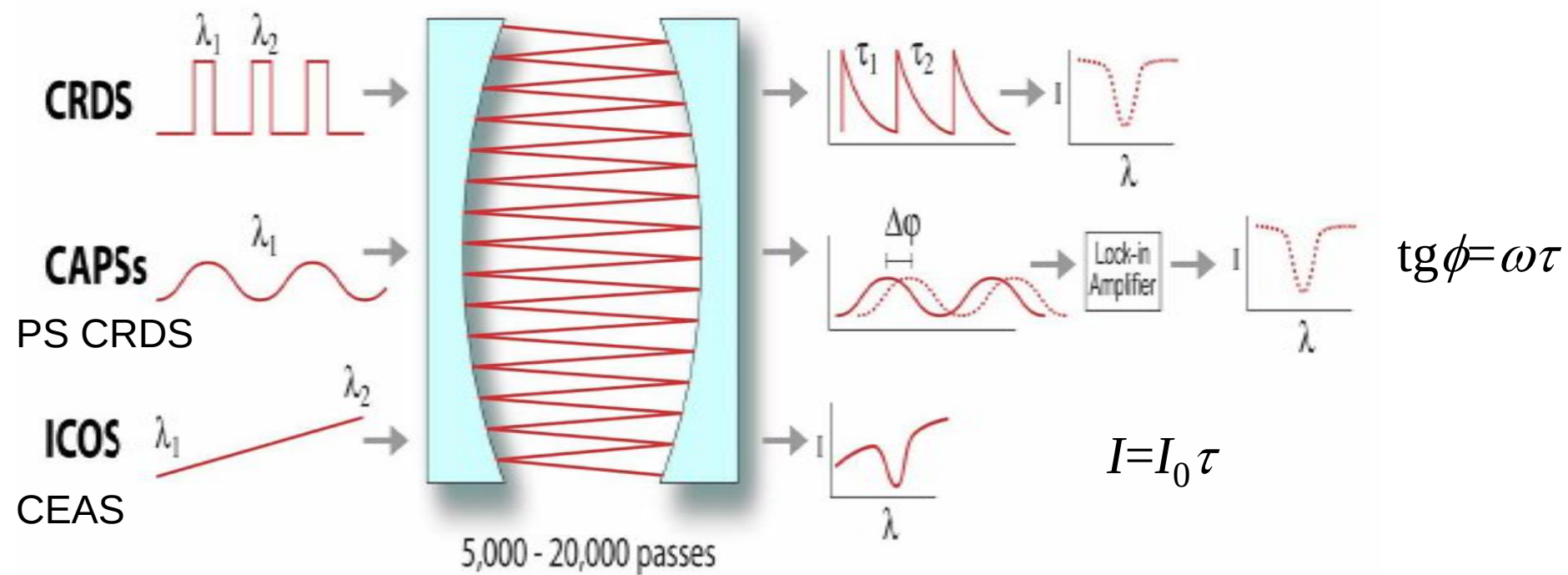


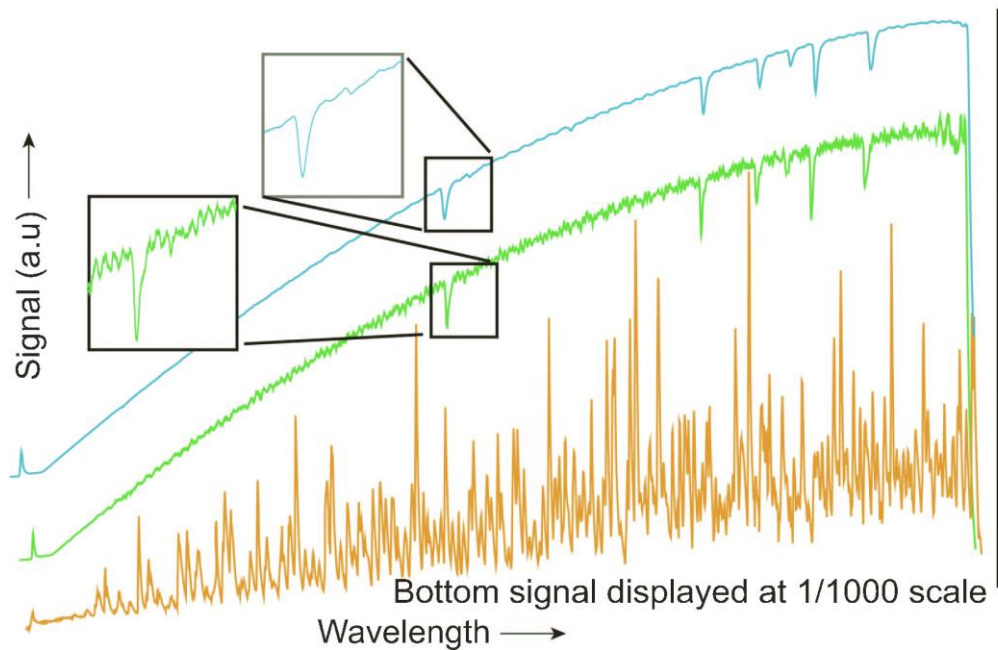
Диодная лазерная спектроскопия с применением излучения отраженного от внешнего резонатора

