Design Alternatives for a submm-wave Fabry-Perot Cavity Antenna

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***Abstract*—This paper discusses different design alternatives for a high gain planar antenna at 240 GHz. The antenna is based on a Fabry-Perot configuration, where two different partial reflection surfaces (PRS) are considered: a free standing metallic plate and a metallized quartz substrate. Similar performance has been found between both alternatives .**

I. Introduction

Fabry-Perot cavity antennas [1,2] are a good solution for high gain low profile antennas. These antennas are based on a resonant cavity created between a partial reflecting surface (PRS) and a ground plane. By controlling the cavity height and the reflection properties of the PRS leaky wave radiation is achieved.

These antennas are inherently narrowband, although several techniques to increase their bandwidth have been proposed, based on thick PRSs [3] or multilayer superstrates [4]. In this case out target application is radiometry and intended operation bandwidth is 0.5 %. Therefore, a simple configuration will be studied, so that the manufacturing process is kept as simple as possible.

Figure 1a) shows a schematic of the analyzed antennas. The PRS is formed by circular air holes of radius r in a metal plate. The holes are distributed in a square lattice with period p. The antenna is fed by a dual polarization feeder which consists of a two perpendicular slot pairs backed by a rectangular waveguide cavity. This cavity will be fed by two perpendicular WR03 rectangular waveguides, so that dual linear polarization is achieved. However, in this study results of only one polarization will be shown, since as presented in [5], the radiation performance of both polarizations is the same.

In this paper we compare some design alternatives for a high gain (higher than 32 dB) FPC antenna. First a free-standing metallic plate, patterned with air holes will be considered. In the second configuration metal and holes pattern will be printed on a quartz substrate. This second configuration will simplify the antenna manufacturing and assembly.

II. Results

Two antennas have been optimized for operation around 240 GHz. In both cases an air cavity is created between a ground plane and a PRS. A free-standing PRS, formed by a 50 microns thick metal plate is considered in one case, and in the second one the PRS is printed on a 300 microns quartz substrate. For each configuration the cavity thickness and the period and radius of the PRS air holes have been optimized, so that the required 32 dB gain is achieved,

The results in Figure 1b) show the comparison of the achieved gain. In both case the 32 dB requirement is fulfilled. In addition, the response is very similar, with no differences in terms of bandwidth. Given the similar response, the solution based on a quartz PRS will be used.

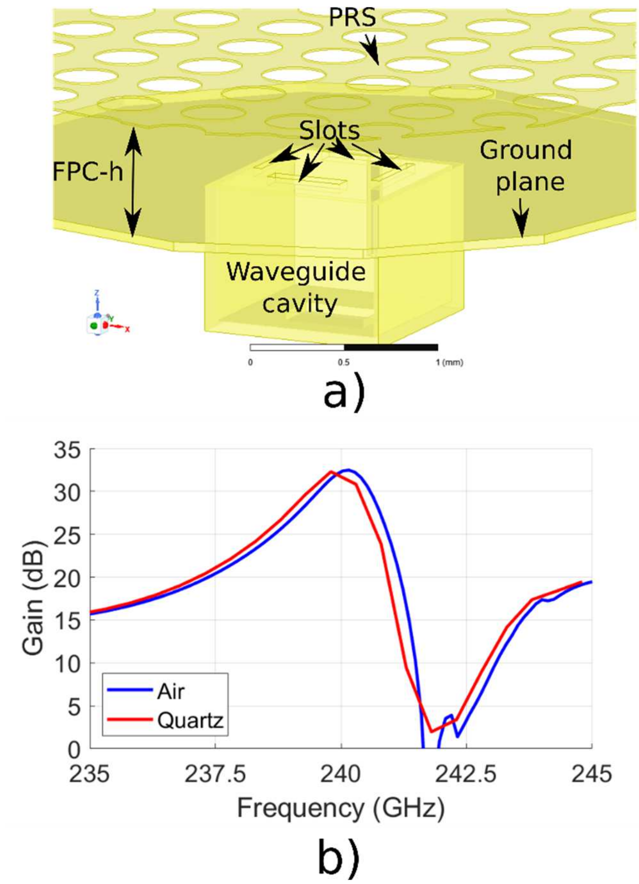

Fig. 1. a) Fabry-Perot cavity antenna. B) Gain of the two design alternatives

Regarding the impedance matching, the achieved reflection coefficient is shown in Figure 2 a). The antenna is matched in a narrow bandwidth, comparable with the radiation pattern where the gin is higher than 32 dB. These results correspond to one of the polarizations supported by the antenna, the response for the other one being the same, as shown in [5]. Finally, the radiation pattern at 240 GHz is shown in Fig. 2 b).

The presented configuration can be a low profile alternative for high antennas in applications, such as radiometry, where narrow bandwidth is required.

III. Acknoledgment

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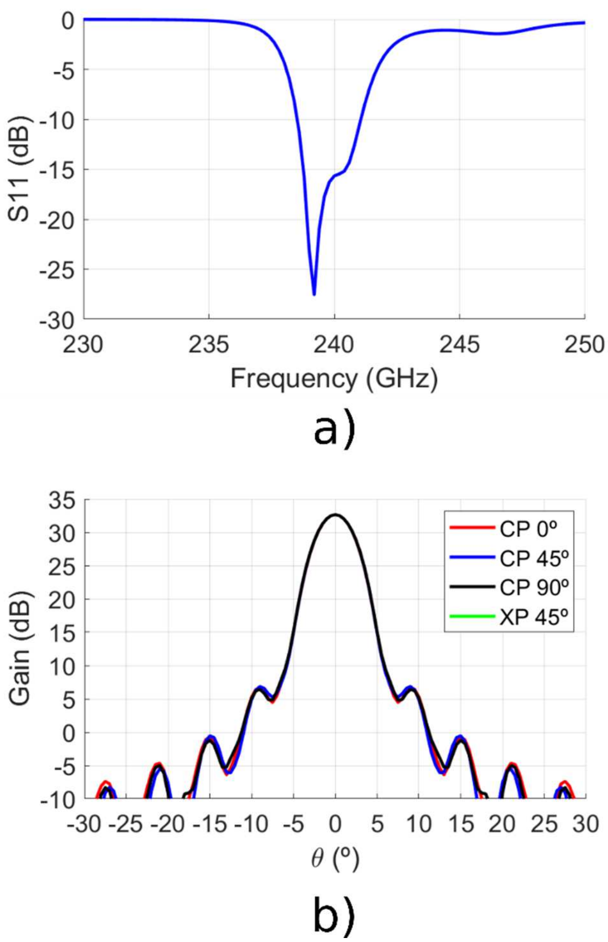

Fig. 2. a) Reflection coefficient of the proposed antenna. B) Radiation pattern at 240 GHz.

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