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CLaSSiC Project
Report CLaSSiC-84-02

July 1984

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**High Marangoni Number Convection
in a Square Cavity;
Additional Results**

by

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Contract N00014-82-K-0335

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additional results**

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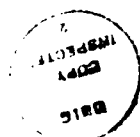
21 June 1984

This manuscript is a companion document to the paper "High Marangoni number convection in a square cavity," by the present authors which, at the time of this writing, is submitted for publication in the Journal of Fluid Mechanics. Thus it should only be read in conjunction with the above mentioned paper.

Complete listing of our computational results is provided in Table I. Figures 1 through 5 show the variation with y of the temperature and u -velocity at the plane $x = 0$. The values of Pr are, respectively, 0.05, 0.1, 1, 10 and 50, while the Re ranges are as indicated in the Figures. For $Pr = 10$, we also include the variation with x of the surface temperature and velocity in Figures 4a and 4b.

Acknowledgment

We wish to acknowledge the partial support of NASA through contract NAS8-33881. E. M. was partially supported through a DAAD scholarship for one year study at Stanford. We are also grateful to the Center for Large Scale Scientific Computation, funded by the Office of Naval Research Contract N00014-82-K-0335 for the use of their computer facilities.



Letter on file

A-1

Table I
Results With The Nonuniform 62x54 Mesh

Pr	Re	Nu ₋	Nu ₊	$-\psi_{\max} \times 10^2$	$-\omega_{\max}$
0.05	1 x 10 ³	1.012	1.027	0.877	1.433
	5 x 10 ³	1.147	1.164	0.512	2.941
	1 x 10 ⁴	1.331	1.315	0.384	4.4xx
	2 x 10 ⁴	1.606	1.589	0.276	7.2xx
	3.5 x 10 ⁴	1.901	1.898	0.208	11.10
	5 x 10 ⁴	2.120	2.131	0.174	14.37
	*5 x 10 ⁴	2.161	2.151	0.180	14.44
0.1	1 x 10 ³	1.051	1.068	0.816	1.93
	5 x 10 ³	1.374	1.377	0.449	5.31
	1 x 10 ⁴	1.715	1.696	0.335	8.99
	2 x 10 ⁴	2.178	2.162	0.248	15.32
	3.5 x 10 ⁴	2.620	2.630	0.196	22.97
	5 x 10 ⁴	2.937	2.957	0.168	29.04
	*5 x 10 ⁴	2.980	2.981	0.175	28.95
1	1 x 10 ³	1.925	1.920	0.479	11.79
	2 x 10 ³	2.470	2.466	0.424	20.20
	3 x 10 ³	2.860	2.852	0.404	26.81
	4 x 10 ³	3.167	3.155	0.384	32.77
	5 x 10 ³	3.420	3.412	0.366	38.37
	6 x 10 ³	3.646	3.633	0.350	43.46
	7 x 10 ³	3.846	3.829	0.337	48.15
	8 x 10 ³	4.027	4.008	0.326	52.50
	9 x 10 ³	4.192	4.169	0.315	56.50
	1 x 10 ⁴	4.343	4.317	0.305	60.20
10	1 x 10 ³	3.924	3.921	0.240	81.97
	5 x 10 ³	6.979	6.949	0.230	146.3
50	20	1.975	1.966	0.470	12.20
	40	2.425	2.426	0.345	22.87
	60	2.718	2.722	0.290	32.97
	80	2.940	2.944	0.257	42.42
	100	3.122	3.125	0.236	51.19
	120	3.278	3.281	0.221	59.30
	140	3.417	3.419	0.210	66.79
	160	3.542	3.543	0.201	73.71
	180	3.657	3.658	0.194	80.10
	200	3.764	3.764	0.188	86.00
	250	4.013	4.010	0.179	98.87
	500	4.895	4.898	0.155	139.4
	*500	4.894	4.896	0.155	139.7

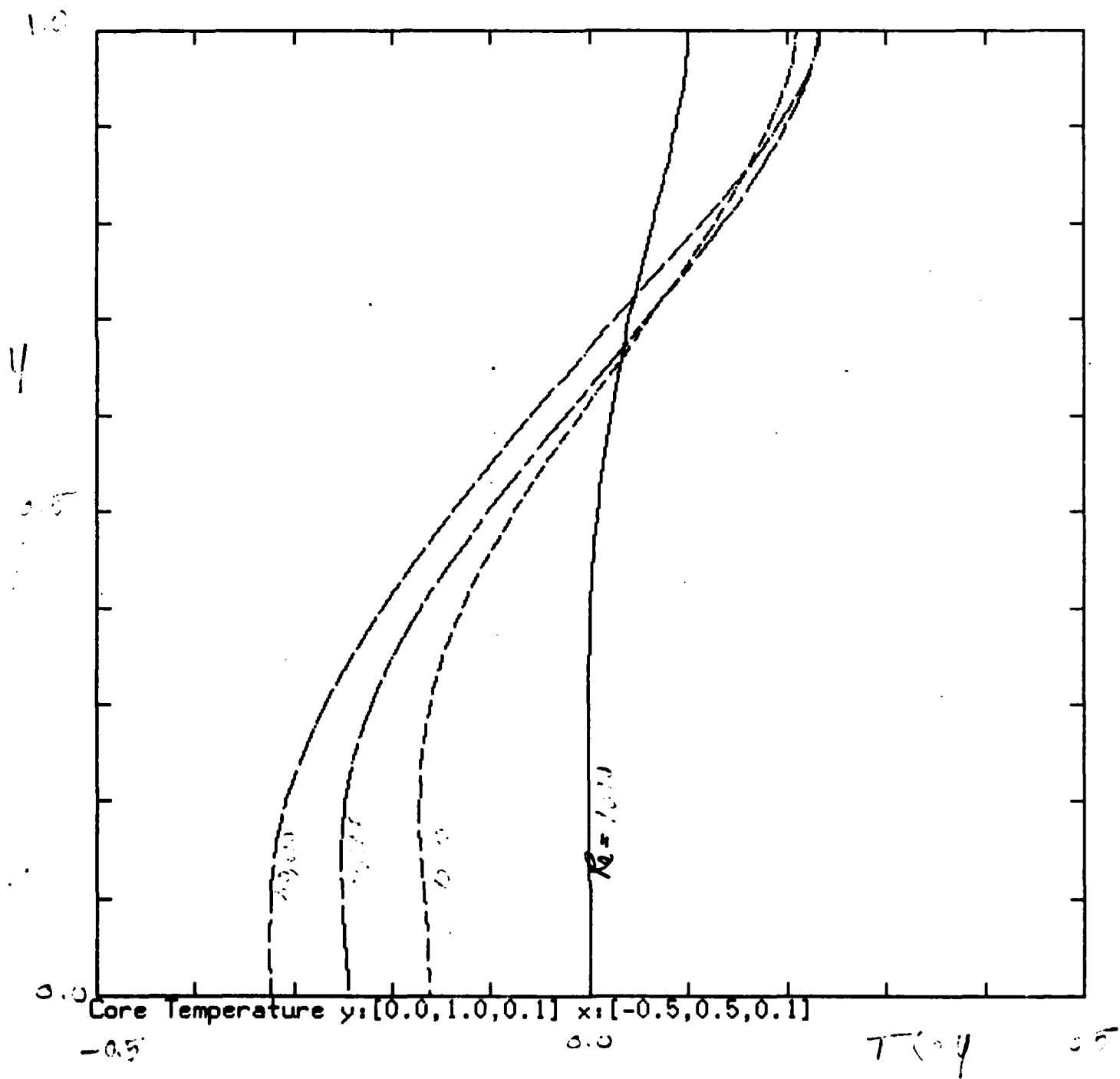
*Results with the nonuniform 70x60 mesh.