С.Н.Цхай, И.В.Николаев, В.Н.Очкин

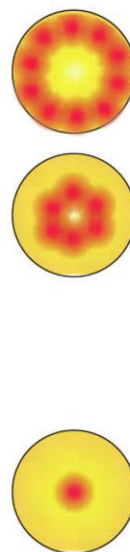
*Физический институт им.П.Н.Лебедева, РАН,
Россия, Ленинский пр. 53, 119991 Москва,
Россия sergei.chae@gmail.com*



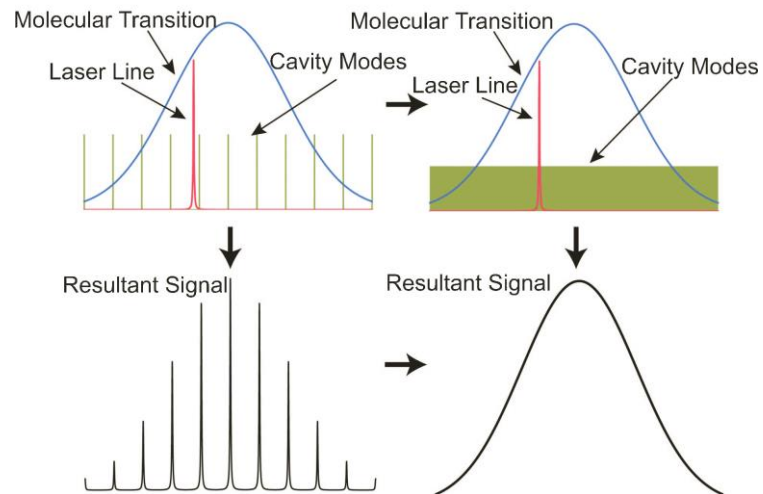
Near-IR Data at 6620 cm⁻¹

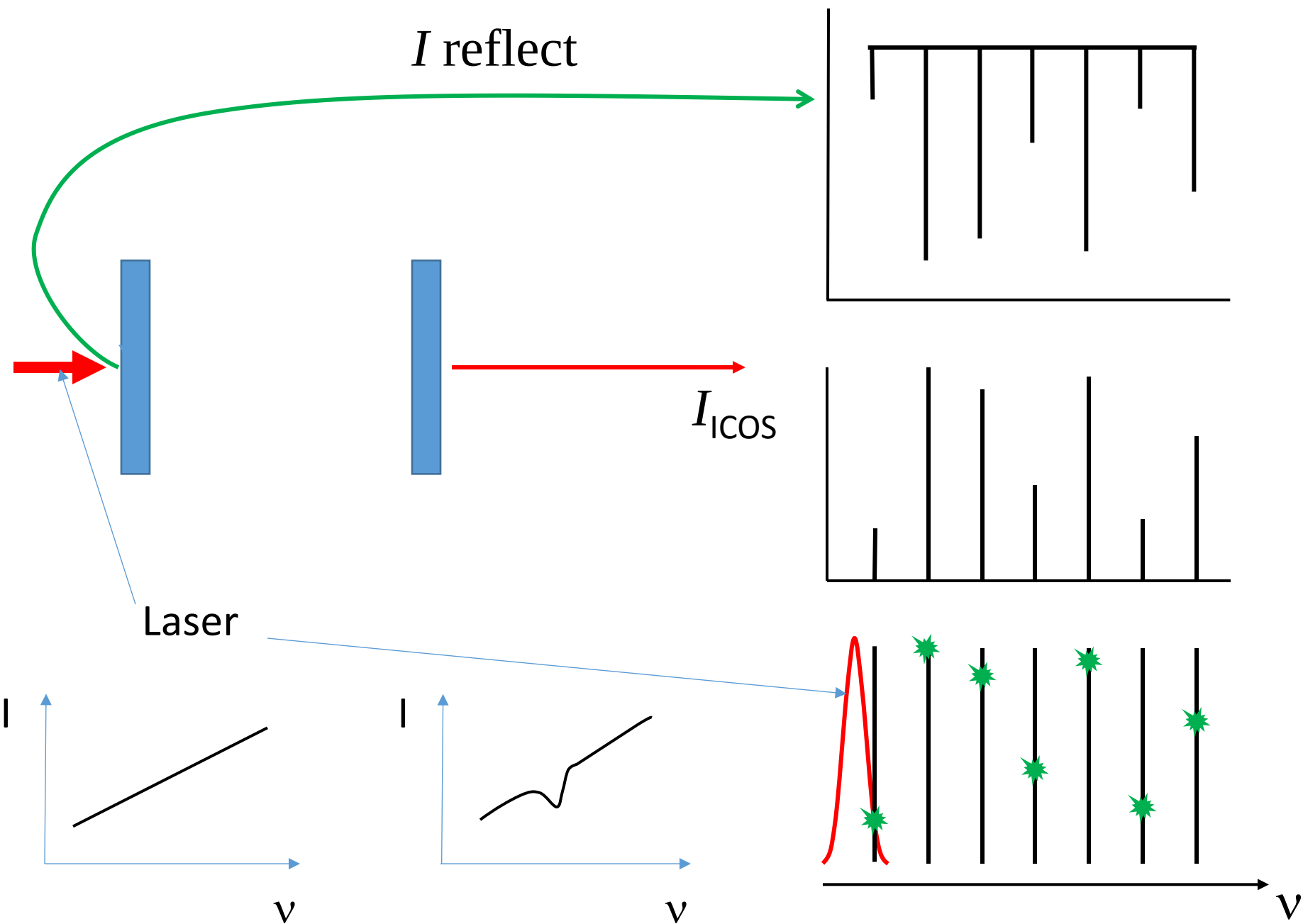


Alignment



On-Axis Alignment Off-Axis Alignment



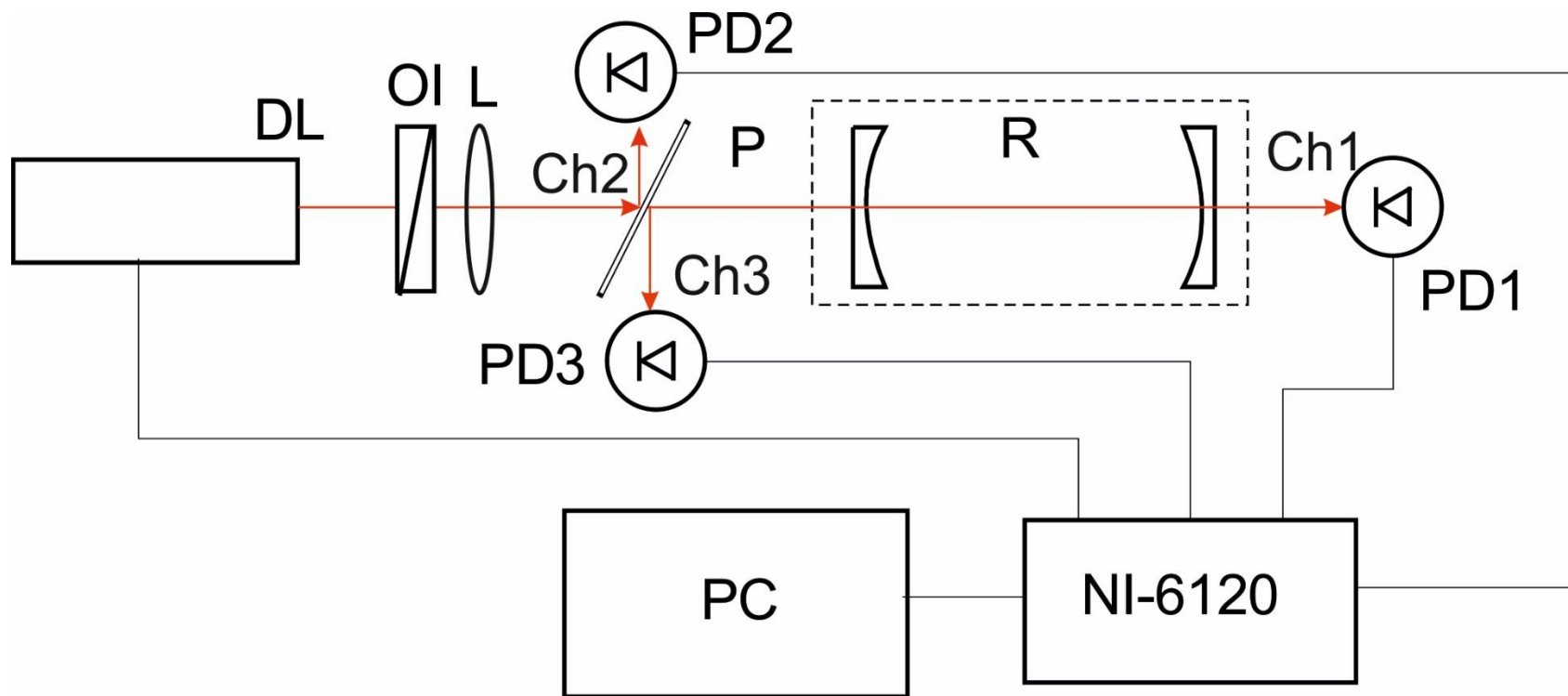


$$T_c = \frac{T_m T^2}{(1 - T_m r)^2 + 4T_m r \sin^2 \delta},$$

$$R_c = \frac{r[1 - (r + T) T_m]^2 + 4T_m r(r + T) \sin^2 \delta}{(1 - T_m r)^2 + 4T_m r \sin^2 \delta},$$

where T_m is the transparency of a substance filling the resonator per single pass of radiation between the mirrors; r are the reflection coefficients of mirrors with respect to intensity; $T = 1 - r - a$ are the transmission coefficients of the mirrors with respect to intensity; a are losses of mirror; and δ is the phase shift attained by a monochromatic wave in a single passage over the cavity

