HOW IT HAPPEN…

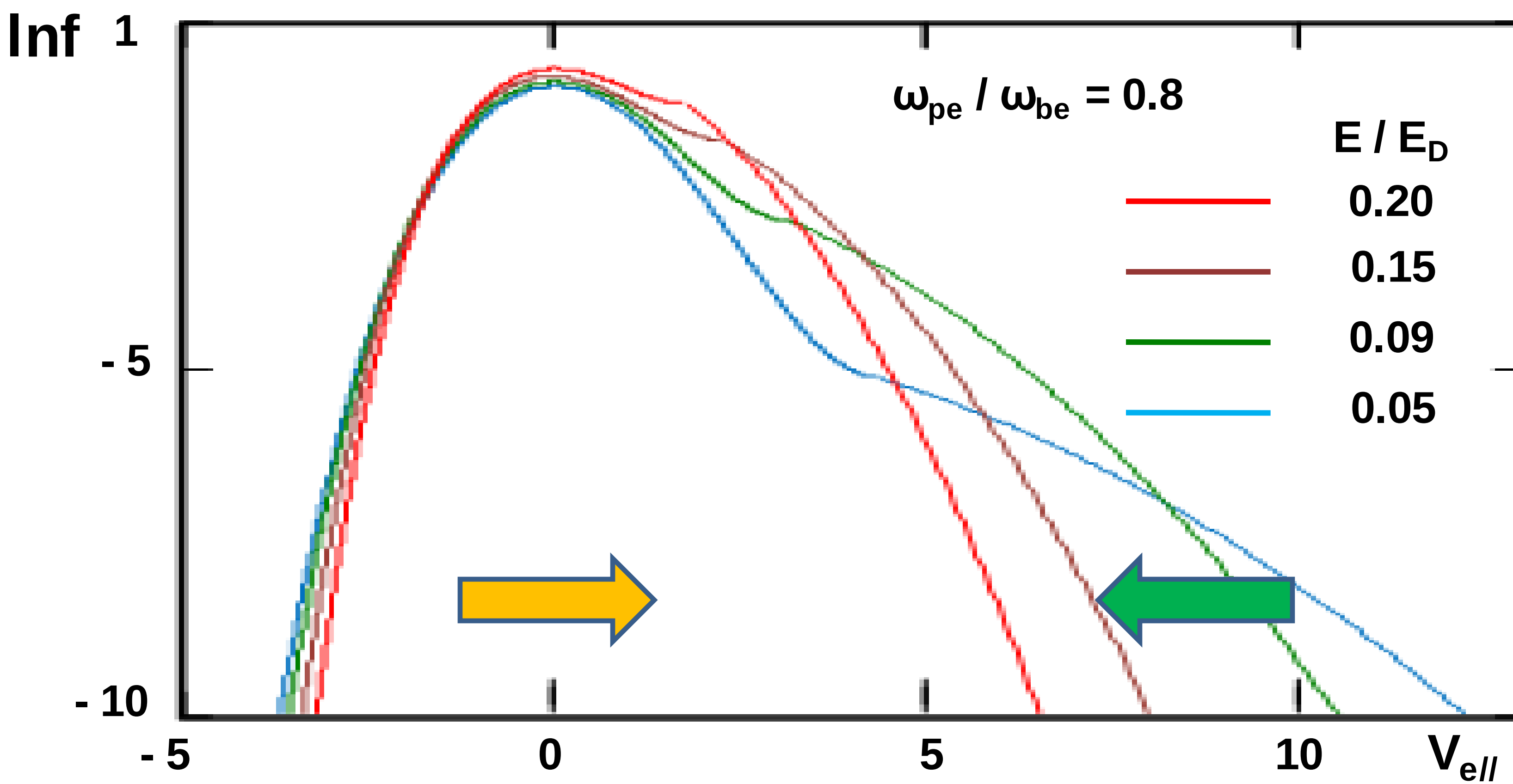
Electron distribution fuction in electric field

Stationary distribution function

Eigen frequencies of plasma (Langmuir) oscillations:

