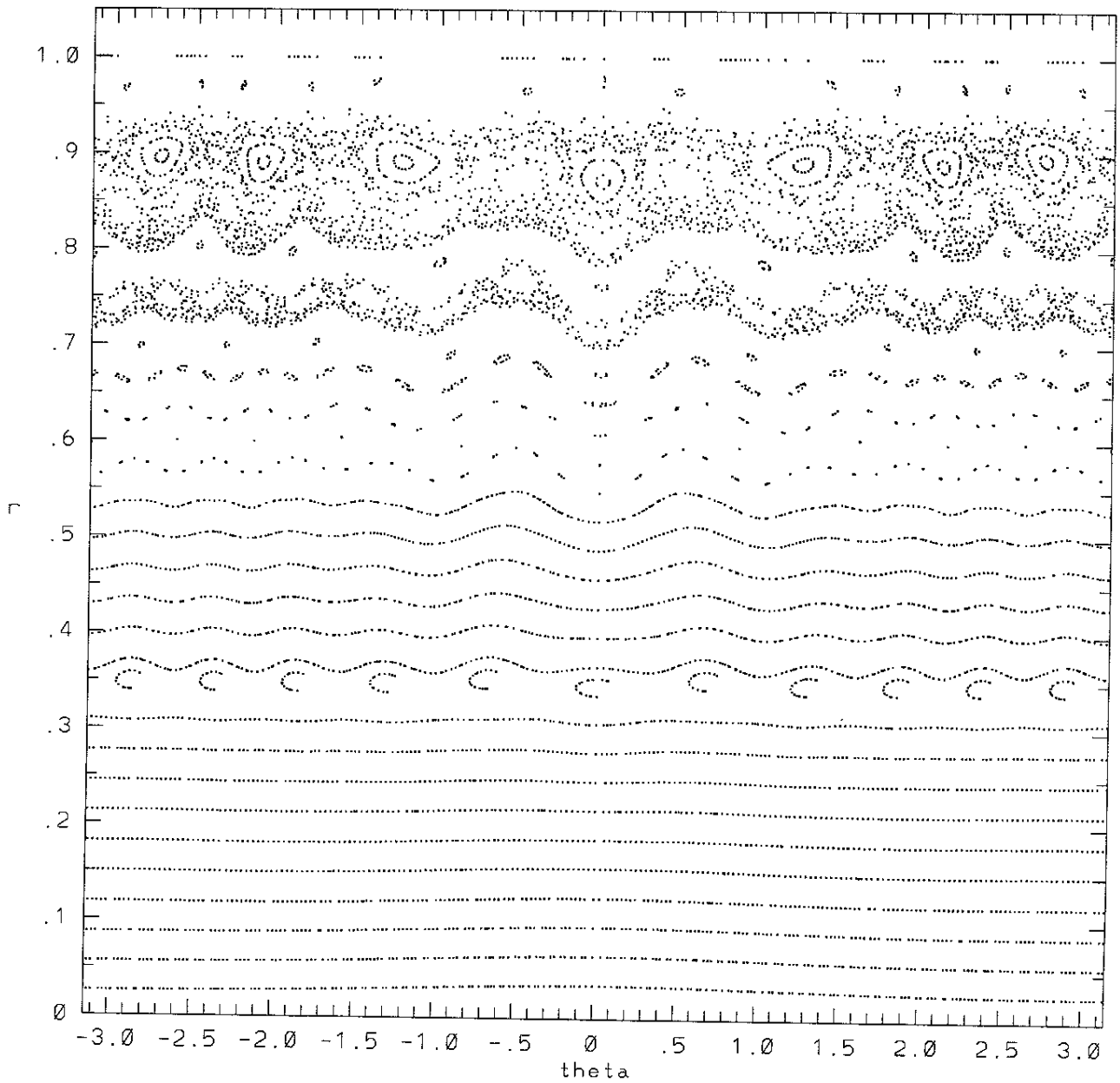
C82 Equilibrium Quality

Don Monticello

- Outline
  - c82 and c10 flux surface comparison: fixed boundary
    - PIES currents
    - VMEC currents
  - Difference between VMEC and PIES currents
    - 0,0 currents
    - resonant effects on Pfirsch-Schluter currents
    - delta function currents in VMEC?
  - Resistive Interchange for c82 and c10
  - Future
    - Convergence studies
    - Ballooning stable pressure profiles
    - Resolution of discrepancies between PIES and VMEC currents
    - W7-AS benchmark
    - Mitigating c82 PIES results
      * bootstrap currents
      * W7-AS benchmark
      * mollifying the Pfirsch-Schulter resonances