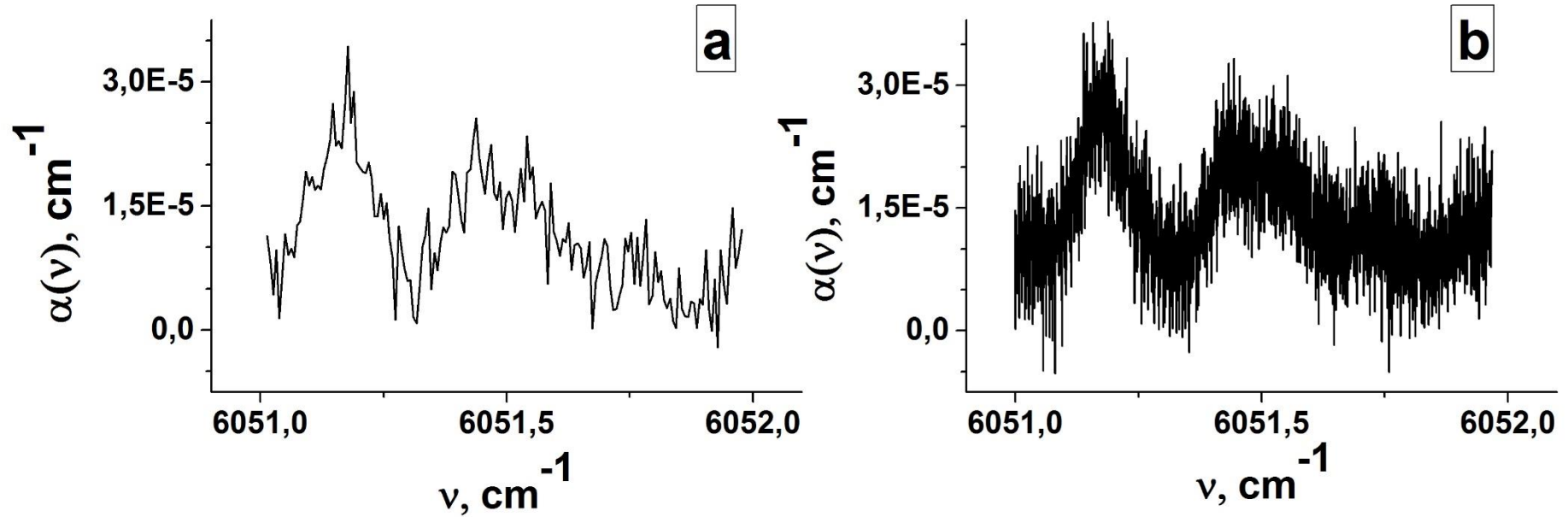
$$\Delta = 1 - R_c - T_c \approx \frac{(1 + r)\alpha L T - r(\alpha L)^2 T}{(1 - T_m r)^2 + 4T_m r \sin^2 \delta}$$



