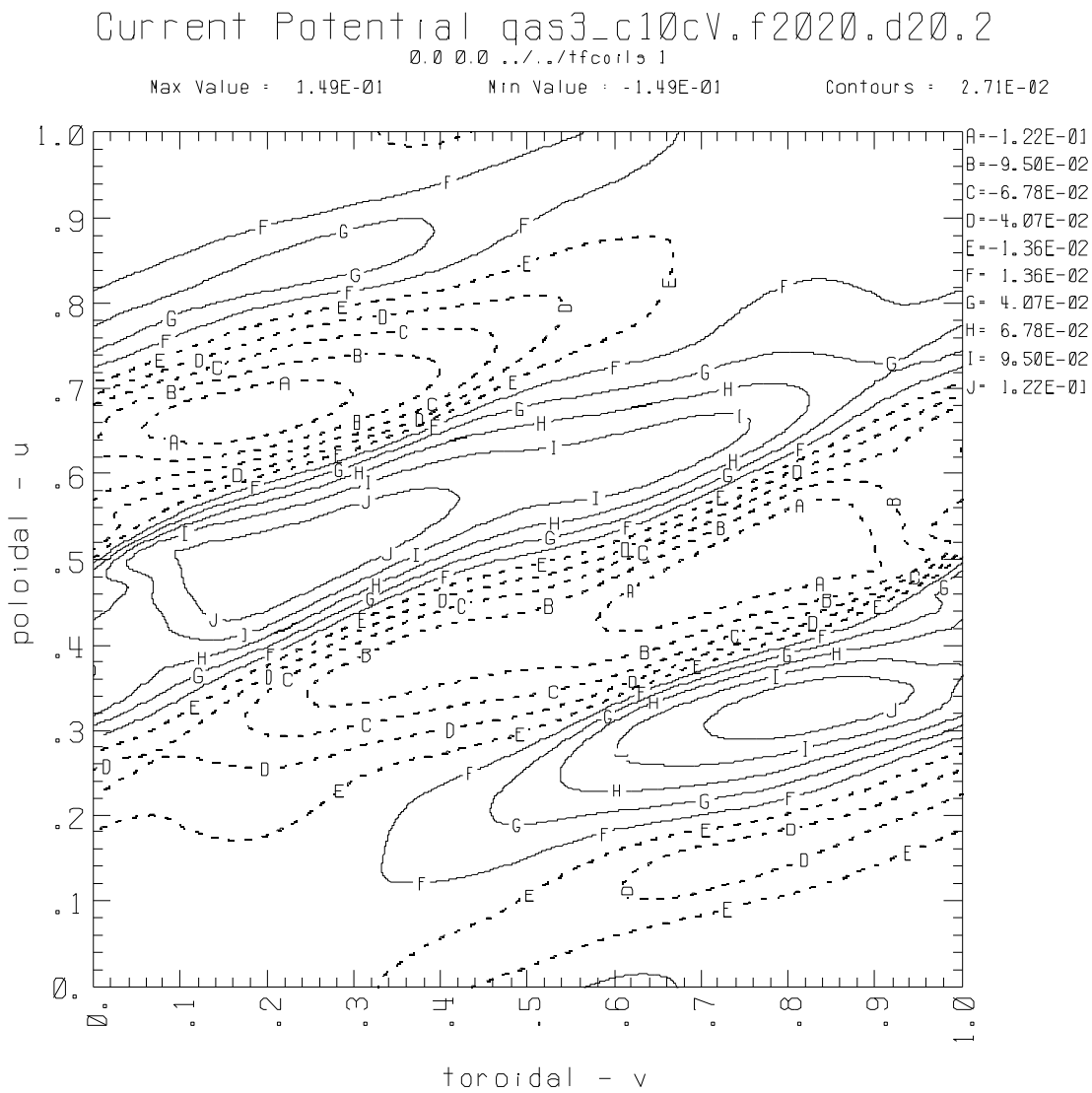
4P. SVD with 300 weights, Ave err = 5.3612E-04, Max err = 4.104E-03



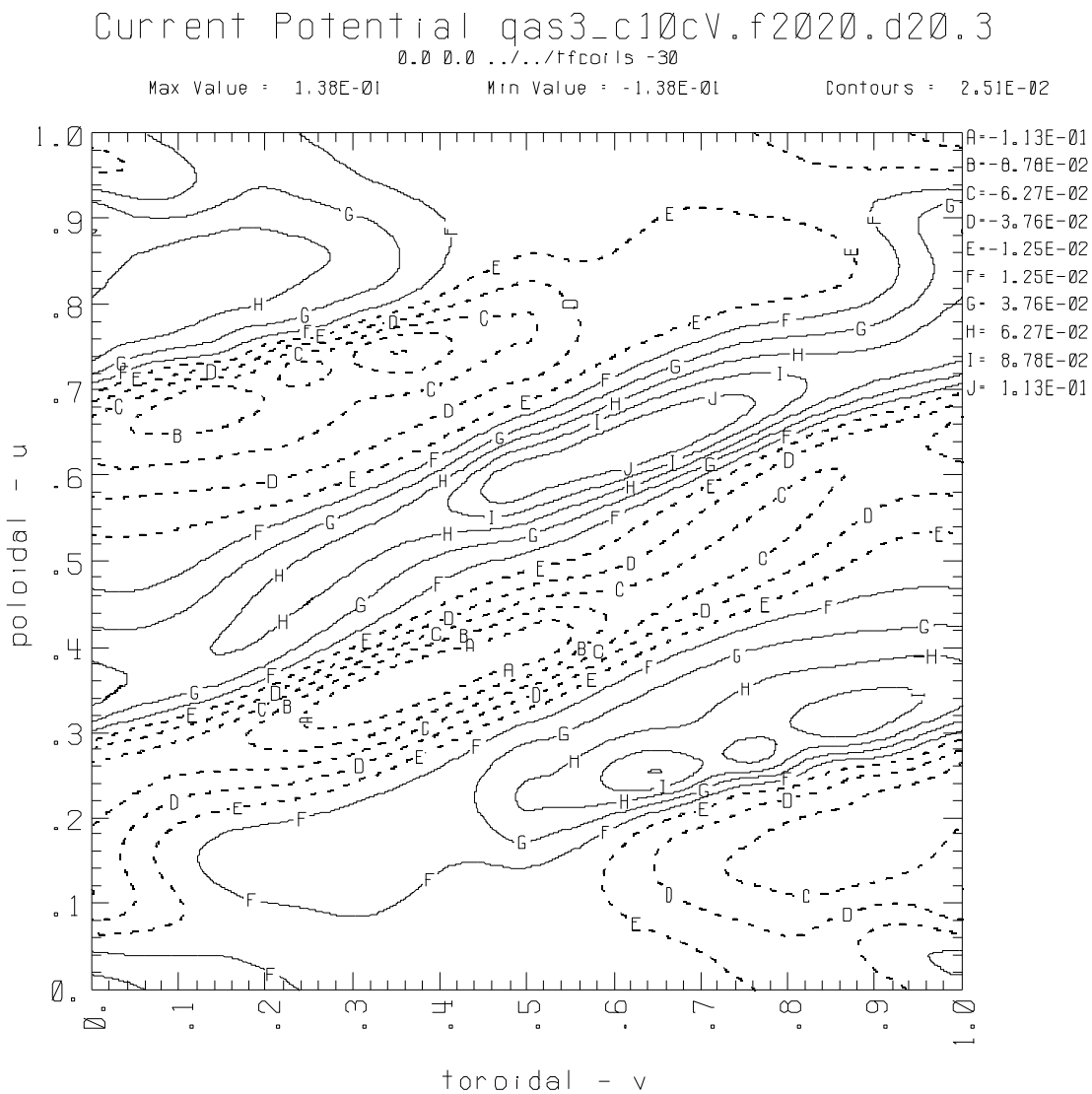
1V. Base SVD case: SVD with all weights used. Ave err = 8.2914E-06, Max err = 1.176E-04



