



*STIMULATED RAMAN
SCATTERING*

BY

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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 ν_0 and Stokes and anti-Stokes lines at $\nu_{0 \pm n\nu_m}$ where $n=1,2,3,\dots$ ν_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

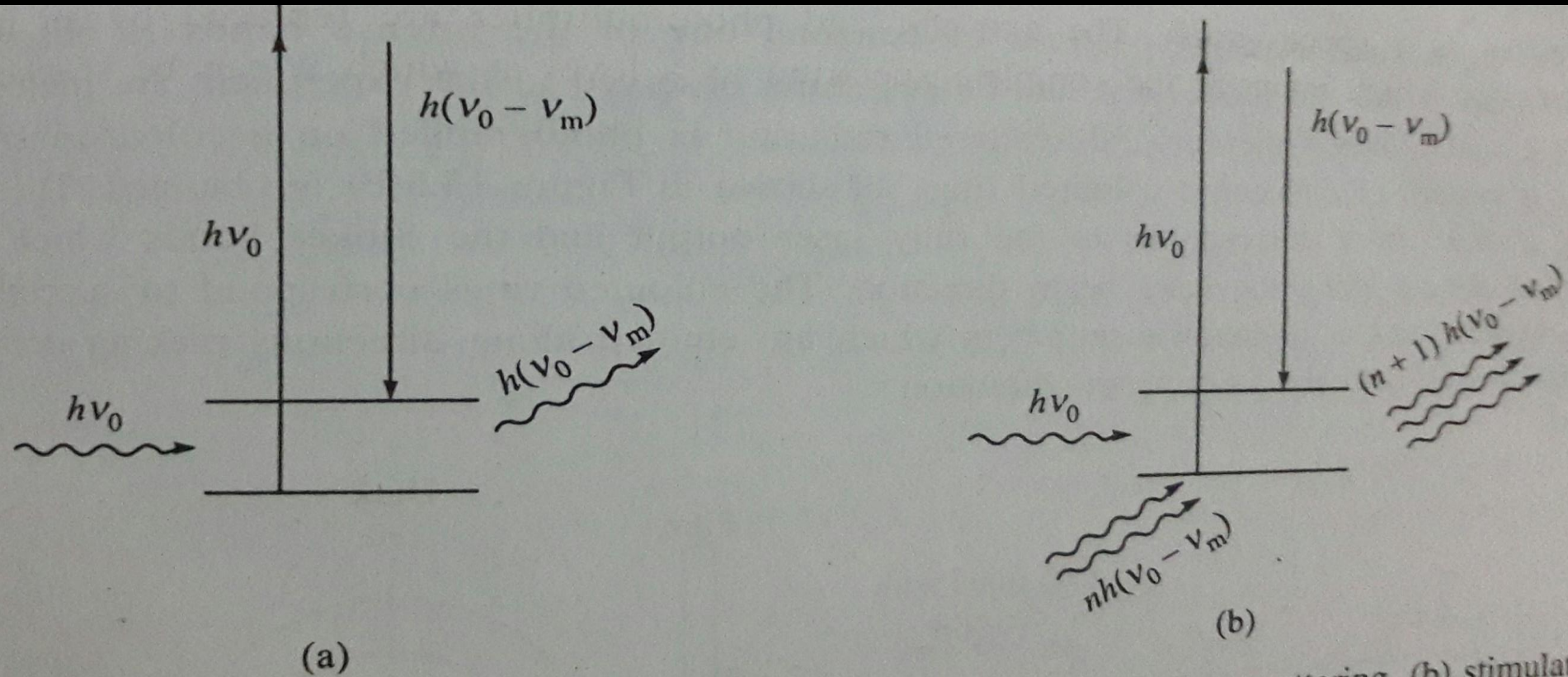


Figure 15.4 Schematic illustration of (a) spontaneous Raman Stokes scattering, (b) stimulated Raman Stokes scattering.