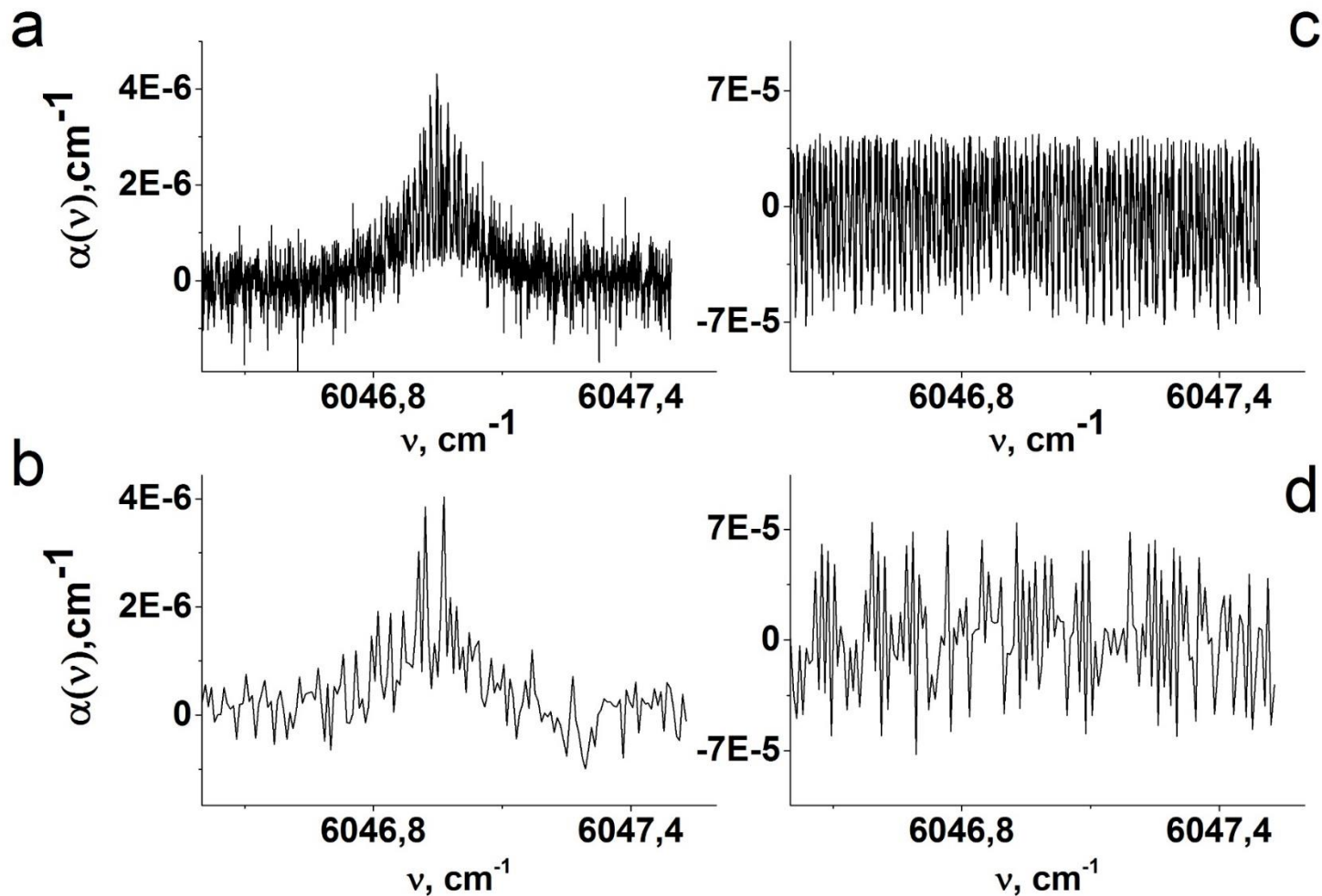
Schematic diagram of the experimental setup:

(DL) diode laser; (L) matching lens; (OI) optical isolator; (P) plane-parallel quartz plate; (R) resonator; (PD1 – PD3) photodetectors; (NI- 6120) multichannel I/O card; (PC) personal computer; (Ch1) analytic channel; (Ch2) base line channel; (Ch3) reflected radiation channel.

Fast recording



Absorption spectra of a natural gas mixture at various rates of laser frequency scanning: (a) 256 and (b) 4096 points per scan at the sampling time of 1.25 ms.



Absorption line in the spectrum of methane recorded by (a, b) the R-ICOS and (c, d) conventional ICOS methods at the recording time of 5 ms and the number of spectral points 4096 (a, c) and at the recording time of 320 ms and the number of spectral points 256 (b, d).