C 82 after 1 iteration

PIBS currents

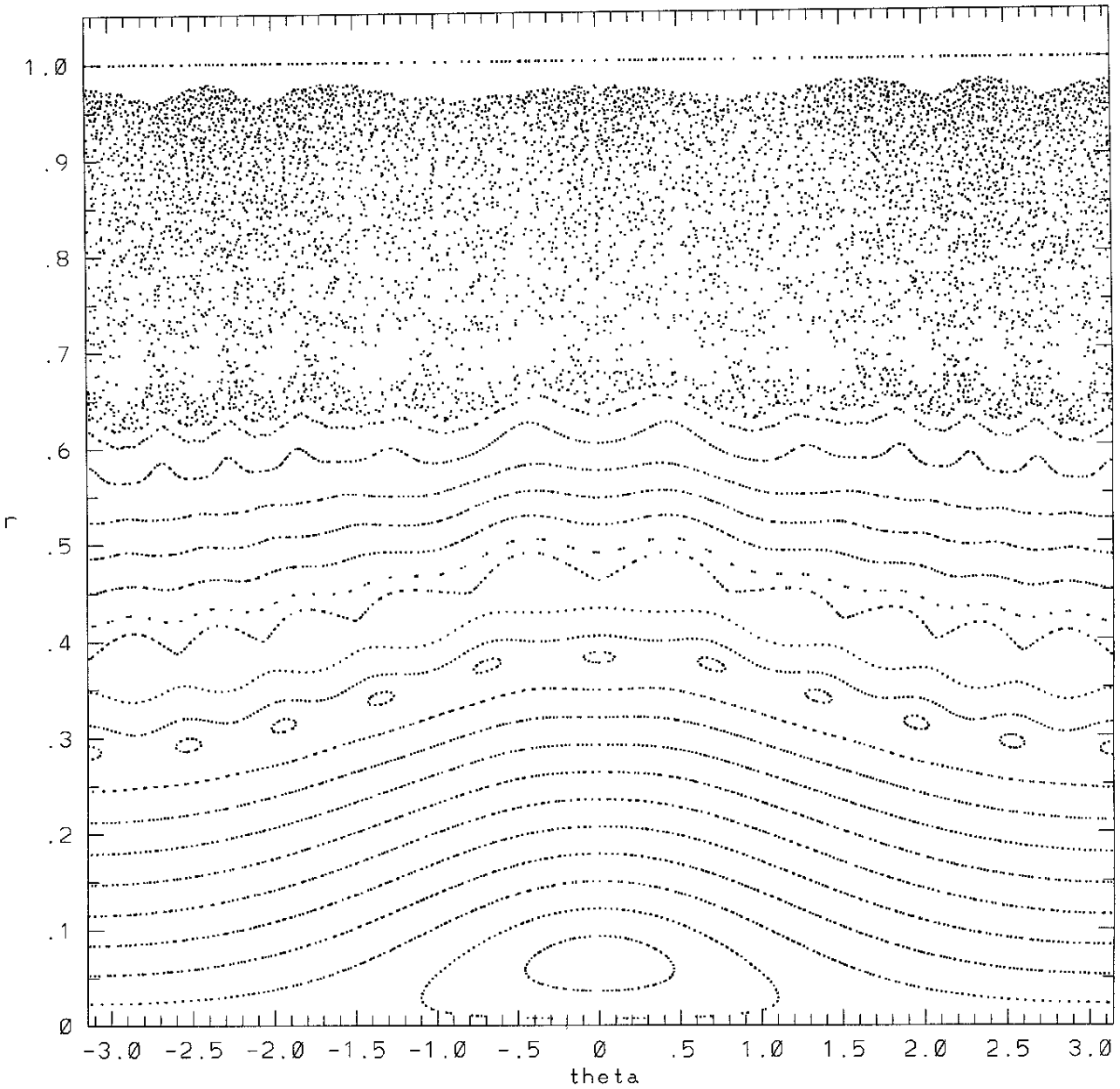


it= 1 rpoinc: background coordinates

Plot 10

C82 after 16 iterations

PIES currents

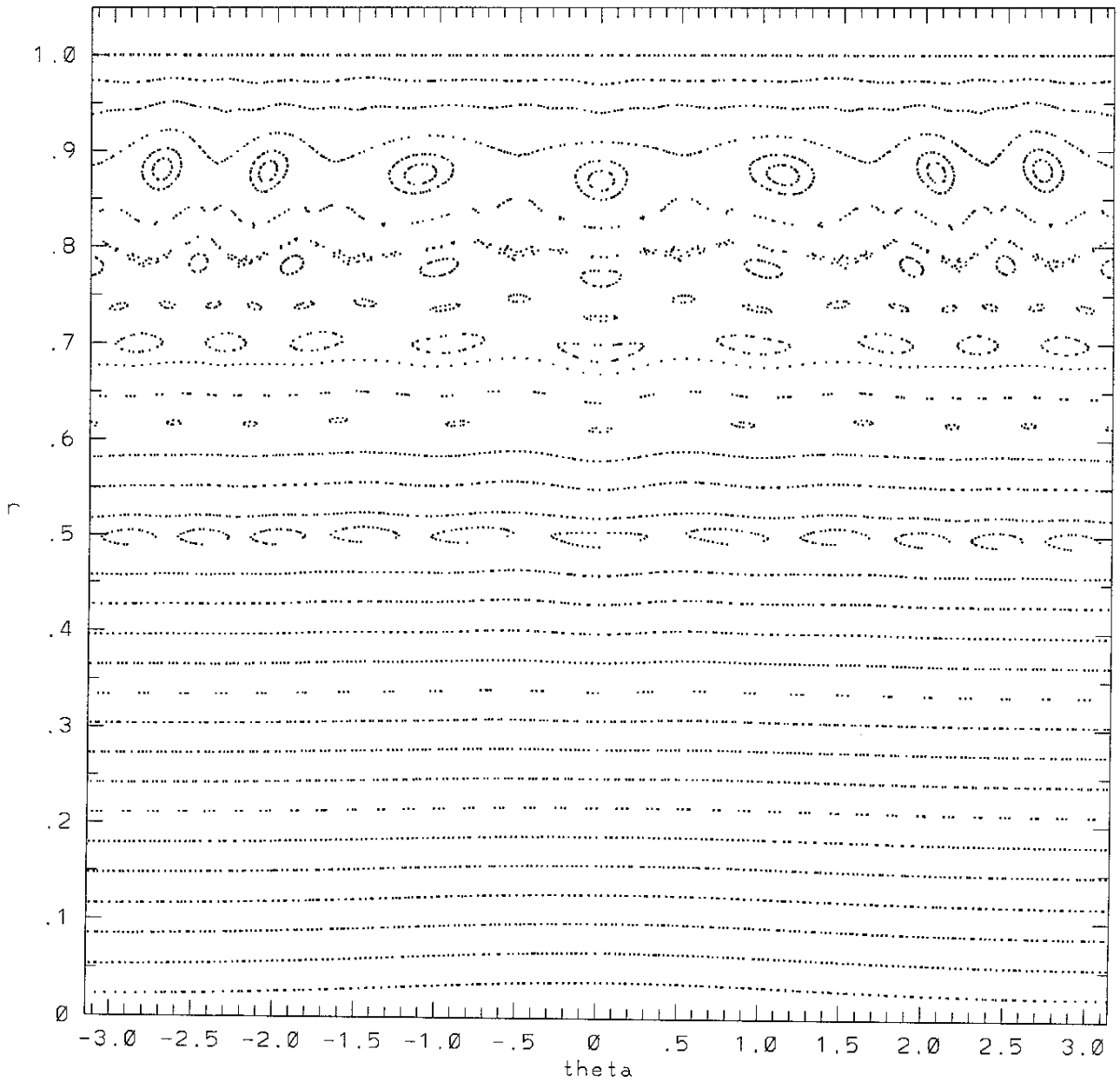


it= 16 rpoinc: background coordinates

Plot 64

C10 after 1 iteration

PIES currents

