Aspect Ratio / Elongation Studies

C. Kessel
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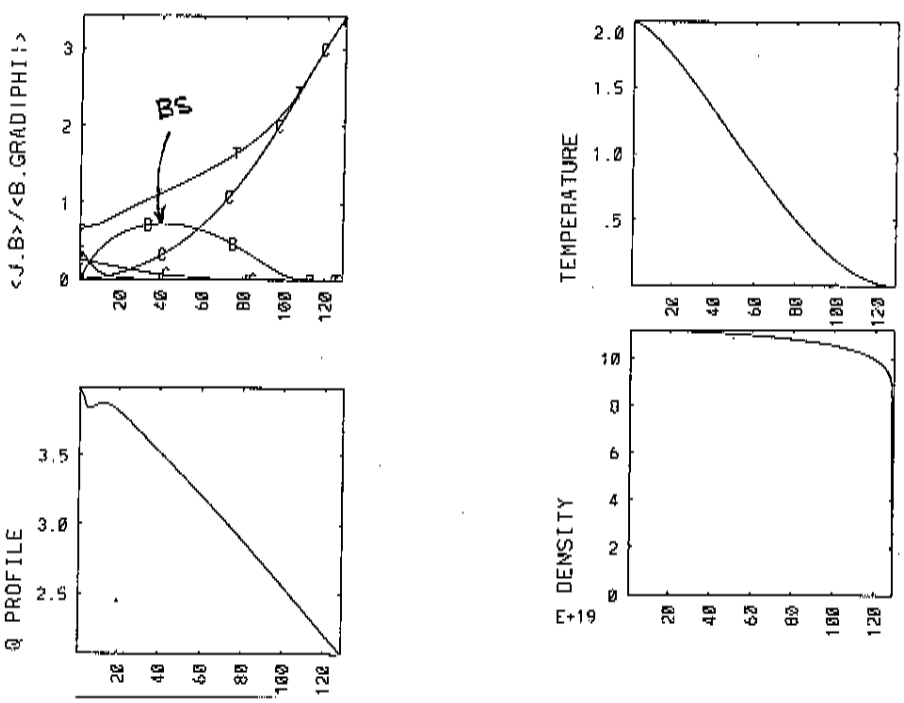
- examining $\bar{R}/\bar{a} = 4.5 - 5.5$ ($\bar{R}/\bar{a} = 3.4$ for C82)
  - assume constant volume
  - assume $B_\varphi(R=\bar{R})$ fixed at 1.1 T
  - assume similar $i(s)$ as C82, use axisymmetric equilibrium to calculate I_{bs}, collisional with $T(0) = 2$ keV at $\beta = 4\%$



