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Precise determination of the 2s22p5 - 2s2p6 transition energy in fluorine-like Ni19+ utilizing a low-lying dielectronic resonance

High precision spectroscopy of the low-lying dielectronic resonances in fluorine-like Ni19+ ions was studied by employing the electron-ion merged-beams method at the heavy-ion storage ring CSRm. The measured dielectronic-recombination (DR) resonances are identified by comparison with relativistic calculations utilizing the flexible atomic code (FAC). The lowest-energy resonance at about 86 meV is due to DR via (2s2p6[2S1/2]6s)J=1 intermediate state. The position of this resonance could be determined within an experimental uncertainty of as low as ±4 meV. The binding energy of the 6s Rydberg electron in the resonance state was calculated using two different approaches, the Multi-Configurational Dirac-Hartree-Fock (MCDHF) method and the Stabilization Method (SM). The sum of the experimental (2s2p6[2S1/2]6s)J=1 resonance energy and the theoretical 6s binding energies from the MCDHF and SM calculations, yields the following values for the 2s22p5 2P3/2 ⟶ 2s2p6 2S1/2 transition energy149.056(4)exp(20)MCDHF and 149.032(4)exp(6)SM, respectively. The theoretical calculations reveal that second-order QED and third-order correlation effects contribute together about 0.1 eV to the total transition energy. The present precision DR spectroscopic measurement builds a bridge which enables comparisons between different theories.

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