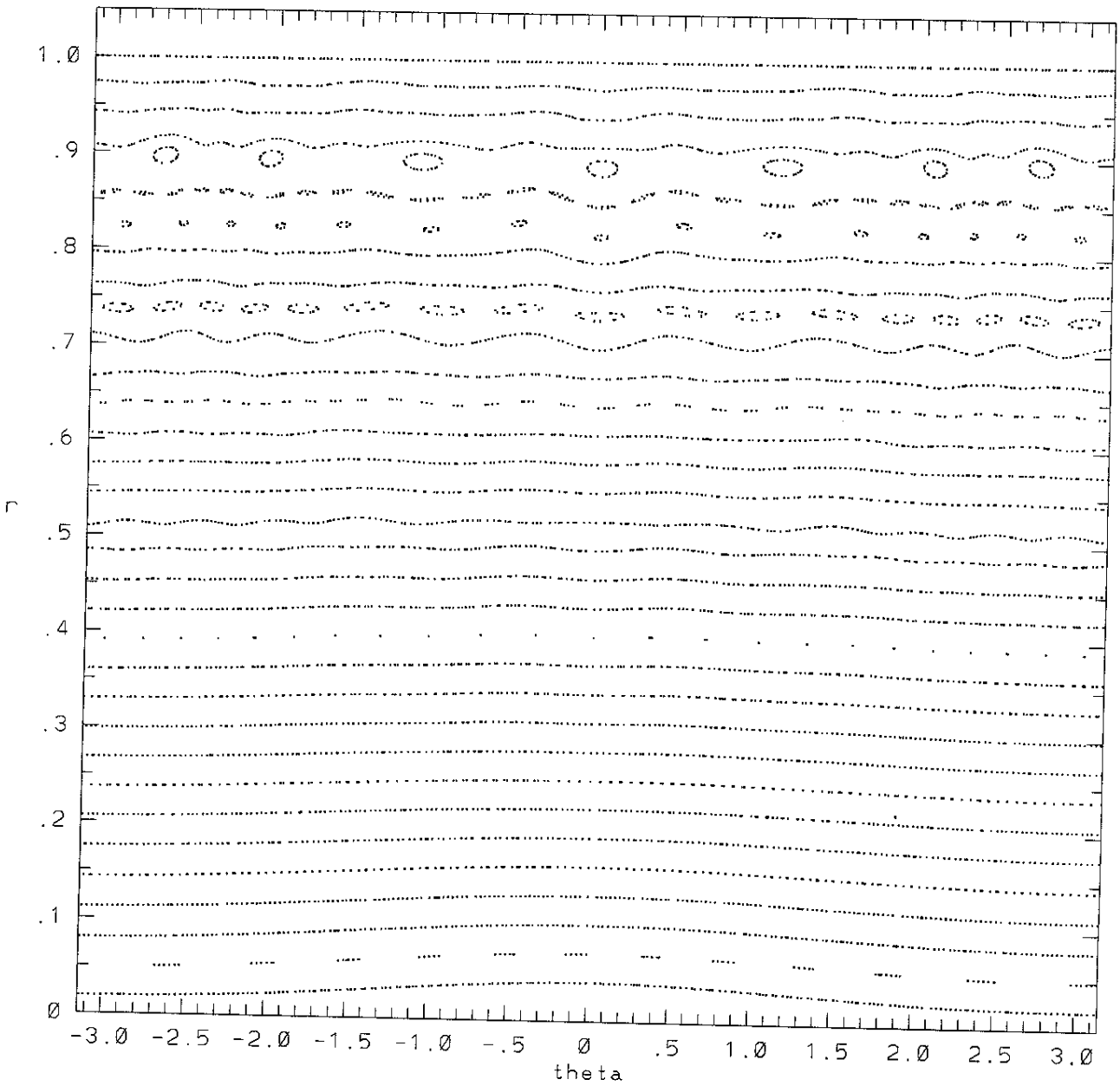


it= 1 rpoinc: background coordinates

Plot 10

C10 after 25 itenations

PIES currents

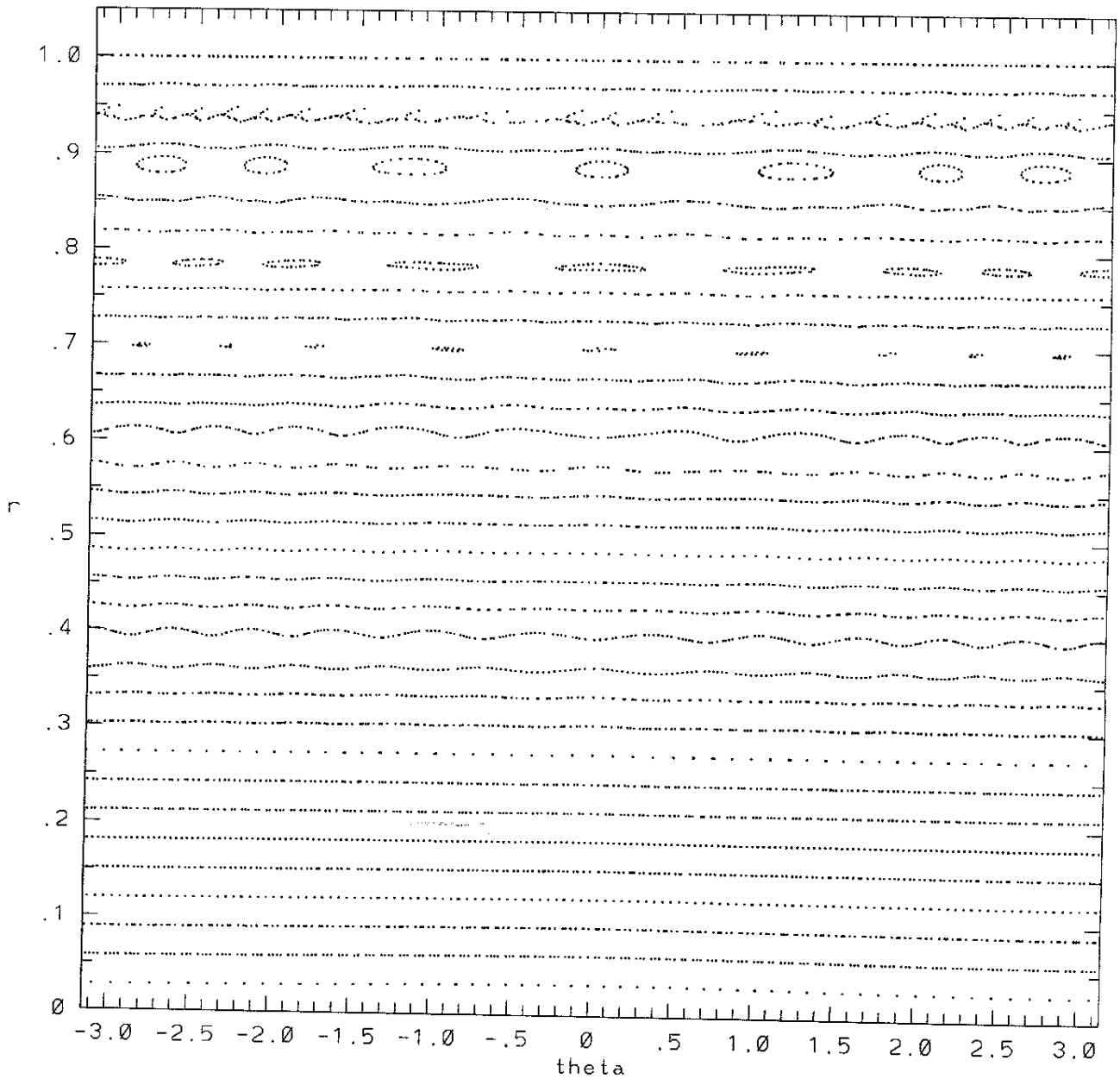


it= 25 rpoinc: background coordinates

Plot 109

C82 USING

VMEC currents

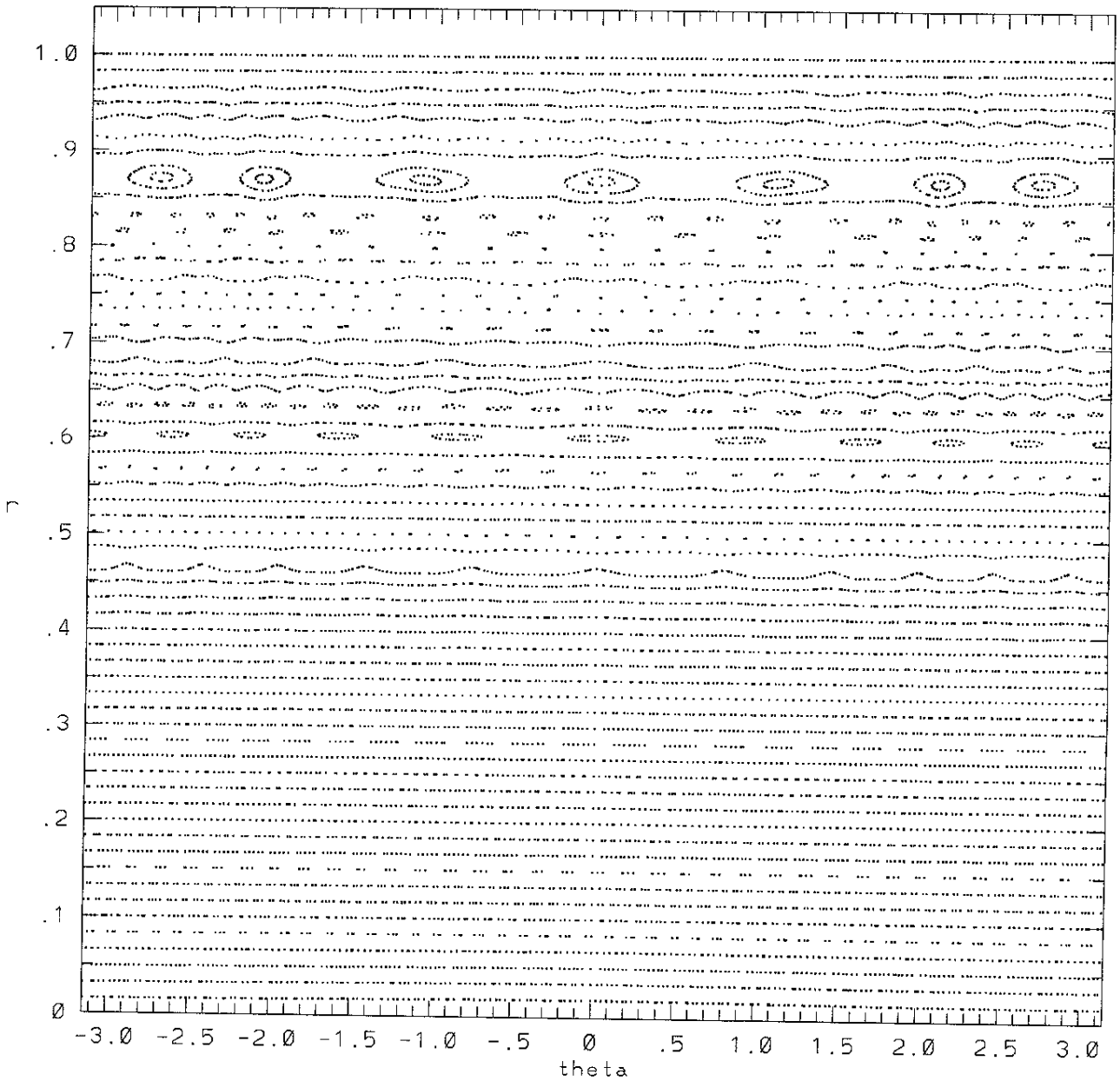


it= 1 rpoinc: background coordinates