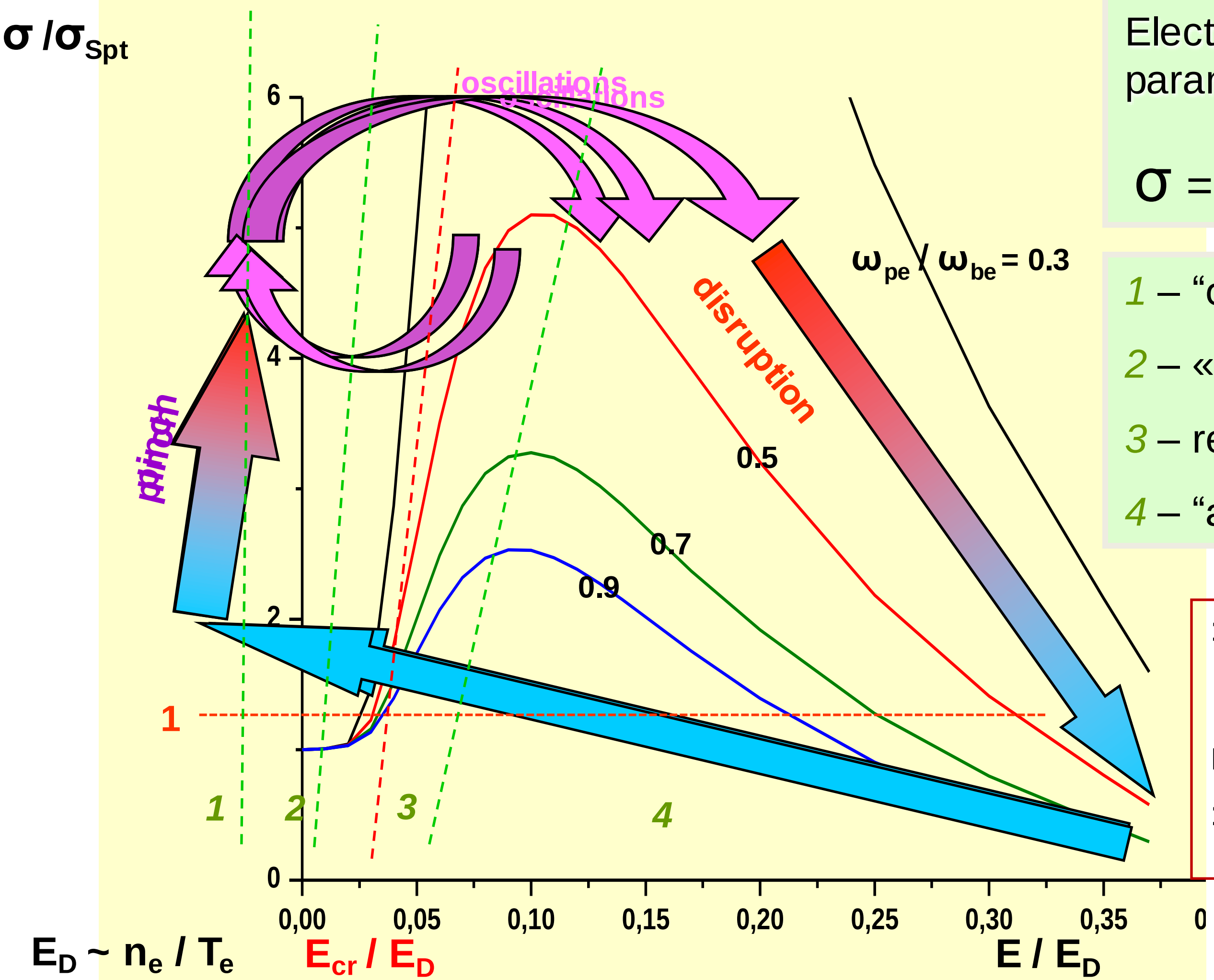
LF - $\omega_{pi} \le \omega_{lf} \le \min(\omega_{pe}, \omega_{be})$; HF - $\max(\omega_{pe}, \omega_{be}) \le \omega_{hf} \le (\omega_{pe}^2 + \omega_{be}^2)^{1/2}$

$\Gamma_E \sim \exp(-E_D / 4E)$, $E_D \sim n_e / T_e$; $\gamma_w \sim n_{res}$, $\Gamma_w \sim -\exp(\exp(-E_D / 4E))$



Electron distribution is compressed in longitudinal direction with rise of electric field

Electric conductivity. Critical electric field



Electric conductivity depends on parameter

$$\sigma = \sigma(E, N_e, B, T_e, Z_{eff})$$

1 – "classical" conductivity

2 – «runaway» regime

3 – regime of saturation

4 – "abnormal" dependence

1994, V.I. Poznyak et al. Proc. in 15 Int. Conf. on Plasma Phys. and Contr. Fusion, Seville, Spain,

Nuclear Fusion, 1995, v. 2, p. 169;

