BROOKHAVEN NATIONAL LABORATORY
Associated Universities, Inc.
Upton, New York

ACCELERATOR DEPARTMENT
Informal Report

AN ALTERNATE ACCELERATING SYSTEM FOR ISABELLE

M. Plotkin

November 30, 1971

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CRISP 71-48
ISABELLE PROJECT

INTERSECTING STORAGE ACCELERATOR NOTES
AN ALTERNATE ACCELERATING SYSTEM FOR ISABELLE

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In Crisp 71-42, an accelerating system for Isabelle is described utilizing a ferrite loaded cavity. A drift tube cavity presents some more desirable features. Using one example from 71-42, for $h = 30$, volts/turn = 10 kV and frequency = 4.45 MHz, we can develop the characteristics.

Using the same total stored energy ($4 \times .08 = .32j$) and a peak applied voltage of 20 kV, the electrode length required is given as $2 \times$ where we center the electrode at a stable phase angle of 15° .

$$-\sin(15 - x) + \sin(15 + x) = 0.5 \text{ (since } \frac{V/\text{Turn}}{V_p} = 0.5)$$

$$x = 15^\circ \quad 2x = 30^\circ$$

At 4.45 MHz, $l = 5.6$ meters

$$\text{stored energy} = \frac{1}{2} C V_p^2 = .32$$

$$\text{thus } C = 1600 \mu\mu f$$

$$\text{and } L = 0.8 \mu h$$

And as in 71-42, let $Q = 30$

$$Z_{\text{res}} = \frac{Q}{\omega C} = 675 \text{ ohms}$$

$$P = \frac{V_p^2}{2 Z} = 300 \text{ kW}$$

This is the same power dissipated as in the four cavities in 71-42. However, instead of cooling a ferrite structure, we have to cool a resistor of about 675 Ω which can be specifically designed for the purpose.

The drift tube electrode is 5.6 meters long with a capacitance of 1600 $\mu\mu f$. (For the moment, we can neglect circuit capacitance.) The C/meter = 285 $\mu\mu f/\text{met}$.

If we let the ID(a) = 10 cm, the OD(b) is derived from C/meter = $\frac{8.85 (2\pi)}{\ln \frac{b}{a}}$

whence the OD is 12.15 cm, or a spacing of 1.08 cm. This spacing can be increased to allow for external circuit capacitance. The external inductance can be an air core device.

Most other parameters in 71-42 for this case, such as beam feed through power, etc. remain the same.

With such structures, the necessary separation of the two beam pipes need only be a few centimeters.

Another solution using two drift tubes (either spaced by a half wavelength or, since $f \approx k$ by any given phase angle) with a $V_p = 20$ kV and 5 K volts/turn per drift tube can be derived similarly. If we still center our drift tubes at a stable phase angle of 15° ,

$$-\sin(15 - x) + \sin(15 + x) = .25$$

$$x = 7.5^\circ \quad 2x = 15^\circ$$

$$\text{at } 4.45 \text{ MHz } l = 2.8 \text{ meters}$$

$$\text{stored energy} = .32 \text{ j} = 2 \left(\frac{1}{2} C_{\text{drift tube}} V_p^2 \right)$$

$$C = 800 \mu\mu f$$

$$L = 1.6 \mu h$$

$$Z_{\text{res}} = 1350 \Omega$$

$$P_{\text{drift tube}} = 150 \text{ kW}$$

$$P_{\text{total}} = 300 \text{ kW}$$

The drift tube cross sections remain the same since the C/meter is the same.

If the drift tubes are spaced a half wavelength on centers
($\frac{\lambda}{2} = 33$ meters), a push-pull drive arrangement for the amplifier can
be used.

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