Figure captions

- Figure 1. a) Core temperature corresponding to $Pr = 0.05$ and $Re = 1000, 10,000, 20,000$ and $50,000$. b) Associated core velocity.
- Figure 2. Same as Figure 1 but with $Pr = 0.1$.
- Figure 3. a) Core temperature corresponding to $Pr = 1$ and $Re = 1000, 2000, 3000, 4000$ and 5000 . b) Associated core velocity. c) Core velocity with $Pr = 1$ but with $Re = 1000, 10,000$ (mod 1000).
- Figure 4. a) Surface temperature corresponding to $Pr = 10$ and $Re = 1000$ and 5000 . b) Associated surface velocity, c) Core temperature, d) Core velocity.
- Figure 5. a) Core temperature corresponding to $Pr = 50$ and $Re = 20, 100$ (mod 20). b) Associated core velocity but with $Re = 20, 200$ (mod 20).

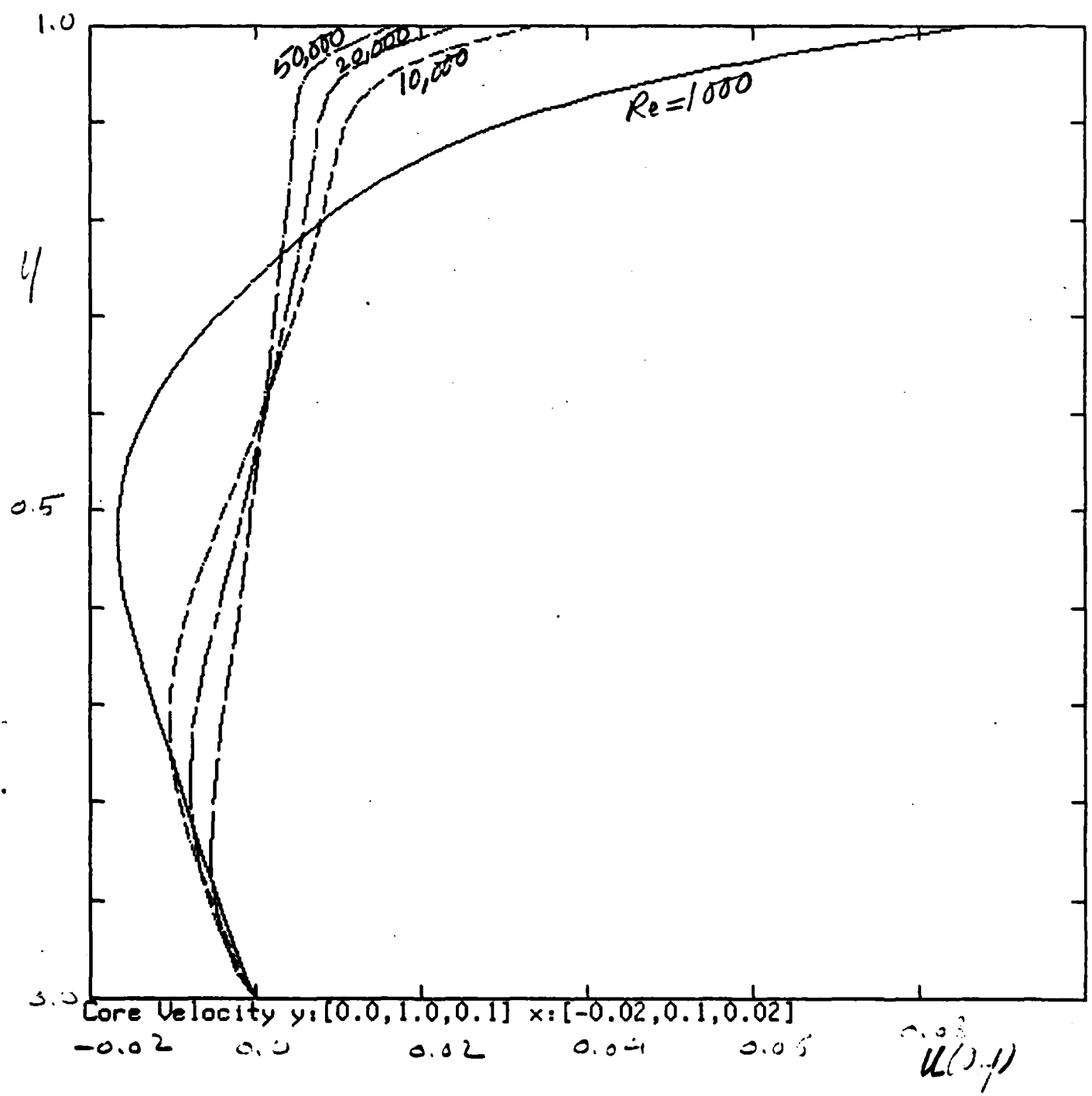
