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Sommario/riassunto	In this thesis, the author develops new high-power millimeter wave techniques for measuring the hyperfine structure of positronium (Ps-HFS) directly for the first time in the world. Indirect measurement of Ps-HFS in the literature might have systematic uncertainties related to the use of a static magnetic field. Development of the millimeter wave devices supports the precise determination of Ps-HFS by directly measuring the Breit-Wigner resonant transition from o-Ps to p-Ps without the magnetic field. At the same time, the width of the measured Breit-Wigner resonance directly provides the lifetime of p-Ps. This measurement is the first precise spectroscopic experiment involving the magnetic dipole transition and high-power millimeter waves. The development of a gyrotron and a Fabry-Pérot cavity is

described as providing an effective power of over 20 kW, which is required to cause the direct transition from o-Ps to p-Ps. Those values measured by the newly developed millimeter wave device pave the way for examining the discrepancy observed between conventional indirect experiments on Ps-HFS and the theoretical predictions of Quantum Electrodynamics.