Symmetric molecules have no permanent dipole moment and are undetectable by rotational spectroscopy. Their interstellar observations have previously been limited to mid-infrared vibration-rotation spectroscopy. Although relatively weak, vibrational difference bands provide a means for detection of non polar molecules by terahertz techniques with microwave precision. Herschel, SOFIA, and ALMA have the potential to identify a number of difference bands of light symmetric species, e.g., C$_2$H$_2$, CH$_4$ and C$_3$. This paper reports the results of the laboratory study on $^{12}$C$_2$H$_2$ and $^{12}$C$_2$D$_2$. The symmetric isotopomers of acetylene have two bending modes, the trans bending $\nu_4$ ($^1\Pi_g$), and the cis bending $\nu_5$ ($^1\Pi_u$). For $^{12}$C$_2$H$_2$, the two bending modes occur at 612 and 729 cm$^{-1}$, respectively. For $^{12}$C$_2$D$_2$, the two bending modes occur at 511 and 538 cm$^{-1}$. The $\nu_5$-$\nu_4$ difference bands are allowed and occur in the microwave, terahertz, and far-infrared wavelengths, with band origins at 117 cm$^{-1}$ (3500 GHz) for $^{12}$C$_2$H$_2$ and 27 cm$^{-1}$ (900 GHz) for $^{12}$C$_2$D$_2$.

Two hundred and fifty-one $^{12}$C$_2$D$_2$ transitions, which are from $\nu_5$-$\nu_4$, $(\nu_5+\nu_4)$-$2\nu_4$ and $2\nu_5-(\nu_5+\nu_4)$ bands, have been measured in the 0.2-1.6 THz region, and 202 of them were observed for the first time. The precision of these measurements is estimated to be from 50 kHz to 100 kHz. A multistate analysis was carried out for the bending vibrational modes $\nu_4$ and $\nu_5$ of $^{12}$C$_2$D$_2$, which includes the lines observed in this work and prior microwave, far-infrared and infrared data on the pure bending levels. Significantly improved molecular parameters were obtained for $^{12}$C$_2$D$_2$ by adding the new measurements to the old data set which had only 10 lines with microwave measurement precision. The experiments on $^{12}$C$_2$H$_2$ are in progress and ten $P$ branch lines have been observed. We will present the $^{12}$C$_2$H$_2$ results to date.