Plot 120

C 10 USING

VMEC currents

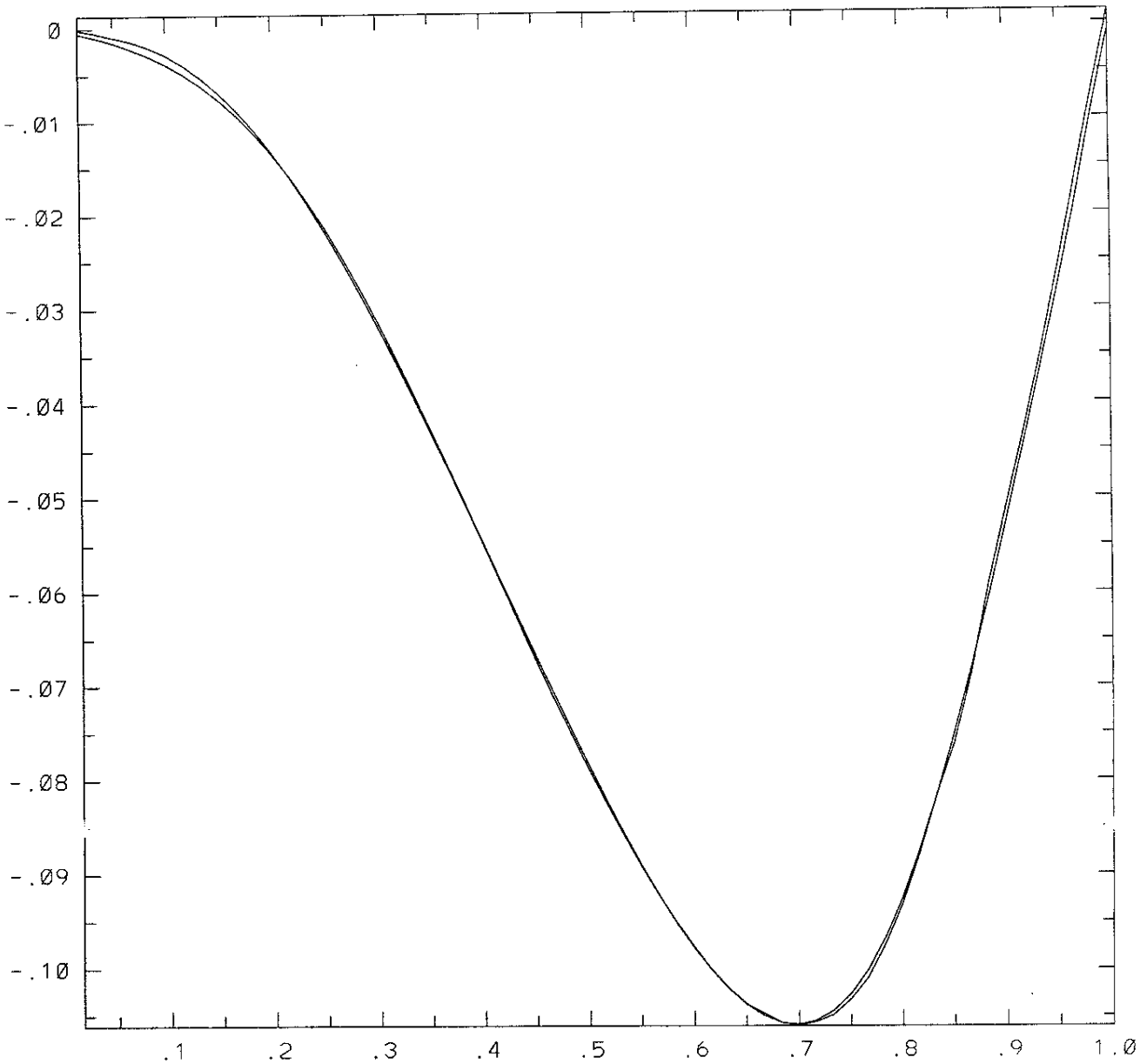


it= 1 rpoinc: background coordinates

Plot 74

C10 PIES & VMEC CURRENTS

∂J^{θ} 0,0

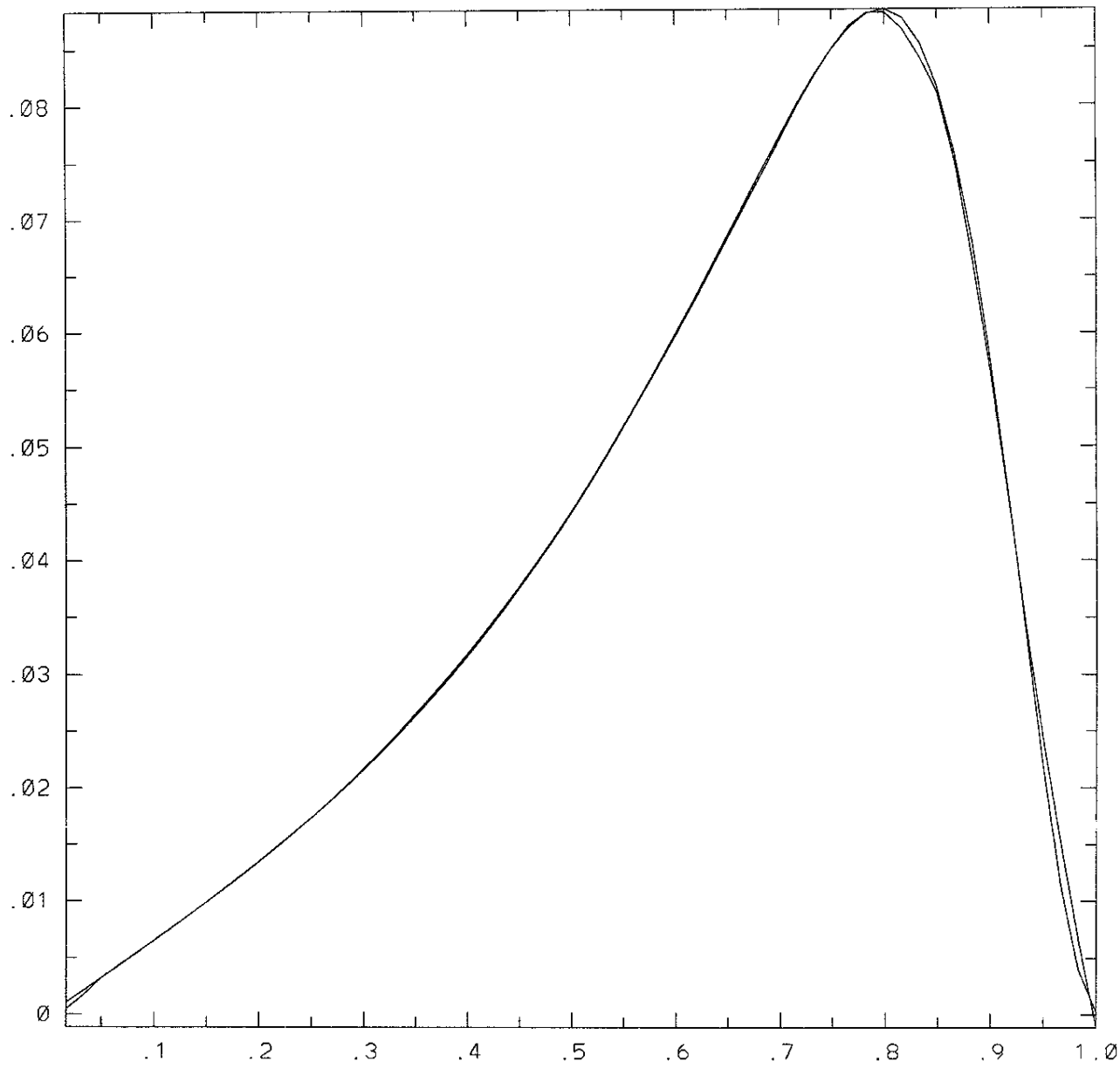


it= 0 fjjup: jtemp2

Plot 17

C 10 PIBS & VMBC CURRENTS

JJ¢ 0,0

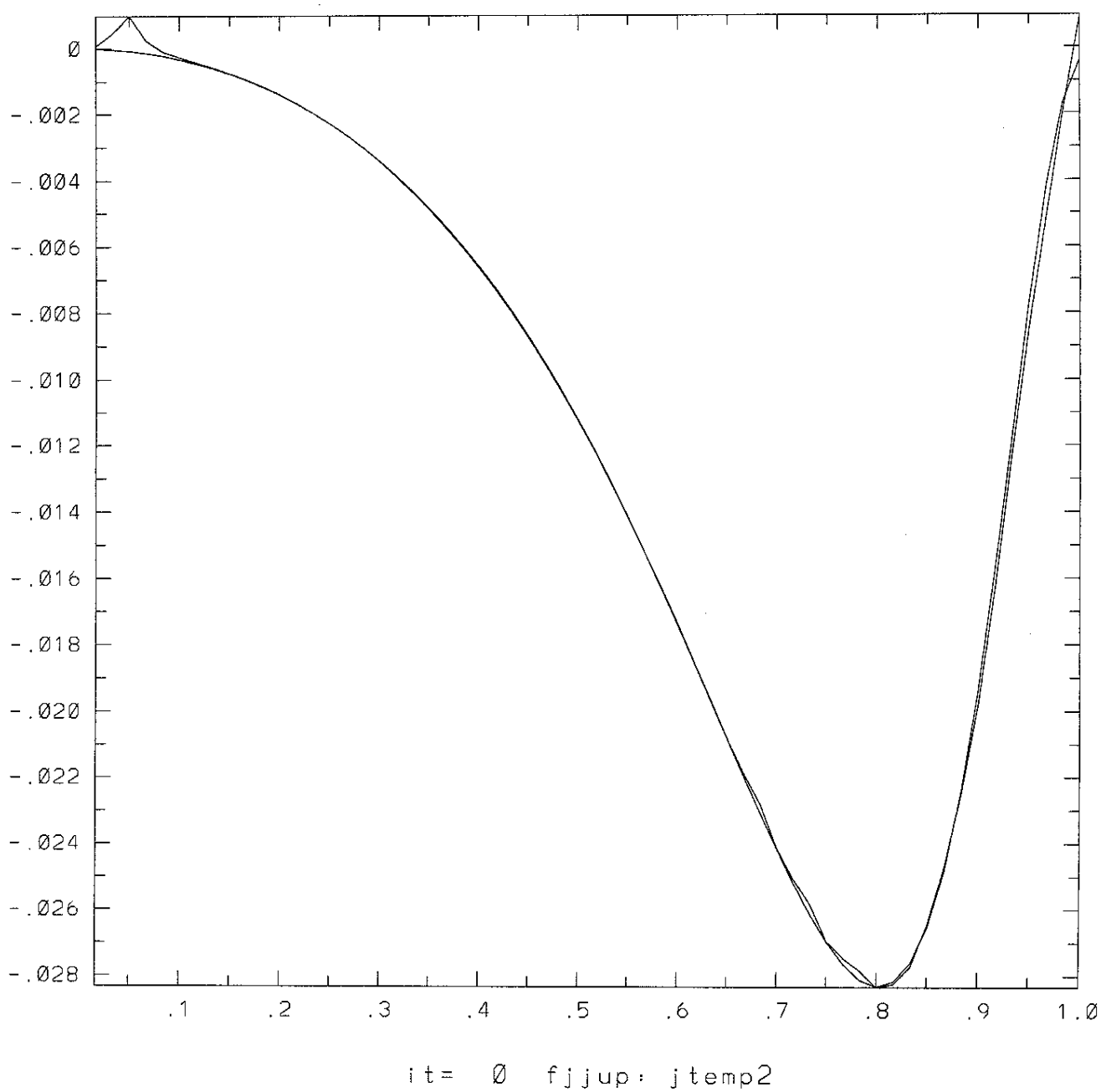


