Mikrovlnná diagnostika plazmatu

Vodivost plazmatu:

$$\sigma = ne^2(\nu/\omega - \mathrm{j})(m\omega)^{-1}$$

Změna rezonanční frekvence a kvality rezonátoru:

$$\Delta\omega_0/\omega_0 = -(2\pi/\omega_0)\left(\int_{V'} \sigma_i E^2 \,\mathrm{d}V\right)\left(\int_{V'} E^2 \,\mathrm{d}V\right)^{-1},$$

$$\Delta(Q^{-1}) = (4\pi/\omega_0)\left(\int_{V'} \sigma_r E^2 \,\mathrm{d}V\right)\left(\int_{V} E^2 \,\mathrm{d}V\right)^{-1},$$

Plazmatická frekvence:

$$\omega_{\mathrm{pe}} = \sqrt{\frac{n_e e^2}{m^* \varepsilon_0}}$$

Mikrovlnná diagnostika plazmatu

Z posuvu resonanční frekvence:

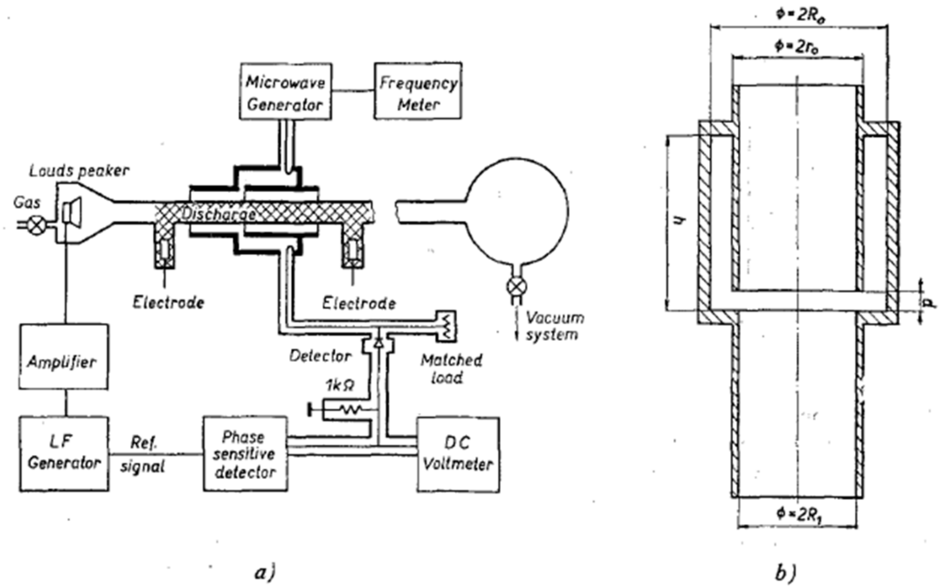
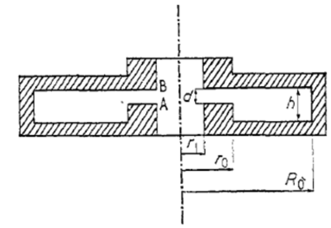


Fig. 3. *a* — Experimental arrangement. *b* — Section and dimensions of the toroidal resonator $R_0 = 4{\cdot}69$ cm, $r_0 = 3{\cdot}81$ cm, $R_1 = 3{\cdot}64$ cm, $h = 7{\cdot}0$ cm, $d = 0{\cdot}5$ cm, resonance frequency $f_0 \simeq 905$ MHz.



