

QUASI-OPTICAL GRILL FOR CASTOR

Coupling & Density Profiles

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Current drive with 3 GHz at densities as high as possible with N_{\parallel} as low as possible (efficiency $\sim 1/N_{\parallel}$), limited by accessibility.

COUPLING

several modes are excited by the antenna structure. The dominant modes are:

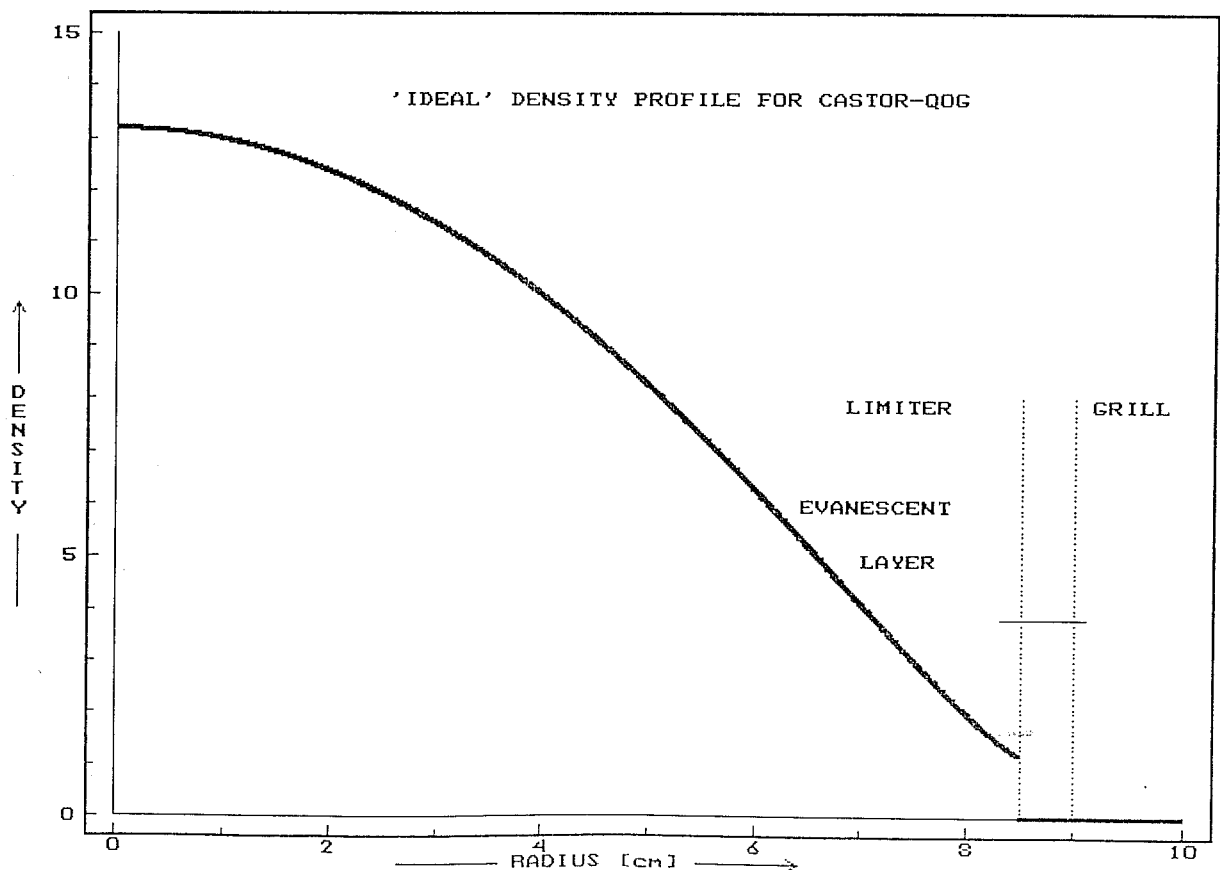
$n=+1$... useful for CD

