DIPARTIMENTO DI INGEGNERIA INFORMATICA E DELLE TELECOMUNICAZIONI

GRUPPO DI CAMPI ELETROMAGNETICI

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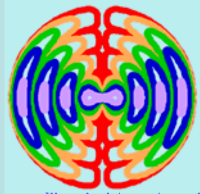

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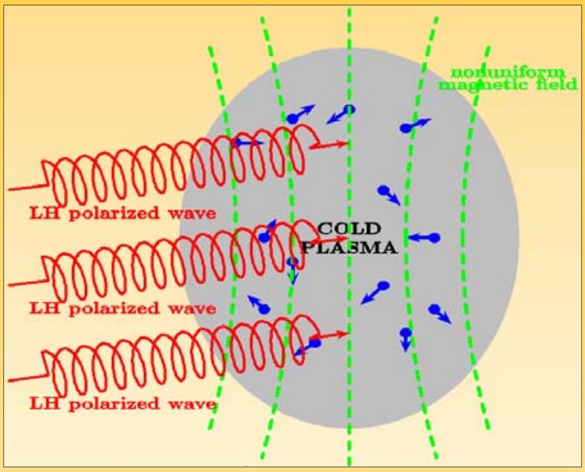
MICROWAVE INTERACTION WITH PLASMA

in collaboration with Laboratori Nazionali del Sud, INFN

One of the most important applications of the interaction between electromagnetic waves and ionized gas is the production of free electrons with kinetic energy high enough to ionize the neighbour atoms. The obtained ions are suitable to be employed in the heavy ions accelerators.



When an electromagnetic wave, left handed circularly polarized

$$\vec{E} = (\hat{x} + i\,\hat{y})\,E_0\,e^{i(kz-\omega t)}$$

interacts with a ionized gas subjected to a magnetic field (uniform or not), under the condition that its frequency is equal to the *gyromagnetic* frequency, defined as

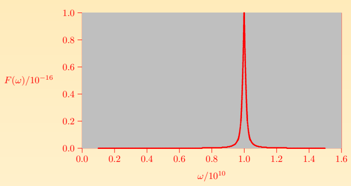
$$\omega_g = \frac{qB}{m}$$

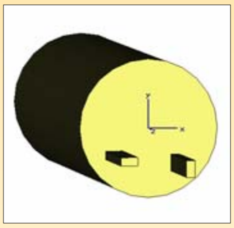
where $q < 0$ and m are the electron charge and mass and B is the magnetic field induction, the resonance phenomenon occurs and it leads to an increase in the electron kinetic energy. In a generic plane $z = constant$, for an electron subjected to a uniform magnetic field directed toward the z direction, we have

$$|v_x|^2 = \frac{q^2}{m^2}E_0^2\frac{1}{(\omega_g+\omega)^2+\omega_{eff}^2} \qquad |v_y|^2 = \frac{q^2}{m^2}E_0^2\frac{1}{(\omega_g+\omega)^2+\omega_{eff}^2}$$

Being the representative function $F(\omega)$:

$$F(\omega) = \frac{1}{(\omega_g+\omega)^2+\omega_{eff}^2}$$

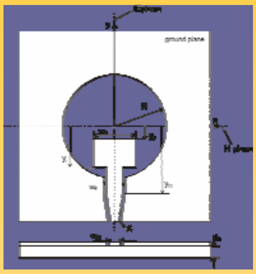


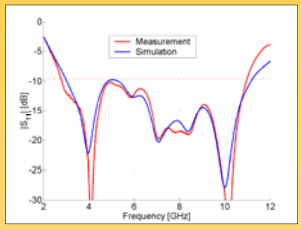


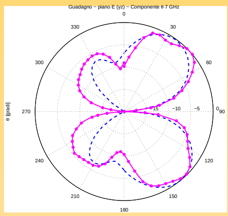
Cavity filled with the confined plasma

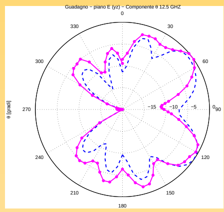
UWB MICROSTRIP SLOT ANTENNAS AND PHOTONIC BANDGAP FILTERS

We study wideband microstrip slot antennas for wireless applications. We deal in particular with antennas suitable for the proposed Ultra-Wideband communications in the [3.1, 10.6] GHz frequency interval. These structures have been also integrated with microwave filters realized by Photonic Bandgap structures. Many prototypes have been realized and fully characterized with experimental measurements in terms of impedance bandwidth and radiation diagrams at different frequencies and in the different coordinate planes.