$Pr = 0.05$

19



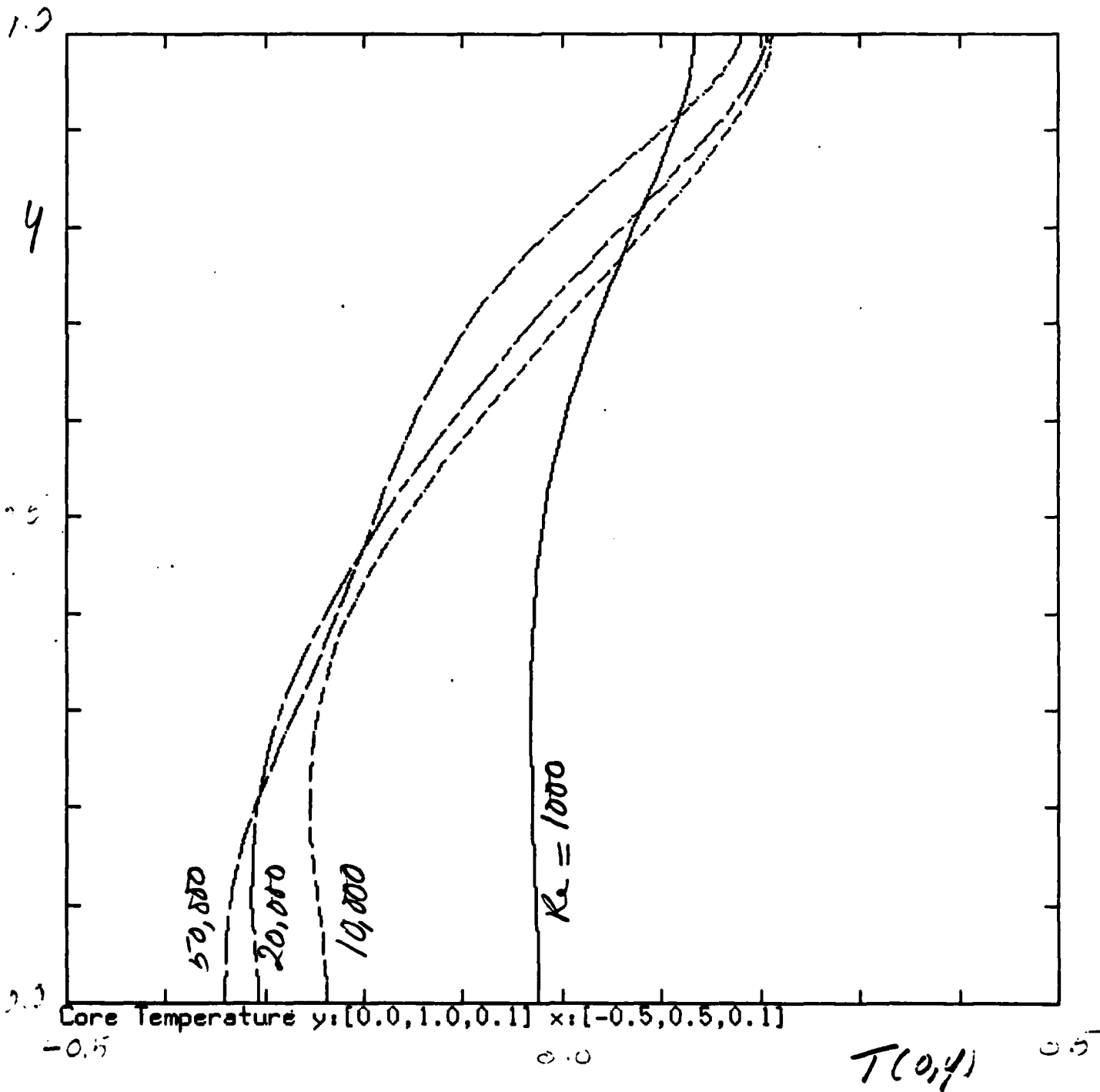
$Pr = 0.05$

1b



$$Pr = 0.1$$

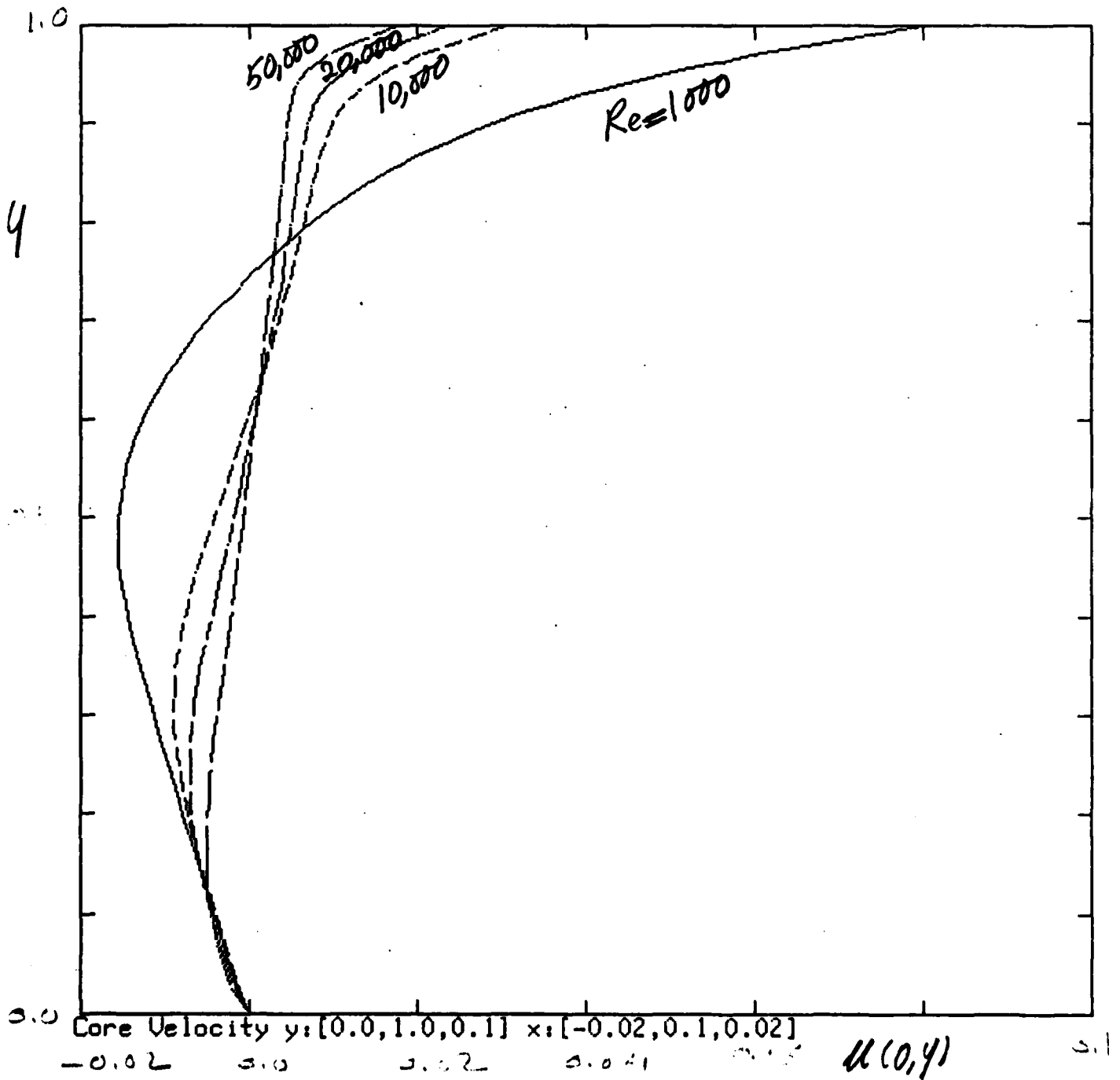
$$Pr = 0.1$$



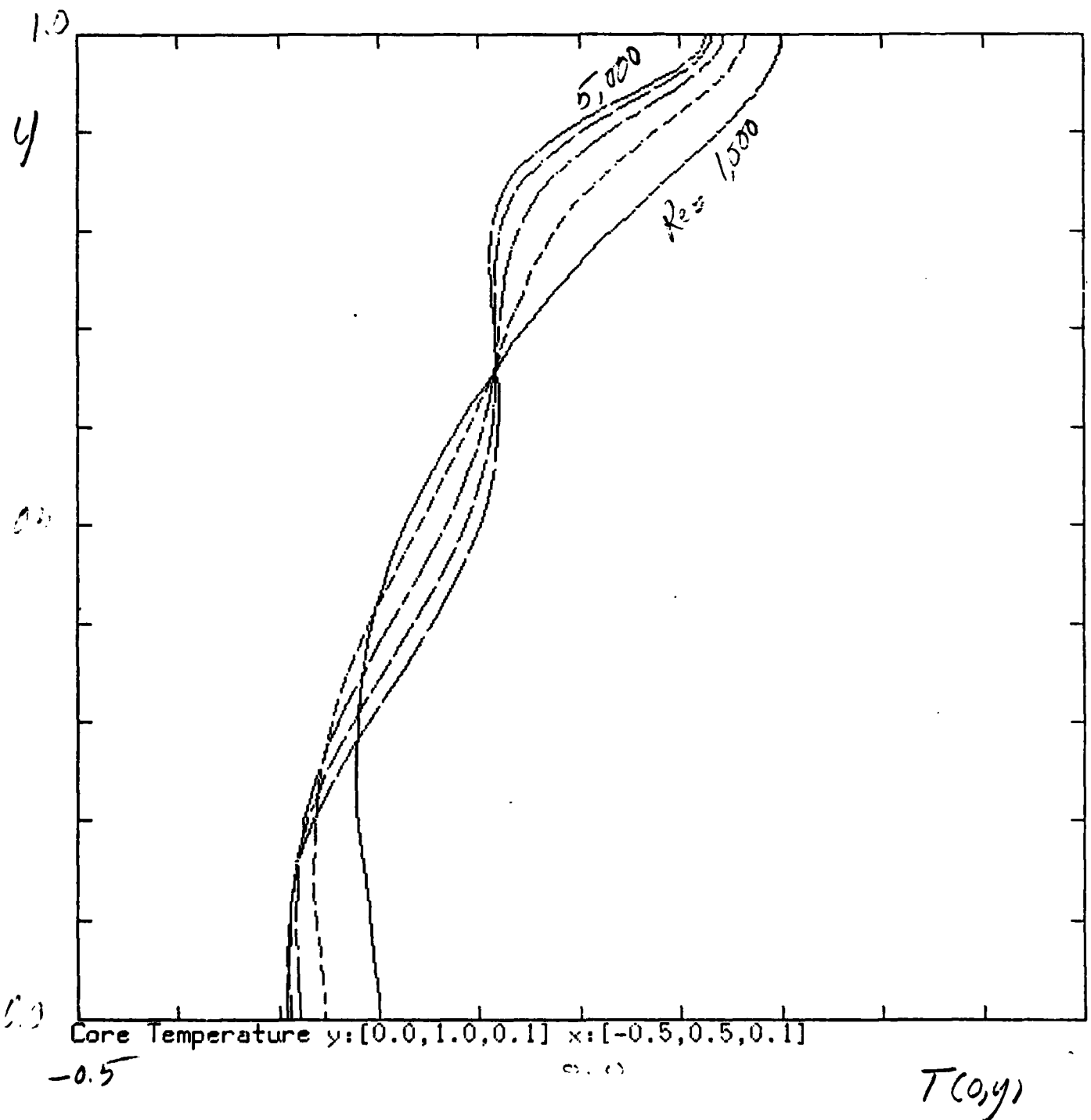
$Pr = 0.1$

2b

$Pr = 0.1$



$Pr=1$



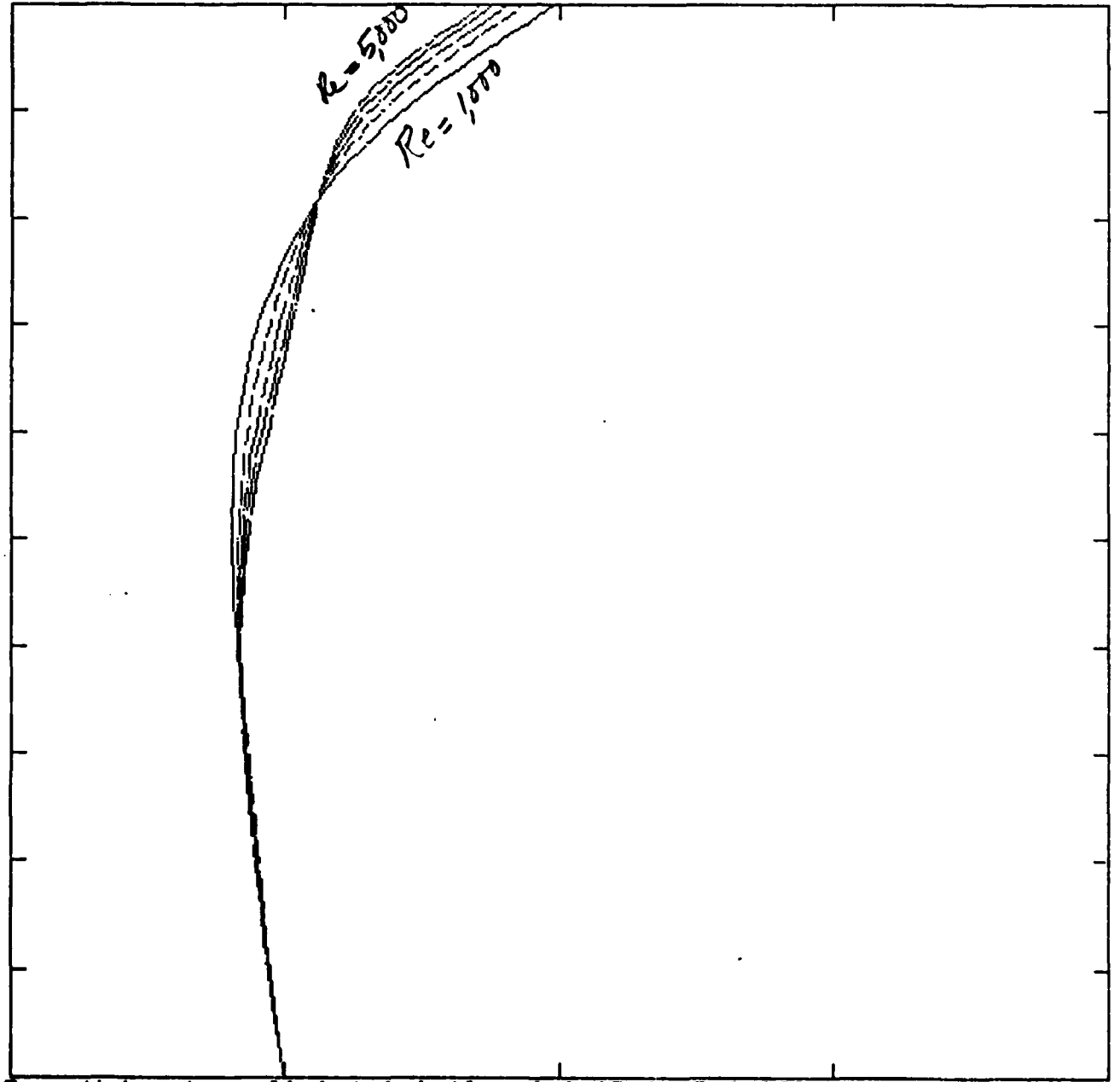
$Pr = 1$

3b

1.0

0.5

0.0



Core Velocity y: [0.0, 1.0, 0.1] x: [-0.05, 0.15, 0.05]

