

## **Possible Remedies for Uncoupled Cells**

This is an attempt to summarize the discussions we have had on how to eliminate or mitigate the problem caused by the last four cells (counting the fundamental output coupler) at the output end of the structure which are not coupled to the manifold in our present design. With these 4 cells not coupled the last 5 modes are poorly damped having Q's in the range from about 3000 to about 6000. These modes can significantly degrade the vertical plane emittance of the beam.

I. Make the fundamental mode coupler a good load for the dipole modes trapped in the last few cells.



A. Conventional coupler with 4 output waveguides and broad band loads (1 1-1 6.5 Ghz).

B. Periodic radial line load matched for fundamental and dipole bands: output coupler cell is enlarged to perhaps 15 cm in diameter and designed to be a lossy periodic slow wave radial line.

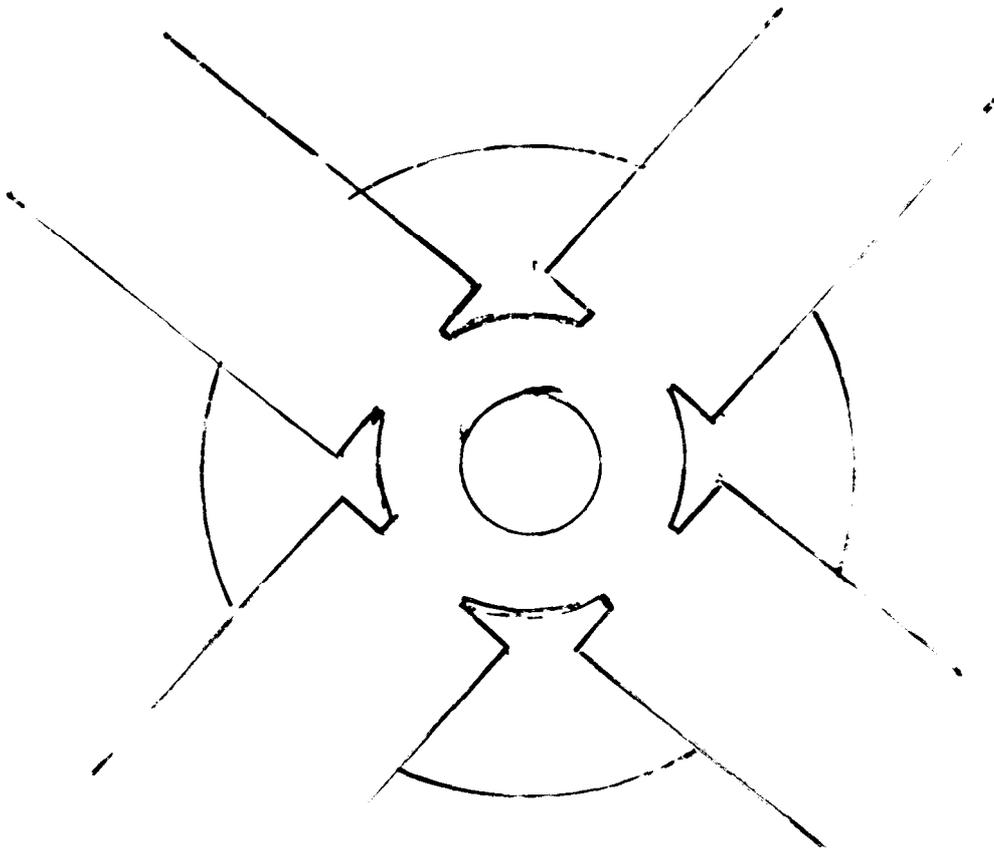
COMMENT: We suspect this approach cannot effectively damp all the problem modes, but it deserves more study. This may be desirable when combined with another solution which damps only the other 3 cells.