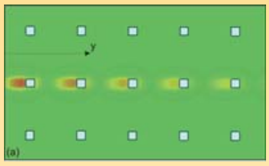




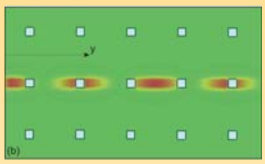


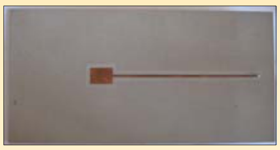


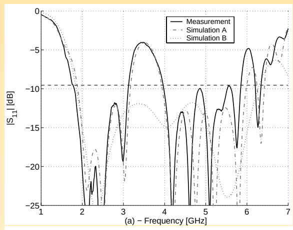
f = 3.7 GHz

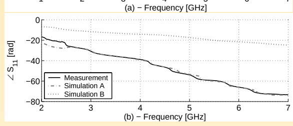


f = 2.5 GHz









EVALUATION OF THE ELECTROMAGNETIC FIELD IN A CYLINDRICAL CAVITY WITH RECTANGULAR WAVEGUIDE FEED

We evaluate the electric field distribution in a multimodal cylindrical cavity where a plasma is confined by a magnetostatic not uniform field to produce a current of high and medium charge state ions. We consider that the cavity is empty, it has lossy walls and it is fed by a rectangular waveguide placed off axis on one of its bases.

$$\vec{E}_{TM} = ie^{i\omega t}A\frac{c^2\mu a_g\omega}{L^2\pi a}\sum_{n,\nu,r}\frac{1}{1-\left(\dfrac{\omega}{\omega_{n\nu r}}\right)^2}\cdot \cdot\frac{\xi_n}{\omega_{n\nu r}^2 x_{n\nu}J_{n+1}^2(x_{n\nu})}\begin{Bmatrix}Re\{I_{n\nu}^{TM}\}\\ Im\{I_{n\nu}^{TM}\}\end{Bmatrix}\cdot \cdot\left[\frac{r x_{n\nu}}{a}J_n'\left(\frac{x_{n\nu}\rho}{a}\right)\sin\left(\frac{r\pi z}{L}\right)\begin{Bmatrix}\sin n\varphi\\ \cos n\varphi\end{Bmatrix}\hat{e}_\rho + \frac{rn}{\rho}J_n\left(\frac{x_{n\nu}\rho}{a}\right)\sin\left(\frac{r\pi z}{L}\right)\begin{Bmatrix}\cos n\varphi\\ -\sin n\varphi\end{Bmatrix}\hat{e}_\varphi + -\frac{Lx_{n\nu}^2}{\pi a^2}J_n\left(\frac{x_{n\nu}\rho}{a}\right)\cos\left(\frac{r\pi z}{L}\right)\begin{Bmatrix}\sin n\varphi\\ \cos n\varphi\end{Bmatrix}\hat{e}_z\right]$$

$$\vec{E}_{TE} = e^{i\omega t}A\frac{c^2\mu a_g}{L^2\pi a}\sum_{n,\nu,r}\frac{1}{i\left(\dfrac{\omega}{\omega'_{n\nu r}}-\dfrac{\omega'_{n\nu r}}{\omega}\right)+\dfrac{1}{Q}}\cdot \cdot\frac{\xi_n r x'_{n\nu}}{\omega'_{n\nu r}(x'^2_{n\nu}-n^2)J_n^2(x'_{n\nu})}\begin{Bmatrix}Im\{I_{n\nu}^{TE}\}\\ Re\{I_{n\nu}^{TE}\}\end{Bmatrix}\sin\left(\frac{r\pi z}{L}\right)\cdot \cdot\left[\frac{n}{\rho}J_n\left(\frac{x'_{n\nu}\rho}{a}\right)\begin{Bmatrix}\cos n\varphi\\ -\sin n\varphi\end{Bmatrix}\hat{e}_\rho + -\frac{x'_{n\nu}}{a}J_n'\left(\frac{x'_{n\nu}\rho}{a}\right)\begin{Bmatrix}\sin n\varphi\\ \cos n\varphi\end{Bmatrix}\hat{e}_\varphi\right]$$