-0.05

0.0

0.05

0.1

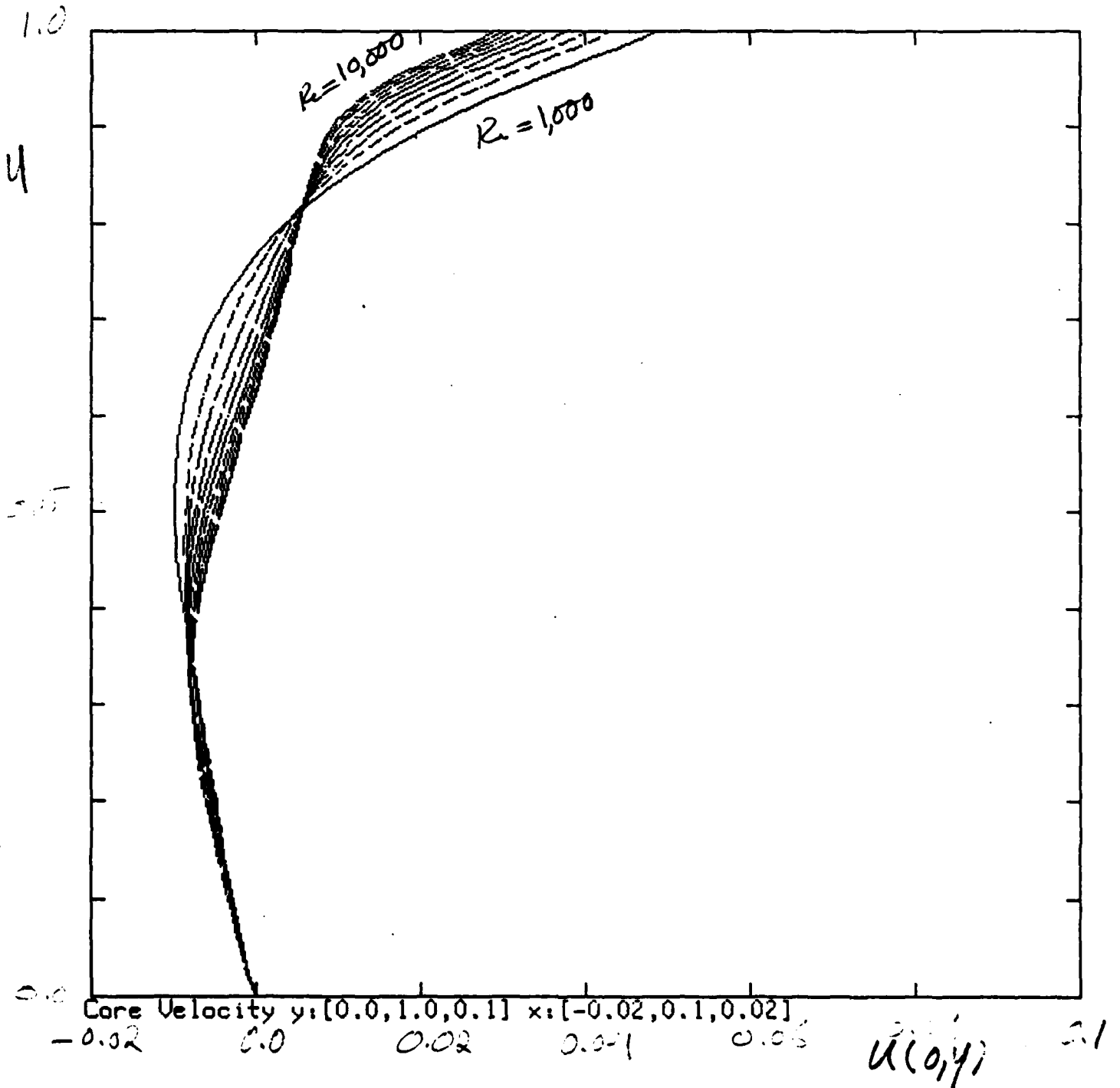
0.15

$u(0,y)$

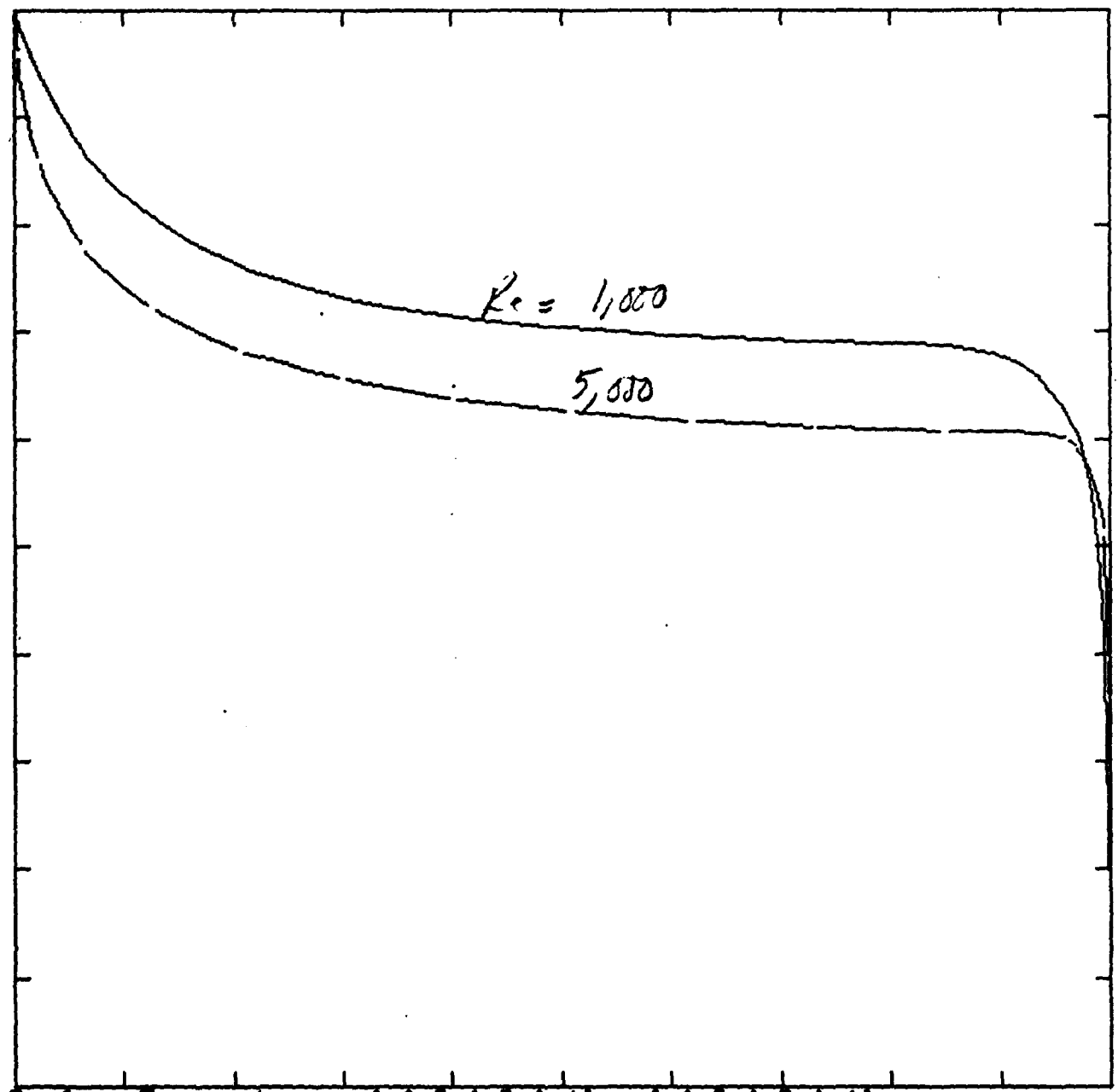
$Pr=1$

