VIBRATIONAL SATELLITES AS A MEANS TO STUDY DENSE AND HOT PARTS OF THE INTERSTELLAR MEDIUM. RESULTS OF A 3 mm LINE SURVEY OF SAGITTARIUS B2(N) AND (M)

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Vibrational satellites of spectral lines from a number of molecules have been found for several species in high-mass star-forming regions or in circumstellar envelopes around mass-losing evolved stars. To excite levels in high energy states and produce emission (or absorption) lines strong enough to be observable by radio or (sub)millimeter telescopes requires high temperatures and/or high densities and/or intense infrared excitation fields. We have carried out a contiguous molecular line survey of the 3 mm wavelength window toward the high-mass star-forming regions Sagittarius B2(N) and (M) with the IRAM 30 m radiotelecope to investigate the molecular inventory of these two famous sources. Selected data have also been obtained in the 2 and 1.3 mm frequency regions. About 3700 and 950 lines above 3σ have been detected toward Sgr B2(N) and (M), respectively. Among the lines identified thus far are several pertaining to molecules in excited vibrational states, such as HCN, HNCO, CH_3OH, and SO_2 or even of minor isotopic species in excited vibrational states, e. g., for the ^{13}C species of HC_3N. In addition, we have detected vibrationally excited emission from several species for the first time. These include $HC(O)NH_2$, OCS, highly excited states of CH_3CN and C_2H_3CN as well as vibrational satellites of the ^{13}C species of CH_3CN. Some of these identifications were facilitated by dedicated laboratory spectroscopic studies. Since rotational lines from within excited vibrational states probe exclusively the very densest and hottest regions they are frequently better suited to investigate these regions than the species in the ground vibrational state, and even more so as vibrational satellite lines are less prone to be optically thick than the ground-state lines and vibration-rotational lines which lie at infrared wavelengths. Some results will be presented in detail. In addition, we will discuss needs for further laboratory spectroscopic investigations, in particular in view of the increased sensitivity of arrays such as the SMA and ALMA.