II. Individually damp each of the uncoupled cells

A. Put a lossy material (perhaps stainless steel) on the inner edge of the irises.

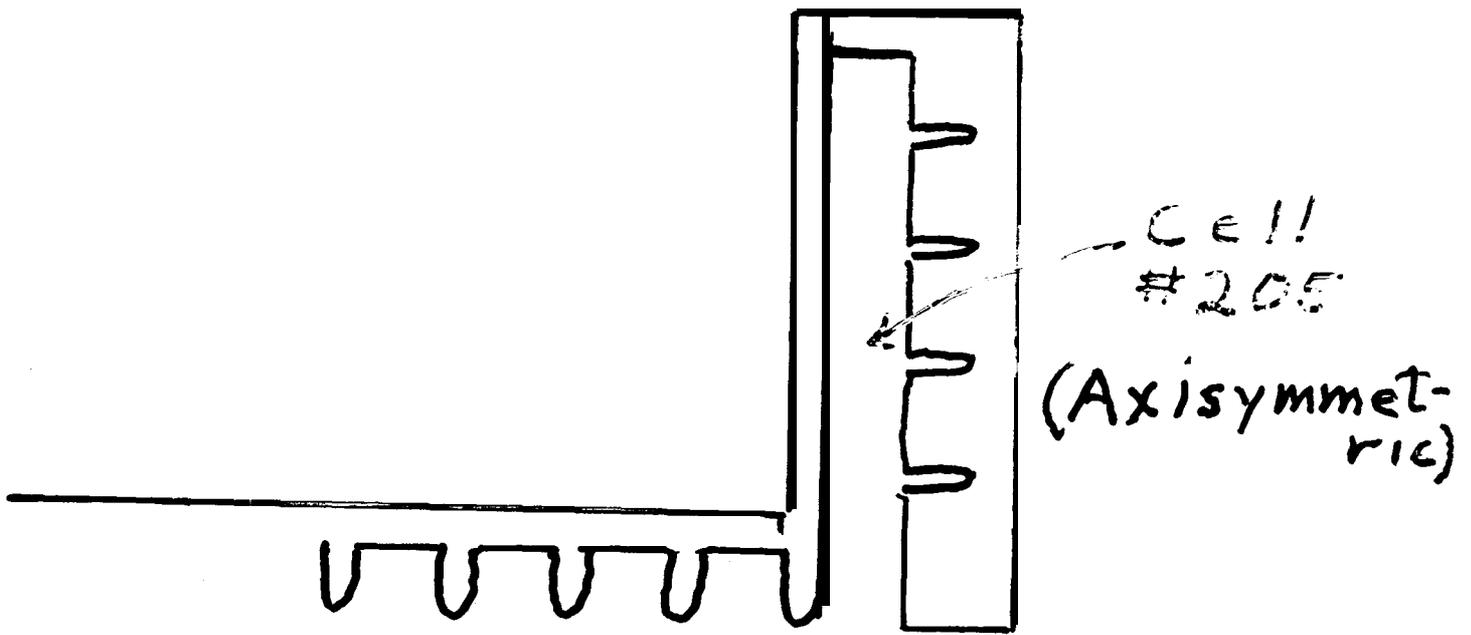
 B. Put highly lossy material (such as SiC) in 4 non-resonant slots in either the outer wall or the outer region of the disks or both.

 C. Couple four lossy dielectric filled resonant cavities to each cell as is often done in



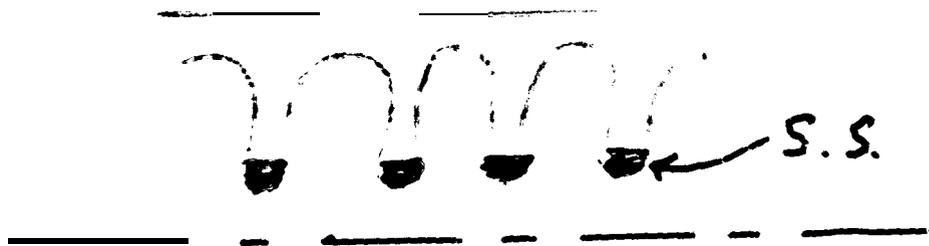
I.A. 4 Output Coupler

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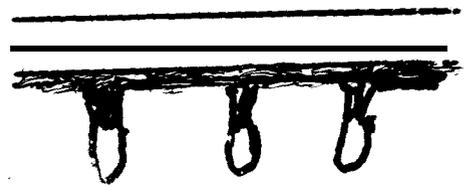
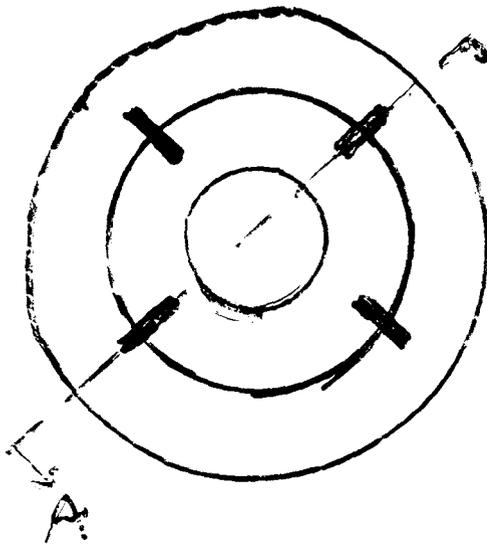
I.B. Periodic Radial Line Load