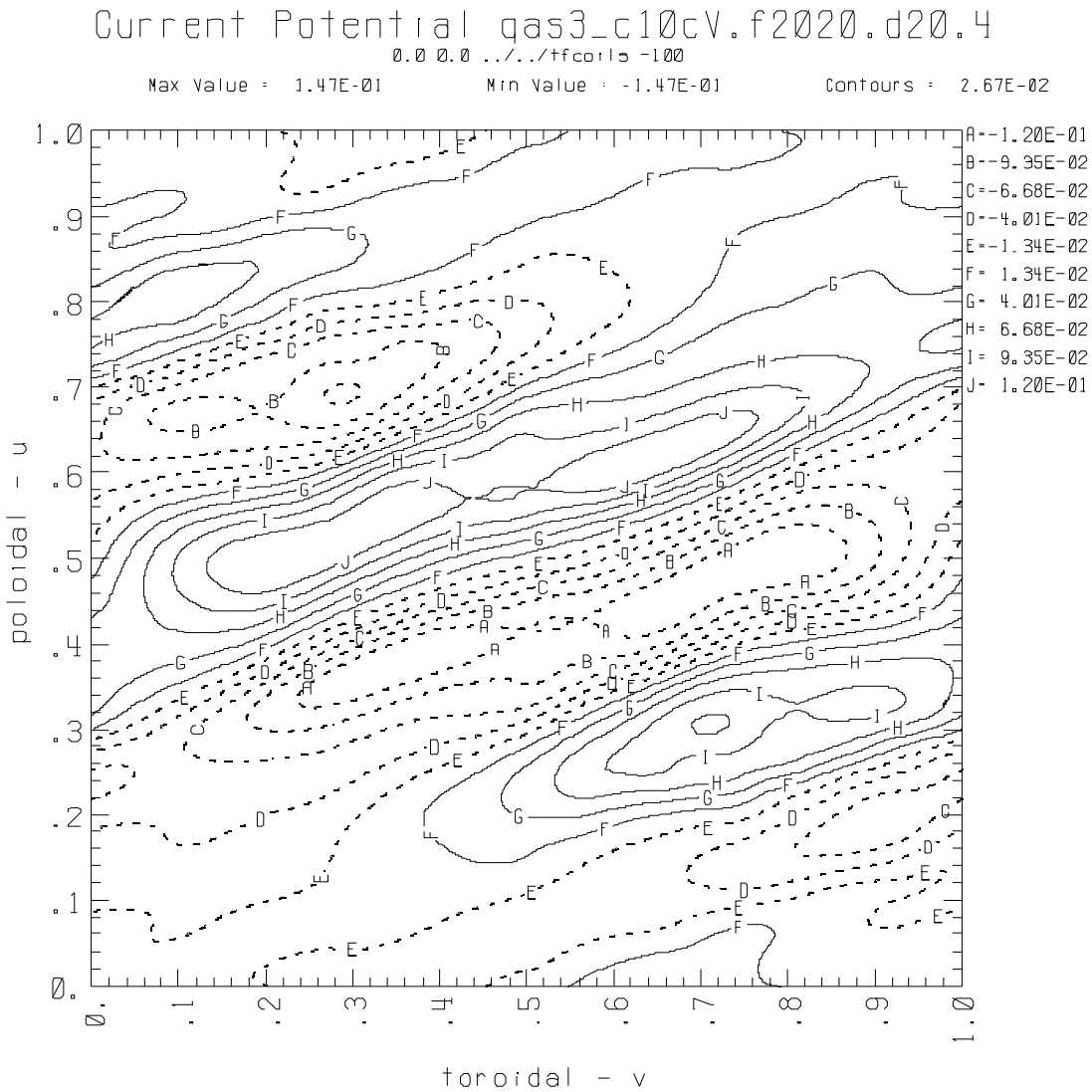
2V. Base SQR case : Ave err = 7.7668E-06, Max err = 1.717E-04



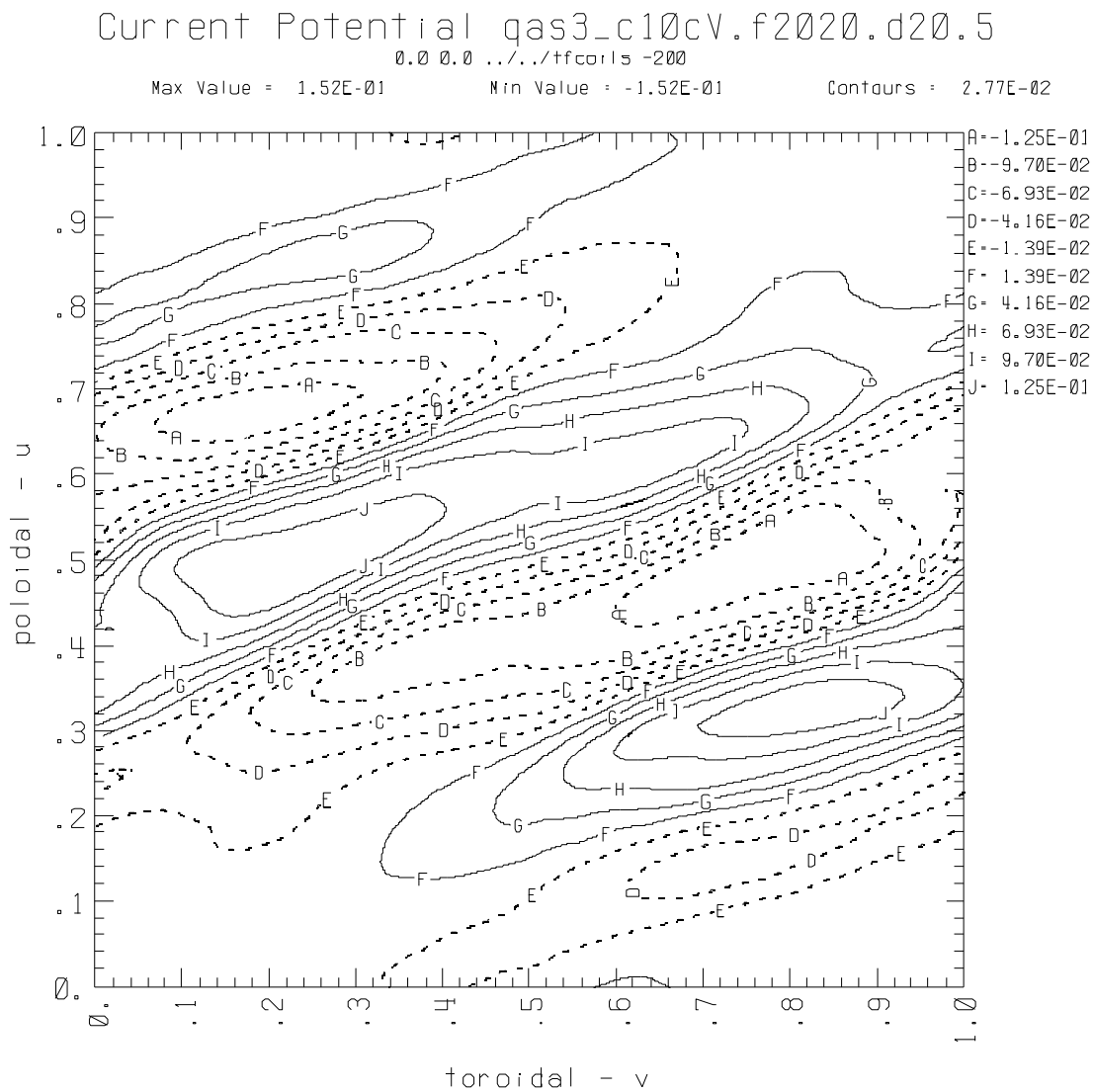
3V. SVD with 30 weights kept Ave err = 6.5342E-02, Max err = 2.298E-01



