1. Record Nr. UNINA9910300396803321

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Titolo	Accurate Calibration of Raman Systems : At the Karlsruhe Tritium Neutrino Experiment / / by Magnus Schlösser
Pubbl/distr/stampa	Cham : , : Springer International Publishing : , : Imprint : Springer, , 2014
ISBN	3-319-06221-2
Edizione	[1st ed. 2014.]
Descrizione fisica	1 online resource (226 p.)
Collana	Springer Theses, Recognizing Outstanding Ph.D. Research, , 2190-5053
Disciplina	535.846
Soggetti	Elementary particles (Physics) Quantum field theory Atomic structure Molecular structure Spectroscopy Microscopy Elementary Particles, Quantum Field Theory Atomic/Molecular Structure and Spectra Spectroscopy and Microscopy
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	"Doctoral Thesis accepted by Karlsruhe Institute of Technology, Germany."
Nota di bibliografia	Includes bibliographical references at the end of each chapters.
Nota di contenuto	Introduction -- The KATRIN Experiment -- Theory of Quantitative Raman spectroscopy -- Experimental Setup -- Calibration Based on Theoretical Intensities and Spectral Sensitivity -- Calibration Based on Accurate Gas Samples -- Comparison of Calibration Methods -- Summary and Outlook -- Appendix A Statistical Terms -- Appendix B Complete Derivation of Integration Formula for Depolarization Measurements -- Appendix C Jones Calculations for Polarization Aberrations in the Raman Collection System -- Appendix D Measurements of Polarization Aberrations in Raman Cell Windows -- Appendix D Error Estimation in Depolarization Ratio Measurements -- Appendix F Relation Between Experimental Error of Raman Intensities and Depolarization Ratios -- Appendix H Demonstration of

Bootstrapping on HYDE Data -- Appendix I Publications.

Sommario/riassunto

Neutrinos can arguably be labeled as the most fascinating elementary particles known as their small but non-zero rest mass points to new mass generating mechanisms beyond the Standard Model, and also assigns primordial neutrinos from the Big Bang a distinct role in shaping the evolution of large-scale structures in the universe. The open question of the absolute neutrino mass scale will be addressed by the Karlsruhe Tritium Neutrino (KATRIN) experiment, currently under construction. This thesis reports major contributions to developing and implementing new laser-spectroscopic precision tools to continuously monitor the isotope content of the windowless gaseous tritium source of KATRIN. The method of choice, Raman spectroscopy, is ideally suited for in-situ monitoring of all six hydrogen isotopologues. In a series of beautiful experiments the author obtained two independent novel calibration methods, first based on a comparison of experimental Raman depolarization ratios with corresponding quantum-chemical calculations, and second on a gas sampling technique. Both methods yield consistent cross-calibration results and, as well as yielding improvements in precision, will be of major importance in reducing systematic effects in long-term neutrino mass measurements. The methods developed in this thesis also have great potential to further broaden the applications of Raman spectroscopy to study extended sources such as in atmospheric physics. .