## II.A. Stainless Steel Loaded irises



## II B Sic in 4 slots

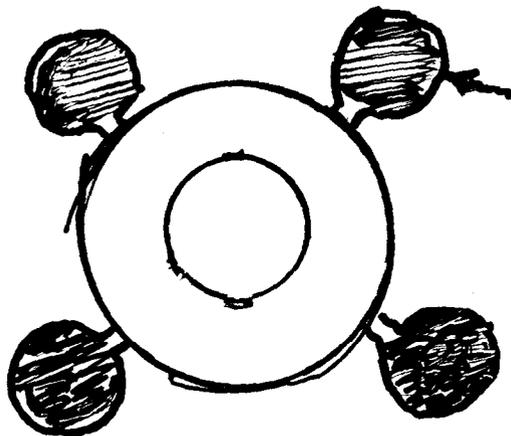
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A-A

## II. C.

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TE<sub>111</sub> Pillbox  
Cavity Filled  
with Lossy  
Dielectric

TWT's and sometimes in klystrons to suppress unwanted modes.

COMMENT: A calculation in which the Q of each the troublesome modes was lowered to 1000 indicates that this would solve the problem. However, lowering the Q of the individual cells does not necessarily lower the Q of the troublesome modes to the same value. The Q of the individual cells may need to be much lower than 1000. This approach looks most promising and should be given the highest priority. I suspect that II. A. cannot achieve low enough Q.

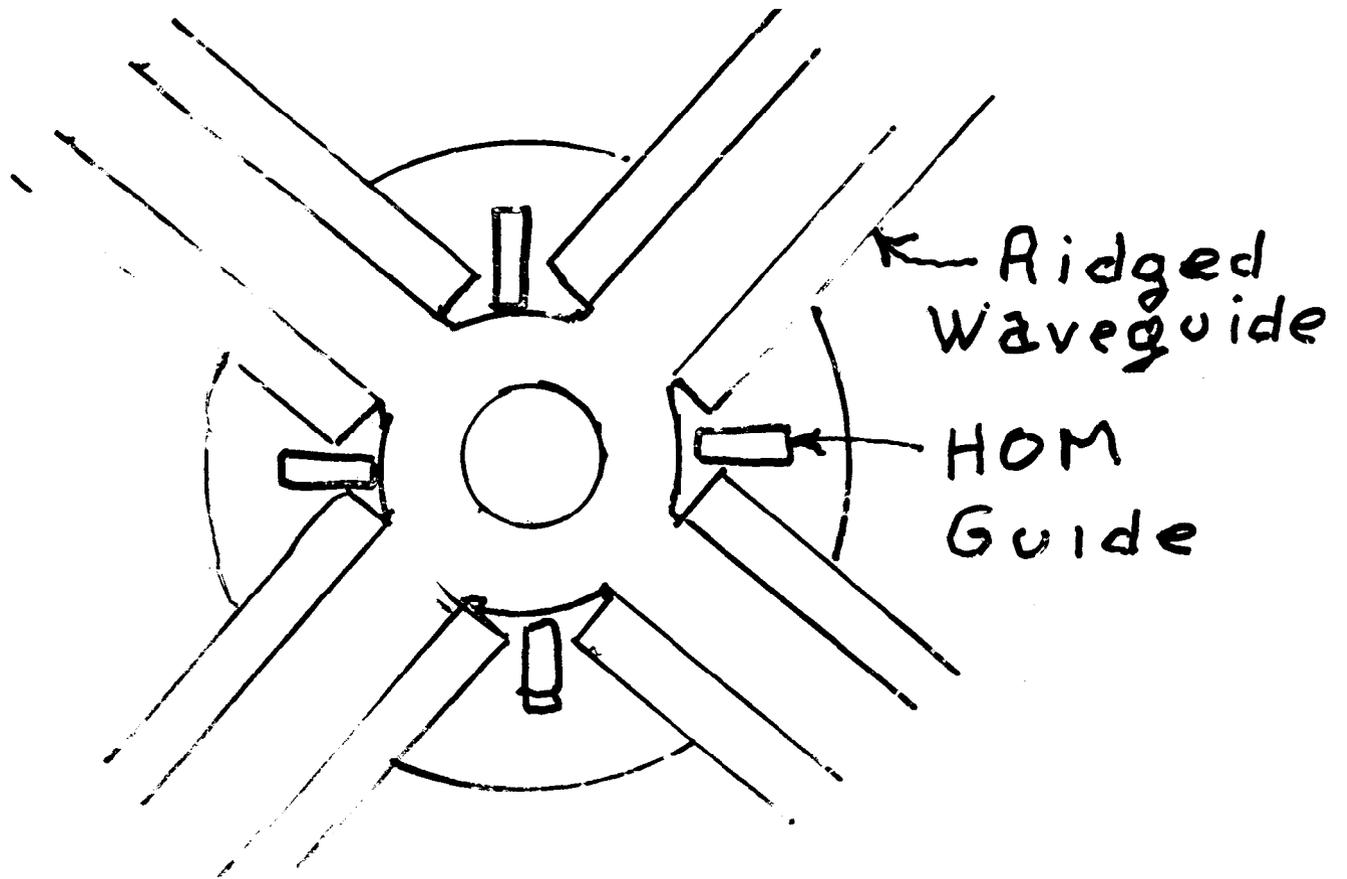
III. Modify the geometry so that it is possible to couple cells 202, 203, and 204 to the manifold. The coupler, cell 205, might be coupled to the manifold or might be damped using the one of the two techniques in I.

