



# *STIMULATED RAMAN SCATTERING*

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# SRS

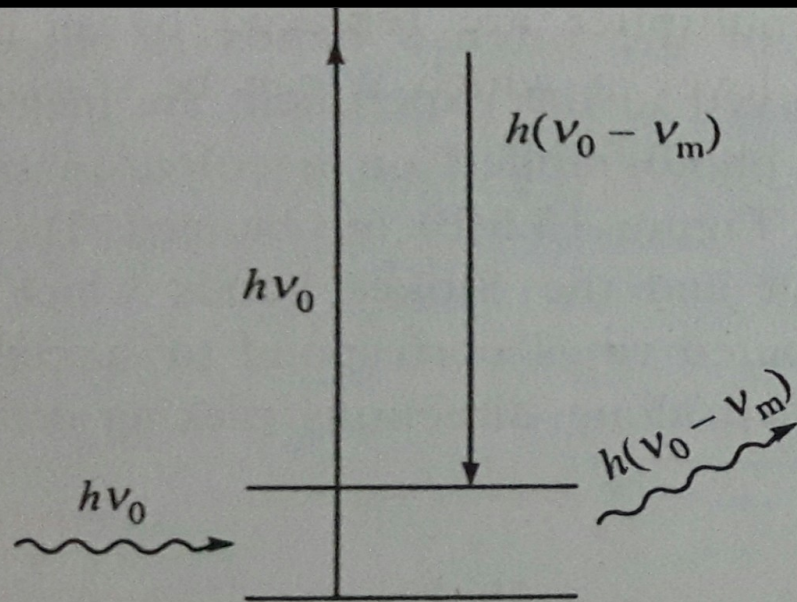
- Shutter for Q switched giant pulse ruby laser.
- In addition to normal stimulated emission there was a high intense radiation in SRS.
- This additional emission, a Raman line of nitrobenzene, showed no. of characteristics of normal stimulated emission.

- When a giant pulse laser is focused into a sample and the scattered radiation is observed along the laser beam direction and a small angle to it. It has an incident frequency  $\nu_0$  and Stokes and anti-Stokes lines at  $\nu_{0 \pm n\nu_m}$  where  $n=1,2,3,\dots$   $\nu_m$  = Raman active vibration of scattering molecule. This phenomenon is called Stimulated Raman Scattering.
- In stimulated Raman scattering there is no need for Population inversion of states.

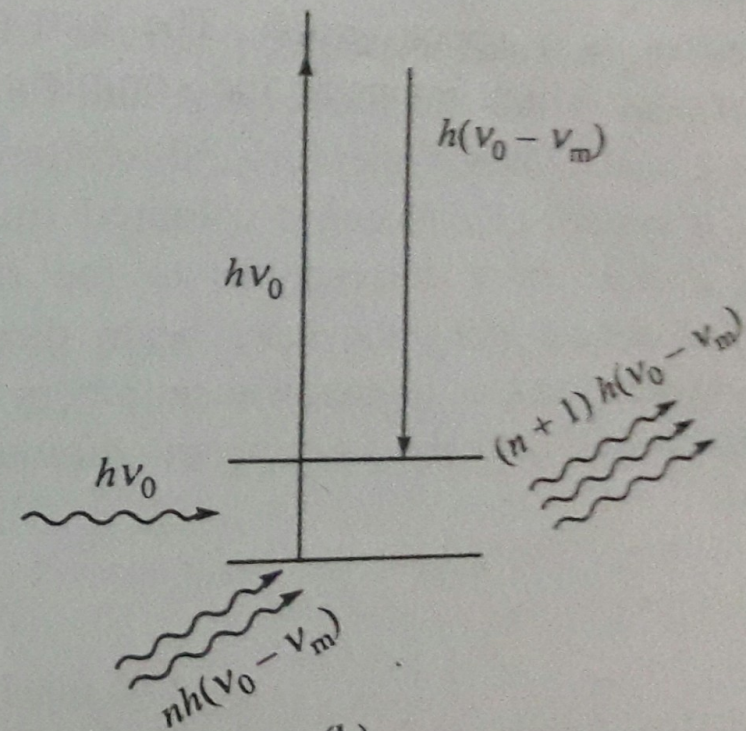


## SPONTANEOUS RAMAN STOKES SCATTERING.

## STIMULATED RAMAN STOKES SCATTERING



(a)



(b)