1995, Proc. in ECE-9, Borrego Springs, California, p. 137;

Positive feedback between current and electric field in "abnormal" regime provides necessary conditions for oscillations up to current disruption

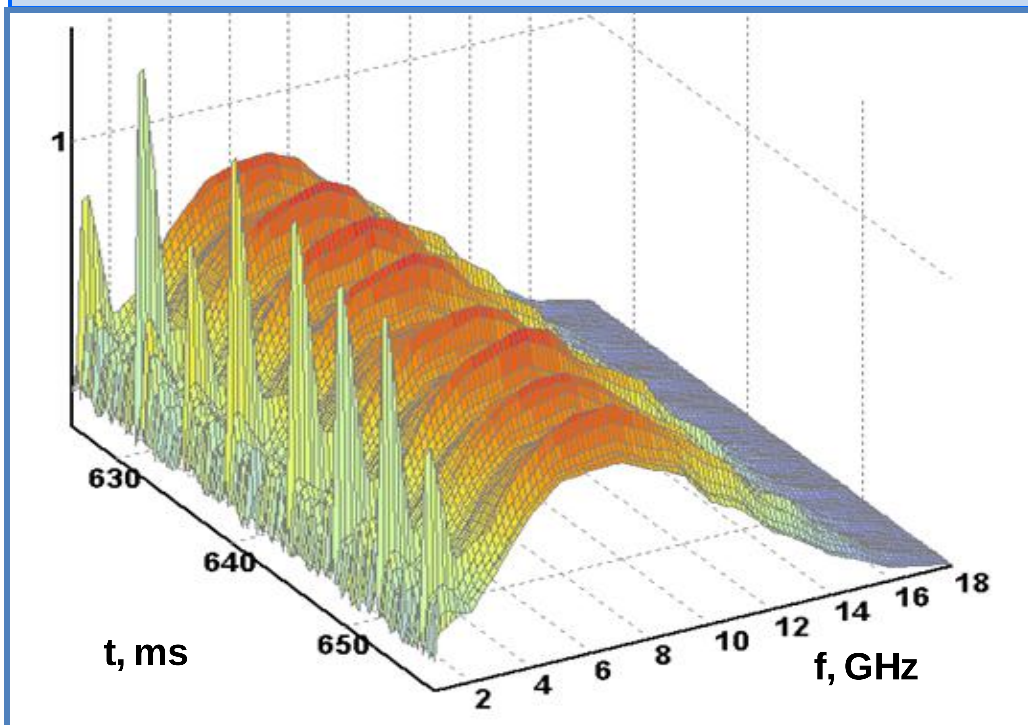
Boundary conditions for plasma waves

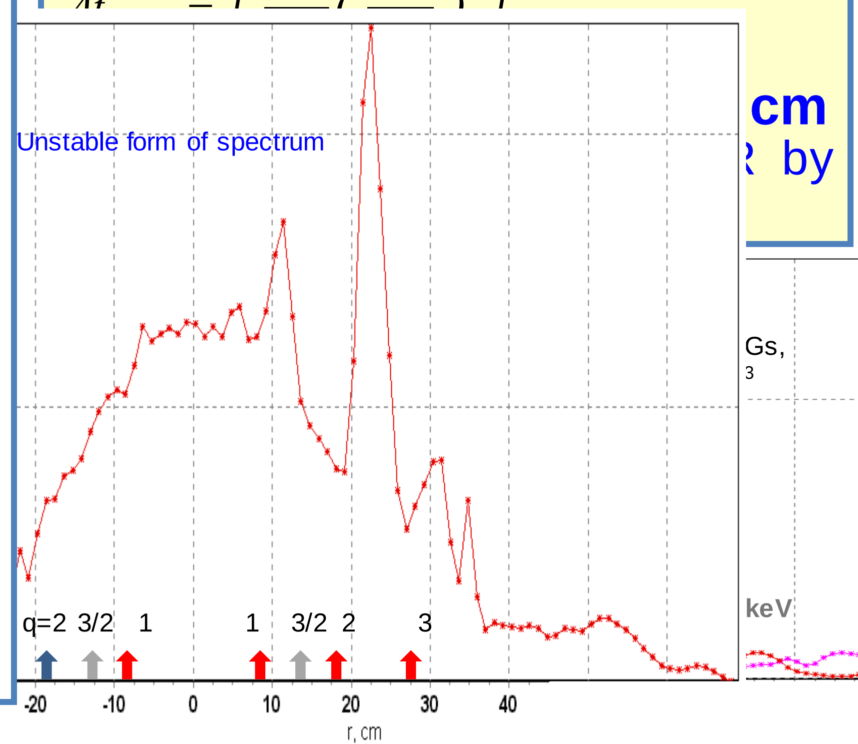
At relaxation zone – distribution function is stationary but plasma is unstable
Outside – distribution function is not stationary but plasma is stable