Toroidal resonator cross section. A, B, pole lengthening heads.

$$N_\mathrm{e}(0) = \Delta f_\mathrm{r} f_\mathrm{r} \frac{2\pi m_\mathrm{e}}{e_0^{\,2}} \frac{\int\limits_v E^2 dv}{\int\limits_{v'} \mathrm{I}_0\left(\frac{2{\cdot}405}{r_1} r\right) E^2 dv}$$

Sicha et al., Czech. J. Phys. B 20, 684, 1970

Mikrovlnná diagnostika plazmatu

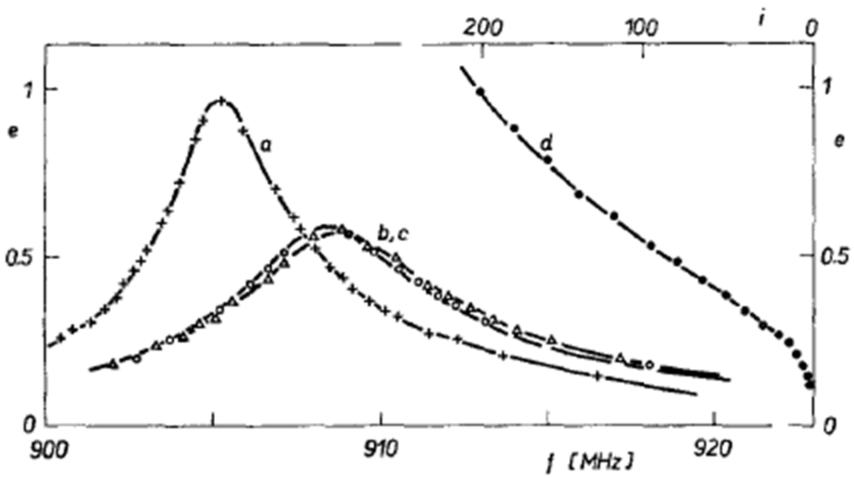
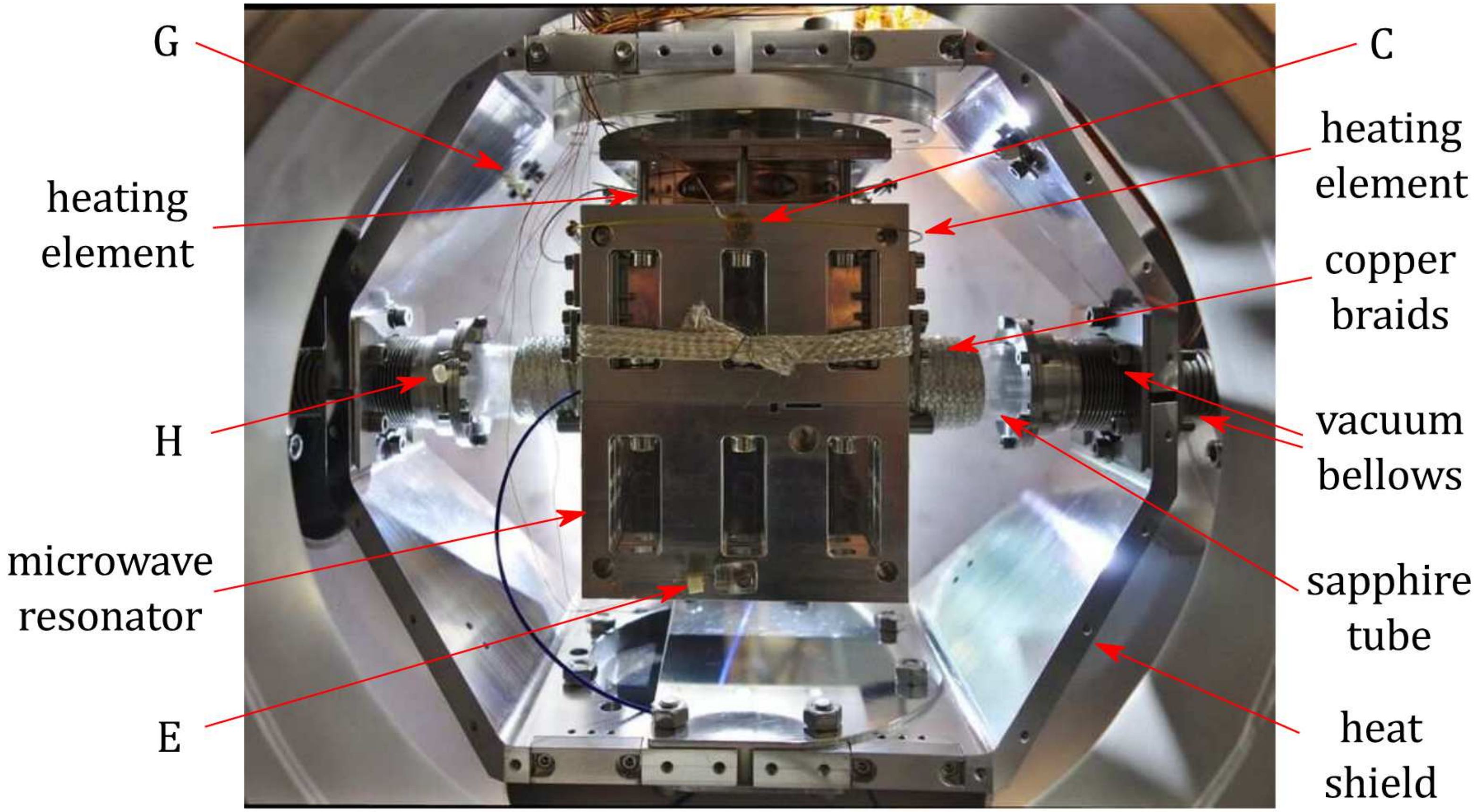