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

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

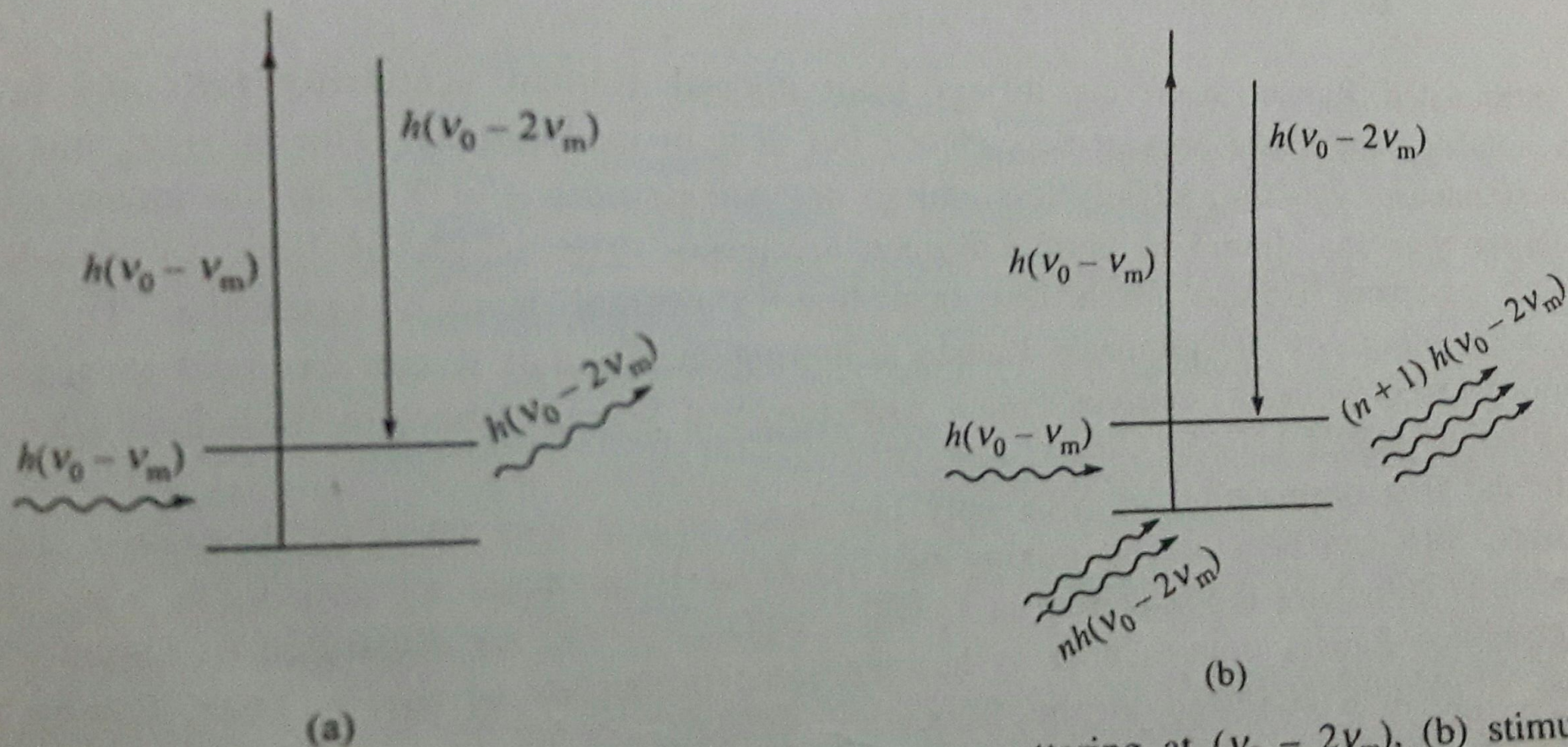


Figure 15.5 Illustration of (a) spontaneous Raman scattering at $(\nu_0 - 2\nu_m)$, (b) stimulated Raman scattering at $(\nu_0 - 2\nu_m)$.