Spectrum of plasma wave is determined by value of electron density at q=1 zone on LFS

V.I. Poznyak et al., Strong Microwaves in Plasmas, 1997

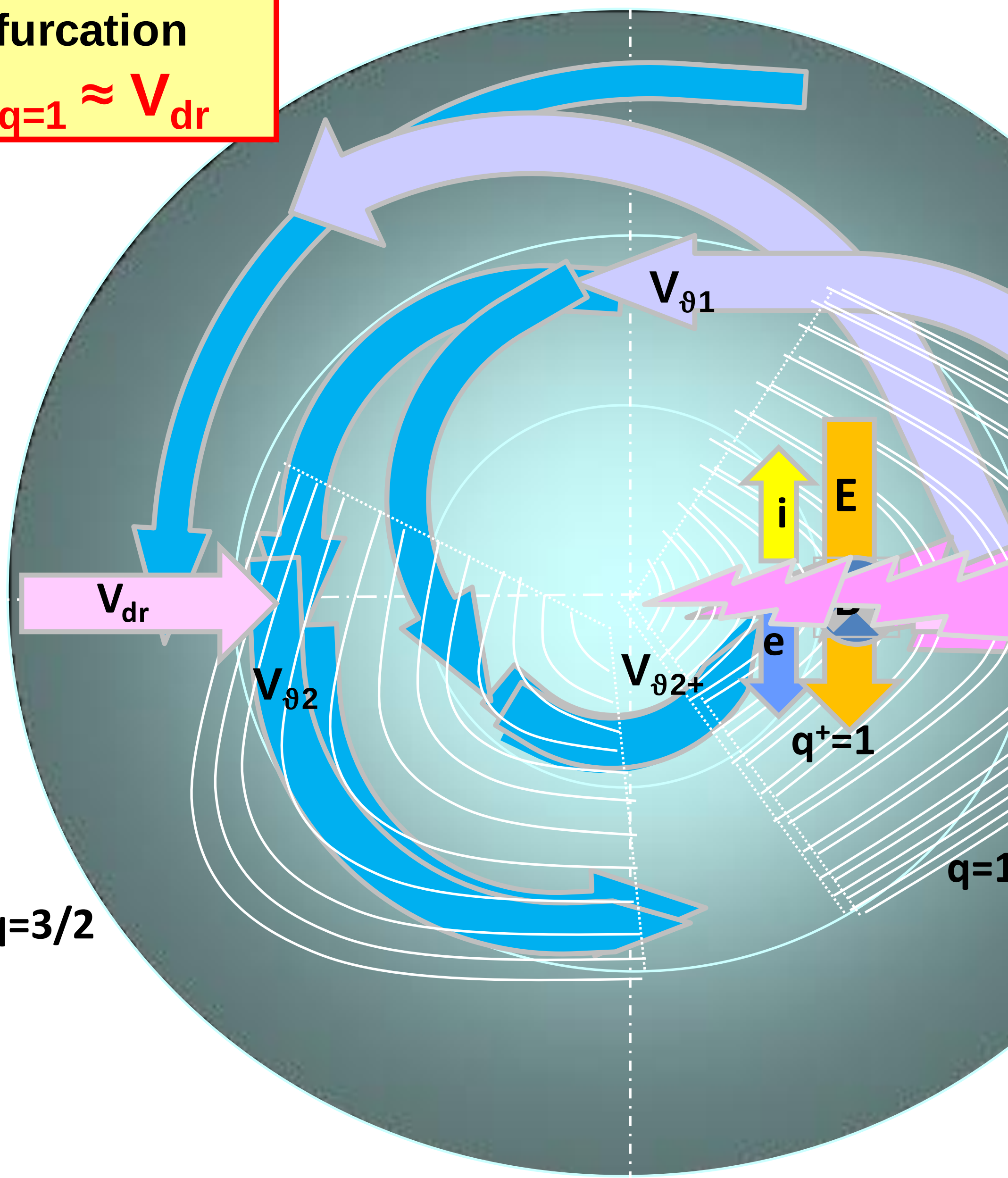
Magnetic field topology determines location of resonance zone for plasma waves. Those peculiarities synchronize process along small radius and simulate "reconnection of magnetic force line". Local values of current poloidal field drop and "solar prominence" bears





