FERMILAB-LU-124

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Modular Optics for 400 MeV Linac

September 16, 1988

I have adopted the following guidelines —

- Each RF power module has same basic optical design. ⇒ double waists at each interface

- Use one or few different focusing strengths.

- Evolve module design in steps from thin lens fodo channel.

Principal Differences from Reference Design

- New results on $ZT^2(\beta)$, $E_m(\beta)$, and $T(\beta)$ from L. Larry based on Lloyd Young's $\beta = 0.566$ cell

- Restriction on number of quad strengths — accomodate PMQ's or hybrid Q's

- Scaling of intermodule spacing with β for smoother beam optics

- Formalization of design scheme

- Doublet based transition section for greater matching range — a new option

Basic Properties of Modules

The new linac is to be segmented into 7 modules each consisting of 4 RF tanks interconnected by bridge couplers.

- Power consumption inc. beam, coupling, and surface imperfection 10 MW
- Spacing between RF tanks in adjoining modules $5\frac{\beta\lambda}{2}$
- Bridge couplers within module $3\frac{\beta\lambda}{2}$
- One quad between each tank
- Aperture 1.5 cm established by RF structure

Design Steps

- Find number of cells to get from T_i to T_f using $T(\beta)$ and E_0 fixed by one of three criteria
  - $E_0 = E_{max}/E_m(\beta)$
  - power per cell fixed using $ZT^2(\beta)$
  - power per meter fixed using $ZT^2(\beta)$

  Remember that longest possible structure uses least power.

- Establish number of tanks per module by finding mimimax $\beta_{x,y}$ as function of distance from waist

- Get iteratively the $E_0 \rightarrow E_0(\bar{\beta}) = \Delta T$ for each tank of cells of length $\beta\lambda/2$

- Adjust E_0's to equalize power/module

- Locate non-accelerating tanks of same RF defocusing strength symmetrically in cell and find Q's for minimax $\beta_{x,y}$ at T_i

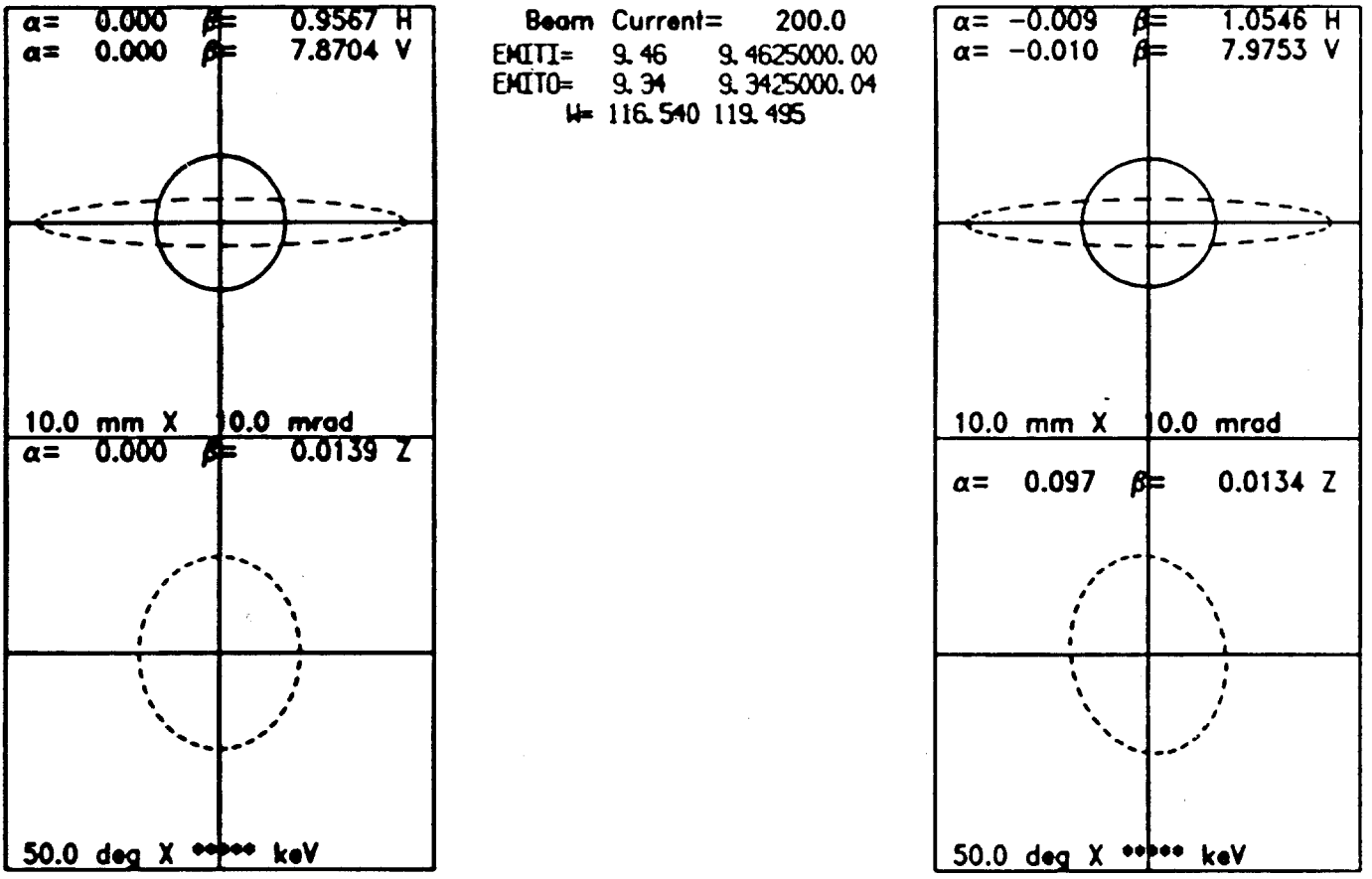
- Locate non-accelerating tanks at required location; then one of following