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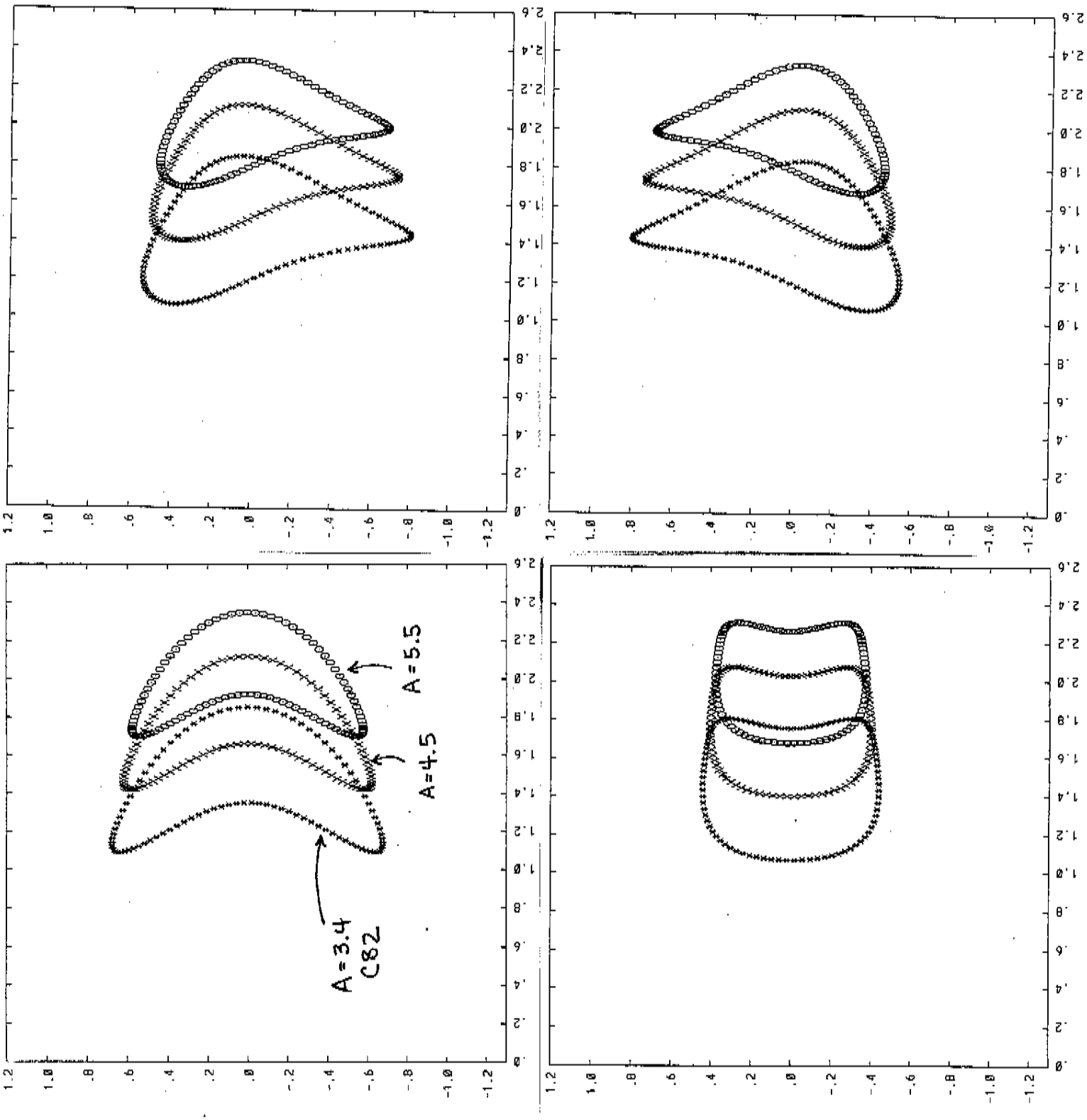

$\bar{R}/\bar{a}$	$\bar{R}$	$\bar{a}$	$\bar{R}B_\varphi$	$I_{bs}^{collisionless}$	$I_{bs}^{collisional}$
3.4	1.46 m	0.43 m	1.66 m-T	250 KA	204 KA
4.5	1.76	0.39	2.00	234	175
5.5	2.0	0.36	2.27	229	145

- optimization of $A = 4.5$ case

  - $\beta = 4\%$ kink stable
    almost ballooning stable (1 unstable surface)
    $B_{mn} < 1\%$ at $s = 0.5$
    $i(a) = 0.49$, $i(0) = 0.333$, $i(\min) = 0.33$

  - $\beta = 4.2\%$ kink stable
    almost ballooning stable (1 unstable surface)
    $B_{mn} \leq 1\%$ at $s = 0.5$
    $i(a) = .495$, $i(0) = .292$, $i(\min) = .290$

  - strong square shaping because of large prescribed current leading to weak $d\iota/ds$ near edge