$n=-1$... parasitic wave

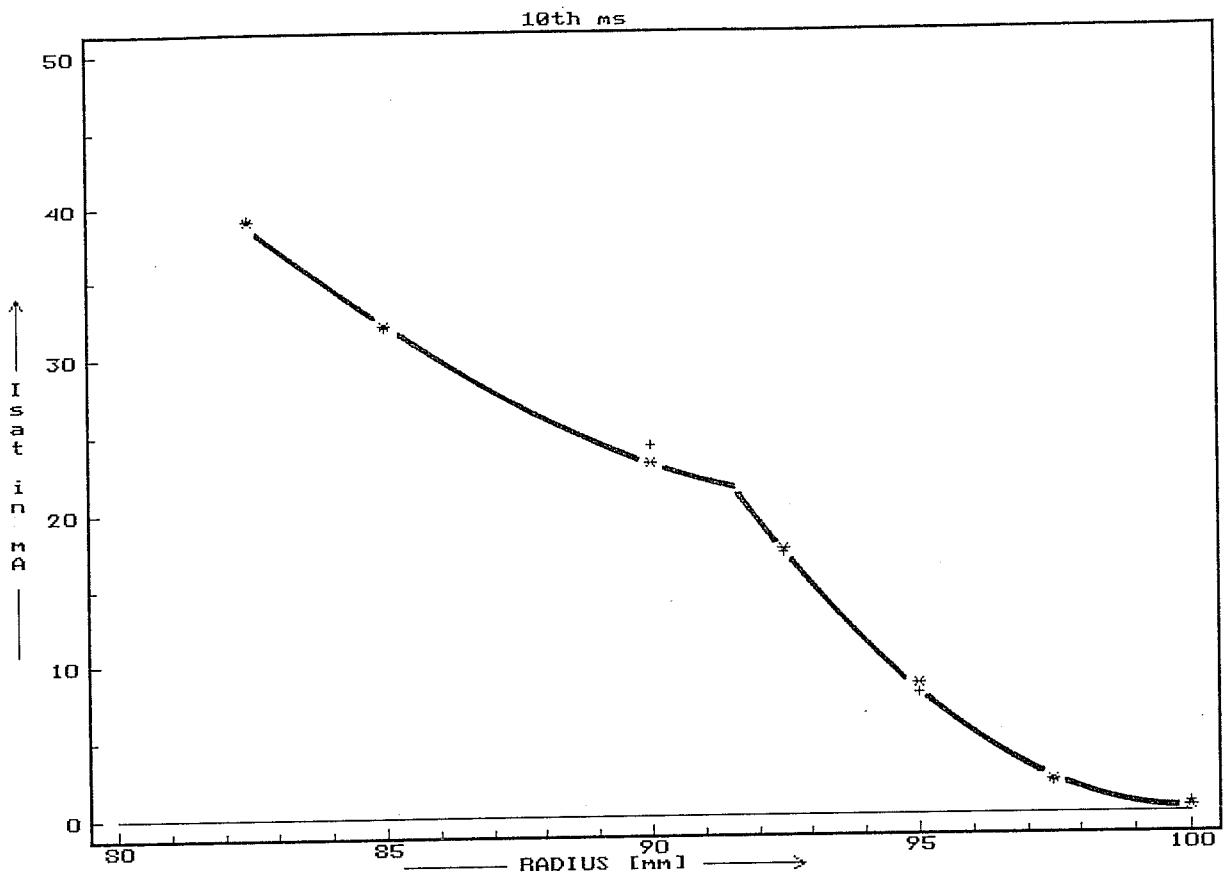
Radial propagation of the modes is controlled by the density profile in front of the QOG.

- Propagation of $n=+1$ mode - Edge density has to prevail a critical density $n_{\text{crit}} \doteq 1.2 \cdot 10^{12} \text{ cm}^{-3}$;
- Suppression of the $n=-1$ mode - A vacuum gap (evanescent layer) as wide as possible should be created in front of the grill!!