Fig. 4. Resonance curve for the microwave cavity without plasma (a) and with a homogeneous plasma, nitrogen 1 torr, 100 mA (b, c). The curve (b) and (c) were obtained for the same position of the cavity but with inverse polarity of the electrodes. The curve (△) corresponds to the case for which the electric field is in the direction of propagation of sound.

The calibration curve (d) for the detector was obtained using a calibrated attenuator, *i* is the detector current and *e* is the microwave output voltage of the generator, both are here in arbitrary units.

Cryo-SA-CRDS

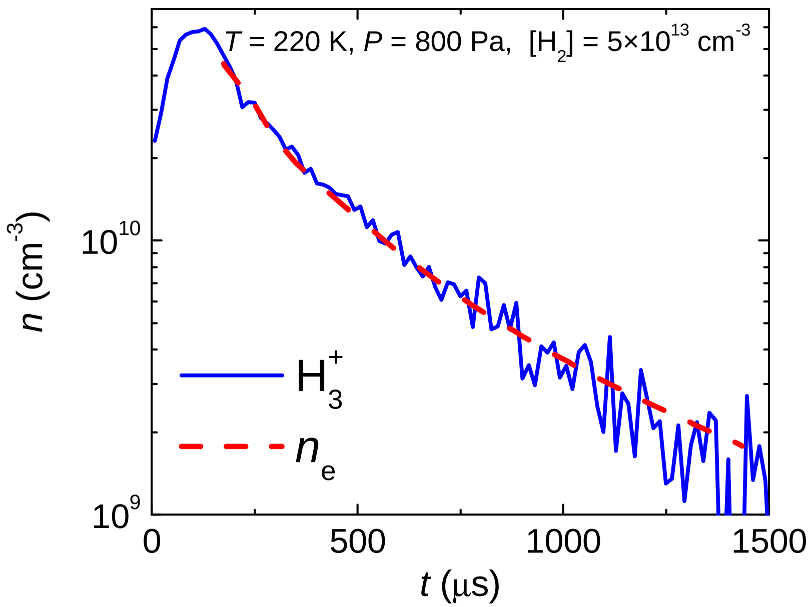