  - find new minmax β for all Q's as foun above

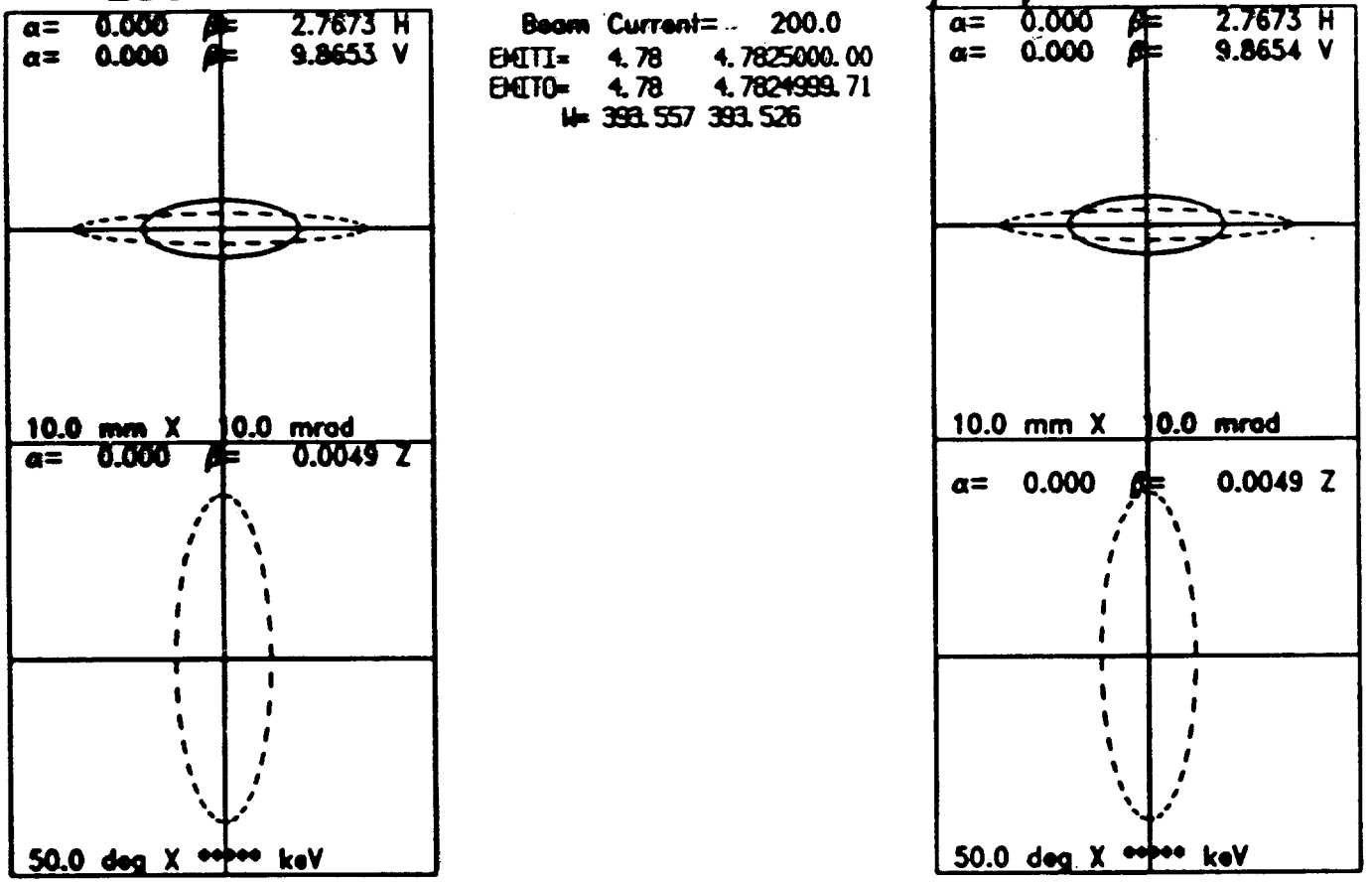
  - find three new strengths and position of Q_2 giving same β