it= 0 fjjup: jtemp3

Plot 18

C10 PIES + VMEC currents

∂J^{θ} 1,-1

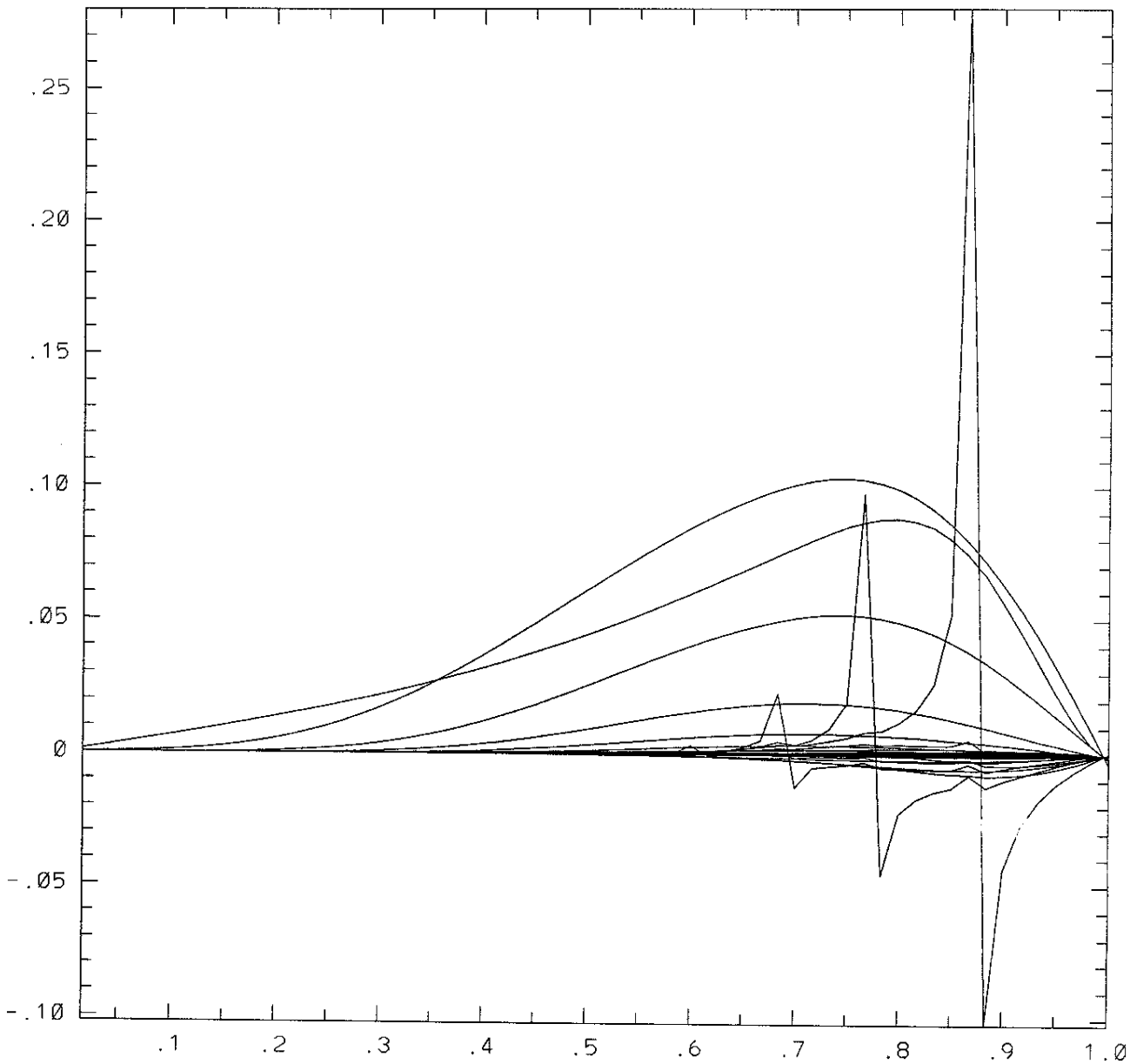


C 10 PIES Currents

JJ^{ϕ} all harmonics

resonant effects on Pfirsh-Schluter currents

STRAIGHT FIELD LINE COORDINATES



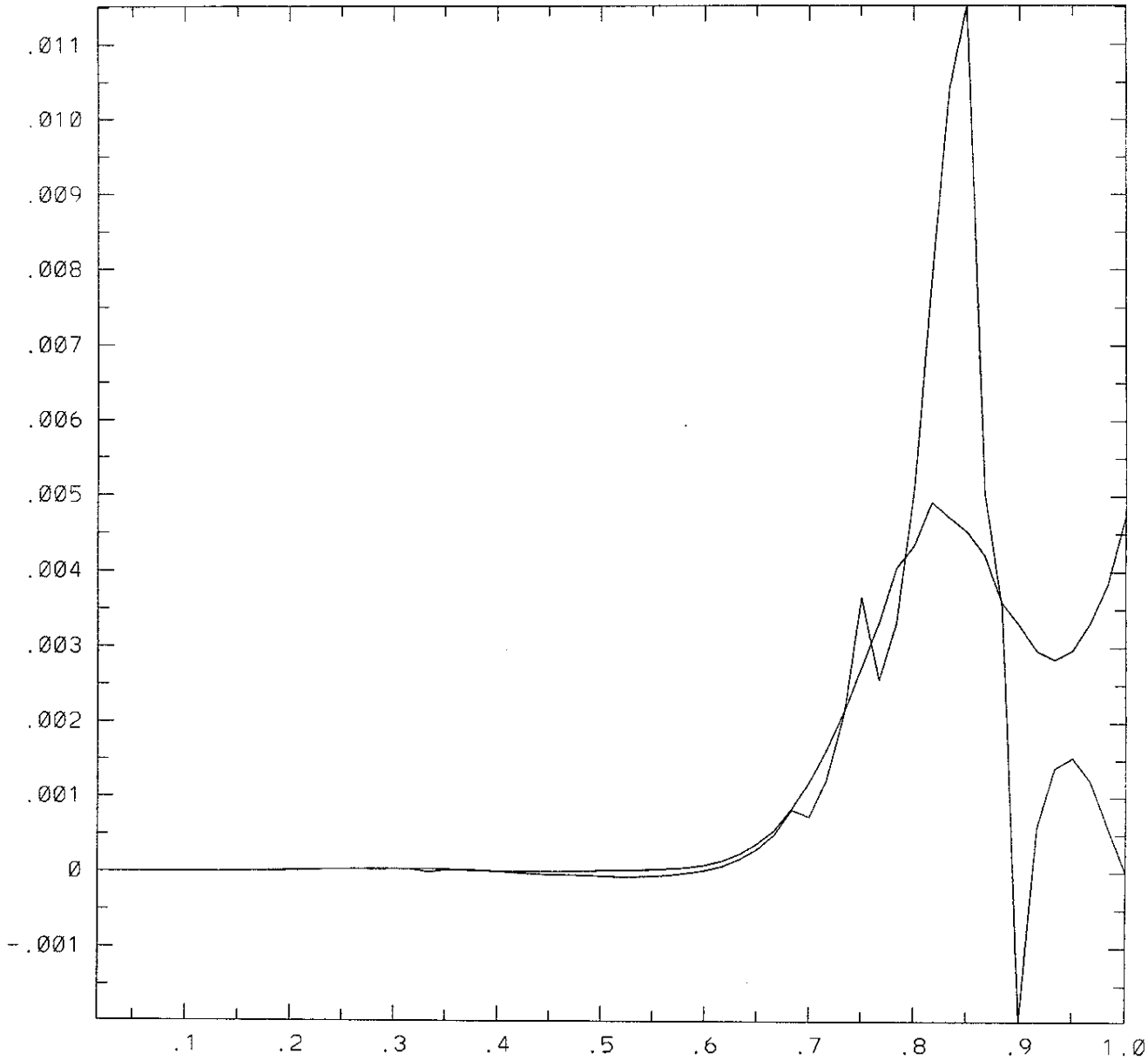
it= 0 fjjupg: jjup(0,-n,1,3)

