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13. ABSTRACT (Maximum 200 words)  
During the tenure of the project, we have studied the ion-molecule reactions involving collisions of low energy CHO<sup>+</sup> ions and CH<sub>4</sub>, H<sub>2</sub>, N<sub>2</sub> and O<sub>2</sub>, etc. molecules. Several electronically excited states have been identified and the reaction rate coefficients have been measured for the strongest band(s) of the excited state molecules or radicals and the atomic lines. We have also extensively studied the Stimulated Raman scattering processes in a wide and capillary tubings and have measured the efficiency of scattered laser lines at various wavelengths in CH<sub>4</sub> and H<sub>2</sub> as gain media. These experiments were performed at high pressures of these gases (100 - 500 PSI) and high pump energy (1-100 mJ) of the third harmonic of the Nd:YAG laser laser. Our results indicate that the capillary tubing is slightly more efficient than the wide bore tubing and a compact Raman laser source may be built for scientific research. In addition, we have studied the competition between the stimulated Raman and Brillouin scattering processes and calculated the corresponding gain coefficients. During the studies of the scattering processes, we have observed the two photon excitation and dissociation of CH<sub>4</sub> and H<sub>2</sub> molecules using the third harmonic pulsed laser line at 355 nm from Nd:YAG. The photodissociative excitation of CH-radicals and H-atomic lines may be used for diagnostic purposes of the unburnt methane and hydrogen gases in combustion flames

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1. Chemiluminescent ..... CHO<sup>+</sup> Ions and CH<sub>4</sub> Molecules  
A. Michael, P. Misra, and V. Kushawaha  
Appl. Spectroscopy, 46, 797, 1992.
2. Laser Wavelength, Pressure..... Gain in H<sub>2</sub>  
K. Sentrayan, L. Major, H. Bryant, A. Michael, and V. Kushawaha  
Spectry. Lett. 25, 627, 1992.
3. Electronic Emission due .....CHO<sup>+</sup> and H<sub>2</sub><sup>+</sup> Ions and CH<sub>4</sub> and N<sub>2</sub> Molecules  
A. Michael, P. Misra, and V. Kushawaha  
J. Phys. B 25, 2343, 1992.
4. Liquid Nitrogen and Room Temperature..... Isotopic Molecules  
K. sentrayan, L. Major, A. Michael, and V. Kushawaha  
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5. Stimulated Raman ... in Capillary Cell  
H. Bryant, K. Sntryan, and V. Kushawaha  
Spect. Lett. (In Press, 1992)
6. Intense Backward SRS-Lasers in H<sub>2</sub> and CH<sub>4</sub>  
K. Sentrayan, A. Michael, and V. Kushawaha  
Appl. Opt. (Accepted, 1992)
7. Observation of Stokes and anti-Stokes.... Nd:YAG laser  
K. Sentrayan, L. Major, A. Michael, and V. Kushawaha  
Appl. Phys. B (Accepted, 1992)
8. Competition between Stimulated Raman and Brillouin Scattering in CH<sub>4</sub> and H<sub>2</sub>

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8. SCIENTIFIC PERSONNEL SUPPORTED BY THIS PROJECT AND DEGREES AWARDED DURING THIS REPORTING PERIOD:

1. A. Michael
2. L. Major,
3. K. Sentrayan
4. A. Farah
5. H. Bryant

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10. BRIEF OUTLINE OF RESEARCH FINDINGS:

During the tenure of the project, we have studied the ion-molecule reactions involving collisions of low energy  $\text{CHO}^+$  ions and  $\text{CH}_4$ ,  $\text{H}_2$ ,  $\text{N}_2$  and  $\text{O}_2$ , etc. molecules. Several electronically excited states have been identified and the reaction rate coefficients have been measured for the strongest band(s) of the excited state molecules or radicals and the atomic lines. We have also extensively studied the Stimulated Raman scattering processes in a wide and capillary tubings and have measured the efficiency of scattered laser lines at various wavelengths in  $\text{CH}_4$  and  $\text{H}_2$  as gain media. These experiments were performed at high pressures of these gases (100 - 500 PSI) and high pump energy (1-100 mJ) of the third harmonic of the Nd:YAG laser laser. Our results indicate that the capillary tubing is slightly more efficient than the wide bore tubing and a compact Raman laser source may be built for scientific research. In addition, we have studied the competition between the stimulated Raman and Brillouin scattering processes and calculated the corresponding gain coefficients. During the studies of the scattering processes, we have observed the two photon excitation and dissociation of  $\text{CH}_4$  and  $\text{H}_2$  molecules using the third harmonic pulsed laser line at 355 nm from Nd:YAG. The photodissociative excitation of CH-radicals and H-atomic lines may be used for diagnostic purposes of the unburnt methane and hydrogen gases in combustion flames. These results have either been published or submitted for publication in various journals.