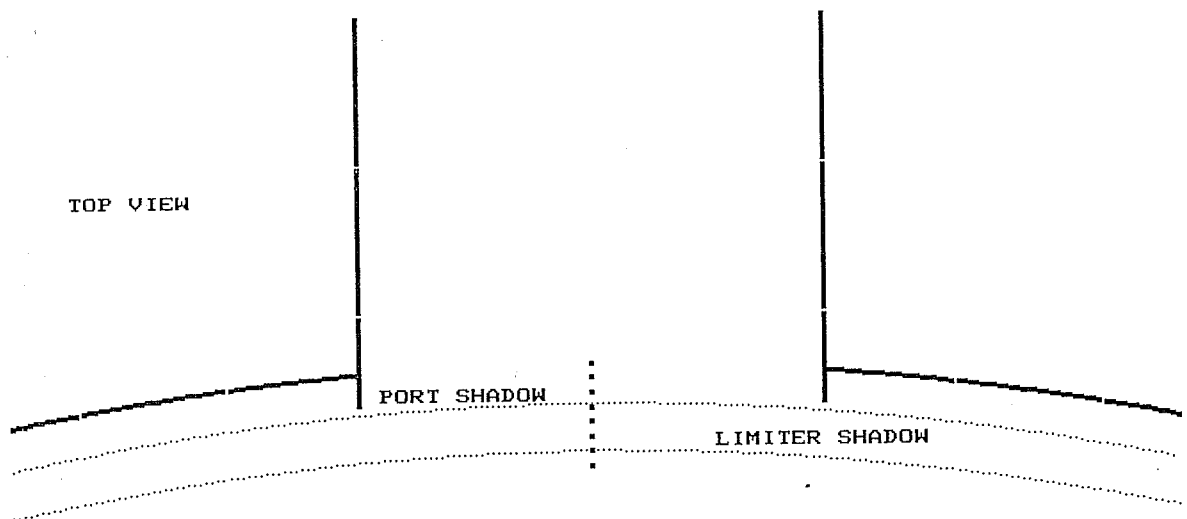
A compromise solution has to be found!!



Radial Profile of Ion Saturation Current (a horizontal port envisaged for the QOG)

