11. Arguing from Appearance: The Numerical Reconstruction of Galactic Tails and Bridges  
Matthias Schemmel

Astronomical objects such as galaxies are known to us from the various kinds of radiation we receive from them. A large part of our information about them is contained in the spatial structures they display in optical and other frequency ranges, such as radio and gamma-ray, information that we first receive in a two-dimensional projection. One of the obvious constitutive tasks of astrophysics is to find physical explanations for the shapes and spatial features of these two-dimensional images.

From the mid-twentieth century, new approaches to finding such explanations became possible through the advancement of computer technology. In particular, computer-simulations of multi-particle objects such as galaxies can be used to construct artificial images of astronomical objects whose features can then be compared to observed objects. In this way, plausible physical explanations of how they occur in nature can be found.

In my contribution, I will present historical examples of the numerical reconstruction of encounters between galaxies. Features of the numerically generated images were used to argue about the physical explanations of features displayed in the observed images. The images (obtained by observation and numerically generated) thus play a pivotal role in the physical argument. They facilitate certain arguments or make them possible in the first place. They provide a link between empirical appearance and theoretical construction.

I will show on the basis of an analysis of the discussions in respective historical publications that the images work as strong argumentative links only because they are part of an overall argument, which goes far beyond what is visible. Such overall arguments are typically based in a broad astronomical and physical knowledge, which itself is the result of a long historical process of interaction between astronomical observation and physical explanation. This knowledge base is not only employed to render the described use of images convincing in the first place, but also to assess the limits of their explanatory power.

The epistemic functions of the images in my case study are mostly in the category “exploration”.