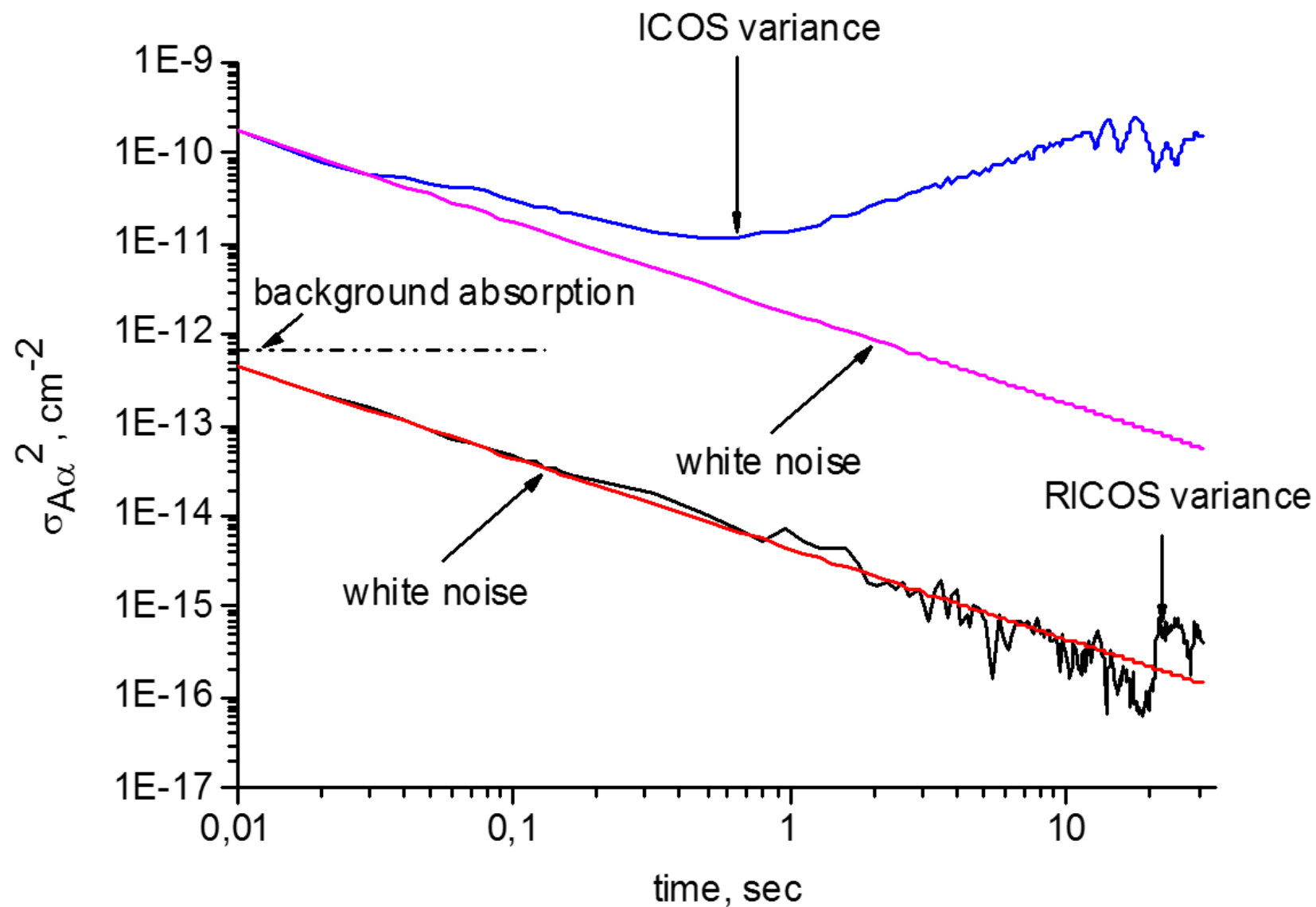
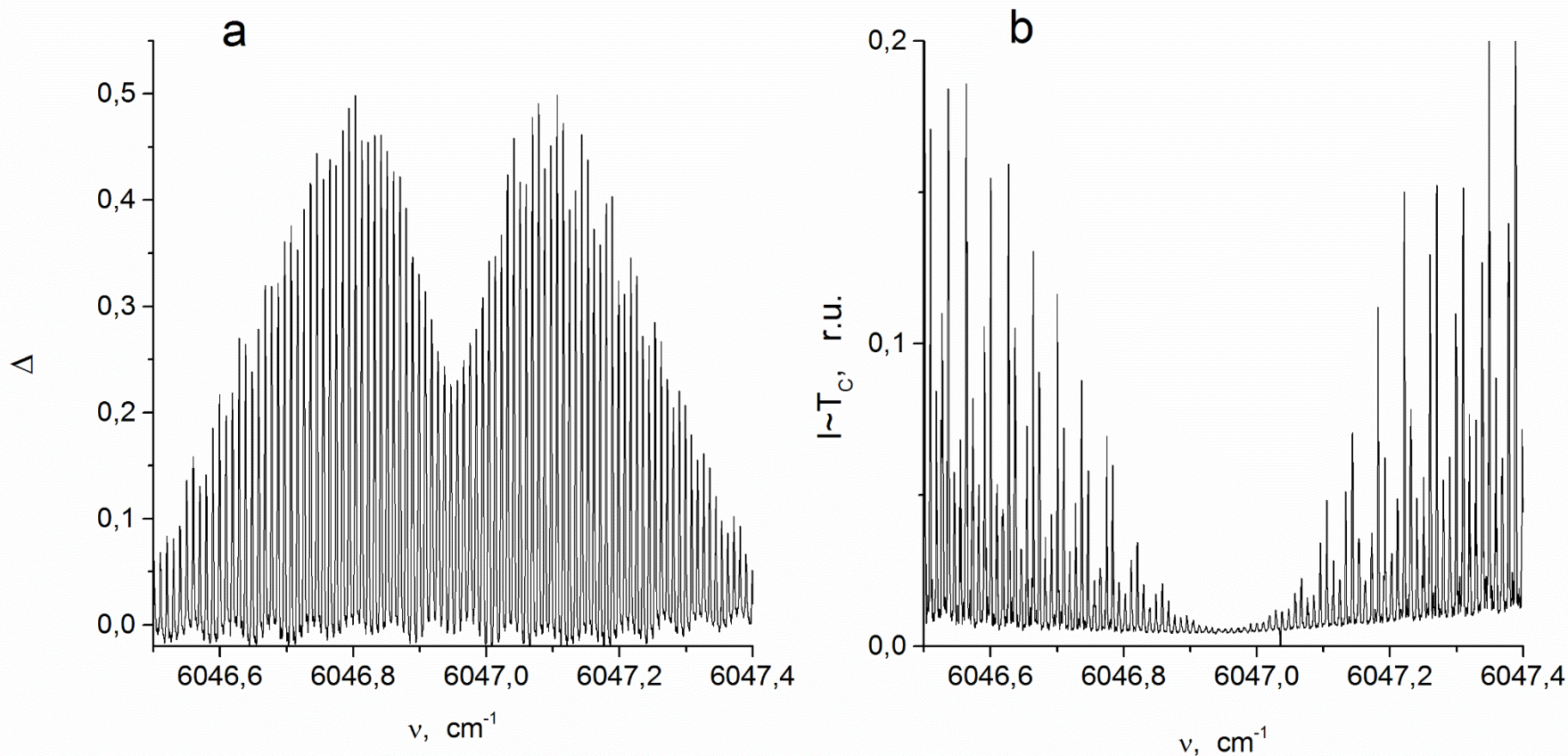
