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SLAC/AP--33

DE65 002587

A SINGLE-CAVITY SLED DEVICE*

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The conventional SLED device used at SLAC requires two cavities. However, the same effect can be obtained with a single cavity; the theory and operation of the device is the same, only the hardware is changed. The single-cavity device is described here.

The basic elements of the new device are shown in Fig. 1. The first section is a "magic (hybrid) tee," shown end-on in Fig. 2. The tee is constructed of two waveguides, 1 and 2, coupling to a circular guide. The polarizations of the guide fields are shown in Fig. 2. The field in 1 is symmetric about the plane $A - A$; that in guide 2 is antisymmetric about $A - A$. The two other arms of the magic tee are the two orthogonal modes in the circular guide that have polarizations at 45 degrees with the field in guide 1. This is shown in Fig. 3a.

The second section of Fig. 1 consists of a quarter-wave plate, set at an angle of 45 degrees to the field in guide 1; or, alternatively, of a Faraday rotator, that rotates the plane of polarization of a wave passing through it by 45 degrees. The final section of Fig. 1 is a resonant cavity, coupled to the middle section by a small hole.

* Work supported by the Department of Energy, contract DE-AC03-76SF00515.

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The key to the operation of the device is the center section. Suppose it contains a Faraday rotator. A wave incident from the first section arrives at the third section with its polarisation rotated 45 degrees, say, clockwise. Similarly, a wave incident from the third section arrives at the first section with its polarization also rotated 45 degrees, clockwise. A wave incident from the first section and reflected from the cavity therefore arrives back in the first section with its polarization rotated by 90 degrees. If a wave is incident from guide 1, the wave reflected back will be orthogonal to guide 1. It will couple only to guide 2. And vice versa.

The quarter-wave plate has exactly the same effect. A wave incident from guide 1 can be resolved into two wave, "a" and "b," with polarizations as shown in Fig. 3a. If the quarter-wave plate is set at the same angle as wave a, the phase of a, after forward and backward transmission, will be 180 degrees behind b. The two waves then will add up to the single wave shown in Fig. 3b. This polarization will couple only to guide 2.

One now sees that, although the construction shown in Fig. 1 has only one cavity, it has the properties required to perform as a SLED device.

Fig. 1

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Fig. 2

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Fig. 3