Plot 4

C10 COMPARISON PIES & VMEC CURRENTS

JJ^{ϕ} 1 harmonic

VMEC COORDINATES



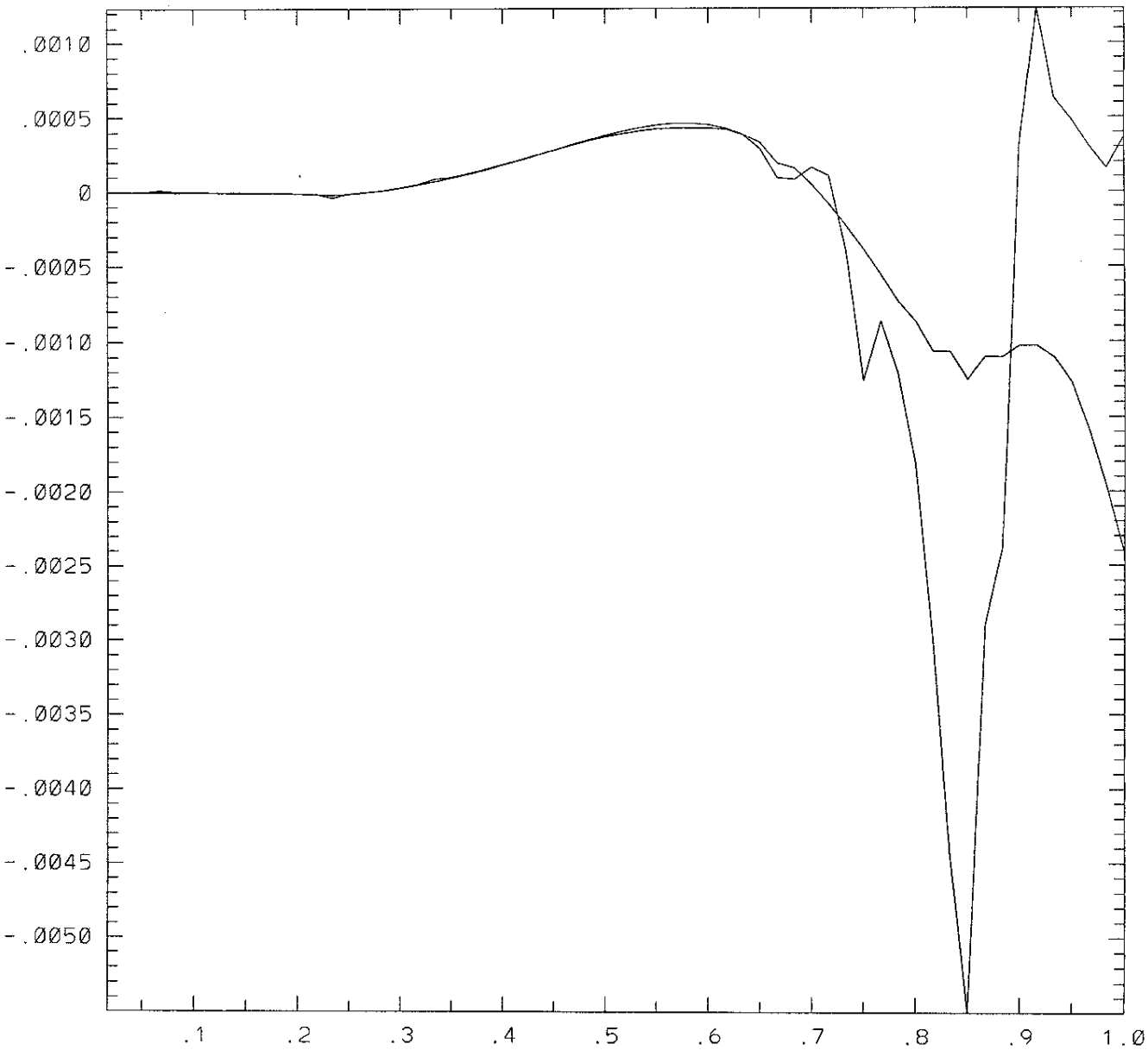
it= 0 fjjup: jtemp3

Plot 48

C 10 COMPARISON PIES & VMEC CURRENTS

J_ζ 1 harmonic

VMEC COORDINATES



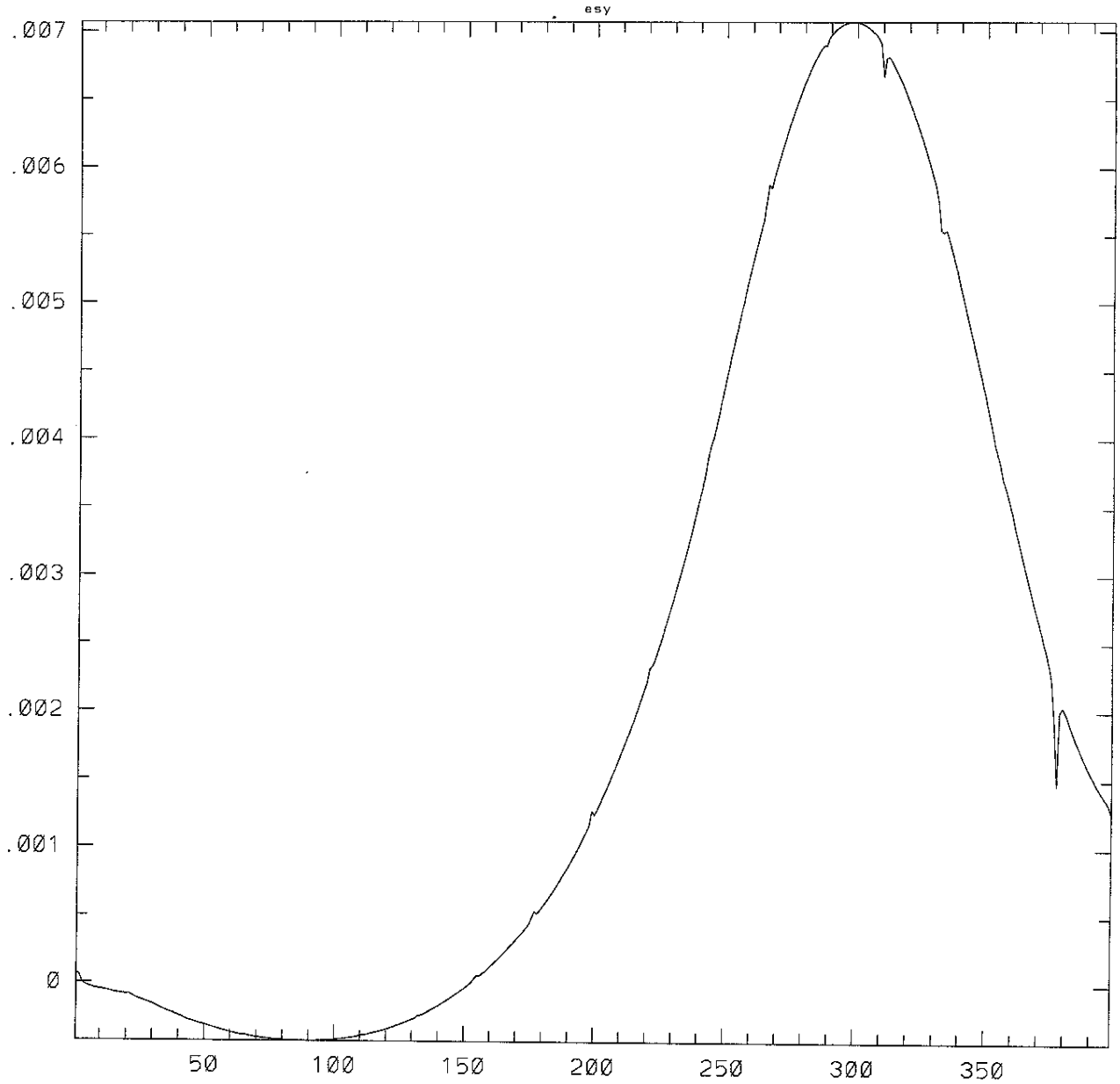
it= 0 fjjup: jtemp3

Plot 38

C 10

RAW VMEC currents

delta function currents?

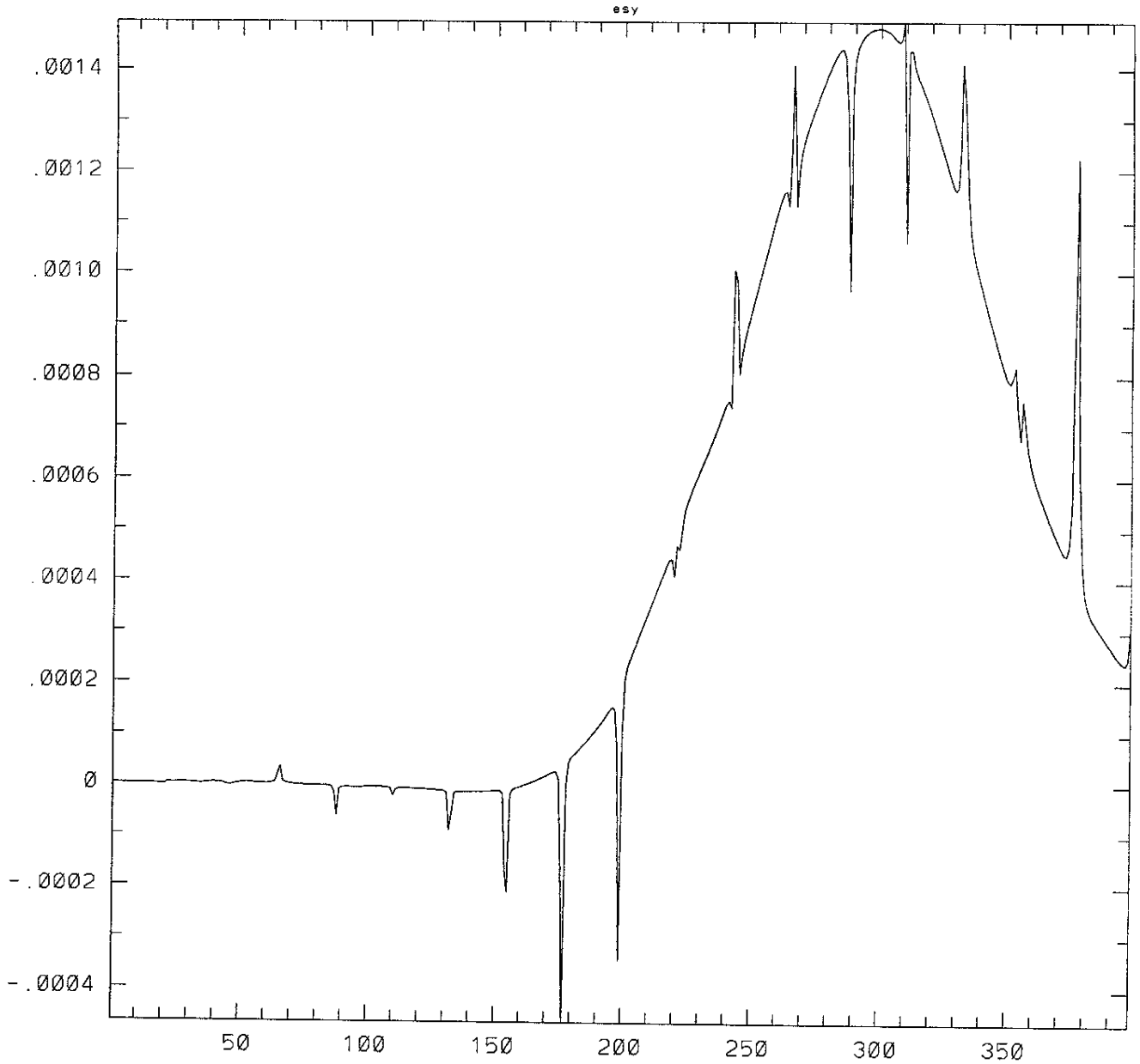


2 9

C/O

RAW VMBC currents

delta function currents?



