Molecular Gas, Dust, and Star Formation in Galaxies
Proceedings IAU Symposium No. 292, 2012
T. Wong & J. Ott, eds.

doi:10.1017/S1743921313001373

Gas and attenuation in galaxies

Médéric Boquien, Alessandro Boselli and Véronique Buat

Aix Marseille Université, CNRS, LAM (Laboratoire d'Astrophysique de Marseille) UMR 7326, 13388, Marseille, France
email: mederic.boquien@oamp.fr

Abstract. To determine the spectral energy distribution of galaxies in large numerical simulations, proper treatment of the attenuation is crucial. One of the most common methods in semi–analytic models is to compute the attenuation from the gas surface density. The aim of the present study is to provide new but still simple relations between the gas surface density and the optical depth, directly calibrated on galaxies. To do so we combine multi–wavelength data and perform a pixel–by–pixel analysis on a sample of nearby galaxies. Examination of the influence of these new relations on simulated FUV and IR luminosity functions shows a clear impact compared to older oft–used relations, which in turn could affect the conclusions drawn from studies based on large scale cosmological simulations.

Keywords. galaxies: ISM — dust, extinction

Understanding galaxy formation and evolution is one of the central questions in astrophysics. Large cosmological simulations of dark matter are one of the most powerful theoretical tools at our disposal. Yet, the transformation of baryonic matter is what drives galaxy evolution. To link dark matter to baryonic matter, semi–analytic models can be used. To predict the emission of galaxies from the FUV to the FIR, proper treatment of the attenuation is crucial. One of the most common methods is to compute the optical depth from the gas surface density. Such relations are based on observations in the Milky Way. The availability of new instruments observing nearby galaxies in a resolved way from the FUV to the FIR now allows us to go one step further.

The aim of the present study is to provide new but still simple relations between the gas surface density and the optical depth, directly calibrated on galaxies. To do so we have selected a sample of 4 nearby resolved galaxies and 40 entire galaxies for which we have a large set of multi–wavelength data from the FUV to the FIR including metallicity gradients, along with radio HI and CO observations. For each pixel in resolved galaxies and for each entire galaxy, we compute the optical depth from the attenuation determined with the CIGALE SED fitting code and an assumed geometry. We determine the gas surface density from HI and CO observations with a metallicity–dependent X_{CO} factor, or from the emission of the dust in the FIR with a metallicity–dependent gas–to–dust mass ratio.

We provide new, simple to use relations between the gas surface density and the optical depth, taking the metallicity into account which proves to be crucial for a proper estimate of the optical depth. The method used to determine the gas surface density or the attenuation has little impact on the relations, contrary to the assumed stars–dust geometry in galaxies. Finally, we provide detailed instructions to compute the attenuation practically from the gas surface density taking into account possible information on the metallicity. Examination of the influence of these new relations on simulated FUV and IR luminosity functions shows a clear impact compared to older oft–used relations, which in turn could affect the conclusions drawn from studies based on large scale cosmological simulations.