62 x 54

$Pr=1$ 32



$Pr = 10$

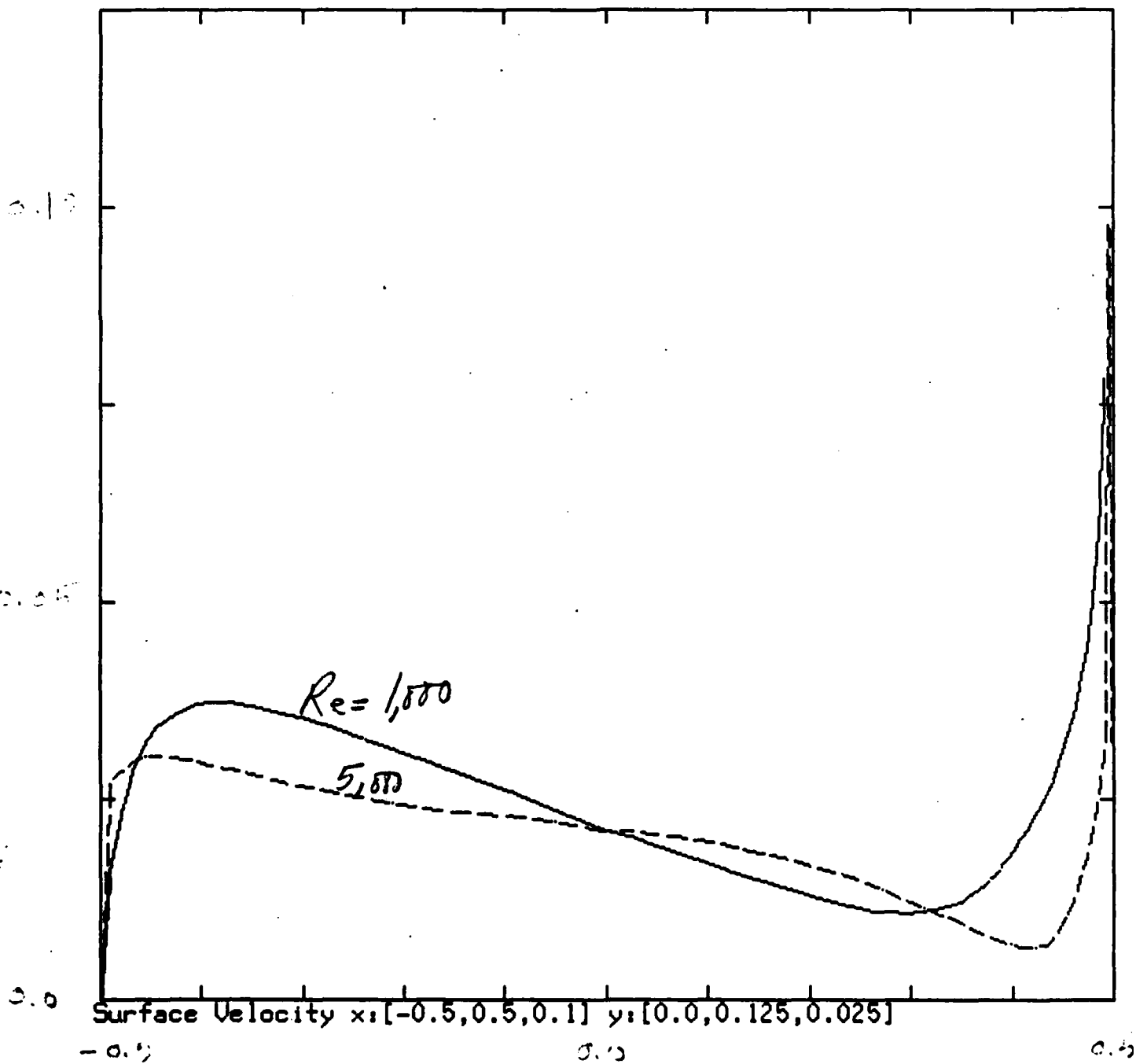


Surface Temperature x: [-0.5, 0.5, 0.1] y: [-0.5, 0.5, 0.1]

