A novel method for double-resonance photofragmentation spectroscopy in a cold quadrupole ion trap has been developed and utilized to differentiate the structures of a cold protonated adenine dimer. A burn laser generates a population hole of a certain conformer of the dimer stored in a cold quadrupole ion trap, and an auxiliary dipolar RF ejects the photofragments by the burn laser from the trap. A probe laser detects depletion of a certain conformer by the burn laser, and a conformer-specific UV or IR spectrum of a cold ion is obtained by scanning the wavelength of the burn or the probe laser. This simple and versatile method is applicable to any type of double-resonance photofragmentation spectroscopy in a cold quadrupole ion trap. To demonstrate its capability, it was applied to UV-UV hole-burning spectroscopy of a protonated adenine dimer. It is proved that a cold protonated adenine dimer has at least two hydrogen-bonding geometries and each has multiple electronically excited states with significantly different spectral bandwidths, possibly due to different excited state dynamics.