

COLOQUIOS 2020

NON-LOCAL THERMODYNAMIC EQUILIBRIUM in planetary atmospheres

During the last few decades, it has become clear that atmospheric modeling and remote sounding of planetary atmospheres from space are affected by non-equilibrium processes which have not been incorporated into traditional radiative transfer calculations. In this talk I will present a brief introduction to non-LTE (non-local thermodynamic equilibrium) and their effects on two major applications areas: a) the retrieval of temperature and species from satellite IR instruments, and 2) on the radiative IR and near-IR heating/cooling rates in the middle/upper atmospheres. I will present some examples of the most recent Earth's observations of temperature and of key atmospheres species (O_3 , H_2O , CO_2 , CO , NO_2 , NO), taken by the SABER/TIMED and MIPAS/Envisat instruments. Secondly, I will present a review of the major radiative heating and cooling rates in the middle and upper atmosphere, the region where non-LTE is most important, and an overview of the current non-LTE parameterizations of those heating/cooling rates for their inclusion in general circulation models (GCMs). I will also touch a couple of peculiar non-LTE processes like the excitation of PAHs in Titan and some examples of non-LTE in exoplanets (distinguishing between non-LTE in the near and mid-IR from the usual "astrophysicist" concept of non-LTE related to the electronic transitions).



Manuel López-Puertas

IAA-CSIC, Granada, Spain

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Sala de Conferencias del **Centro de Física Miguel A. Catalán**
C/Serrano 121, 28006 Madrid