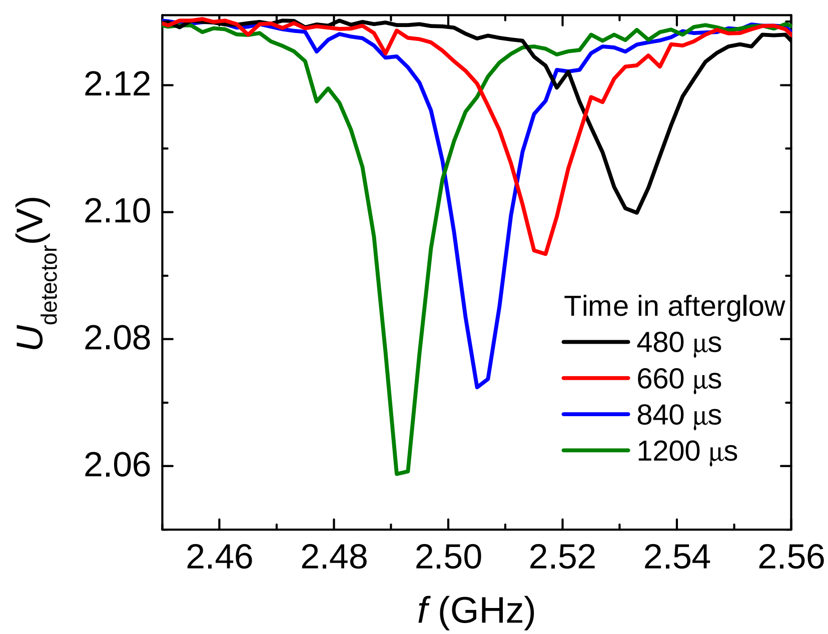
30 – 300 K

Plašil, R; Dohnal, P; Kálosi, Á; Roučka, Š; Shapko, D; Rednyk, S; Johnsen, R; Glosík, J, *Rev. Sci. Instrum.*, **89**: 063116, 2018.

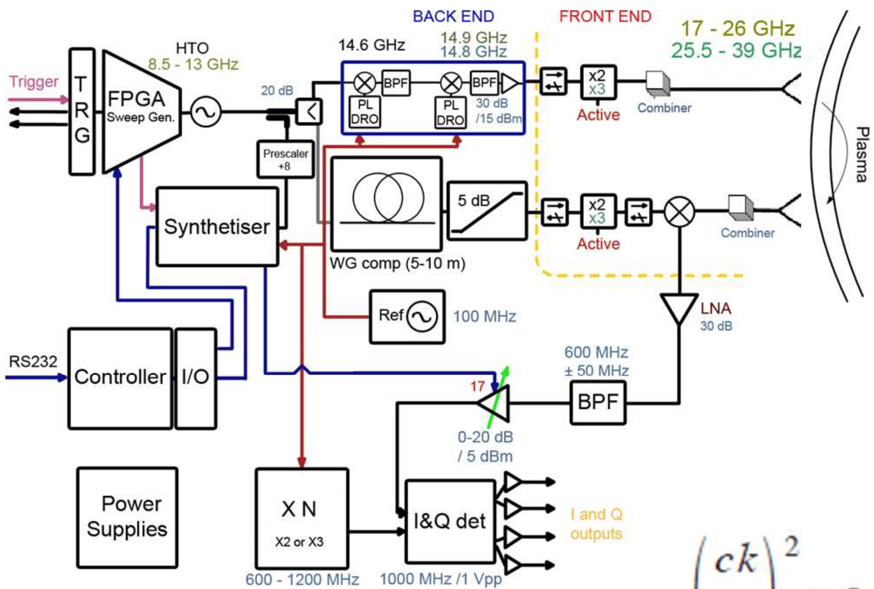
Cryo-SA-CRDS

- Electron number density measurement





Mikrovlnná reflektometrie



$$\omega_{\mathrm{pe}} = \sqrt{\frac{n_e e^2}{m^* \varepsilon_0}}$$

$$\left(\frac{ck}{\omega}\right)^2 = \varepsilon = 1 - \frac{X}{1 - \frac{Y^2 \sin^2\theta}{2(1-X)} \pm \left[\frac{Y^4 \sin^4\theta}{4(1-X)^2} + Y^2 \cos^2\theta\right]^{1/2}}$$

$X = \omega_{pe}^2/\omega^2$

$Y = \omega_{ce}/\omega, \quad \omega_{pe}^2 = n_e e^2/\varepsilon_0 m_e$