Condition of bifurcation

$V_{\vartheta q=1} \approx V_{dr}$



$V_{\vartheta 1} = V_{dr} = 1$

$n_e\,(R) = const$

$T_i\,(R) = const$

$V_{dr}\,(R) = const$

$r_{q=1}\,/\,r_{q+=1} = 2$

$S_{q=1}\,/\,S_{q+=1} = 4$

$V_\vartheta = V_{\Delta j\vartheta} \rightarrow \Delta j_\vartheta \sim j_\vartheta$

$V_{\vartheta 2,3(q=1)} = 0.5$

$V_{\vartheta (q=1+)} = 2$

$V_{\vartheta 2,3\,(q=1+)}\,/\,V_{\vartheta 2,3(q=1)} = 4$

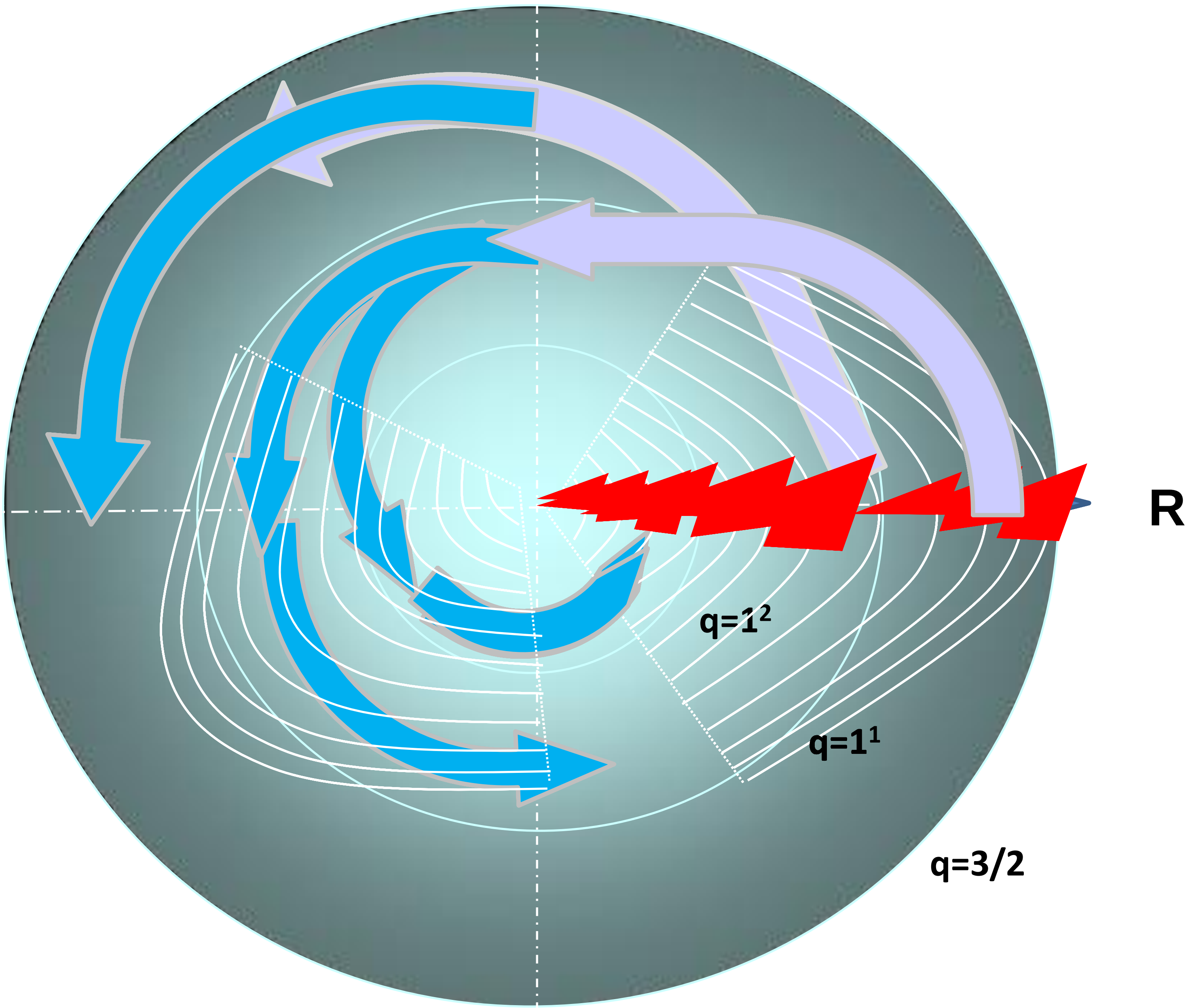
Rhythm of motion is odd

¾

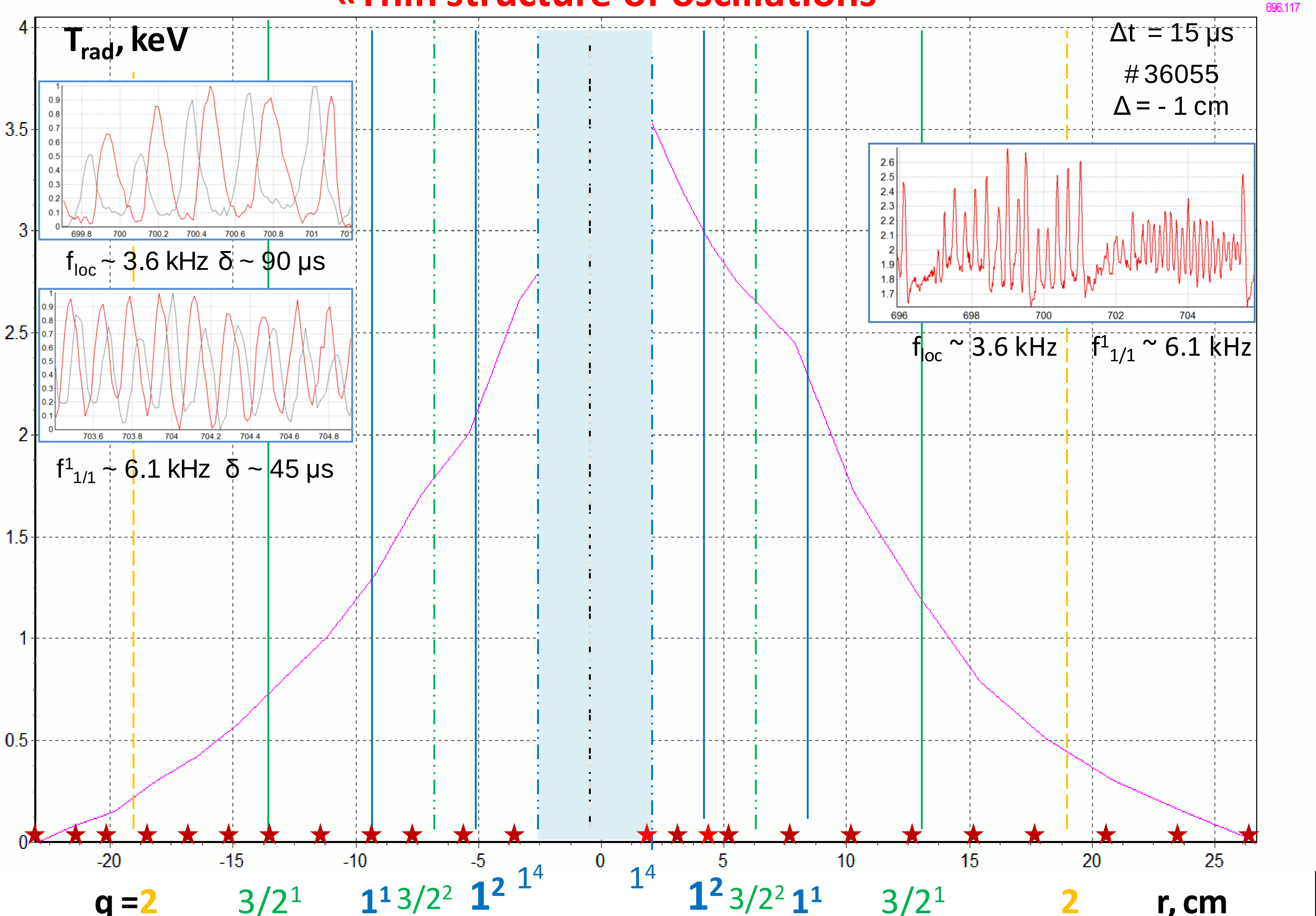
Собственные частоты

$\omega_q = 2\pi(v_{iB\blacktriangledown B}\,/\,2r_q)$

$\omega_{\,q=1+}\,/\,\omega_{q=1} = 2$


R
q=1²
q=1¹
q=3/2

«Thin structure of oscillations



"Thin structure" of oscillations