A. HOM loads downstream of fundamental mode coupler cell. This would require reducing the size of both the HOM manifold and the 11.4

Ghz waveguide from the fundamental mode coupler since at their present sizes there would be a large overlap. The HOM manifolds could easily be tapered down to a rectangle similar to the DDS3 manifolds. While the large dimension of the rectangle (which is in the radial direction) must be greater than 10 mm, the small dimension (which is the critical dimension) might be as small as 3 mm. The fundamental mode guides must be greater than 14 mm wide if they are vacuum filled rectangular guides. However, this dimension can be greatly reduced by filling the guide with a dielectric, or by making the guide a ridged or double ridged guide.



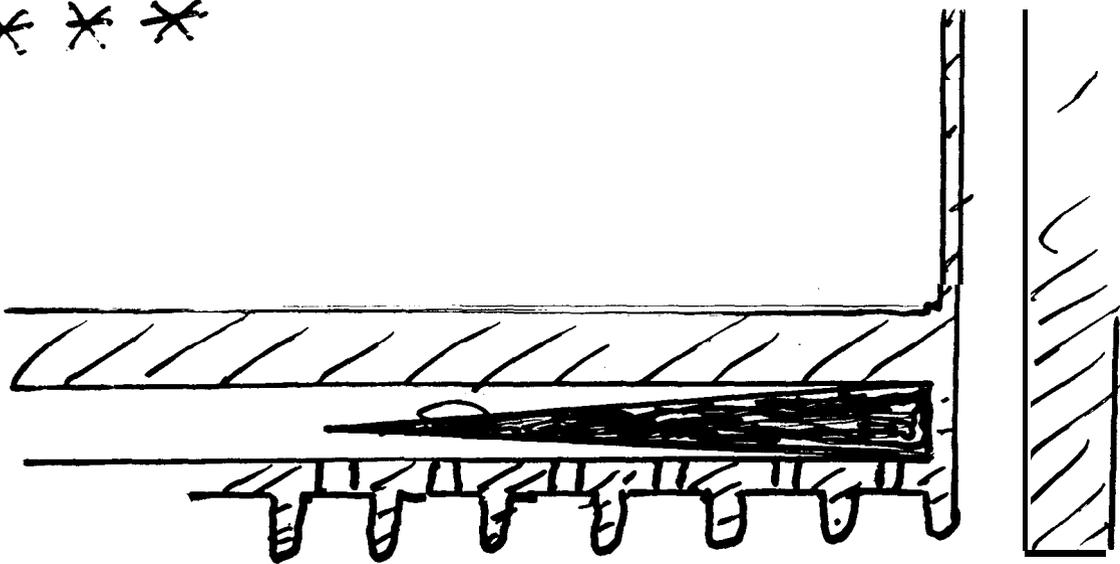
B. HOM loads upstream of fundamental mode coupler cell. The manifolds could be terminated internally by introducing a lossy material (like SiC) into the last 5 cm or so of the manifold upstream of the fundamental mode coupler. In principal, the cells in this region could be coupled to the manifold. If such a



III. A. HOM Loads Down Stream

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III. B Internal HOM Load

design is possible it would perhaps be the simplest and cheapest to mass produce.

C. HOM right angle couplers without miters. It may be possible to design a right angle HOM coupler without a miter which lets cells 202, 203, and 204 be coupled to the manifold. Such a coupler could have small (6 mm by 12 mm) rectangular waveguides running radially out from the HOM manifolds in cells 203 and 204. In such a design the fundamental mode coupler would probably have 4 output guides rotated at 45 degrees from the HOM couplers.

COMMENT: This design would lead to a very “busy” and complex output coupler region.

 IV. Interlacing structures with several different designs would certainly mitigate the effect of uncoupled cells and when combined with one of the other solutions might produce an optimum reduction of wakefield effects.