<u>**Abstract of PhD thesis**</u>

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Title: Photoionization modelling as a density diagnostic of line emitting/absorbing regions in Active Galactic Nuclei

From the study of correlation between the continuum and lines variability in Active Galactic Nuclei (AGNs), it is widely accepted that the photoionization is the principal mechanism of emission and absorption lines production. This effect is observed in various AGN components: broad line region, narrow line region, warm absorber and dusty torus, where it is strongly believed that gas is photoionized by the AGN continuum radiation. One of the most important physical parameters is the location of the absorbing/emitting clouds from the SMBH, which is related to the gas density. Hence, the knowledge of gas density directly gives the location of the photoionized gas which is very essential to understand the AGN environment. The density of the emitting/absorbing plasma in AGNs is constrained from the various methods each of them having their own limitations. So, any new independent method of estimating the gas density in these regions is of particular importance. In this thesis, I show that the photoionization modelling of the ionized gas can be potentially used as a density diagnostic of the absorbing and emitting plasma in AGNs. In particular, the observational properties of AGN: the absorption measure distributions (AMDs) and the line emissivity radial profiles are compared with that from simulations done with the photoionization codes TITAN and CLOUDY.I demonstrate that both AMDs and line emissivity radial profiles depend on the gas density which opens a new potential method of density diagnostic. Additionally, I show that the newly observed intermediate line emission region (ILR)can be successfully recovered from the photoionization simulations by assuming the high gas density of this region.