4V. SVD with 100 weights kept, Ave err = 1.8286E-02, Max err = 7.032E-02



5V. SVD with 200 weights kept Ave err = 8.8408E-04, Max err = 4.771E-03



Summary of SVD runs for qas3_c10 with Plasma, ccs at 20 cm mf=nf=20

Case	W's kept	Ave Err%	Max Err%	Contours
1	No SVD	5.268E-03	2.616E-01	Poor
2	All 840	8.204E-03	1.125E-01	Bad
3	200	1.366E-01	8.513E-01	Good
4	300	5.361E-02	4.104E-01	Fair

Summary of SVD runs for qas3_c10 Vacuum, ccs at 20 cm mf=nf=20

Case	W's kept	Ave Err%	Max Err%	Contours
1	All 840	8.291E-04	1.176E-02	Good
2	Base	7.766E-04	1.717E-02	Poor
3	30	6.5342	22.98	Poor
4	100	1.8286	7.032	Fair
5	200	8.840E-02	4.771E-01	Good

SVD condition number (ratio of max/min w) = 25490.2
Total number of weights = 840

Art made coils from the plasma cases 1, 4, and 5
qas3_c10aP.f2020.d20.4 and qas3_c10aP.f2020.d20.1
using 11 contours levels each
(this produces a helical seperating the saddles which shows the most promise).
They both had reasonable errors but poor reconstructions:

	Max Err,%	Mean Err,%	<M>
Current Sheets			
qas3_c10aP.f2020.d20.4	**0.41**	**0.05**	**2.312**
qas3_c10cV.f2020.d20.5	**0.48**	**0.09**	**2.379**
Filaments			
qas3_c10aP.f2020.d20.1.11	**3.73**	**0.74**	**2.910**
qas3_c10aP.f2020.d20.4.11	**3.75**	**0.76**	**3.209**

The <M> number above is an indication from vmec of the coil surface distortion. Art found that a value of 2.3 from previous current sheet solutions indicates good reconstruction. Values above 2.4-2.5 are noticably distorted. Values above 2.75 moderately distorted. Above 3.0 is highly distorted.

Thoughts on why Standard (Least Square) vs SVD with all weights can differ:

See Fig. 1 (Standard) vs Fig. 2 (SVD) current potential contour plots

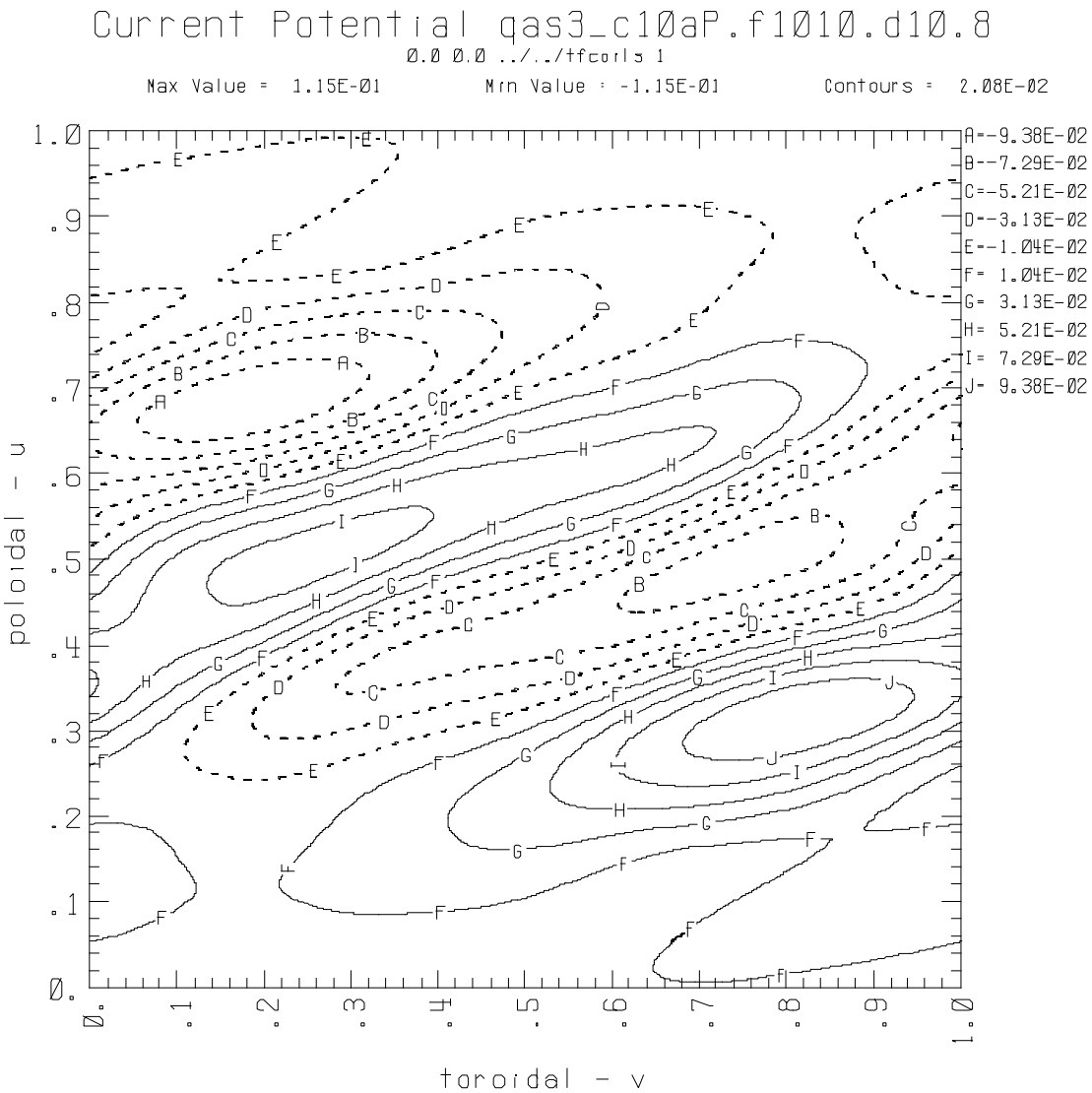
In standard nescoil, when the integral over plasma surface of (bncoil-ben)^2 is done (i.e., sum_i[(bncoil-ben)^2 * dsur(i)^2]), one has to use the surface element.