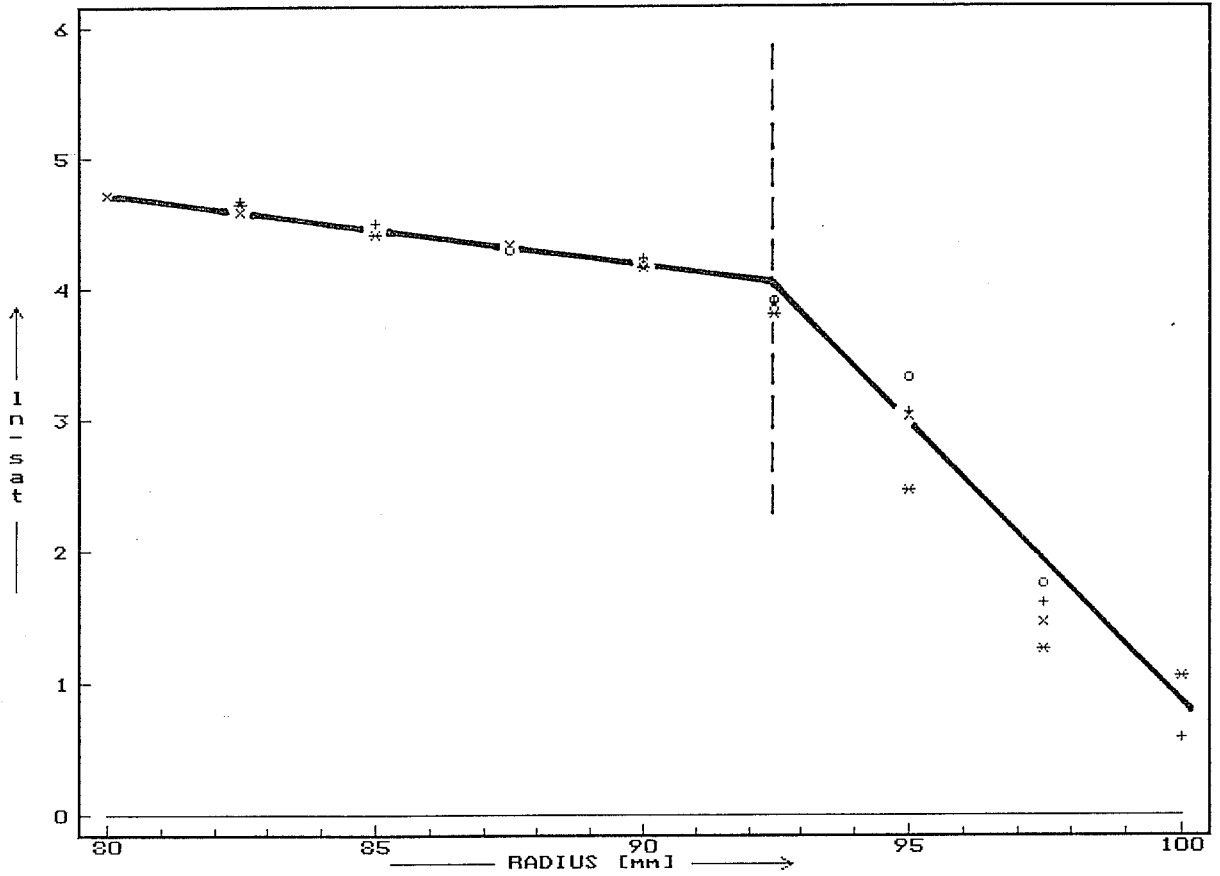


Geometry of the horizontal port (schematically)