C82

	S	Mercier	Resistive Interchange
1	4.1667E-02	1.9000E-03	1.2678E-03
2	6.2500E-02	2.8891E-03	1.7667E-03
3	8.3333E-02	3.1915E-03	1.4702E-03
4	1.0417E-01	3.4688E-03	1.1368E-03
5	1.2500E-01	3.6704E-03	7.4560E-04
6	1.4583E-01	1.3138E-03	-2.1037E-03
7	1.6667E-01	1.4255E-03	-2.4591E-03
8	1.8750E-01	4.0146E-03	-3.4192E-04
9	2.0833E-01	4.0978E-03	-6.1579E-04
10	2.2917E-01	4.1286E-03	-8.7542E-04
11	2.5000E-01	4.1127E-03	-1.1197E-03
12	2.7083E-01	4.0625E-03	-1.3326E-03
13	2.9167E-01	3.9747E-03	-1.5169E-03
14	3.1250E-01	3.8234E-03	-1.7030E-03
15	3.3333E-01	3.3020E-03	-2.1831E-03
16	3.5417E-01	2.5402E-03	-2.9469E-03
17	3.7500E-01	2.7731E-03	-2.6600E-03
18	3.9583E-01	3.2572E-03	-1.9843E-03
19	4.1667E-01	3.1021E-03	-1.9454E-03
20	4.3750E-01	2.8537E-03	-1.9625E-03
21	4.5833E-01	2.1670E-03	-2.3235E-03
22	4.7917E-01	-1.3716E-02	-1.9000E-02
23	5.0000E-01	-1.2749E-02	-1.8107E-02
24	5.2083E-01	1.8095E-03	-2.4480E-03
25	5.4167E-01	1.3146E-03	-2.6692E-03
26	5.6250E-01	1.0721E-03	-2.6515E-03
27	5.8333E-01	5.7908E-04	-2.8618E-03
28	6.0417E-01	-1.5183E+00	-1.5223E+00
29	6.2500E-01	-1.3767E+00	-1.3803E+00
30	6.4583E-01	-2.9677E-04	-2.9017E-03
31	6.6667E-01	4.2952E-04	-1.9390E-03
32	6.8750E-01	2.2840E-04	-1.8907E-03
33	7.0833E-01	6.1755E-05	-1.8190E-03
34	7.2917E-01	-2.7087E-04	-1.9473E-03
35	7.5000E-01	-1.8132E-03	-3.3460E-03
36	7.7083E-01	-9.4505E-02	-9.7253E-02
37	7.9167E-01	-7.6754E-02	-7.8545E-02
38	8.1250E-01	-1.9233E-03	-2.4039E-03
39	8.3333E-01	-3.3148E-04	-7.6371E-04
40	8.5417E-01	-1.3454E-04	-4.8057E-04
41	8.7500E-01	-9.9168E-05	-3.6781E-04
42	8.9583E-01	-9.4777E-05	-3.0304E-04
43	9.1667E-01	-9.6191E-05	-2.5965E-04
44	9.3750E-01	-1.4587E-04	-2.7417E-04
45	9.5833E-01	-1.5069E-04	-3.0358E-04
46	9.7917E-01	7.1639E-05	-7.4598E-05

C10

	S	Mercier	Resistive Interchange
1	4.1667E-02	2.2809E-03	1.2838E-03
2	6.2500E-02	4.3409E-03	2.5830E-03
3	8.3333E-02	4.0196E-03	1.3279E-03
4	1.0417E-01	3.6866E-03	3.3225E-05
5	1.2500E-01	4.0461E-03	-4.2526E-04
6	1.4583E-01	4.4018E-03	-7.8844E-04
7	1.6667E-01	4.4462E-03	-1.4070E-03
8	1.8750E-01	4.4098E-03	-1.9950E-03
9	2.0833E-01	-3.1278E-02	-3.7723E-02
10	2.2917E-01	-3.0867E-02	-3.7589E-02
11	2.5000E-01	4.2779E-03	-3.0512E-03
12	2.7083E-01	4.2018E-03	-3.2584E-03
13	2.9167E-01	4.0675E-03	-3.4236E-03
14	3.1250E-01	3.8658E-03	-3.5718E-03
15	3.3333E-01	3.5455E-03	-3.7683E-03
16	3.5417E-01	-1.1847E-03	-8.3718E-03
17	3.7500E-01	-1.1349E-03	-8.0997E-03
18	3.9583E-01	3.0197E-03	-3.6131E-03
19	4.1667E-01	2.8169E-03	-3.4963E-03
20	4.3750E-01	2.5327E-03	-3.4199E-03
21	4.5833E-01	6.9169E-04	-4.6659E-03
22	4.7917E-01	3.2167E-04	-4.9166E-03
23	5.0000E-01	1.6679E-03	-3.5895E-03
24	5.2083E-01	1.4237E-03	-3.3841E-03
25	5.4167E-01	1.2411E-03	-3.1893E-03
26	5.6250E-01	1.0637E-03	-2.9826E-03
27	5.8333E-01	-1.1986E-01	-1.2246E-01
28	6.0417E-01	-1.0987E-01	-1.1235E-01
29	6.2500E-01	2.1746E-04	-3.0883E-03
30	6.4583E-01	5.2361E-04	-2.4109E-03
31	6.6667E-01	3.9068E-04	-2.2418E-03
32	6.8750E-01	1.8362E-04	-2.1732E-03
33	7.0833E-01	-2.6013E-04	-2.3650E-03
34	7.2917E-01	-2.4023E-03	-4.3931E-03
35	7.5000E-01	-9.3124E-02	-9.3513E-02
36	7.7083E-01	-7.5547E-02	-7.5707E-02
37	7.9167E-01	-1.3109E-03	-2.0032E-03
38	8.1250E-01	-4.4554E-04	-1.0354E-03
39	8.3333E-01	-2.7037E-04	-7.3410E-04
40	8.5417E-01	-2.1532E-04	-5.6834E-04
41	8.7500E-01	-1.8522E-04	-4.4783E-04
42	8.9583E-01	-1.5642E-04	-3.4886E-04
43	9.1667E-01	-1.3659E-04	-2.8181E-04
44	9.3750E-01	-1.5884E-04	-2.6334E-04
45	9.5833E-01	-6.2817E-05	-1.4785E-04
46	9.7917E-01	1.9349E-05	-6.1421E-05

MERCIER & RESISTIVE INTERCHANGE

(LONG-POLE KU)

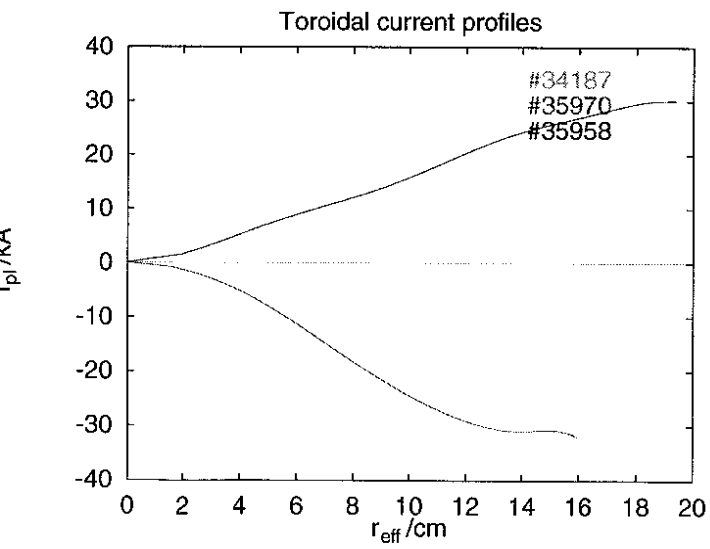
W7-AS (GEIGER)