In SVD, however, attempt is made to match the normal field ben at each (u,v) point, so the surface element never enters. (Even if you put it in, it cancels from both sides of G(i,j)*phi(j)=ben(i)).

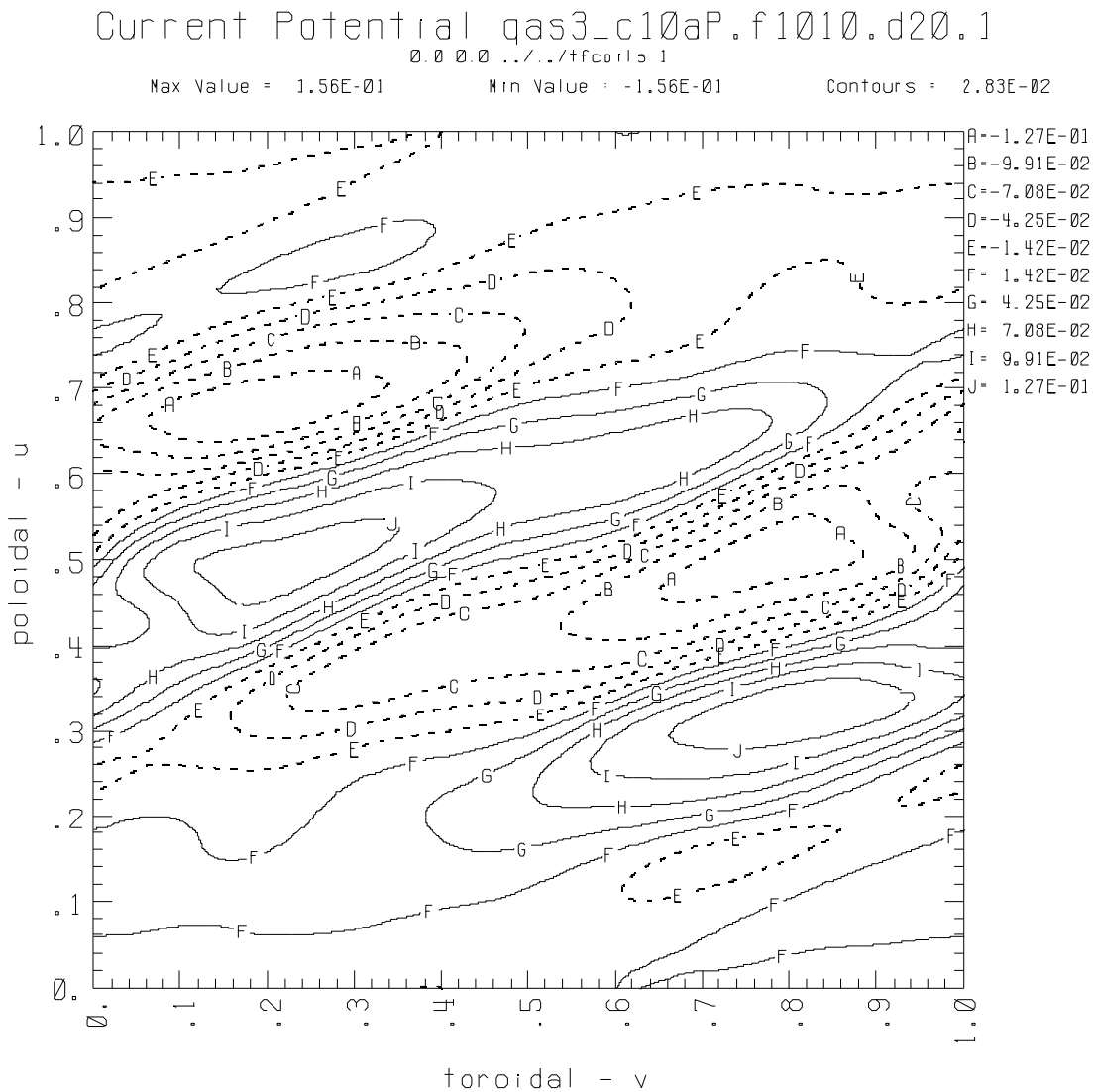
If ben at each point is exactly matched, i.e. , (bncoil-ben) = 0, then the different weights (dsur(i)) at different points will make no difference, and one will get the same answer.
In other words, solving G*phi=ben by SVD should give exacly same answer as minimizing |G*phi-ben|^2 or minimizing sum_i[dsur(i)^2*|G*phi-ben|^2].

However, if the matrix were not square or well conditioned, (bncoil-ben) will not be exactly zero, and one can get different answers. In other words, the small non-zero values of (bncoil-ben)(i) at each point will get weighed by different dsur(i).

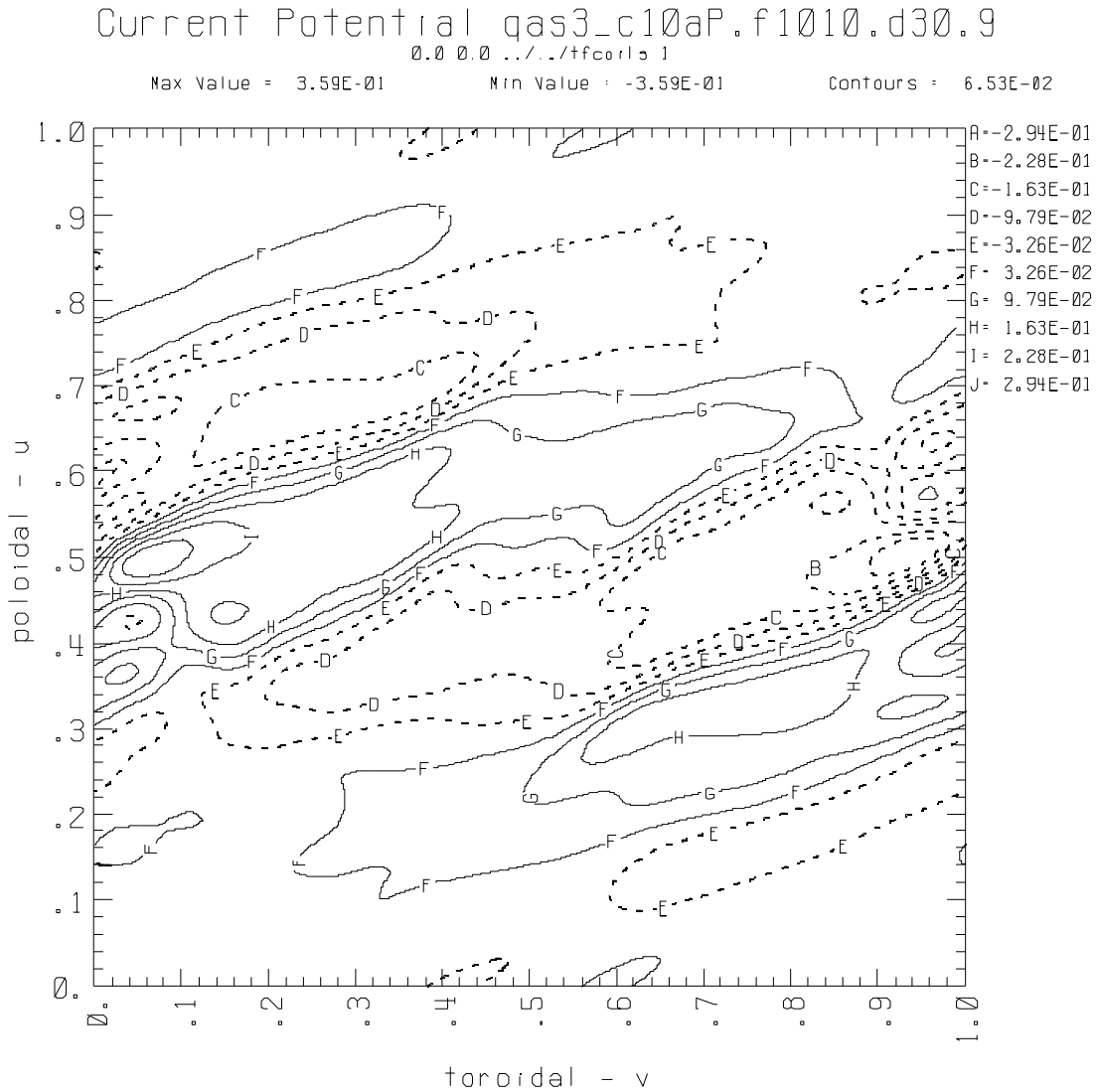
Since the number of phi(m,n) we are using is smaller than the number of match points (u,v) on plasma surface, this may be the case.



