A modeless laser is a device which provides intense coherent broadband light fields. It finds applications in areas such as high resolution spectroscopy, medicine, radar-lidar, metrology [1] where a coherent broadband radiation is needed.

In a modeless laser, the constructive interference of the optical wave, which would lead to spectral mode structure, is prevented by the insertion of an intra-cavity frequency shift on each round trip. In order to eliminate the mode structure, the frequency shift should occur by a mechanism which does not simultaneously change the cavity length. A common technique to achieve this is to use an acousto optic frequency shifter device (AOM) that will cause a discrete frequency shift of \( \Delta = 2\nu_{AOM} \) on each round trip. We note that in order to achieve broadband continuous emission the ratio of \( \Delta / \text{FSR} > 0.01 \) [2] where FSR is the free spectral range of the cavity without AOM.

In this paper, we demonstrate for the first time a 300GHz bandwidth (FWHM) continuous wave operation of a modeless Vertical External Cavity Surface Emitting Laser (VECSEL). The laser cavity design (fig.1) is based on a frequency-shifted-feedback laser design using an intracavity acousto optic frequency shifter with \( \nu_{AOM} = 110 \text{ MHz} \) and ~ 92\% 1st order diffraction efficiency. The gain is provided by high gain GaAs based multiple quantum well (12QW) semiconductor chip emitting at 1070nm. This semiconductor structure includes a backside DBR HR mirror (99.9\%). It is pumped with a 250mW single-mode pump (785nm), focused on the semiconductor chip with a 50\( \mu \text{m} \) waist. To reach a low laser threshold operation, a \( M \)-shaped cavity has been designed (overall length of 1.5 m) as it permits two passes per round trip in the gain medium, compared to linear cavities. The emitted power reached 30mW, with TEM00 emission and strongly linear polarization (>20dB).

References