  - coil complexity measure is higher than C82

  - examining lower current & β variation

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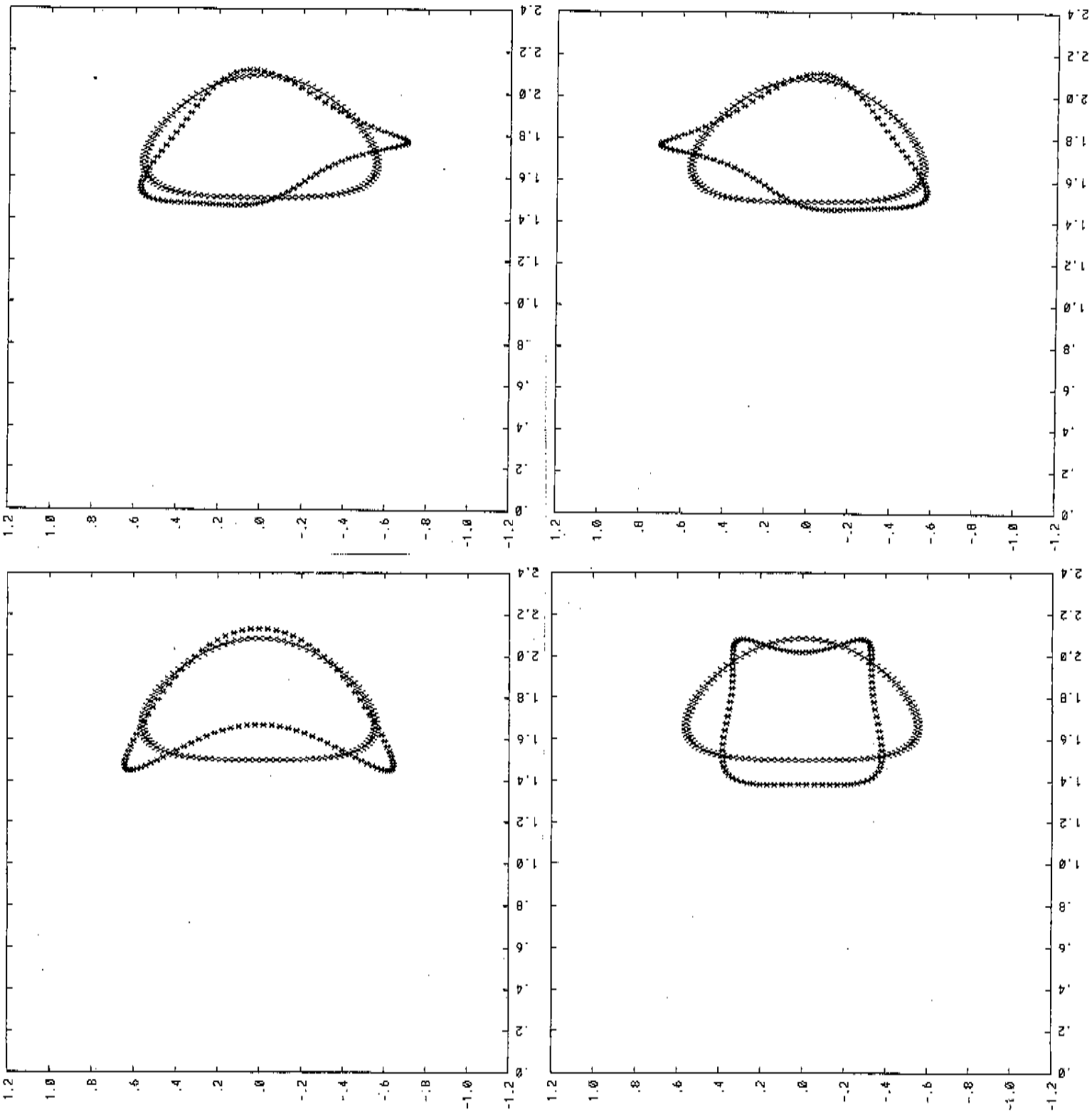