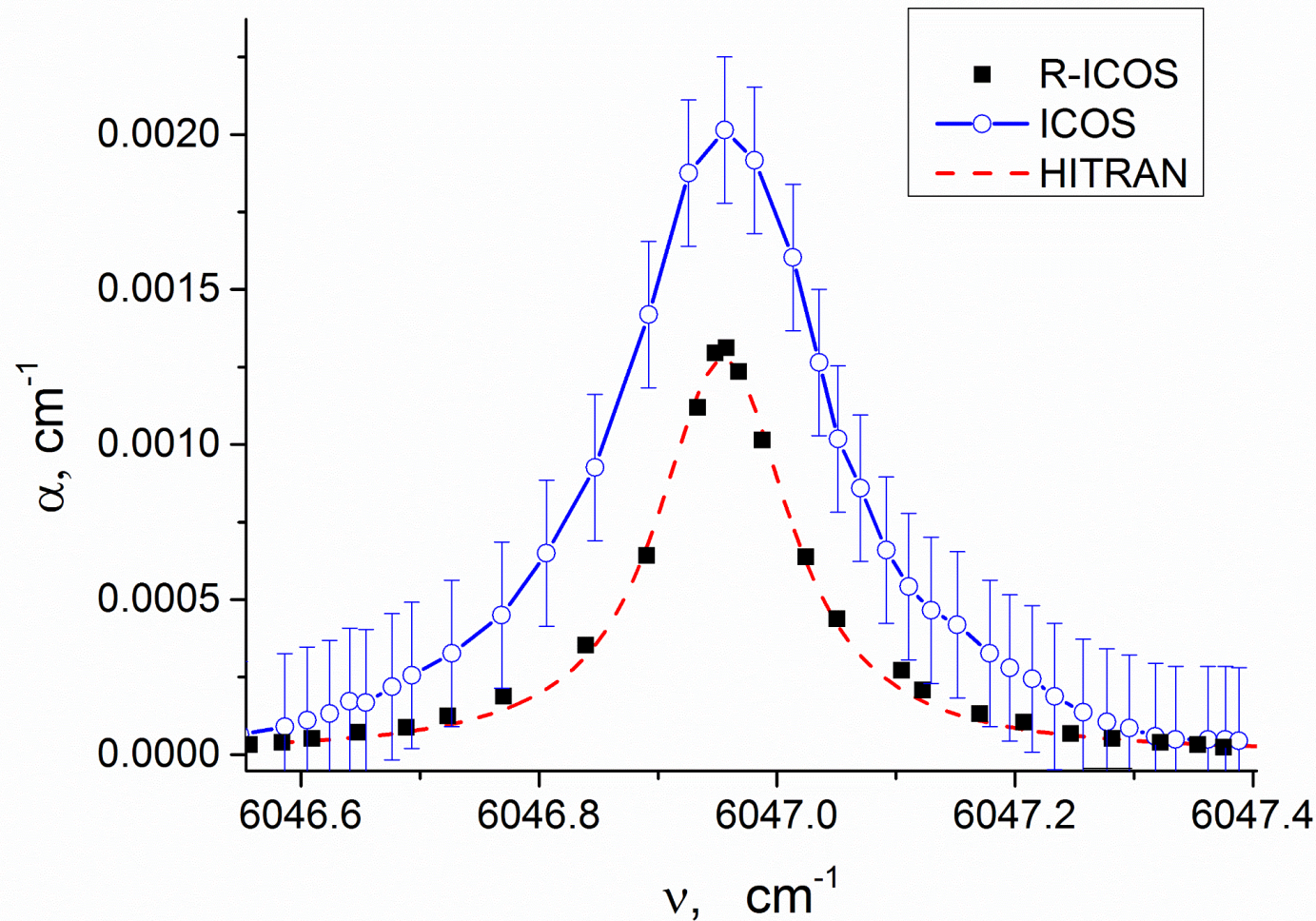


