Colour Evolution of Disk Galaxy Models from \(z=4\) to \(z=0\)

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We calculate synthetic \(UBVRIJHKLM\) images, integrated spectra and colours for the disk galaxy formation models of Samland2, from redshift \(z=4\) to \(z=0\). Two models are considered, an accretion model based on \(\Lambda\)CDM structure formation simulations, and a classical collapse model in a dark matter halo. Both models provide the star formation history and dynamics of the baryonic component within a three-dimensional chemodynamical description. To convert to spectra and colours, we use the latest, metallicity-calibrated spectral library of Westera2, including internal absorption. As a first application, we compare the derived colours with Hubble Deep Field N data.

However, for understanding of the galaxy formation process also theoretical models are needed. Modern galaxy formation models, based on the hierarchical structure formation scenario, predict halo formation histories and the assembly of the baryonic matter inside these halos Nagamine1, Pardee0, Navarro0, Hultman0, Bethermin0, Kapstein0, Mamon8, Brinchmann0, Frenk0, Daverio9, Mo9, Wyithe0, with hybrid models Boissier6, Jimenez9, & with dynamical models that share their main properties. These models include cosmological initial conditions, dark matter, baryonic matter, and radiation. We discuss the colour evolution of the disk galaxy models. We use the GISSEL93 code to derive intrinsic luminosities of the models, and the Bruzual & Charlot evolutionary tracks and isochrones to derive integrated spectra and colours. We compare the derived colours with Hubble Deep Field N data. In the last section, conclusions are drawn, and an outlook on further work is given.

Short description of the new galaxy evolution models chapter2

The observations of high redshift galaxies of interest here provide magnitudes, colours and some information about morphology (asymmetry and concentration parameter). Interpreting these data fully requires detailed models for galactic evolution. In this paper, we want to show, that a dynamical multiphase galaxy model provides the necessary physical information to interpret the high redshift data. For this purpose, we use the 3-dimensional chemodynamical models described in detail in the companion paper Samland2. Here, we only summarize briefly their main properties. These models include cosmological initial conditions, dark matter, baryonic matter, and radiation. We use the GISSEL93 code to derive intrinsic luminosities of the models, and the Bruzual & Charlot evolutionary tracks and isochrones to derive integrated spectra and colours. We compare the derived colours with Hubble Deep Field N data. In the last section, conclusions are drawn, and an outlook on further work is given.

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radius consists of ionized primordial gas. The accreted gas can cool, forms clouds, dissipates kinetic energy and finally collapses inside the dark halo. The collapse is delayed by the feedback processes and a galaxy with an extended disk forms. This is in agreement with the result of weil98, that the formation of disc galaxies requires feedback processes.

In the collapse model, the infall of baryonic matter into the innermost 20 kpc of the dark halo is determined only by dissipation and feedback processes between stars and ISM. The black line in Fig. bild01 represents the baryonic mass flow into resp. out of a sphere of 20 kpc radius surrounding the model galaxy centre. The collapse model shows an early mass infall that ends more or less at $z = 1$. Later there is some in and outflow, but this does not change the mass of the galaxy significantly. As this 20 kpc region is responsible for most of the star formation (SF), the total SFR (Fig. bild02, upper left panel) is strongly correlated with the collapse time, and thus peaks very early at $z \approx 2$ (corresponding to an age of $\sim 3$ Gyr). The modest SF from $z = 1$ until the present epoch, is maintained by the gas return from long lived main sequence stars entering the planetary nebula phase. For the colour evolution of a galaxy it is important to know the SF and the enrichment history. The lower left panel of Fig. bild02 shows the metallicity distribution and the average metallicity of the stellar particles as a function of the time when they were born. In the first $\sim 1.5$ Gyr of the simulation, the metallicity shoots up from $\sim -4$ dex to around solar. From this point on, it stays constant, reaching not much more than $\sim 0.1$ dex at the present epoch. This can be explained by the fact that after the first $\sim 1.5$ Gyr, the bulk of the SF, and hence of the gas enrichment, is completed. Morphologically, the outcome of the collapse model is an early-type disk galaxy.