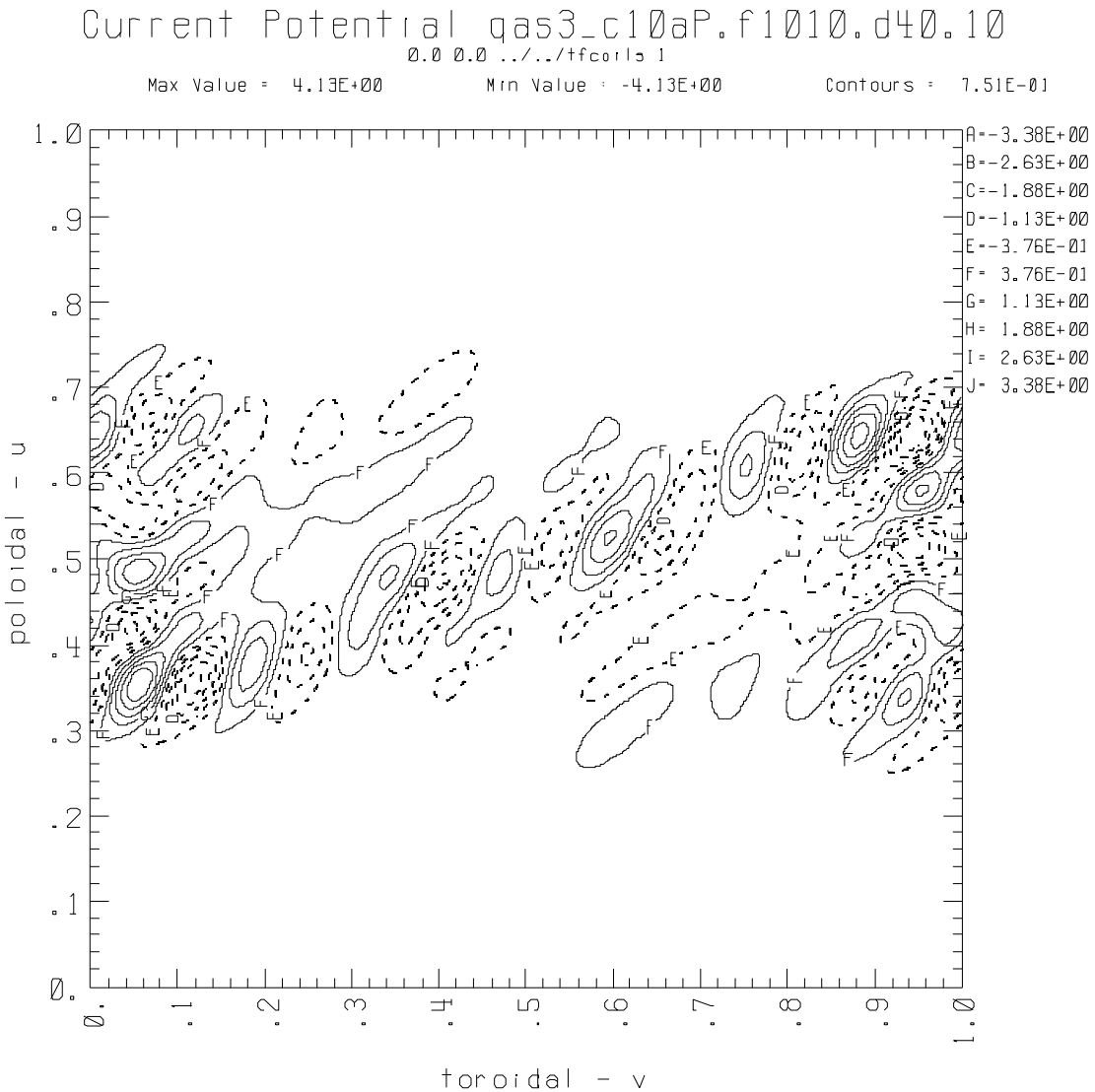
Ave err = 8.0566E-04, Max err = 2.100E-02



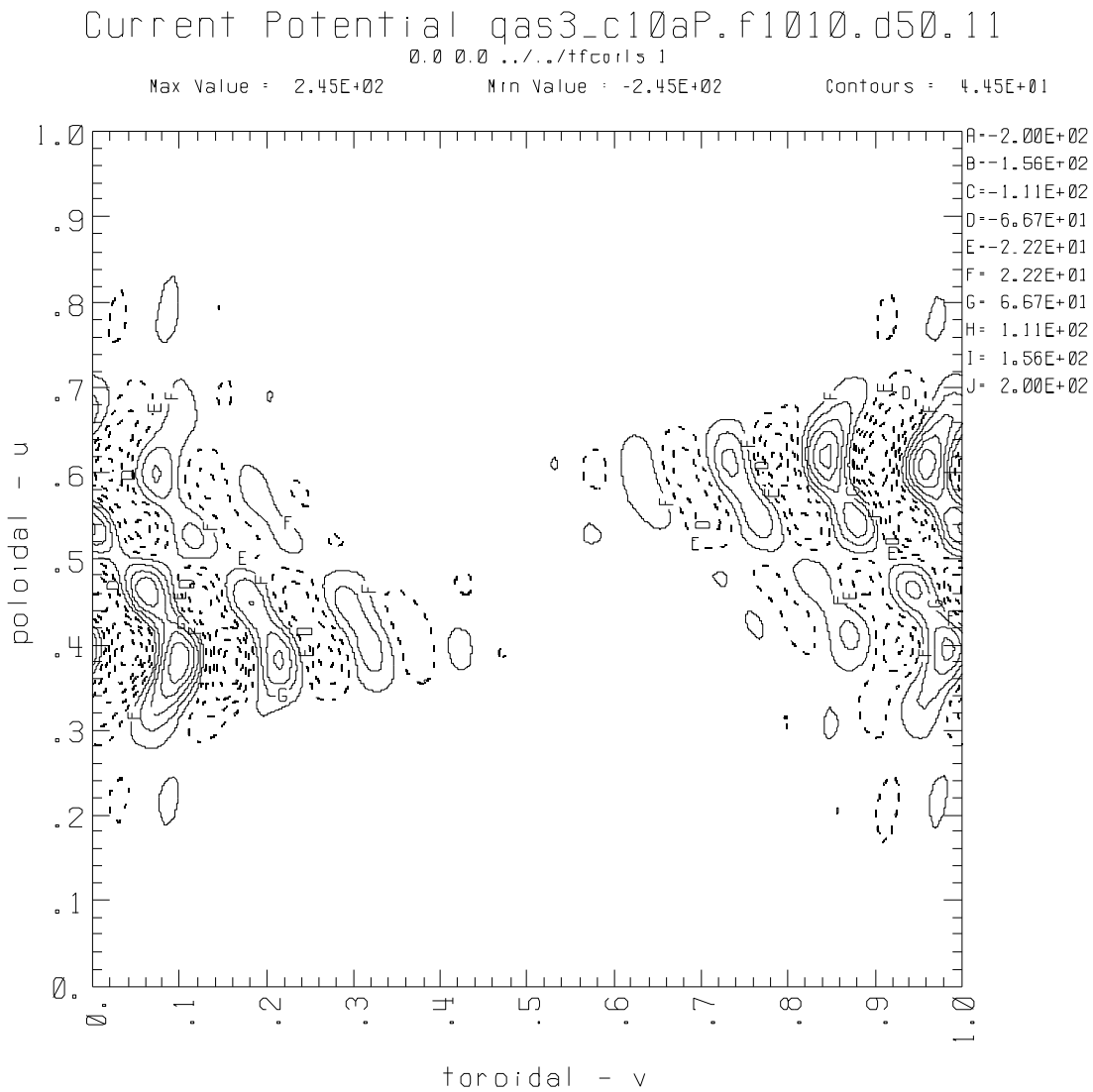
Ave err = 9.4363E-04, Max err = 2.166E-02