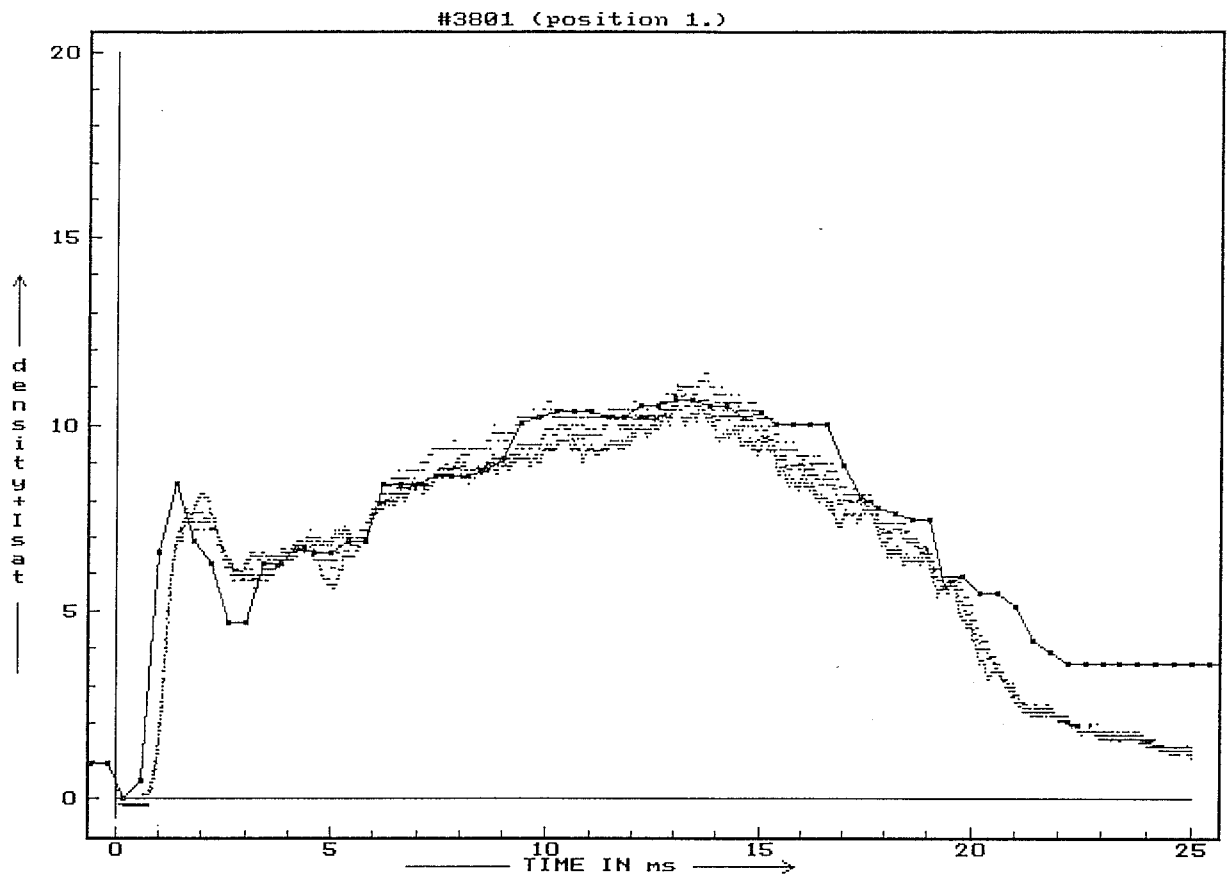


Density Scale Length in SOL

$$\lambda_n = \left(\frac{dn}{dr} \cdot \frac{1}{n} \right)^{-1}$$



Edge Density Control by Gas Puffing

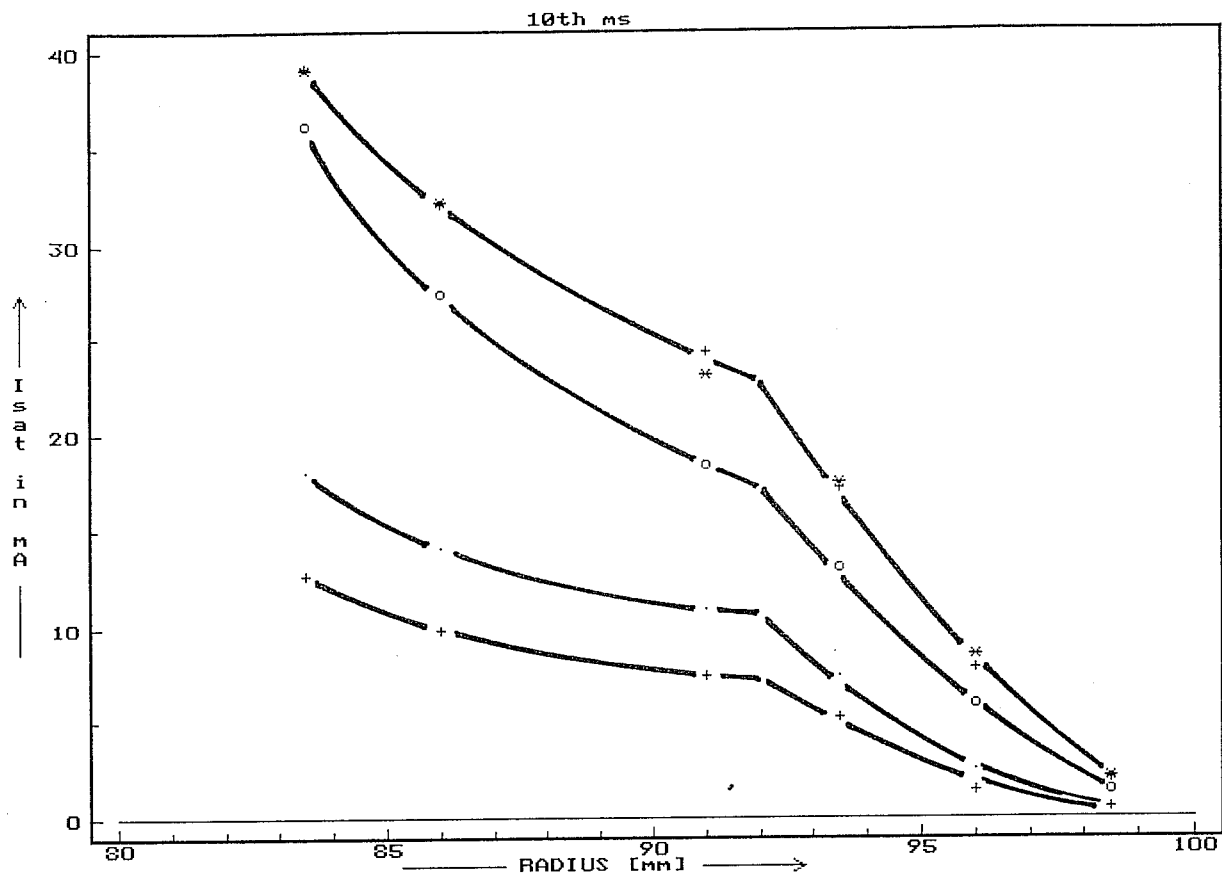


Full line - line average density

Dotted lines - ion saturation current at $r = 82, 90$ and 95mm
(normalized to \bar{n}_e)

- Edge density follows the core density
- Edge density profile remains unchanged with gas puffing