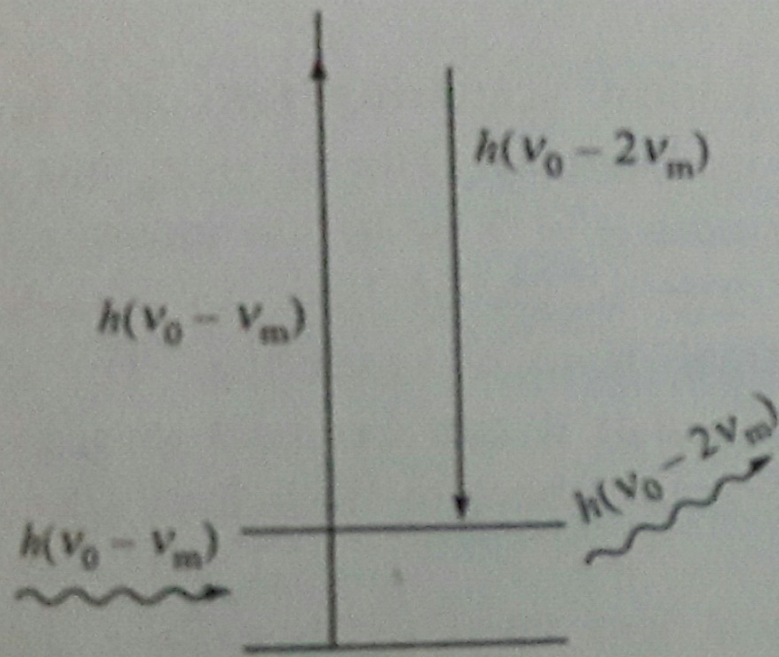
**Figure 15.4** Schematic illustration of (a) spontaneous Raman Stokes scattering, (b) stimulated Raman Stokes scattering.

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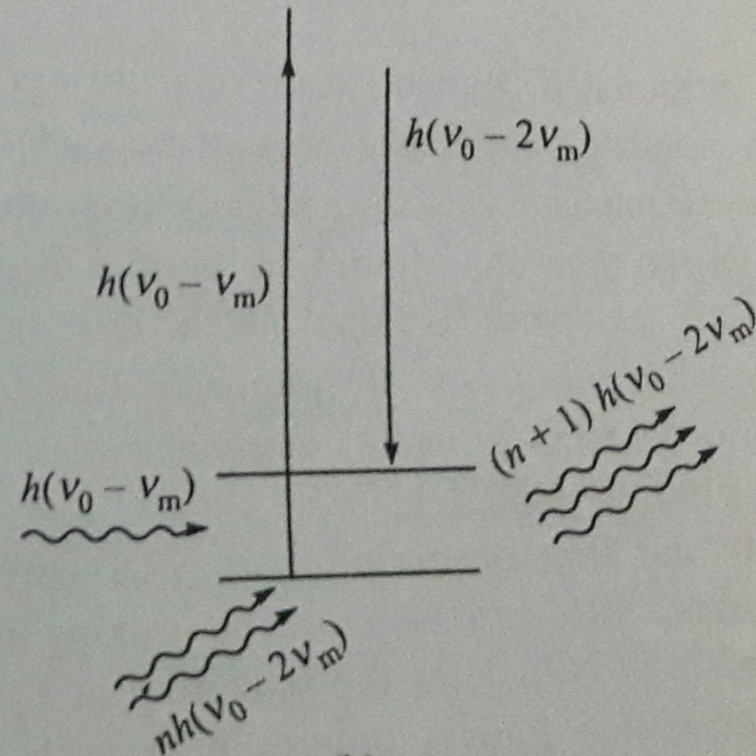


SPONTANEOUS RAMAN SCATTERING AT  
 $(\nu_0 - 2\nu_m)$

STIMULATED RAMAN SCATTERING AT  
 $(\nu_0 - 2\nu_m)$



(a)