Ave err = 1.2392E-03, Max err = 2.385E-02



Ave err = 1.6997E-03, Max err = 2.625E-02



Ave err = 2.2012E-03, Max err = 3.244E-02

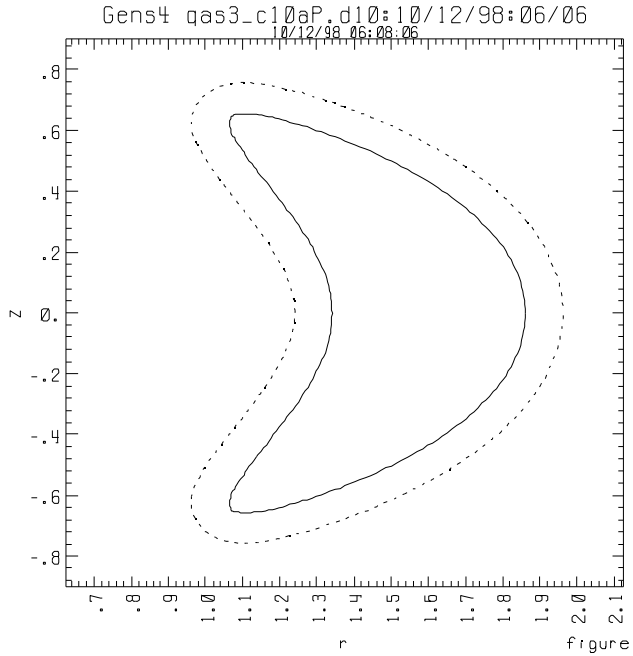


figure 4

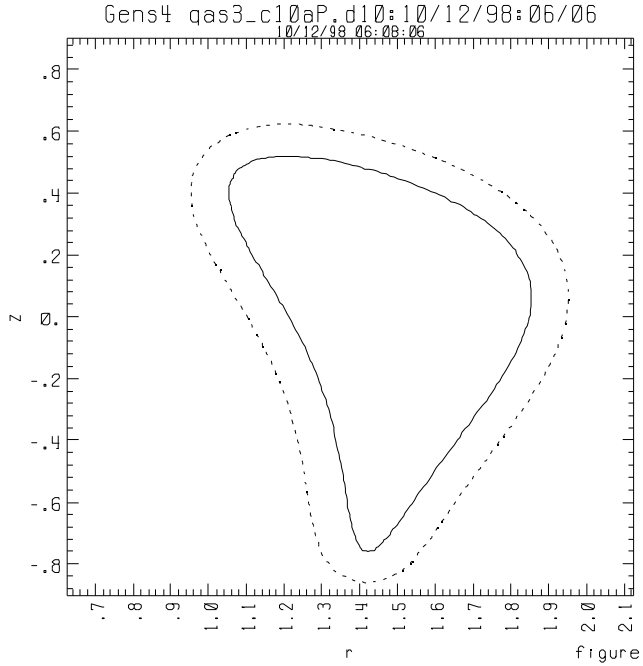


figure 5

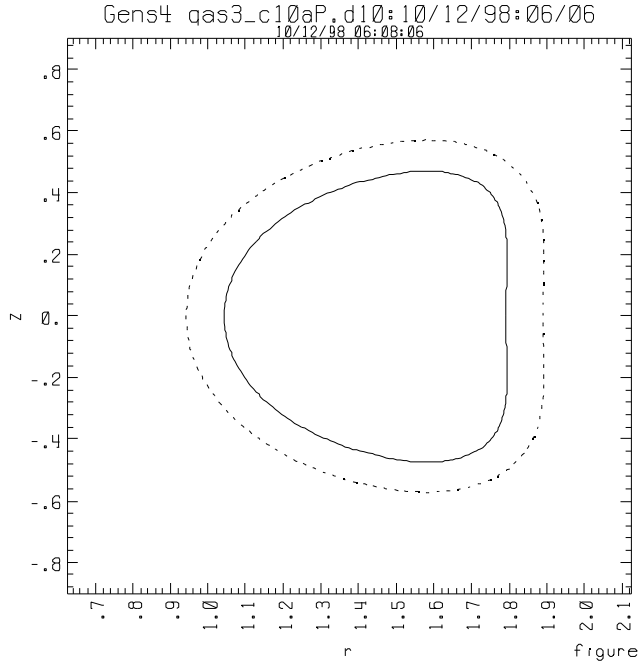


figure 6

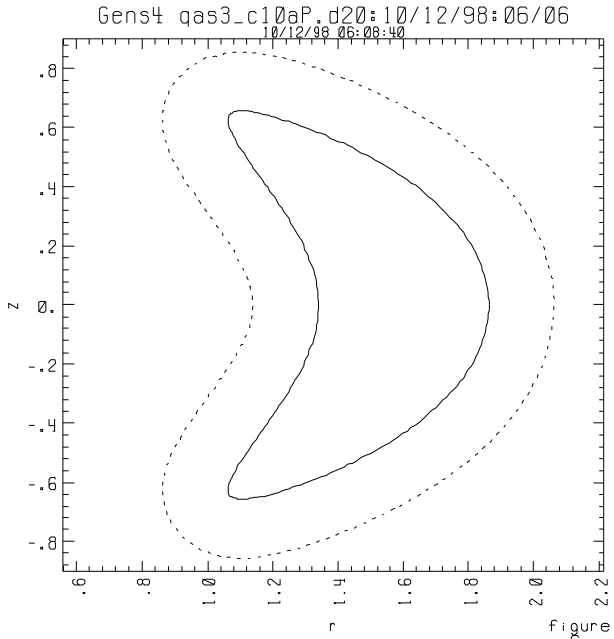