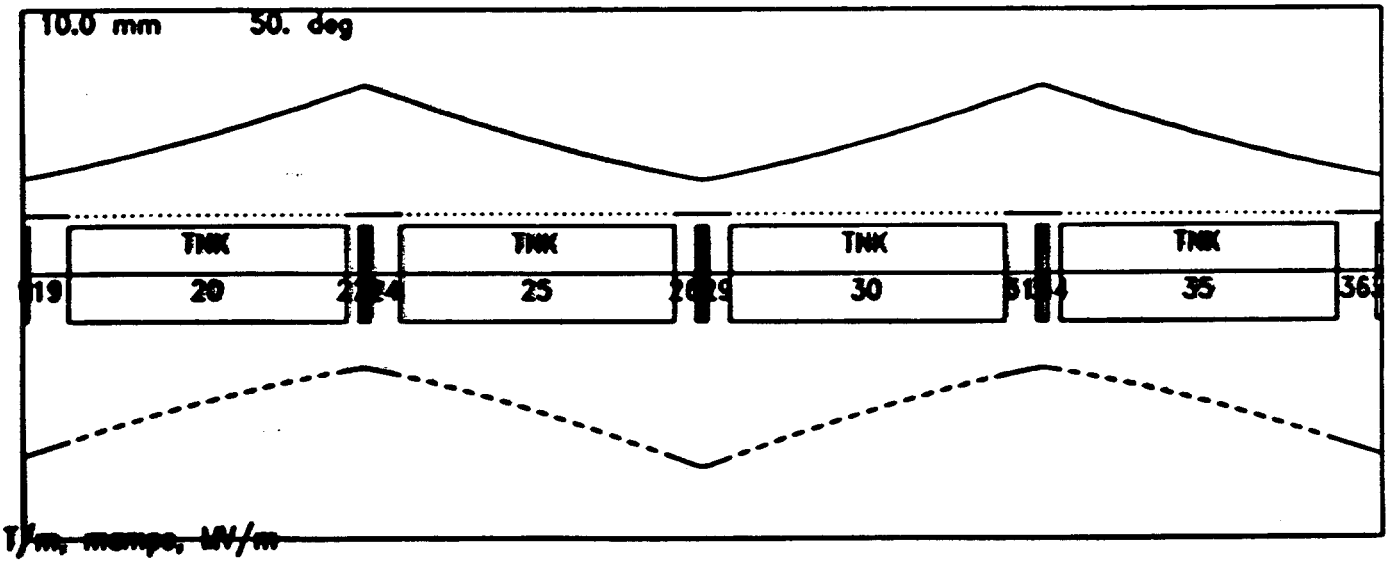
LY805BM: Mimmax Beta

15-SEP-88 15:02:43



LY805BM3: Match @ 398 to 116 Opt Q's 14-SEP-88 06:55:45





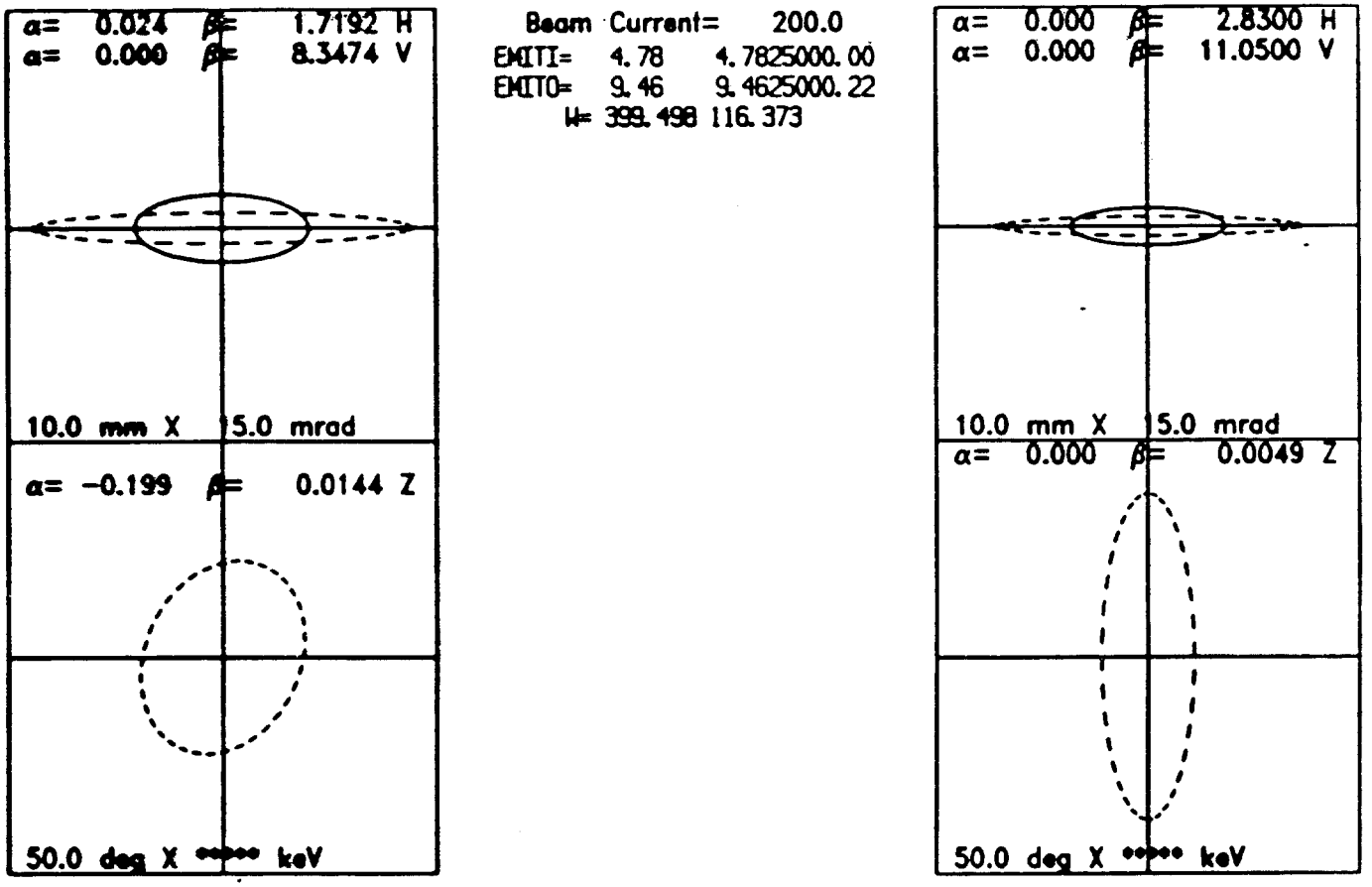
mm, mrad, T/m, mamps, MV/m

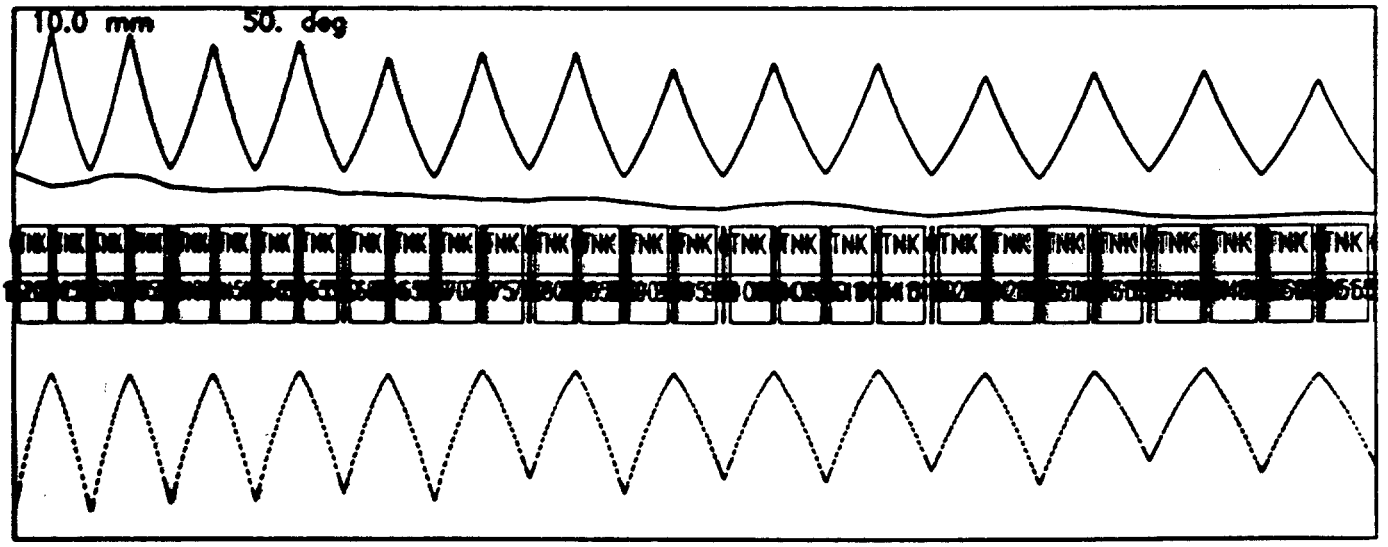
