In this work, we study the dynamics of circumstellar discs, with a focus on the β Lyræ A binary system. This system has been extensively observed by photometry, spectroscopy and interferometry. All these observations were recently interpreted by a radiation-transfer kinematic model [Brož et al. 2021]. In order to apply dynamical models, we first review the theory of steady-state viscous accretion discs, including the α-parametrisation of the viscosity.

We modified the analytical models [Shakura and Sunyaev 1973] for a general opacity prescription, $\kappa = \kappa_0 \rho^A T^B$, and derived radial profiles of various quantities (Σ, T, H). The profiles were computed for the accretion rate $\dot{M} = 2 \cdot 10^{-5}\,M_\odot\,\mathrm{yr}^{-1}$, inferred from the observed rate of change of the binary period. To achieve this rate, the surface densities Σ must be much higher (of the order of $10000\,\mathrm{kg\,m^{-2}}$ for $\alpha = 0.1$) than in the kinematic model. Viscous dissipation and radiative cooling in the optically thick regime lead to high mid-plane temperatures. The disk is still gas pressure dominated.

More general models were computed numerically. We used 1-dimensional radiative hydrodynamic models [Chrenko et al. 2017], accounting for viscous, radiative as well as irradiation terms. The initial conditions were taken from the analytical models. The simulations achieved a steady state on the viscous timescale. To reconcile temperature profiles, we have to distinguish three different temperatures: mid-plane, atmospheric and irradiation. The latter two are comparable to observations (30000 to 12000 K). We demonstrate that the aspect ratio of 0.08 can be achieved in the hydrostatic equilibrium, as opposed to [Brož et al. 2021] who considered the disc to be vertically unstable.