We have developed a new reflecting element, all-metal axicon mirror, and demonstrated its use to generate hollow conic beam. The axicon mirror has a base angle of ~3 degree and is made of copper. It was fabricated in Laser Workshop of RRCAT, polished on a diamond turning machine in Machine Dynamics Division of BARC and gold coated in the Optical Workshop of RRCAT. Using this axicon mirror, a good quality hollow conic beam has been generated with a power conversion efficiency of ~ 85% for transformation of a Gaussian beam into a hollow conic beam. Focusing of the hollow beam by a lens was investigated and it was found that it is possible to have a region of length several cm over which the hollow beam diameter is few mm. This is suitable for guiding of cold atoms by using a suitably detuned laser beam.

Fig. L.6.1 *CCD image of the hollow beam generated by axicon mirror.*

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L.7 Development of near 100 watt kinetically enhanced copper vapor laser

Kinetically enhanced copper vapor lasers are the advanced CVL systems with high efficiency 1.2-1.5% and increased output power (2-3 times) as compared to standard CVLs, where efficiencies are normally less than 1%. The carefully optimized HCl component of the buffer gas controls the electron density in the discharge medium by the process of dissociative attachment (DA), thus ensuring most favorable excitation conditions in the CVL. We have recently demonstrated a high power KE-CVL which was capable of generating about 94watt output power at ~ 10 kHz repetition rate using special buffer gas mixture in the discharge medium. The KE-CVL was based on 58mm bore and 1450mm length discharge tube. Alumina bulk fibre was used as thermal insulation around the discharge tube. Two water-cooled electrode assemblies were supported at two ends of the discharge tube with suitable end mounting flanges. HCl component of the buffer gas was prepared online by using a carefully optimized quartz cell containing high purity zirconium cloride as the source material. The total input power required was about 7kW. The overall wall plug efficiency was about 1.4 % which is highest so far achieved in our laboratory and very close to maximum value of 1.49% reported so far in KE-CVLs in the literature. The laser require about one hour to reach maximum output power after threshold lasing. The laser pulse durations are typically of about 50ns FWHM. The near field pattern of the beam cross-section is Hat Top type with higher intensity at the center.

Fig. L.7.1 *94 watt CVL beam being coupled out from laser window.*

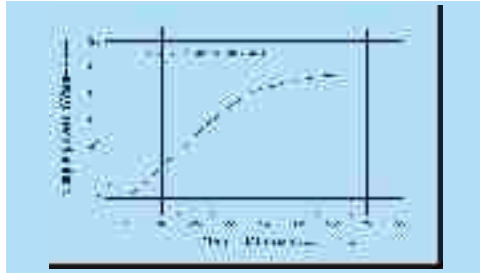

Fig. L.7.2 *Laser power buildup with time.*

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L.8 Generation of 120 watt CVL beam from single stage oscillator amplifier configuration

The kinetically enhanced (KE) CVLs offer high wall plug efficiency (1.2-1.5 %) and increased output power (2-3 times) capabilities as compared to standard CVLs by favorably enhancing the inter-pulse discharge kinetics using special buffer gas mixtures and other operating parameters [*B. Singh, V.V. Subramaniam, S.R. Daultabad, A. Chakraborty, Review of Scientific Instruments 126104, Dec 2005*]. These individual KE-CVL units can be grouped into oscillator amplifier configurations (fig. L.8.1) to generate single high power CVL beam. We have recently demonstrated a single stage oscillator-amplifier configuration using two KE-CVLs which was capable of