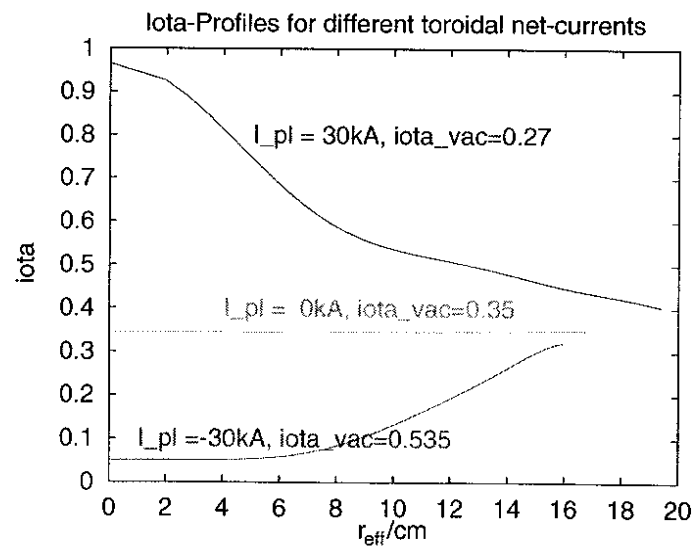
Equilibrium Calculations(2) : effects by toroidal net-current

- toroidal net-currents: bootstrap current (internal drive),

  inductive currents, Okhawa current, ECCD current (external drives).
- change of ι-profile: $\Delta\iota(\mathrm{r_{eff}}) \approx \mathrm{I_{pl}}(\mathrm{r_{eff}})\mathrm{R}/(2\Phi(\mathrm{r_{eff}}))$ for large aspect ratio.
- change of plasma boundary

Examples: Toroidal current and ι profiles (color coded)





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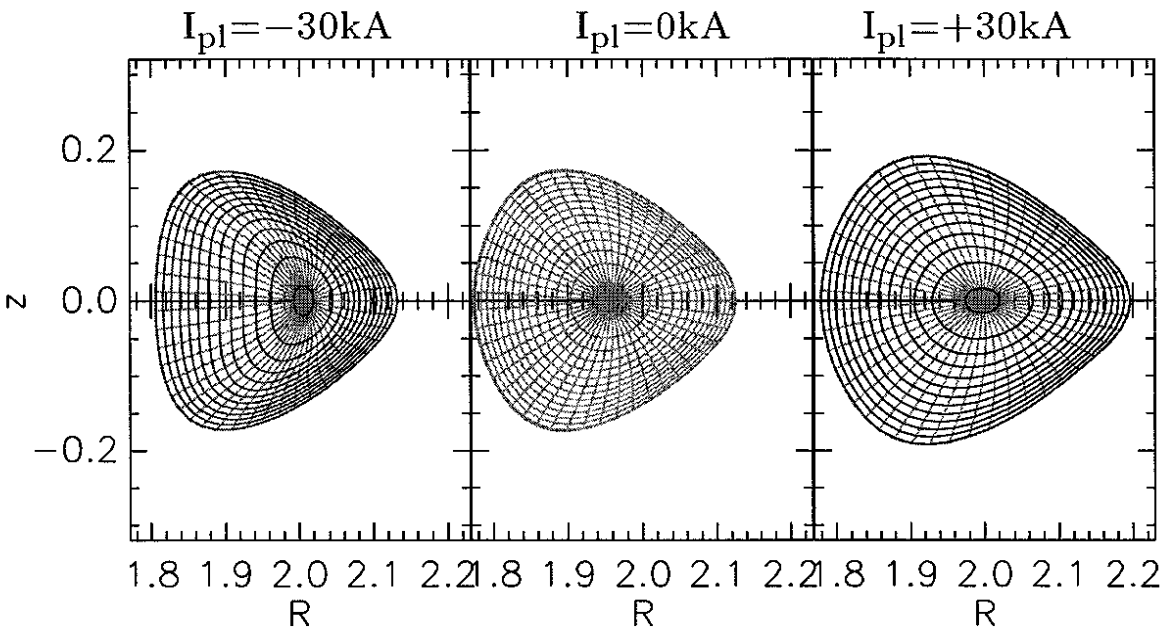
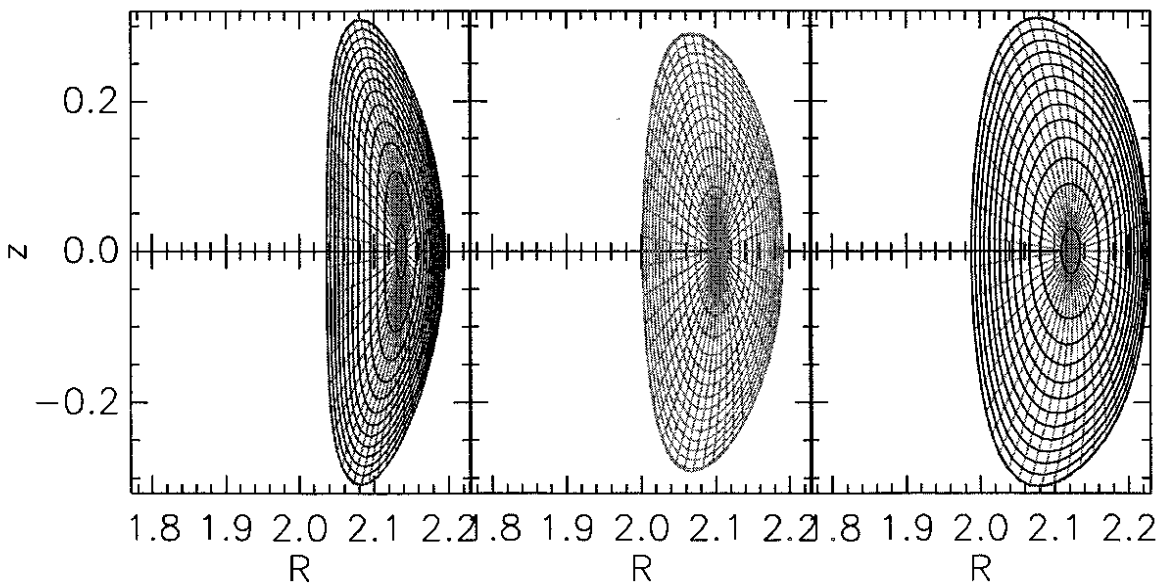
W7-AS

Triangular plane ($\varphi = 0°$)



Elliptical plane ($\varphi = 36°$)



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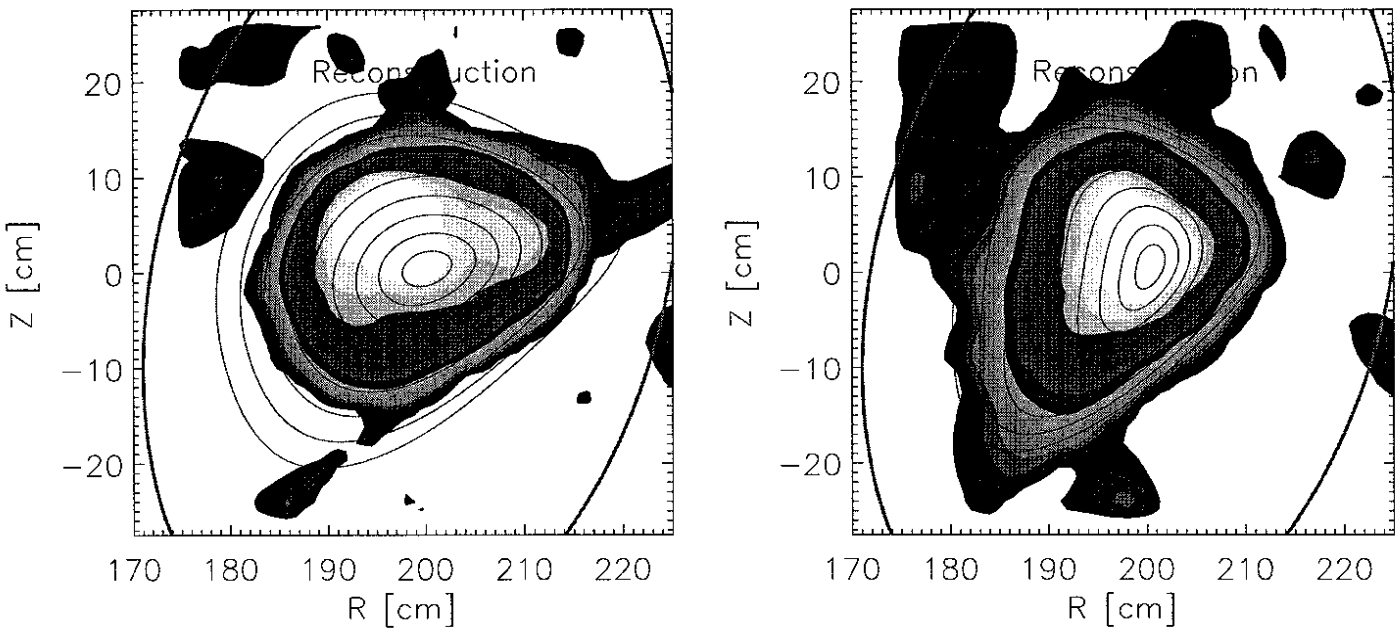
W7-AS

omparison of Soft-Xray emissivity (MiniSoX-system) with NEMEC flux surfaces for $I_{pl} = 30\mathrm{kA}$ (left) and -$30\mathrm{kA}$ (right).

(see Poster by C.Görner)



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TOTAL P.20