A=4.5

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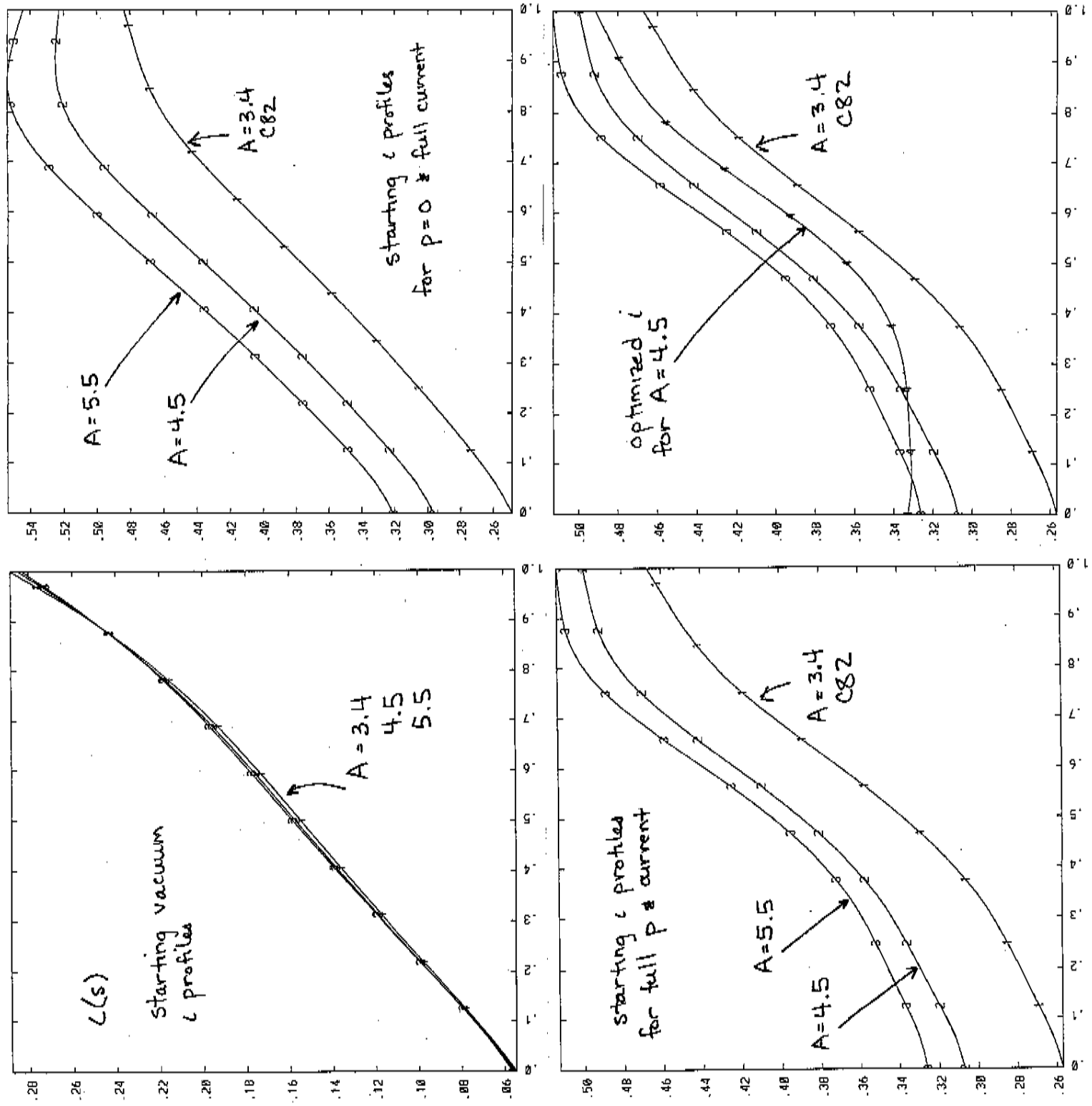
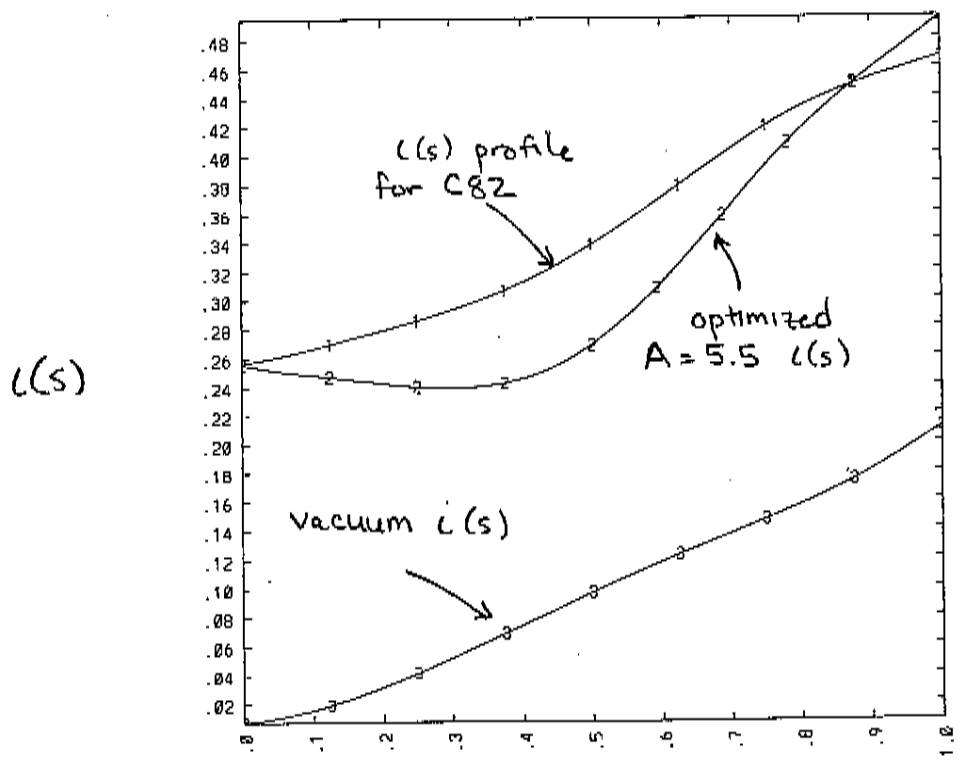