Fig.7. Allan variance for measured absorption coefficient. $r=0.99$.

High density

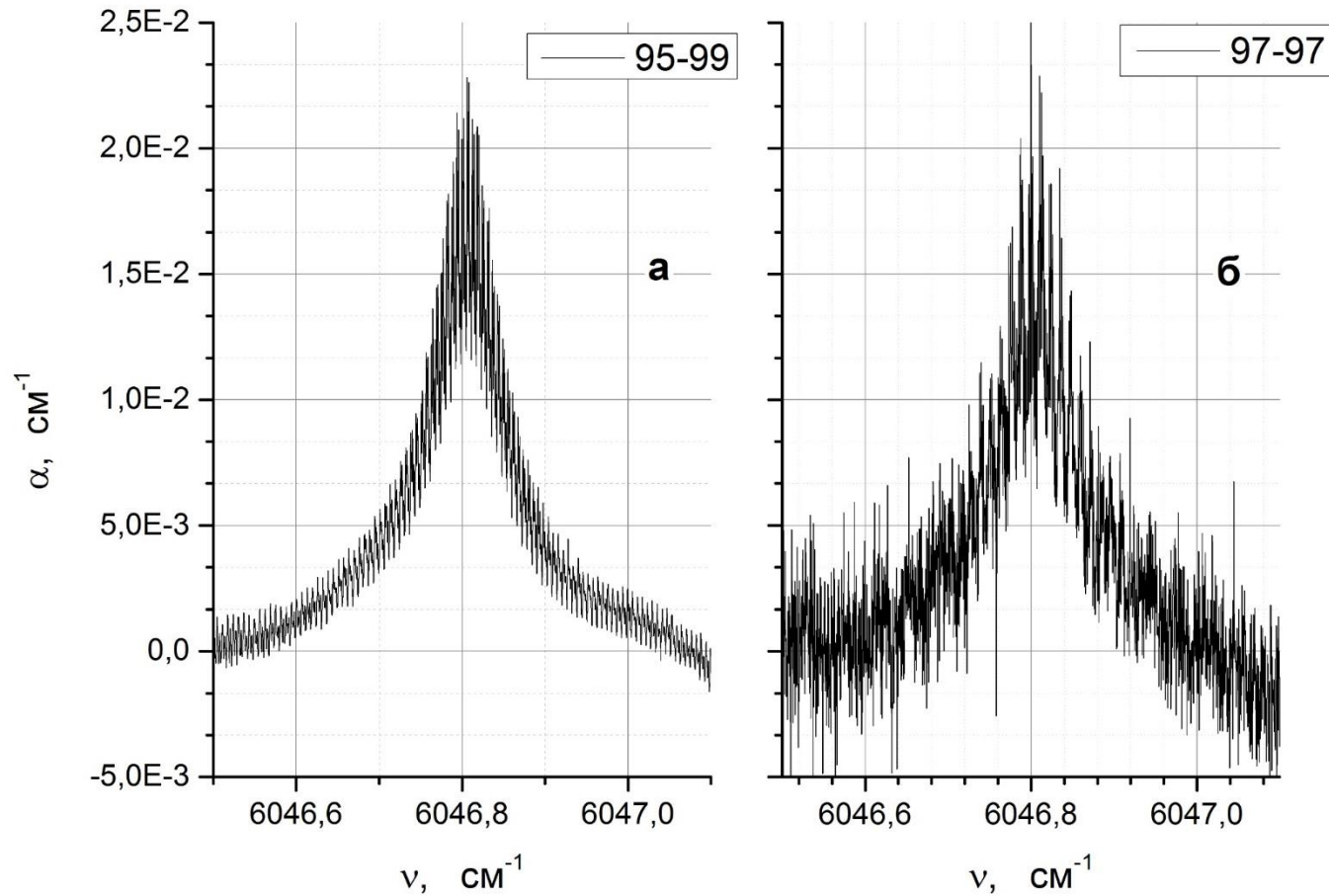


Spectral signals obtained by (a) R-ICOS method and (b) ICOS method (I is intensity of radiation that has passed through the cavity) averaged over 100 scanning cycles at a temperature of 25 °C and atmospheric pressure.



Absorption spectra of methane. 1) spectrum reconstructed by the R-ICOS signal (averaging over 100 scanning cycles), 2) absorption spectrum reconstructed by the ICOS signal, 3) spectrum calculated by the HITRAN database for the experimental conditions.

Asymmetric resonator



Absorption spectrum of methane at 1650 nm
(a) asymmetric, (b) symmetric resonators

Спасибо за внимание!