SCHEMATIC REPRESENTATION OF SRS

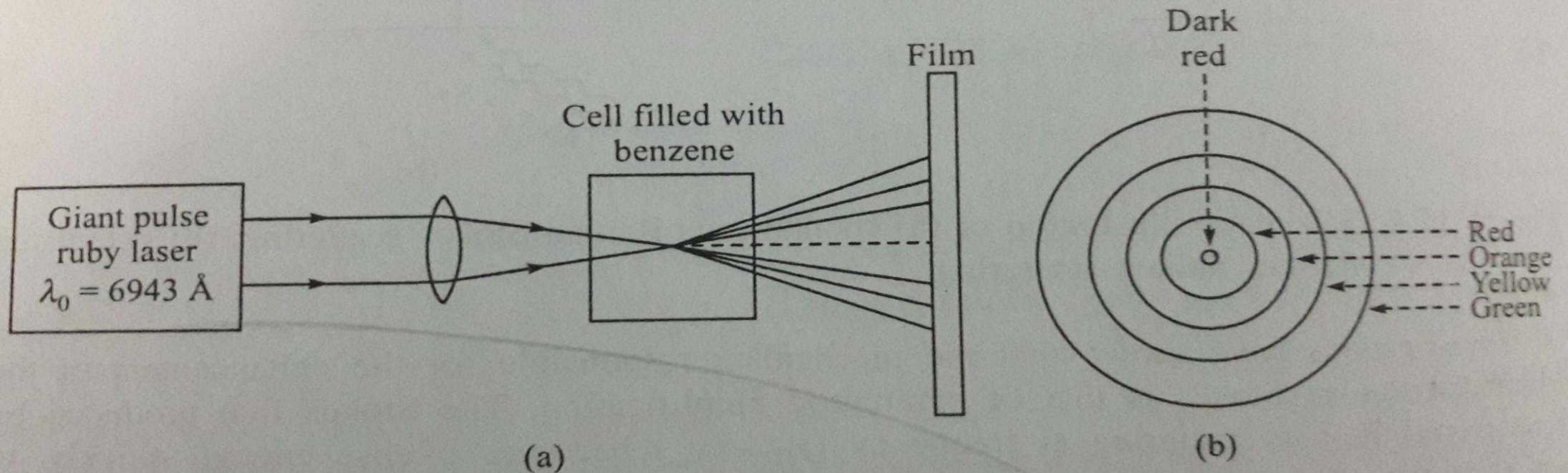


Figure 15.6 (a) Schematic representation of SRS experimental set-up, (b) observed pattern for benzene.

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 ν_2 has the same properties as the ν_2 laser.
- During the process a gain is produced at frequency ν_2 whereas photons of frequency ν_1 are annihilated.
- Therefore there are two ways to perform the experiment either by measuring the gain at the frequency ν_2 or by measuring losses at frequency ν_1 .
- These two are sometimes referred to as RAMAN GAIN SPECTROSCOPY and RAMAN LOSS SPECTROSCOPY.

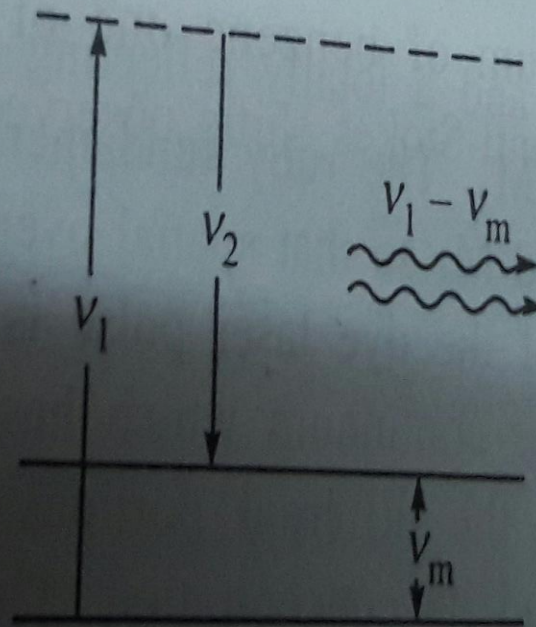


Figure 15.7 Stimulated Raman process with two lasers having frequencies ν_1 and ν_2 .

