Tuesday Morning, 22 May 1990
8:30 am -- Regency Ballroom

"Physics and Applications of
Advanced Pulsed Power
Accelerators and Particle Beams"

Dr. Pace VanDevender
Sandia National Laboratory

Tuesday Morning, 22 May 1990
9:40 am -- Regency Ballroom G&H

Oral Session 3A
Intense Beam Microwave Sources - I
Chairman: S.H. Gold

3A-1&2 INVITED

Characteristics of a High Efficiency, High Power X Band TWT Amplifier.

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ABSTRACT

We present a description of results obtained on the performance of several X band TWT amplifiers. The amplifiers operate in a TM_{01} mode in a cylindrically symmetric rippled wall configuration. In some cases the amplifier is severed to ensure that the system does not oscillate due to positive feedback. Peak output powers of several hundred megawatts have been achieved at efficiencies of up to 45% and energy efficiencies of greater than 35%. The performance of the amplifiers will be compared with expectations based on theoretical analysis and simulation results.

This work was supported in part by the Air Force Office of Scientific Research, by the Department of Energy, and by the Strategic Defense Initiative Office of Innovative Science and Technology, and administered by Harry Diamond Laboratories.

3A-3

Experimental Studies of High Power Plasma Filled Backward Wave Oscillators*

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Recently, it has been demonstrated that a plasma loaded backward wave oscillator (BWO) powered by a relativistic electron beam can generate hundreds of megawatts of microwave radiation at high efficiency (about 40%). In this paper, the results of an experimental study of an 8.4 GHz BWO filled with an externally controlled background plasma is reported. It was found that the enhanced efficiency can be maintained even for large electron beam currents approaching to the vacuum space charge limiting current and we anticipate that this might hold even beyond the space charge limiting current. A small frequency up-shift (few percent) was detected for the plasma loaded BWO. A hydrogen flashover plasma gun was used and its characteristics, including plasma density, drift velocity and temperature, were investigated. Detailed studies of beam propagation in vacuum as well as in plasma loaded structures will be presented. It appears that a slightly over-moded device will be needed for peak power handling capability of 5-10 GW.

*Work sponsored by AFWL and administered by NRL.

3A-4

Absolute Instability for Enhanced Radiation from a High-Power Plasma Filled Backward Wave Oscillator

K. Minami, M. M. Ali, K. Ogura, T. Hosokawa, H. Kazama, T. Ozawa (Niigata University, Japan), T. Watanabe (Institute for Fusion Science, Japan), V. L. Granatstein, W. W. Destler, R. A. Kehs, Y. Carmel, W. R. Lou, and D. Abe (University of Maryland, USA)

The linear theory of electromagnetic radiation from a high-power backward wave oscillator (BWO) with a plasma filled, sinusoidally corrugated waveguide driven by a relativistic electron beam has been derived and analyzed numerically. It is shown that our experimental results [1] of enhanced radiation from plasma BWO's can be explained by the linear theory developed here. Among previous works on the study of BWO's, we describe what seems to be the first thorough analysis as an absolute instability classified generally by Briggs.

We consider an infinitely long axisymmetric slow wave structure in which a uniform, cold, collisionless and strongly magnetized plasma is filled. A solid beam with a longitudinal velocity is passing through it. We obtain an accurate linear dispersion relation, $D = 0$.

The parameters corresponding to our experimental conditions are used in the numerical computations. The procedure is as follows: the solution of complex wavenumber k for a given complex frequency, f, can be found at the center of contour circles of $|D|$ on the complex k plane. There are many roots of $D = 0$ on the complex k plane for a real f. We have to sort out the spatially growing waves from