starting vacuum
ι profiles
A = 3.4
4.5
5.5
starting ι profiles
for full P & current
A=5.5
A=4.5
A=3.4
C82
optimized ι
for A=4.5
A=3.4
C82
starting ι profiles
for P=0 & full current
A=5.5
A=4.5
A=3.4
C82

(6)

- optimization of $A = 5.5$ case
  - $\beta = 4.1\%$ kink stable
    almost ballooning stable (1 unstable surface)
    $B_{mn} < 0.5\%$ at $s = 0.5$
    $i(a) = .495$, $i(0) = .256$, $i(\min) = .239$
  - some level of square shaping over C82 shape
  - non-monotonic $\iota(s)$ profile due to attempts to keep $\iota(a) < 0.5$, shifting entire i_{ext} profile down
  - coil complexity measure is higher than C82



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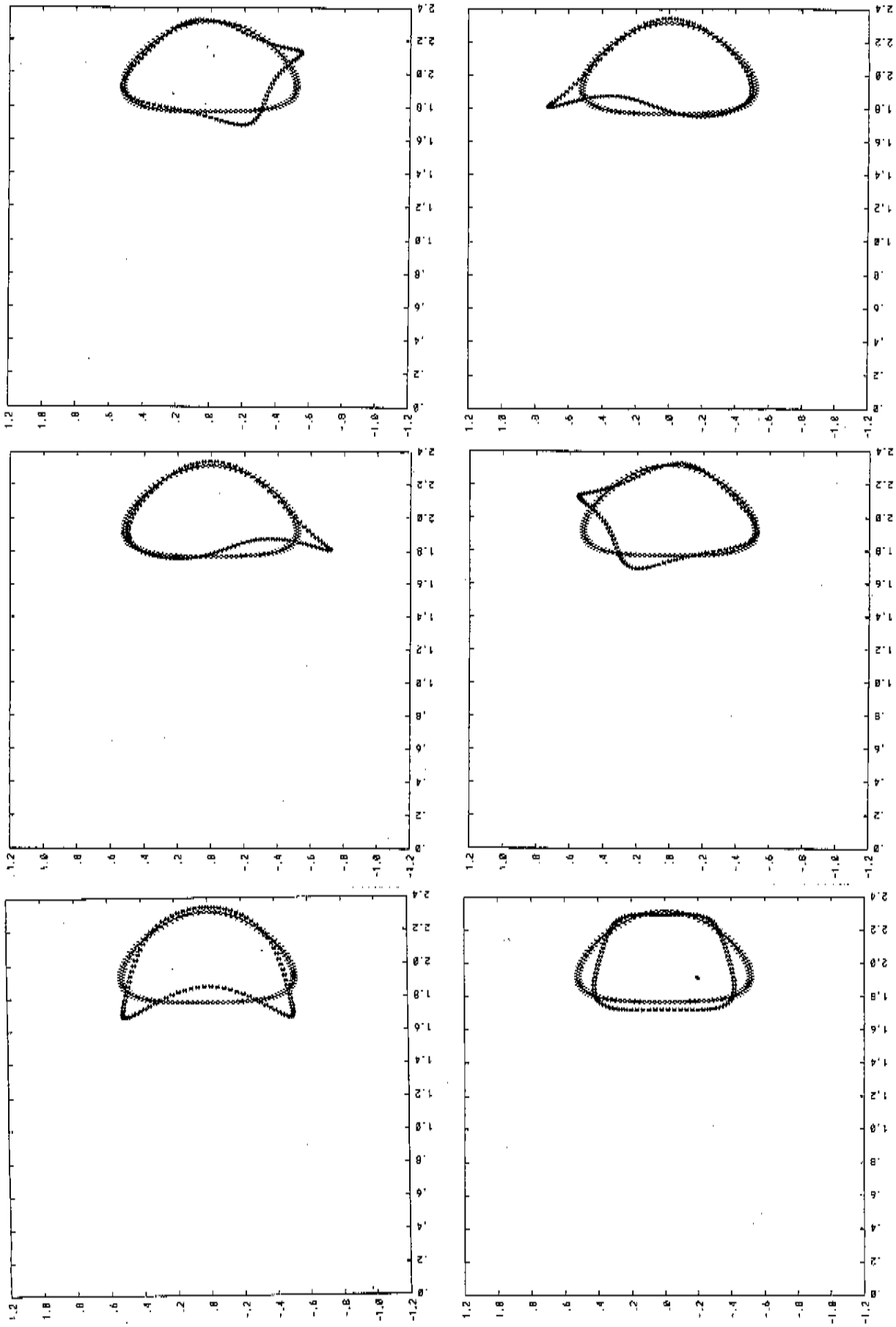


