Pr3+:YLF laser is solid-state laser with a gain-line shape corresponds to Lorentzian profile which belongs to homogeneous broadening [2016, Li Qing-Song]. The gain coefficient can be expressed as [wolfram]

 (1)

where ω­0 is the central frequency and ωg is full width at half-maximum of the laser gain-line shape.

By introducing a frequency shift of the Stark splitting ωs from the unperturbed frequency, induced by the laser field, Eq. (1) can be written as

(2)

According to the rough self-mode-locking criterion for solid-state lasers [1992, Zhijiang Wang], self-mode-locking pulses can occur when .

[2016, Li Qing-Song]. “The effect of the depth of single longitudinal mode modulation in Q-switching pre-Pr3+:YLF laser”

[wolfram]. <http://scienceworld.wolfram.com/physics/LorentzianLineshape.html>

[1992, Zhijiang Wang]. “Novel self-mode-locking mechanism in narrow-band lasers”