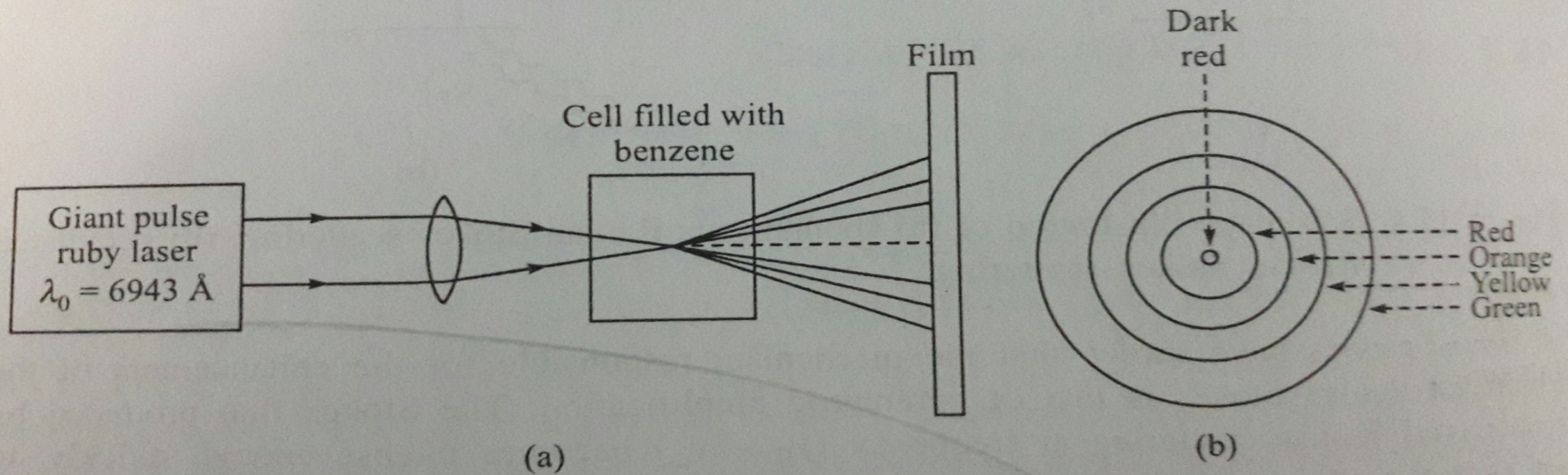


(b)

Figure 15.5 Illustration of (a) spontaneous Raman scattering at  $(\nu_0 - 2\nu_m)$ , (b) stimulated Raman scattering at  $(\nu_0 - 2\nu_m)$ .



# SCHEMATIC REPRESENTATION OF SRS



**Figure 15.6** (a) Schematic representation of SRS experimental set-up, (b) observed pattern for benzene.

# DIFFERENCE BETWEEN STIMULATED RAMAN SCATTERING AND NORMAL RAMAN SCATTERING.

- Wave number pattern and angular dependence.
- Intensity is different.
- $n=3$  or  $4$ , intensity will be larger in stimulated Raman scattering than normal Raman scattering.
- The width of stimulated Raman scattering is less than that in normal Raman scattering.
- High conversion efficiency in stimulated Raman scattering.



- If SRS is of 2 lasers then generated raman frequency at  $\nu_2$  has the same properties as the  $\nu_2$  laser.
- During the process a gain is produced at frequency  $\nu_2$  whereas photons of frequency  $\nu_1$  are annihilated.
- Therefore there are two ways to perform the experiment either by measuring the gain at the frequency  $\nu_2$  or by measuring losses at frequency  $\nu_1$ .