- Check that these Q's used in a linac of constant $\Delta T/\Delta L$ transforms β matched at begining to β predicted for equivalent non-accelerating cell at T_f

- Put these Q's into power optimized structure and trim to double waists at module boundaries using position of interior quads

LY805SS: MATCHED

14-SEP-88 10:49:08





LY805SS: Transition Section

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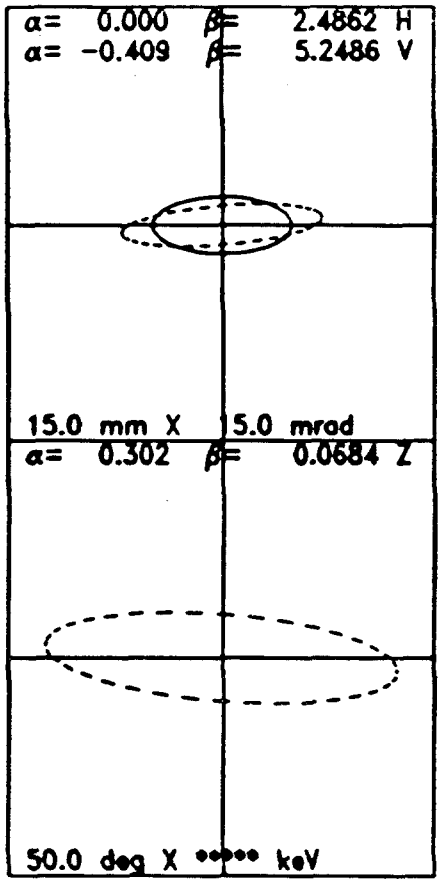

