Thomas Henning

in conversation with Bo Reipurth

Q: *What was your PhD about, and who were the most important influences for you as a student?*

A: I wrote my PhD thesis about radiative transfer in circusmtellar dust shells to explain the physical propeties of massive young stellar objects. This remained a topic of great interest to me and we later designed one of the first Monte Carlo radiative transfer codes. During the time of my PhD thesis I realized the importance of fundamental dust properties and learned a lot from the members of the Jena school of interstellar medium studies.

Q: *You grew up in what was at that time East Germany. What were the strengths and weaknesses of higher education in this part of the world?*

A: I had the great privilege to grow up in a very liberal family environment where classical education in literature and music was highly valued. I learned early that natural sciences allow one to be more independent from ideology and that knowledge is an important achievement. I was very much interested in mathematics, chemistry and physics where education was excellent. The main threat was my tendency to speak openly about the things I did not like. In addition, the rather limited "public opportunities" led to self-driven curiosity: I established my own chemical laboratory in the basement of our house and later became heavily interested in non-linear dynamics. As I student I had a great time because I could participate very early in active research.

Q: *Your most cited paper is the study that Ossenkopf and you did in 1994 on dust opacities for protostellar cores. What were the key new insights that made this paper so recognized?*

A: The mass of an astronomical object, being it a star, a galaxy, a molecular cloud or a protoplanetary disk, is one of the most fundamental quantities. During one of the runs at the SEST telescope in La Silla I realized that we can rather precisely measure the millimetre flux of optically thin configurations, but that the dervived masses strongly depend on the selected dust model. We then developed a rather comprehensive physical model of dust evolution in molecular cloud cores and calculated the relevant dust opacities over a wide wavelength range. It tuned out that these opacities survived many observational tests and are of high value for the derivation of dust masses.

Q: *How has this field moved forward in the intervening twenty years?*

A: The interest moved both to more global scales, dust evolution in galaxies and the high-z universe, and the more local environments of protoplanetary disks. In protoplanetary disks the situation is more complex than in molecular clouds because dust properties change strongly with time and position in these disks and dust and gas evolution are coupled via complicated physics. Meanwhile we developed very detailed models of dust evolution in disks, taking into account experimental results provided by laboratory groups. I am very excited that I laid the foundation for some of these groups and was able to build a network of laboratory facilities in Germany.

Q: *Have observations of grains in young circumstellar disks reached the point when meaningful comparisons with carbonaceous chondrites can be made?*

A: This is actually a topic of great interest to me. The carbon budget in disks and the relation to oxygen-rich materials drive the composition of exoplanets and their atmospheres. We are presently developing a model combining planet formation, evolution, and atmosphere composition. What we really do not know is the C/O ratio in these disks. In the solar system we have a deficit of carbonaceous material compared with the interstellar medium and we do not have fully understood what the reason is. Spitzer spectroscopy has revelaed a wealth of information about silicates in disks and with Herschel we could even detect molecular water ice. However, we know very little about the carbonaceous component of dust in these disks.

Q: *Another influential paper was your 1998 review in Science with Salama on carbon in the universe. Today does this field advance mainly through observations or through laboratory studies?*

A: Today many astronomers discuss PAHs as part of the life cycle of matter and as an important component for the heating of the ISM. This is mostly driven by the enormous amount of data ranging from local molecular clouds and HII regions to distant galaxies. At the same time, laboratory experiments are starting to provide key answers as to how this material is formed and evolves under interstellar conditions.

Q: *What do you see as the most significant results from Herschel in the study of dust in star forming regions?*

A: Dust remains a great tracer of molecular cloud structure. The high dynamic range and large mapping speed of Herschel allowed the mapping of molecular clouds in our and other galaxies and revealed the filamentary structure of these clouds. The combination of Herschel data with Spitzer and submillimeter data is presently providing better constraint of dust properties. For the first time, we were able to determine the amount of cold dust in supernova remnants with sensitive Herschel observations.

Q: *When you became director of the MPIA in Heidelberg, what was the vision you developed for the institute?*

A: In order to make progress in star and planet formation one has to combine strong observational programs with theoretical studies and instrumentation programs. MPIA is providing a unique environment to develop such a program. I am very proud that we have been heavily involved in the PACS instrument for Herschel, the MIRI instrument for JWST and we are just celebrating the very successful commissioning of the planet finder instrument SPHERE for ESO's VLT. Our theory group is very strong and we are able to contribute to solving the puzzle how massive stars form.

In addition, one of my visions has been always to provide a very inspiring and open atmosphere for students and postdocs from all over the world and together with my co-director Hans-Walter Rix we have made the MPIA to an international center in our research fields. Many of my former students, postdocs and collaborators are now Professors at leading research institutions which may - at some point - be the greatest achievement.

At the moment, I am very eager to establish an "Origins of Life Center" in Heidelberg and we made the first steps in this direction.

Q: *What are currently the main focus and challenges of the study of planet and star formation?*

A: In planet formation we really need to make a connection between disk structure and chemical content of disks with the structure of planetary systems and exoplanet atmospheres. I am extremely excited by the discovery of asymmetric structures in disks with high-contrast AO-assisted imaging and submillimetre intereferometry, especially with ALMA. We are now talking about the discovery of dust traps, something we predicted many years ago based on theoretical studies. In star formation the questions remains to find a predictive recipe for the rate of star formation in molecular clouds and to connect our tremendous knowledge on local star formation with star formation on galacic scales. The various galactic surveys from the near-infrared to centimeter wavelengths provide a unique multi-wavelength dataset to explore star formation in our and other galaxies. The discovery of giant molecular filaments is just the beginning of a larger endeavour to reveal the star formation potential of galaxies.

Q: *What are the next big projects for your department?* We are heavily involved in the search for young exoplanets in disks with the VLT and LBT and the discovery of transiting planets with the Hat-South network. These studies will provide the best targets for observations with JWST, especially with the MIRI instrument. For the VLT Interferometer we are part of the Matisse and Gravity consortia - instruments which will allow the imaging of disks at near- and mid-infrared wavelengths. In Europe we are all working together to make the E-ELT a reality and I am eager to collect photons from exoplanets with this machine.