Edge Density Control by Vertical Fields



Radial plasma position is feedback-controlled

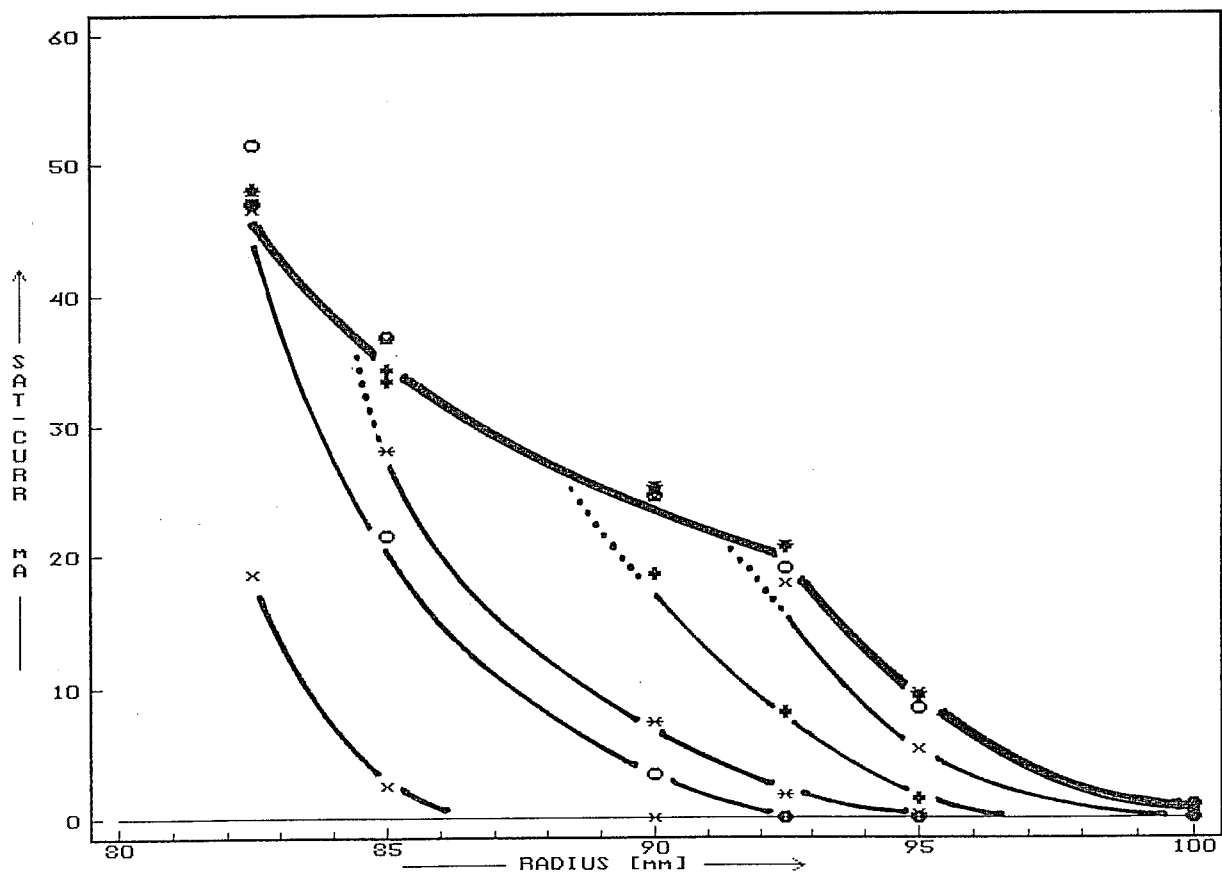
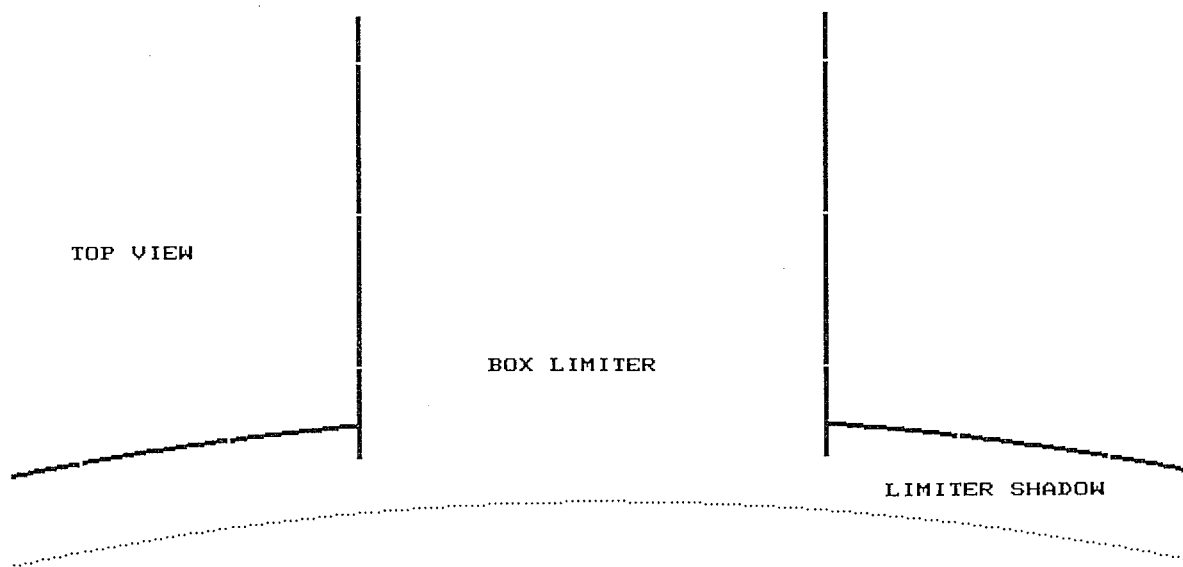
Here: 1, 2, 3, 4, 5 - five different values of the pre-programmed vertical field.

1 - the most outward displacement (close to QOG)

5 - the most inward displacement

Density scale length remains unchanged with the displacement!

