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Measurement of the C-forbidden 2 $^3\mathrm{S}_1 \rightarrow$ 2 $^1\mathrm{P}_1$ transition in positronium

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We report the results of a new measurement of the $2\ ^3\mathrm{S}_1 \rightarrow 2\ ^1\mathrm{P}_1$ transition (ν_F) in positronium (Ps). This transition, which is strictly forbidden by charge conjugation symmetry (C), can be observed in a magnetic field. Using a pulsed Ps beam we optically generate radiatively metastable $2\ ^3\mathrm{S}_1$ atoms, and then drive them to the $2\ ^1\mathrm{P}_1$ level in a rectangular waveguide using microwave radiation. Using the same technique, we also measured the C-allowed $2\ ^3\mathrm{S}_1 \rightarrow 2\ ^3\mathrm{P}_1$ transition (ν_1) in the same waveguide, and used the observed Zeeman shift to determine the local magnetic field strength. The measurements were performed in a range of magnetic fields, making it possible to determine the field-free ν_1 and ν_F transition frequencies, and to set limits on the C-forbidden transition matrix element $|\langle 2\ ^1\mathrm{P}_1|H_{CP}|2\ ^3\mathrm{P}_1\ \rangle|$.

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