-0.5

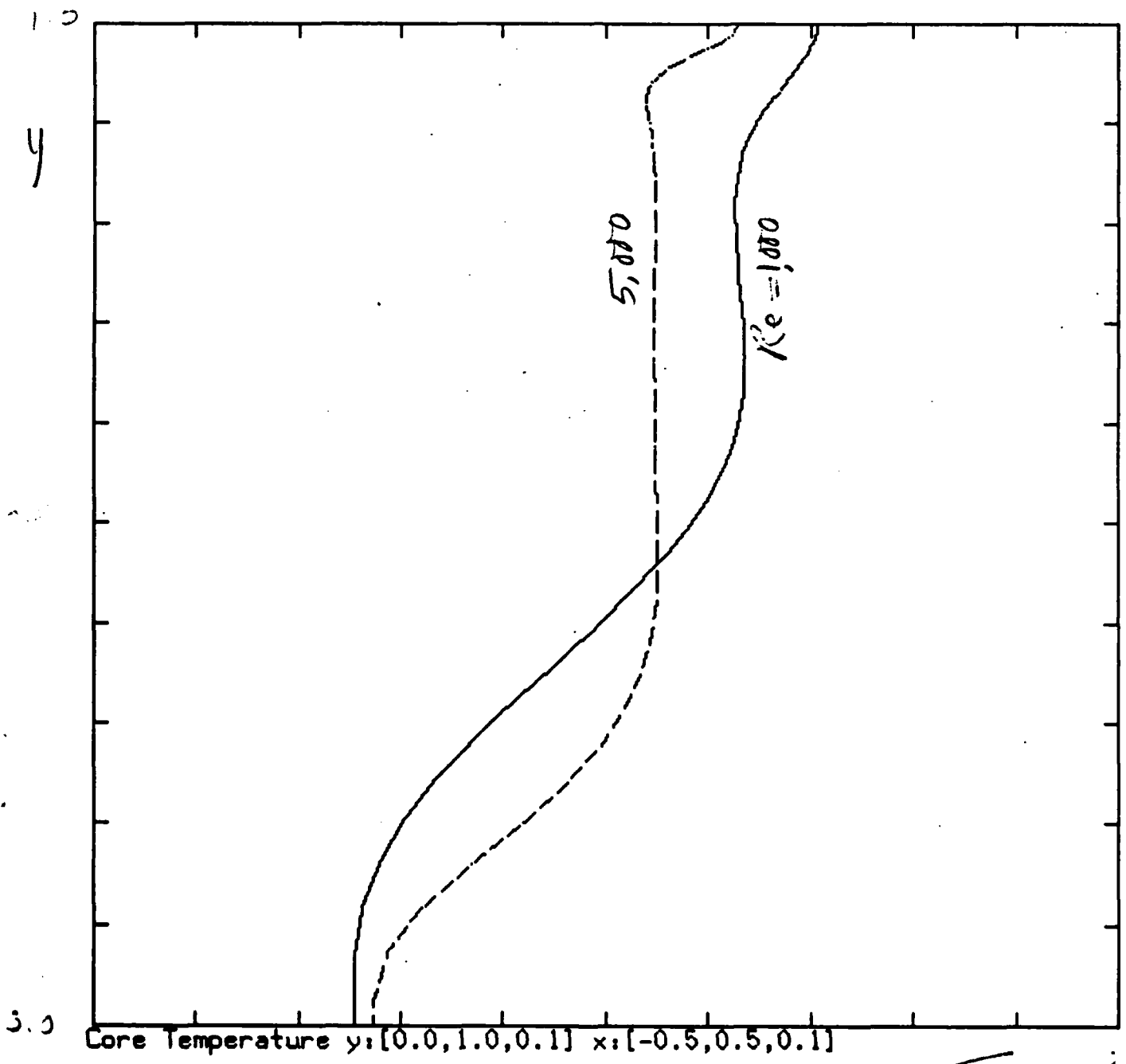
0.0

0.5



$Pr=10$

4c

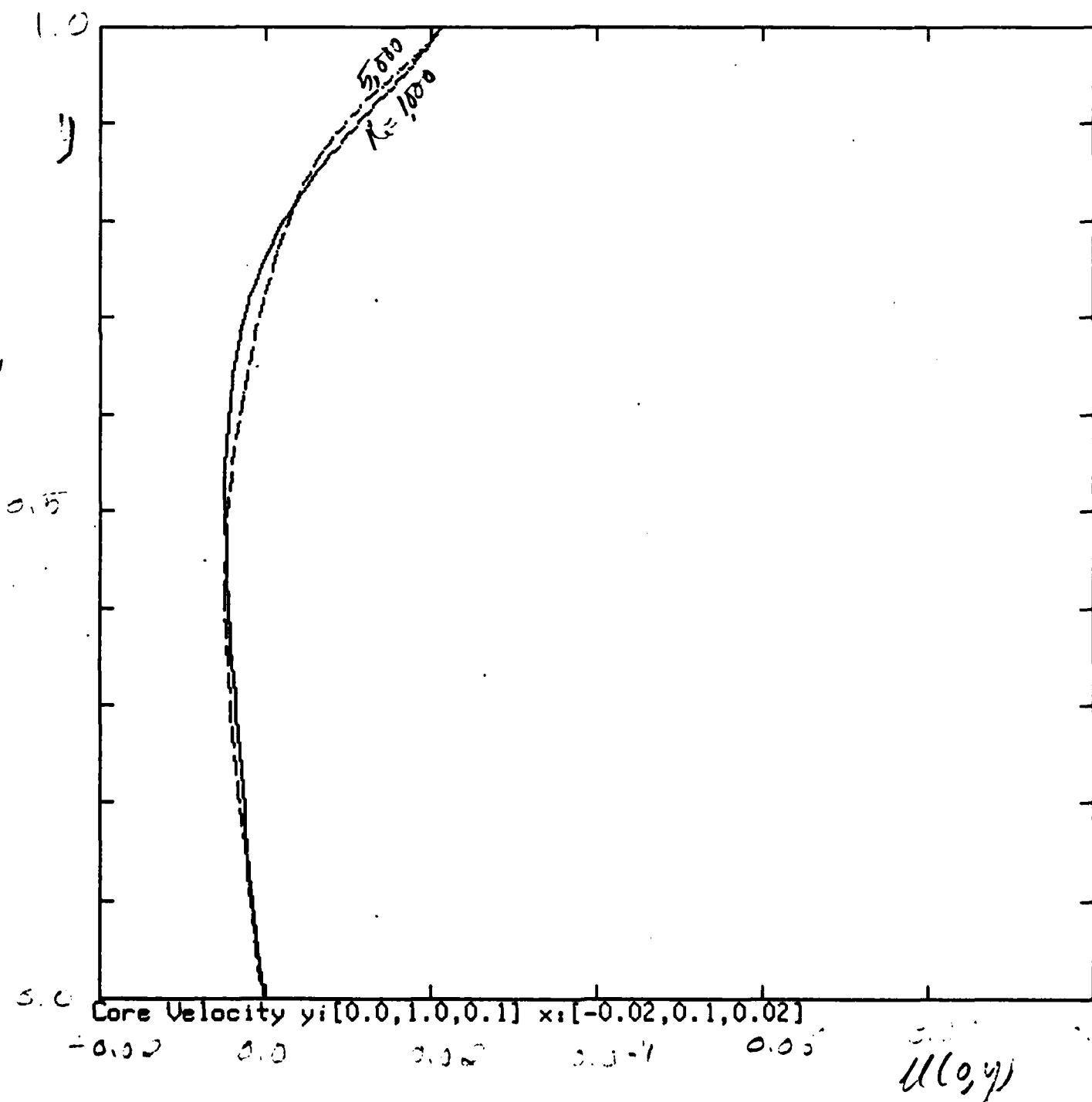


-0.5

0.0

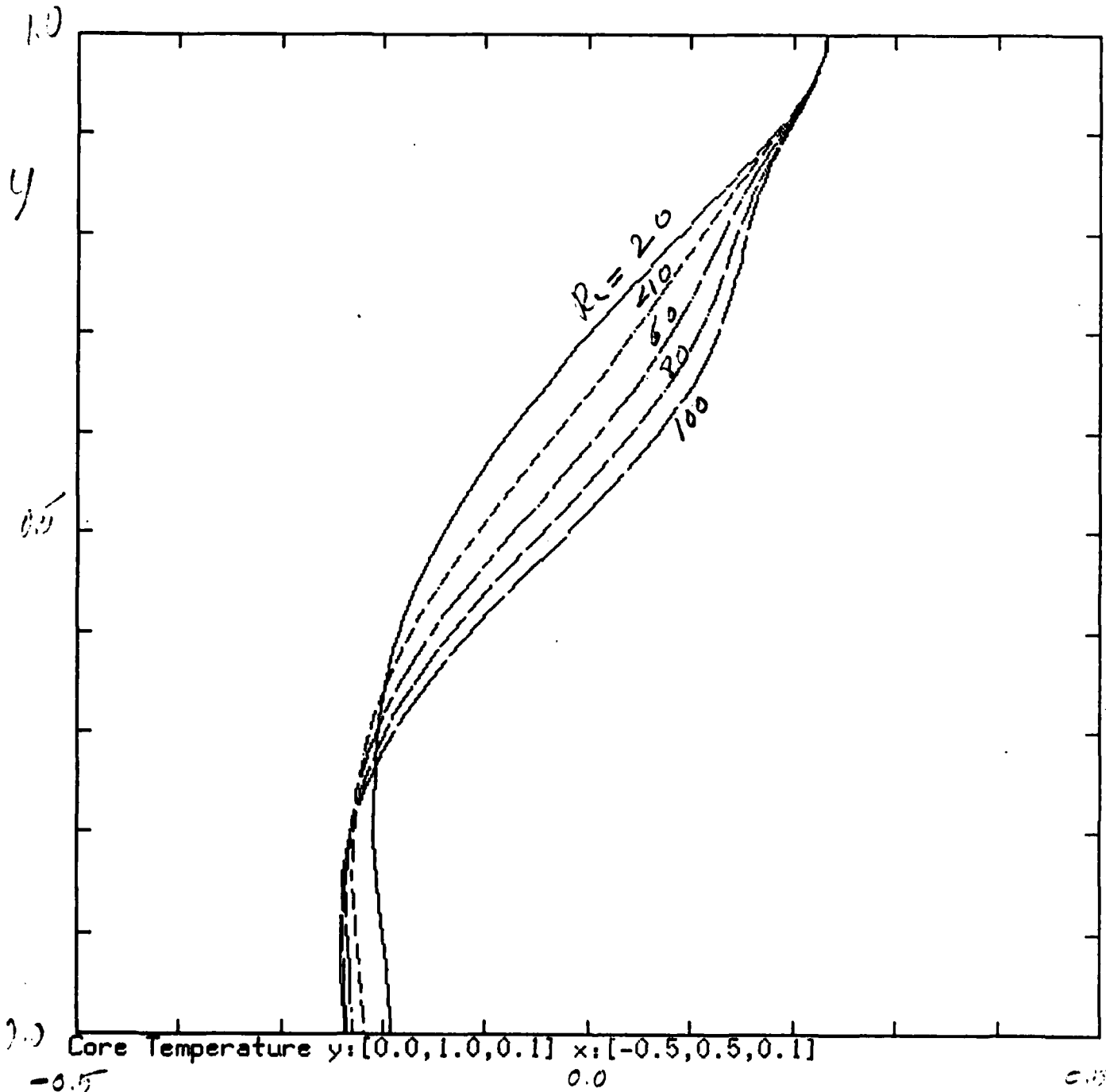
$T(0,y)$

$$Pr = 10$$



