Recommendation of the PhD thesis of
Mgr. Adama Růžička
by the supervisor

Interacting galaxies
Magellanic Clouds and Milky Way

1 Subject of the thesis

The subject of the thesis is the interpretation of the observed distribution of neutral hydrogen HI in Large (LMC) and Small (SMC) Magellanic Clouds and in connected large scale structures such as Magellanic bridge, Magellanic stream, Leading arm and Interface region. Adam Růžička uses a high-resolution HI survey of the Magellanic system by Brüns et al. (2005), which presents a 3 dimensional data cube giving the HI distribution in (l, b, VR) space. This actual distribution results from past LMC x SMC interactions as they move in the halo of the Milky Way (MW). The main task is to constraint the mass and space orientation of the LMC and of the SMC and explore what are the plausible orbits to reproduce the current shape of the Magellanic system.

2 The Method of the Approach

Adam Růžička performed a search in the multi-dimensional parameter space describing the mass, shape and space orientation of the LMC and SMC and positions and velocities of the clouds 4 Gyrs ago. The main events such as close LMC x SMC encounters influencing the actual shape of the Magellanic system happened during the last 4 Gyrs. To include even deeper past is beyond possibilities of the information available now. He uses the restricted N-body approach: the clouds are described as Plummer spheres moving in the gravitational potential of the MW composed of disk, bulge and halo. The test particles move in the time dependent gravitational potential of MW + LMC + SMC. An important part is the proper treatment of the dynamical friction of the MW halo influencing substantially the satellite orbits.

The novelty in the thesis is the adoption of the genetic algorithm in the search for the set of best parameters. Up to now was this approach used in other fields. The thesis demonstrates that the genetic approach can apply also in the interpretations of shapes resulting from galaxy interactions. The crucial point is the selection of the fitness function to compare the observed and simulated shapes.

3 The results

Adam Růžička gives the plausible sets of LMC and SMC characteristics and concludes on the sensitivity of individual parameters. He shows that a very sensitive parameter is the space velocity of the Clouds. The velocity space should be the subject of a future search, which may increase the fitness to even higher values. An important result concerns the shape of the MW halo: the orbits of the LMC and SMC sensitively depend on the halo flattening, which

has important consequences to motion of other MW satellites and for scenarios of the MW formation.

4 Suggestions

Part of the results has been published. I do recommend to publish other results shown in the PhD thesis, such as the space velocity search. I also recommend further genetic algorithm searches excluding parameters of low importance. Also the MW halo shape should be tested more deeply with a different gravitational potential function allowing higher flattening.

The thesis shows the potential of Adam Růžička to perform a scientifically important project using new methods of approach. I do recommend to award the PhD degree to the candidate.

Jan Palouš

Prague 17th October 2006