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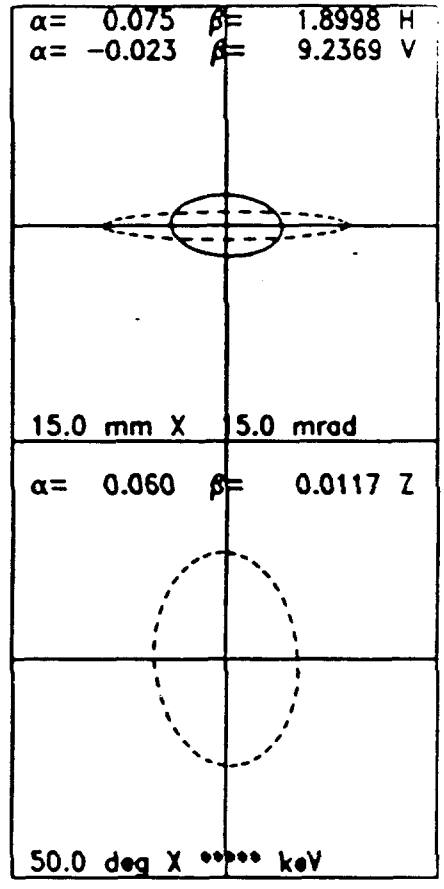
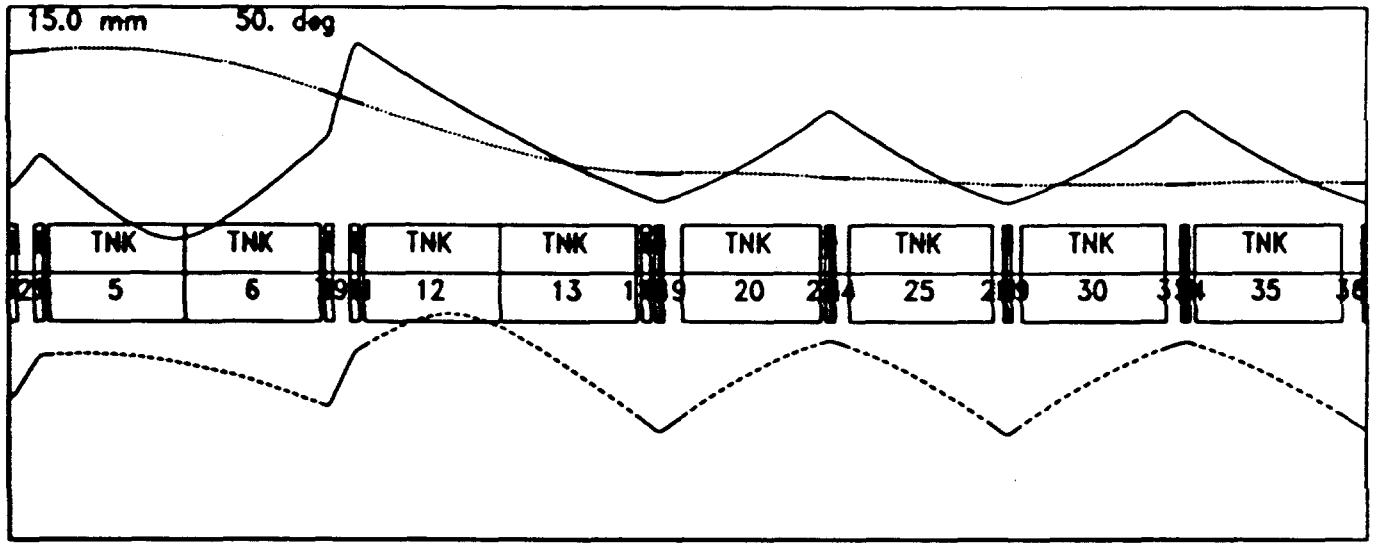
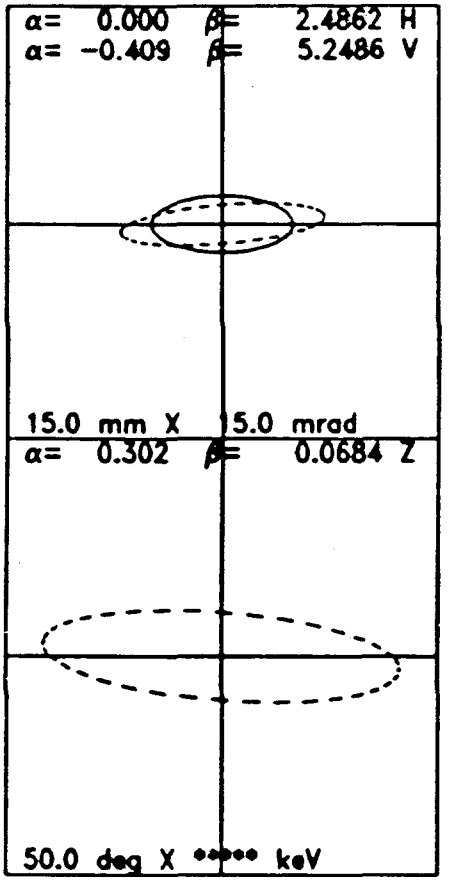
EMITO= 8.31 8.3024999.88
μ= 116.540 148.819





LY805: No Changes from LY805SS Q's 15-SEP-88 07:28:03



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