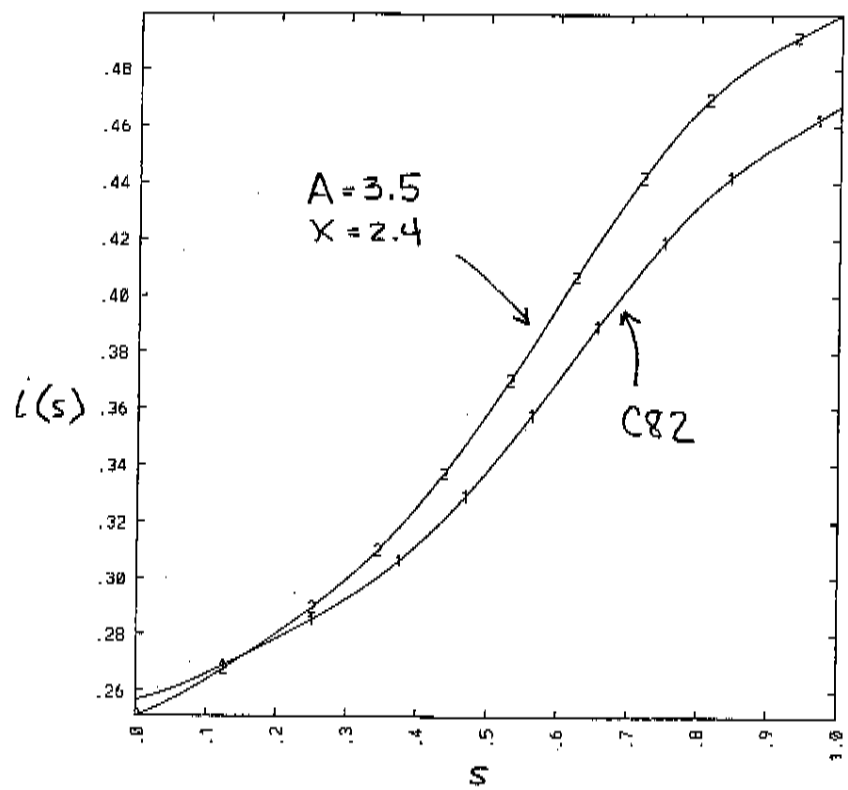
A=5.5

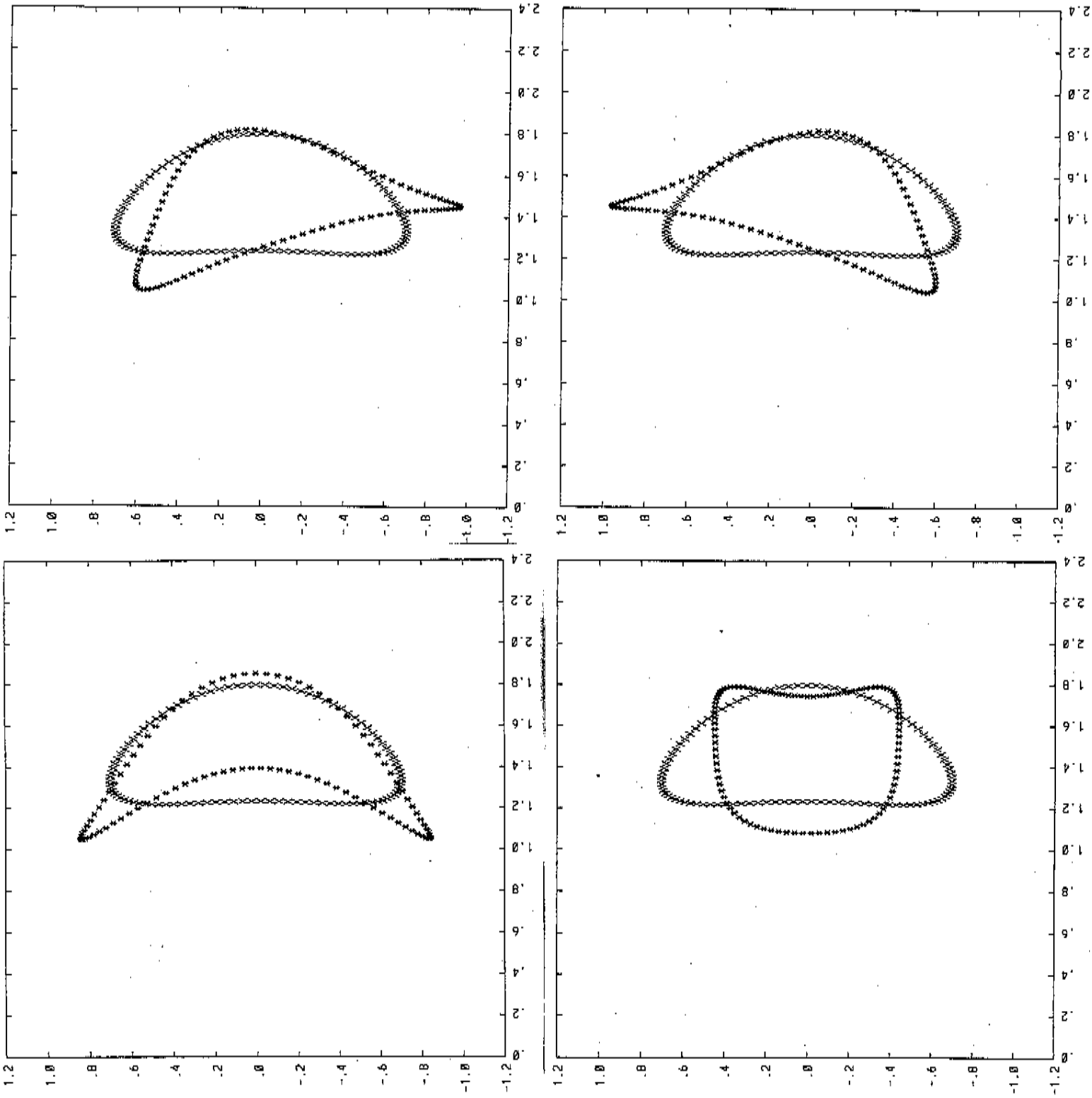
(8)

- $A = 3.5$, $\kappa = 2.4$ optimization

  - I_{bs} determined to be 225 KA from axisymmetric calculation, same assumptions as previously

  - $\beta = 5.25\%$ kink stable
    ballooning stable
    $B_{mn} < 1\%$ at $s = 0.5$
    $i(a) = 0.499$, $i(0) = 0.25$ monotonic





A=3.5
X=2.4

- how do we compare plasmas at different aspect ratios, with different shapes, periods, etc.

  - achevable β
  - thermal energy confinement
  - fast particle confinement
  - coil impact / complexity of plasma shape
  - surface quality

  - constraints / do these make sense for NCSX
    - $\iota(s)$ monotonic increasing everywhere ??
    - I_{total} forced to bootstrap consistent ??
    - profiles for pressure & $I(s)$??