$Pr = 50$

5a

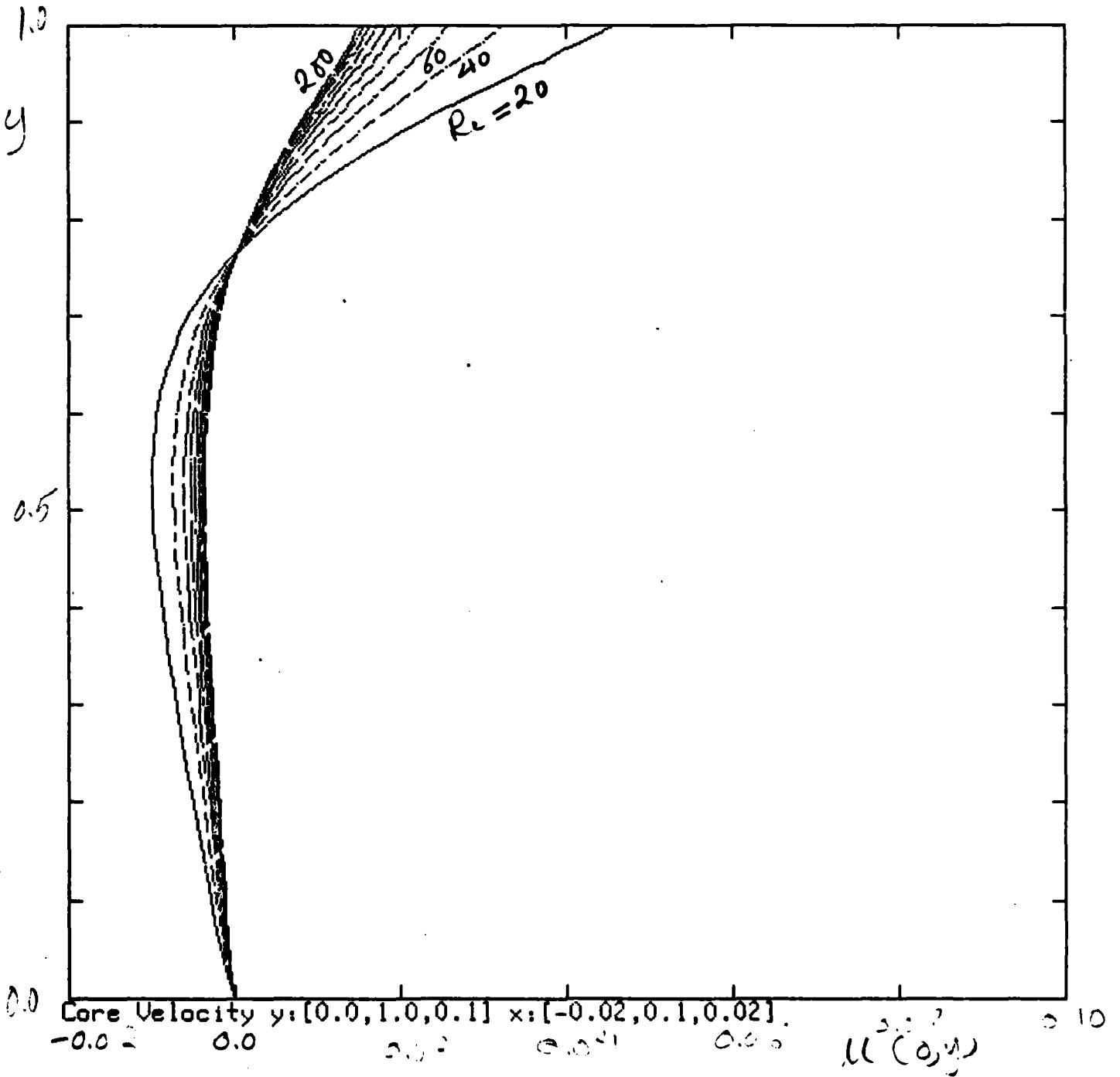


$T(x, y)$

0.15

$Pr = 50$

$Re = 20, 40, 60, 80, 100,$
 $120, 140, 160, 180, 200$



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