RF Controlled Atom-Vapor Based Material for Electric Field Metrology

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We offer a different perspective on the use of RF controllable materials, in which we show that the controllable property of a material can be used for electrical field metrology in order to make direct SI-traceable measurements. Over the past 15 years, metamaterials have been a very active area of research with novel applications occurring on a daily basis. The Holy Gail of these potential applications has been the pursuit of cloaking materials. However, due to the physical limitation (no broadband lossless materials) cloaking materials have not come to fruition. Besides this application, research has turned to other interesting properties of materials. One particular property that is of great desire is to have frequency controllable materials for a wide range of applications (that is, a material whose property can be easily changed over a wide range of frequencies). In the presentation, we discuss an atomic-vapor based optical material in which the absorption and transmission properties are changed with an applied RF electric (E) field. We will show that the E-field strength of the applied RF field can be determined by detecting the absorption spectrum of an optic field (called the probe laser) propagating through this atomic-vapor based material. The RF E-field changes the susceptibility of the medium seen by the probe laser, causing the medium to be absorptive or transparent to the probe laser. In fact, the RF field creates two regions (separated by a particle frequency) where the losses of the medium go to zero, hence resulting in two transparency windows, see Figure 1a). The separation in these two transparency windows (Δf) is directly proportional to the applied RF field strength. Thus, by measuring Δf, the field strength of the applied field can be determined *[Holloway et el., IEEE Trans AP, **62**, 12, 2014]*, see Figure 1b). We are using this fundamentally new approach to develop direct SI traceable measurement of RF E-fields and power.

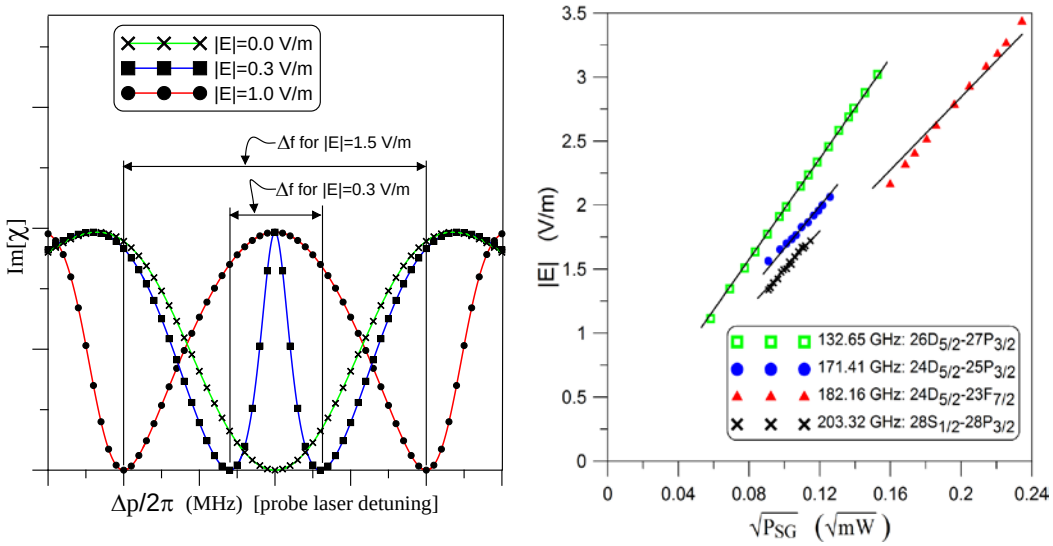

Fig 1: a) susceptibility as a function of applied RF field strength, b) measured E-field from the Rydberg atom-based approach.