These two are sometimes referred to as RAMAN GAIN SPECTROSCOPY and

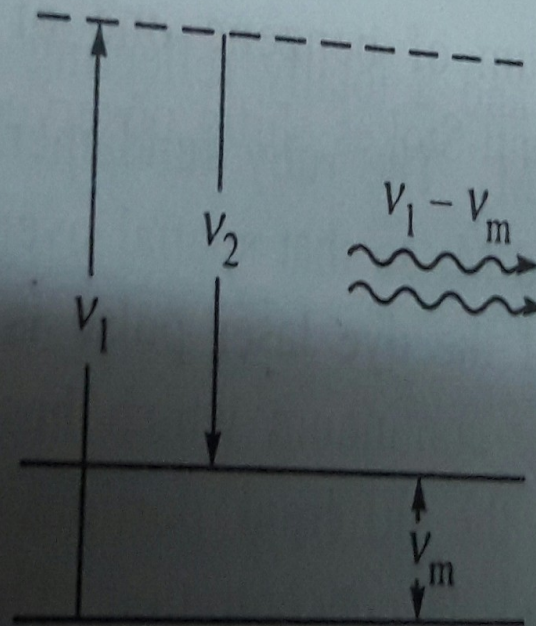


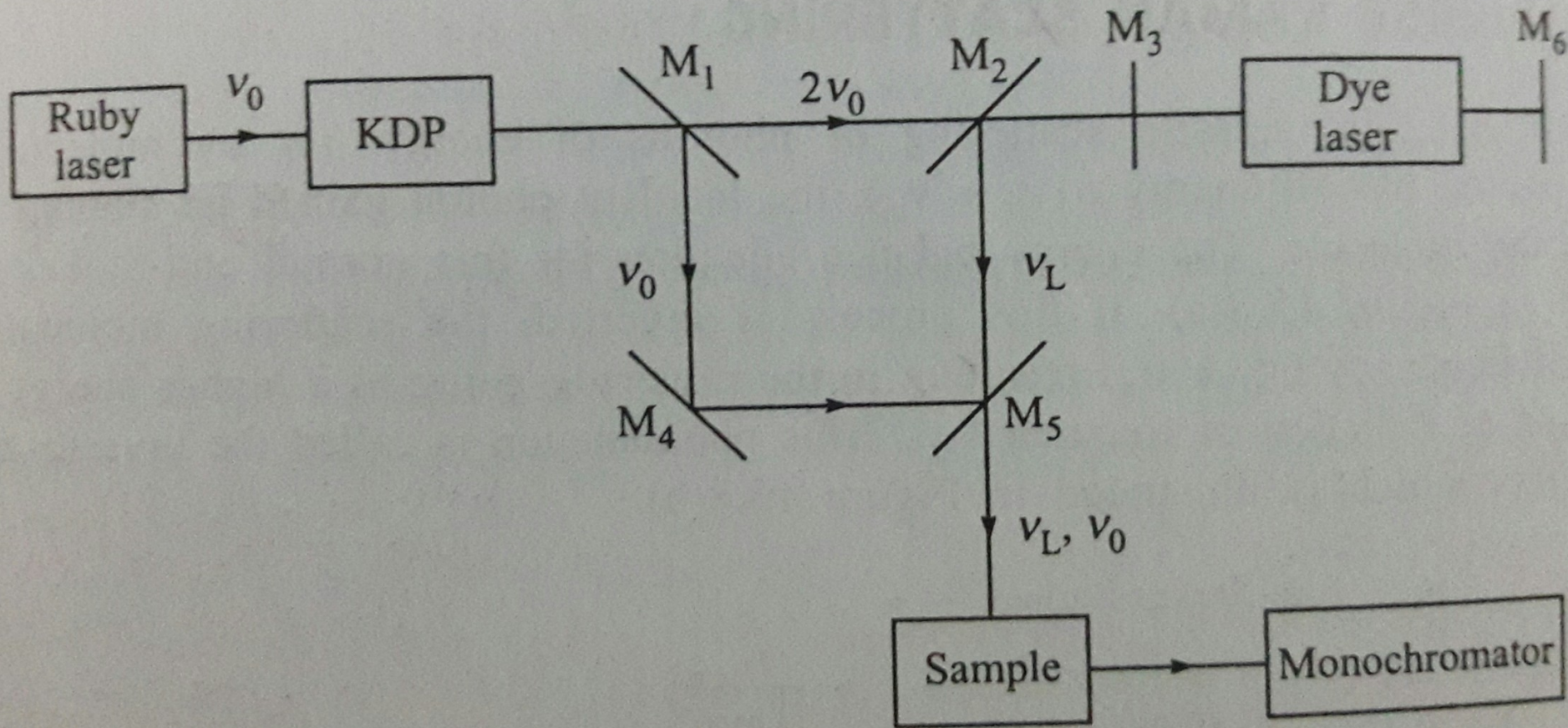
Figure 15.7 Stimulated Raman process with two lasers having frequencies  $\nu_1$  and  $\nu_2$ .



# INVERSE RAMAN SCATTERING

- The scattering molecule absorbs radiation of frequency  $(\nu_0 + \nu_m)$  resulting molecule going into higher energy level and emission of frequency  $\nu_0$ . This phenomenon is called the **inverse anti-stokes Raman effect**.
- The absorption of radiation of frequency  $\nu_0 - \nu_m$  by the molecule would result in decrease in the energy of the scattering molecule by  $h\nu_m$  and emission of radiation of energy  $h\nu_0$ . This process is called **inverse Stokes Raman scattering**.

# SCHEMATIC REPRESENTATION OF INVERSE RAMAN SCATTERING.



**Figure 15.9** Schematic arrangement of the experimental set up for inverse Raman scattering.  
 $M_1, M_2, M_3, M_4, M_5, M_6$  are dichroic mirrors.



The background features a solid black field. At the top, there is a decorative, wavy band of color that transitions from a bright yellow-orange on the left to a vibrant cyan on the right, with a dark, almost black, undulating line separating it from the main black area.

***THANK U .....***