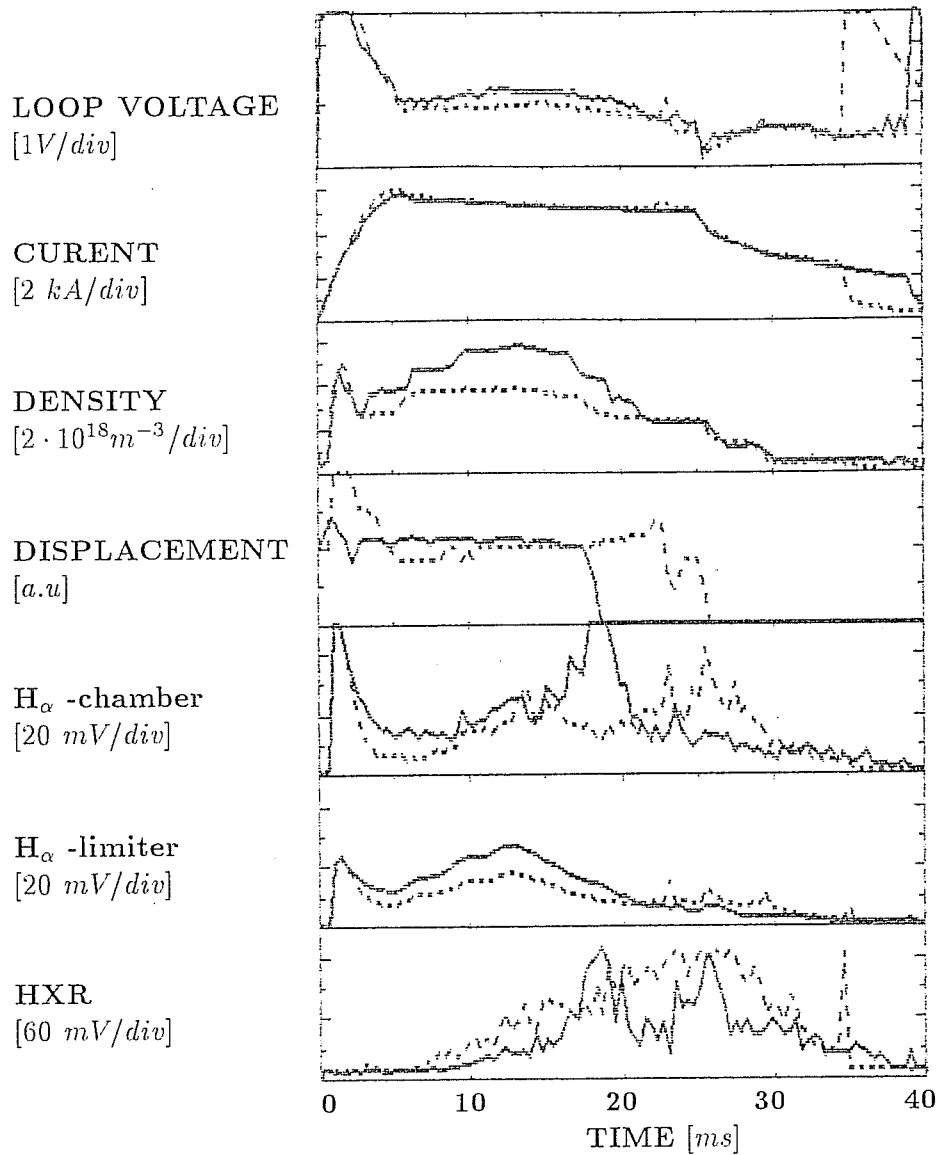
Edge Density Control by a Box Limiter



Evolution of a CASTOR shot

#3801

#3802



full lines - the most outward displacement (pos. 1)

dashed lines - the most inward displacement (pos. 5)

SUMMARY

- The rake probe allowing to measure the edge density profile in a single shot was developed.
- Densities above the critical value for 10 GHz ($n_c = 1.25 \cdot 10^{18} \text{ m}^{-3}$) can be simply reached in CASTOR.
- Density in front of the grill can be controlled by gas puffing and/or by a displacement of the plasma column.
- The density scale length is typically 1.5-2 cm close to the limiter radius (comparable with the SOL-width).
- To create the evanescent layer in front of QOG, an additional limiter (box) can be used. The density scale length inside the box is reduced to 2.5-3 mm in this case.

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