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Remote Sensing of a Comet at Millimeter and Submillimeter Wavelengths from a Comet Orbiting Spacecraft

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A millimeter wavelength instrument (MIRO) which operates in the band from 1.6 mm to 0.5mm was launched onboard the ESA ROSETTA spacecraft in March 2004 headed for a rendezvous with comet 67P/Churyumov-Gerasimenko in May 2014. The MIRO instrument is one of 11 experiments on the ROSETTA orbiter spacecraft. Twenty co-investigators from France, Germany, and the US are participating in the investigation. MIRO will address the nature of the cometary nucleus, outgassing, and the development of the coma as strongly interrelated aspects of cometary physics. The MIRO instrument will measure abundances of water ($H_2{}^{16}O$, $H_2{}^{17}O$, $H_2{}^{18}O$), carbon monoxide (CO), ammonia (NH_3,) and methanol (CH_3OH) in order to characterize the abundances of major volatile species and key isotope ratios in the nucleus. It will measure the near surface temperature and out gassing rates for H_2O, CO (5-4) and other species to understand the processes controlling out gassing in the surface layer of the nucleus. Spectral line shapes of eight molecular transitions will be measured directly. Density, velocity, and temperature in the inner coma will be determined from the measured spectral line shapes. In addition to cometary science, MIRO will search for low levels of gas in the asteroids Steins and Lutetia. This paper will present the key features of the MIRO instrument and in flight performance data obtained since launch.