figure 4

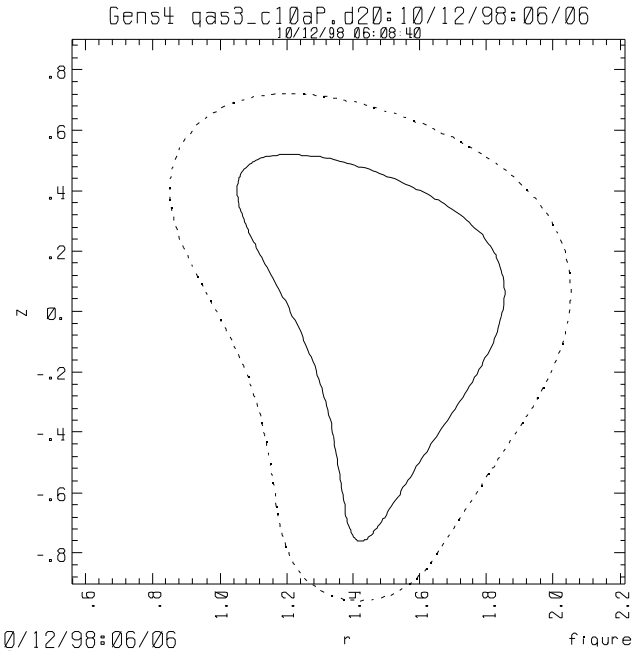


figure 5

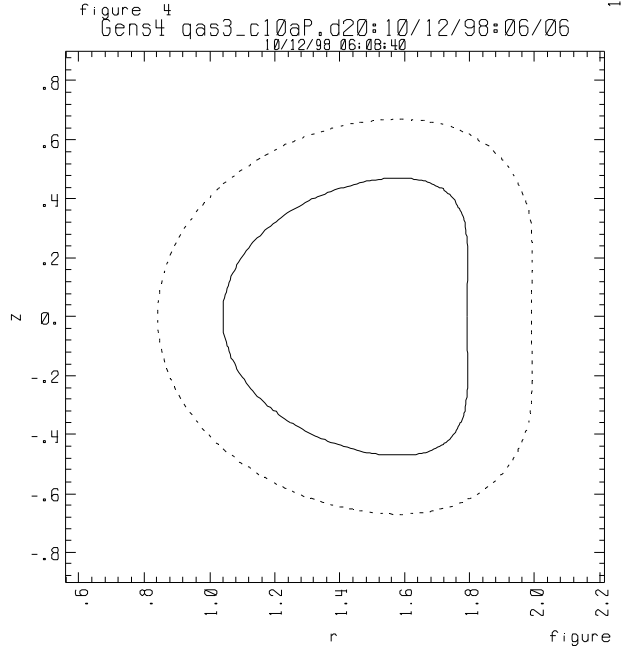


figure 6

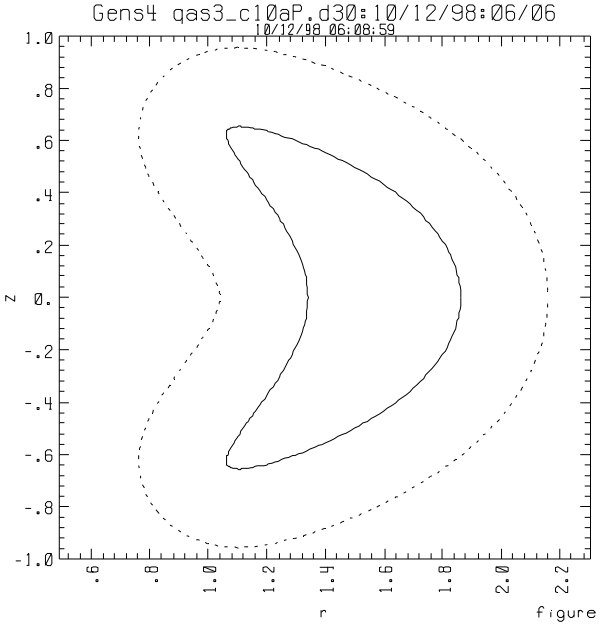
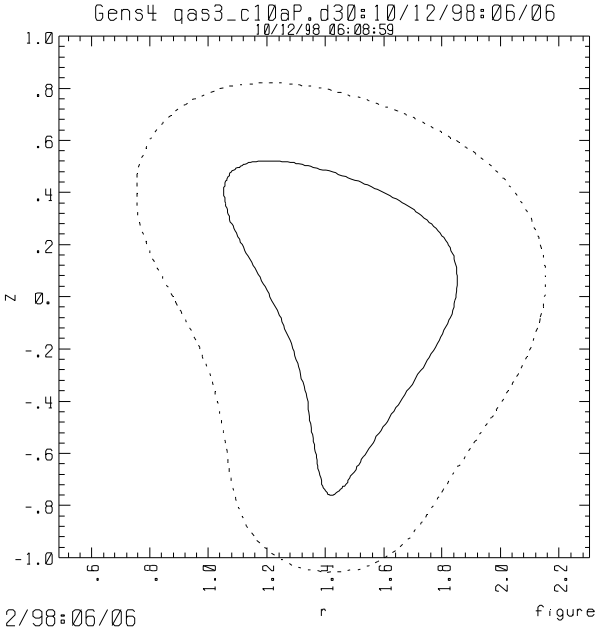


figure 4



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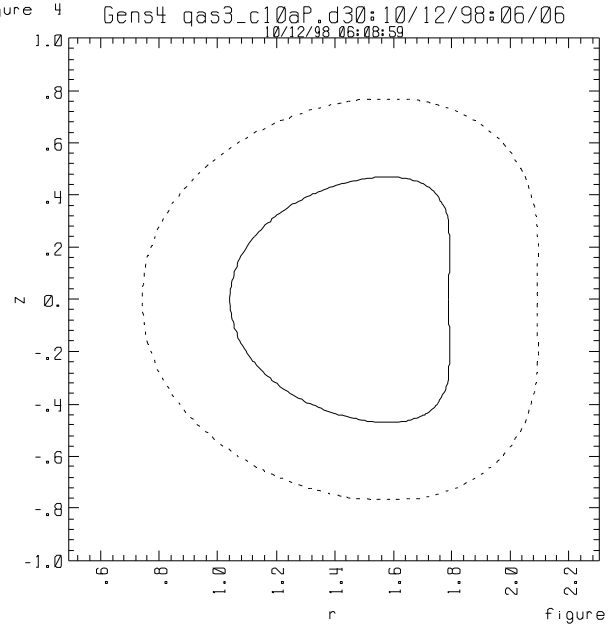