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 ν_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.

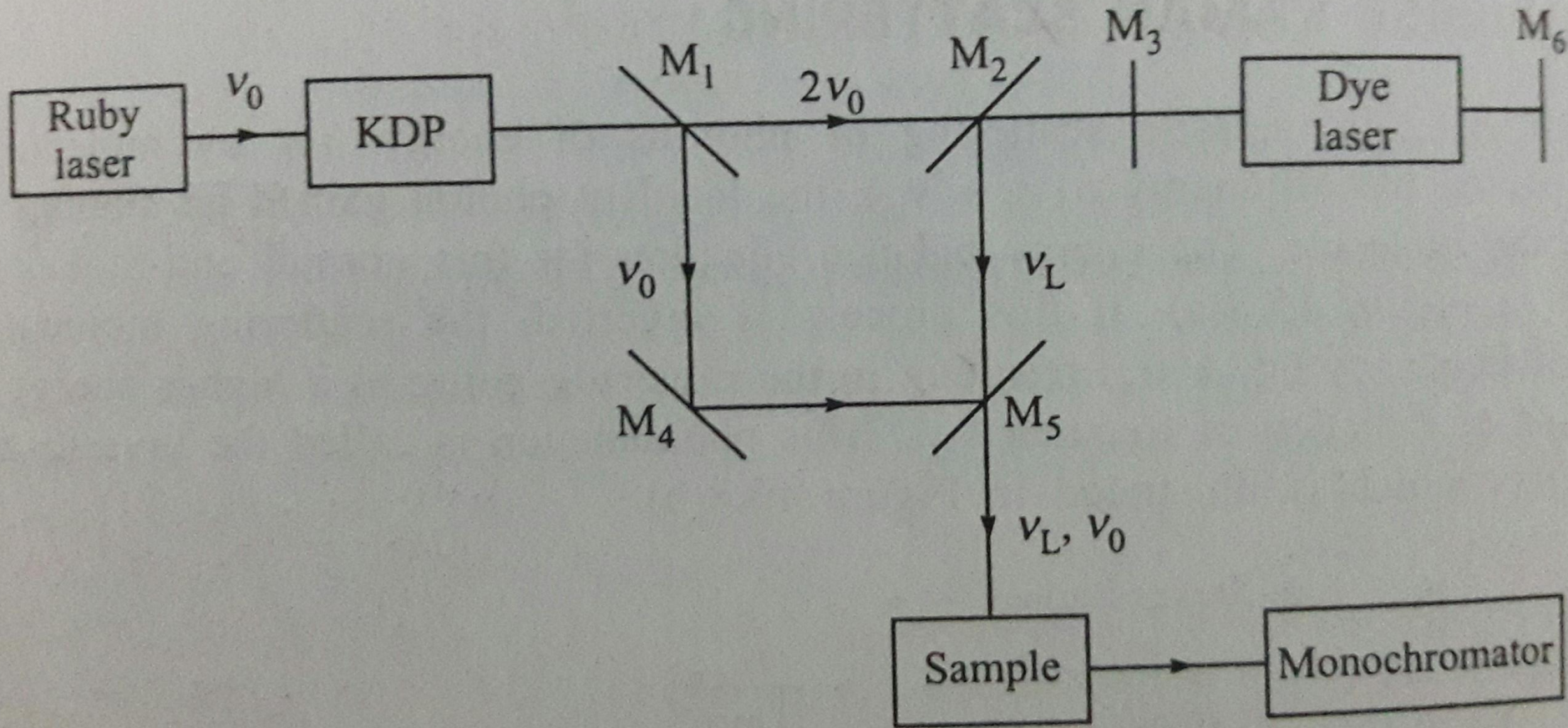


Figure 15.9 Schematic arrangement of the experimental set up for inverse Raman scattering.
 $M_1, M_2, M_3, M_4, M_5, M_6$ are dichroic mirrors.



THANK U