figure 6

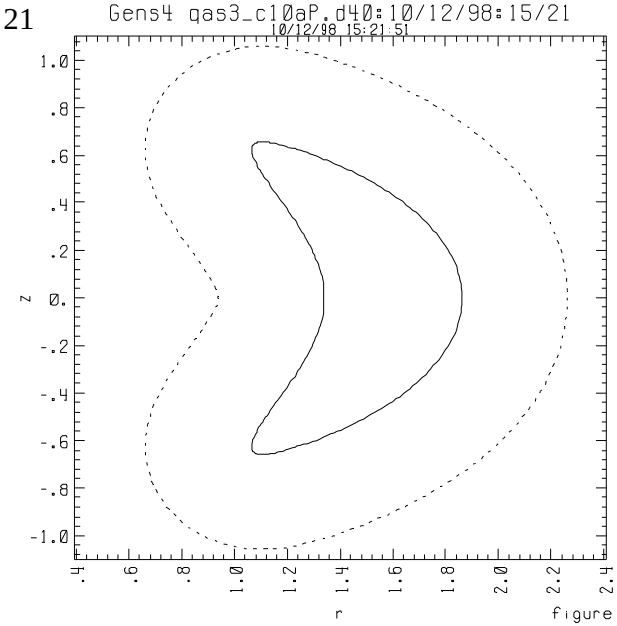

figure 4

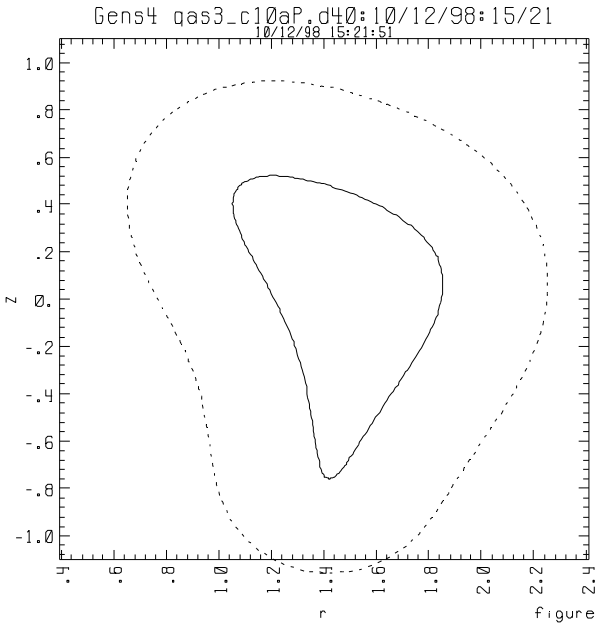

figure 5

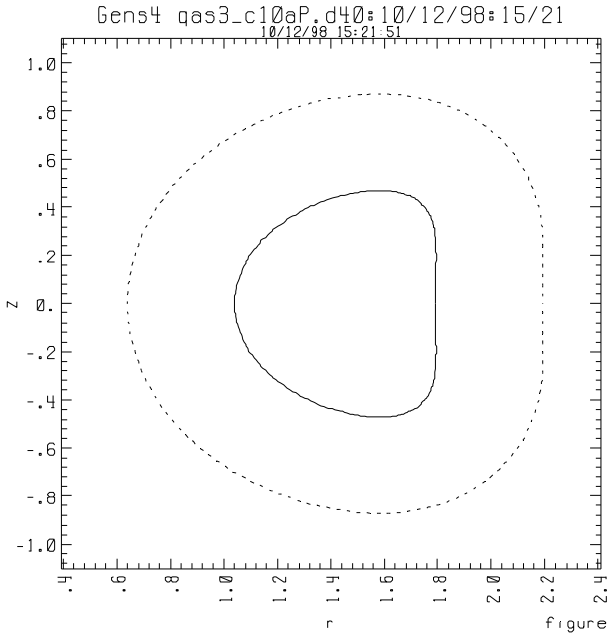

figure 6

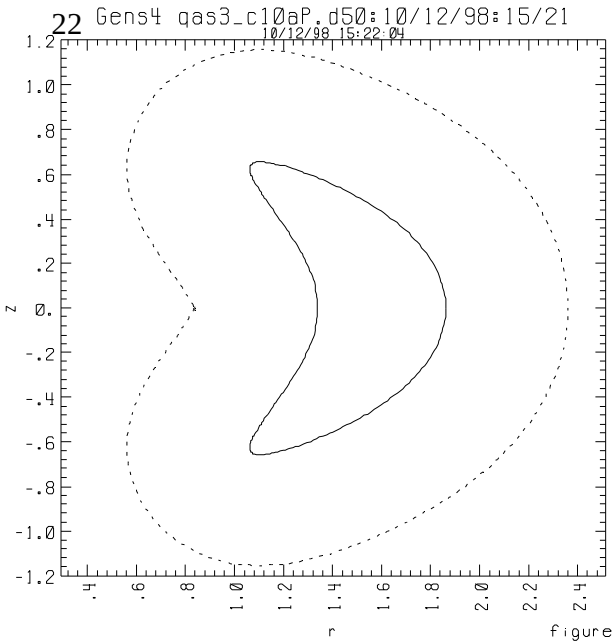

figure 4

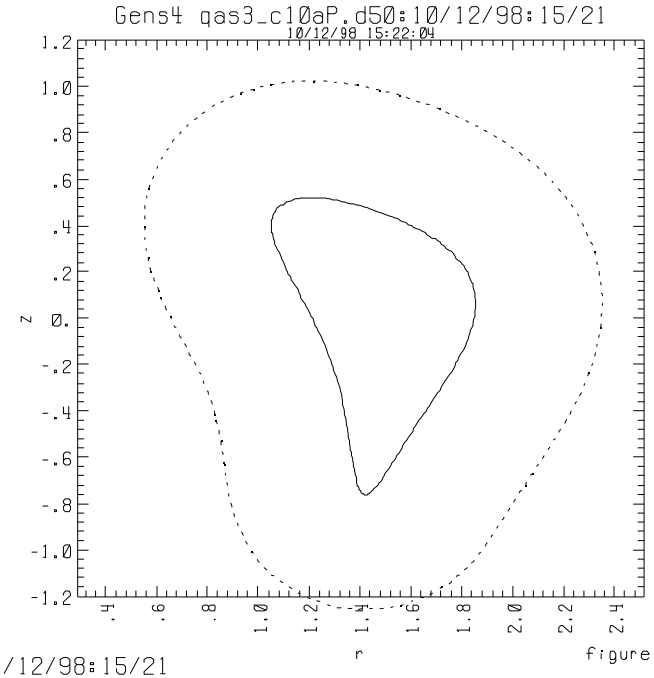

figure 5

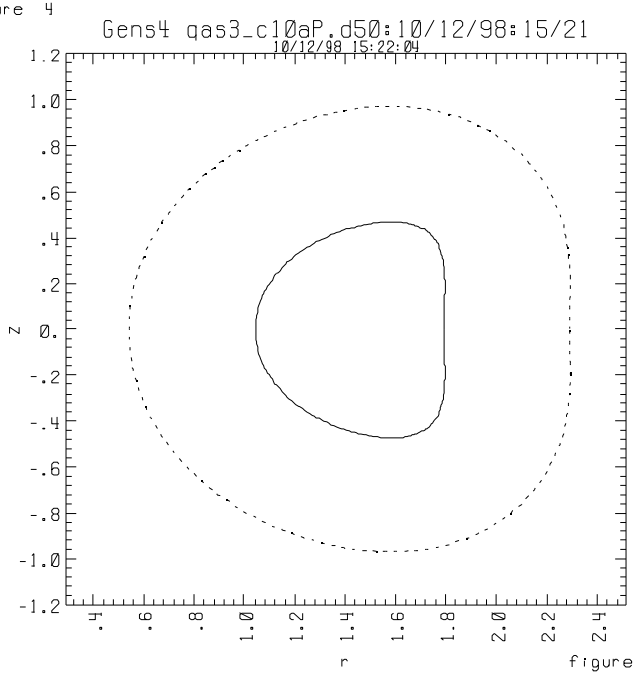

figure 6