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Editorial

Personal Reminiscences of Reinhard Schlickeiser

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In 1979, I arrived back at the University of Chicago from a two-year stint in Australia to find a very large German post-doc eagerly awaiting me, so we could work together on transport of cosmic ray electrons perpendicular to the galactic plane. He was Reinhard Schlickeiser, with whom I have worked on and off through to the present day. Reinhard became a very good friend indeed and has just recently retired from being Professor of Theoretical Astrophysics at the Ruhr-University, Bochum, Germany. We worked very well together for his post-doc year at Chicago and, as it turned out, also my last year at Chicago.

The basic problem of including convection, adiabatic deceleration, diffusion, and synchrotron radiation loss for cosmic ray electrons in a galactic magnetic field whose strength decreases with height above the galactic plane, and of then determining the associated synchrotron radiation spectrum with galactic height, is non-trivial. The importance of the problem lies in the fact that one measures such radiation with galactic height for a number of galaxies seen edge on. Many show breaks in the spectral index with height. If the basic problem could be solved, then the spectral index break and the height at which it occurs could be used to estimate the galactic wind speed transporting the relativistic electrons out of the plane of each galaxy. Reinhard and I solved this problem in the year he was there.

I then went to work in the oil industry for five years to get enough money to put my children through college. I then took a job at the University of South Carolina doing geology, oil risking, and sundry other matters. As an astrophysical interlude, I was invited by Reinhard to go and work with him in Bonn for a couple of months in summer 1986. He and his student Wolfgang Droege had been working for a while on the repowering problem of supernova relativistic electrons. While in Australia, Jim Caswell and I had effected a clumsy and palliative solution to the problem, but neither of us was happy with it, but equally, despite large quantities of beer, neither of us could see how to take the problem any further. Reinhard and Wolfgang had obtained the basis of a solution figured out in the time in between (Alfvén wave scattering but with the waves both ahead of and behind the shock front was the crucial ingredient in correctly solving the problem). Thus, Reinhard, Wolfgang and I worked first on cleaning up the solution. At the same time, Reinhard and I were involved in what is known as the secondary to primary ratio problem. Secondarily produced cosmic rays (by spallation of primary cosmic rays from the interstellar medium) have a different power spectrum than the primaries. Just before I left to return to Columbia, South Carolina, Reinhard and I figured out how to do that problem quantitatively and obtained a theoretical result for the difference in the spectra that precisely matched that observed.

I was heavily engaged with Jolynn Carroll (now at Tromsoe, Norway) in writing the final version of the sedimentary processes volume using radionuclides. I had also been "commuting" across the Atlantic to Germany with the environmental work. On one of the trips, I stopped off at Bochum where my old friend Reinhard Schlickeiser was now Professor of Astrophysics. Reinhard had previously asked me if I would proofread a book he was doing on cosmic ray astrophysics, and I had gone through one version with lots of recommended changes for him to handle. During my visit, he asked me if I would like to visit Bochum during the summer of 2001 to handle some astrophysics problems. I told him that it had been a long time since I had been seriously involved in quantitative astrophysics and I was not sure he would get value for his money. Reinhard grinned and said "Even

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you cannot be so incompetent" and bet me a case of beer that I could still do problems in astrophysics. I ended up having to pay the bet of course! Thus, summer 2001 was spent pleasantly in Bochum doing astrophysics. I was also editing a special issue of a journal at the same time so my evenings were also very busy.

I spent a second summer in 2002 at Bochum solving astrophysics problems quite happily during the week and, at weekends, doing basin analysis, environmental, and economics problems in Halle. That summer turned out to be highly productive. Reinhard and I found a solution to a twenty-year-old problem in astrophysics concerning the heating and cooling of the interstellar medium. The disparity between heating and cooling rates was many orders of magnitude no matter how one tweaked the parameters. This glaring discordance had survived many attempts to find a solution, including earlier attempts Reinhard and I had also made. Everyone had worked through the complex problem assuming the interstellar turbulence was isotropic. We allowed the turbulence to be anisotropic and then figured out what the degree of anisotropy had to be in order to get heating and cooling rates to agree. This was the first time anyone had even obtained a solution to the problem. When the work appeared, the main antagonists wrote things like the solar wind is not so anisotropic so how can the interstellar medium be? Of course, they failed to understand that one could turn their question on its head and ask: Why is the solar wind turbulence so isotropic in comparison to the interstellar medium? I figure it will be at least a decade before they choose to understand, as is not unusual in science!

In 2005, there was the chance of a stay for a year at the Ruhr University in Bochum where I would be involved again in plasma astrophysics. Approval came through for a one year Mercator Professorship for me to do astrophysics at the Ruhr University in Bochum so again I would be interacting intensively with Reinhard Schlickeiser. The first day of work I was greeted by Reinhard who had a list of astrophysics problems he thought needed to be solved and had figured I was the guy to do them. My brain was still locked into some geology and economic risk problems. I had not had time to finish (or even start) while at Leipzig so cranking my brain into the astrophysics mode once more was not easy. Indeed, I ended up doing astrophysics during the day and evenings were spent hammering away (another pun!) at the geology problems.

My time in Bochum was also spent commuting between Bochum and Halle at weekends. The nominal travel time on the train was 4 h. However, a change had to be made at Hannover and, cleverly, the German rail system had arranged a magnificent 6 minute overlap time for the connection. Of course, one train was always ten minutes late and, cunningly, the connecting train was always punctual and so had left the station before the first train arrived. This punctual lateness of the German rail system meant that the elapsed time was closer to 6 h rather than the official 4 h. One famous day, when I had to give the physics colloquium at Bochum at midday, I left Halle on the 5 a.m. train to ensure I would have plenty of time to set up the projector and such. Amazingly, the train connection was superbly delayed long enough that I arrived just 10 min before my talk—Reinhard was having kittens with the panic at the thought I was somewhere lost in the labyrinthian train system.

On one such trip, I was trying hard to solve one of Reinhard's problems on the train. The inebriated football fan next to me sort of bleary-eyed looked at what I was writing and asked "What language is that?" I answered it was mathematics. A long pause before he came back with the ultimate question "Can you speak it fluently as well as read and write it? " Ah yes, German train rides can be amazingly educational. The long train rides were actually good for solving problems because there were no interruptions from students and I cherished the time to concentrate. In this way, a majority of the problems were indeed roughed out.

By the time my stay in Bochum was over, all of the problems on Reinhard's list had been solved ranging from a variety of new plasma instabilities (mostly done with Robert Tautz and some with Anne Stockem) through to ways of balancing the heating and cooling rates of the interstellar medium (a basic problem that had defied prior solution for

nearly twenty years and the general solution extended enormously the funny anisotropic solution Reinhard and I had worked out in 2002) that was completed with Reinhard and Felix Spanier, and ending with the solution of a highly nonlinear problem for radiation production and polarization from gamma ray emission objects (done mainly with Urs Schaeffer-Rolffs and Robert Tautz). The final farewell dinner was fun not the least reason being that a chess set was given to me with pictures of the whole group where the chess pieces normally were placed. The reason for this gift was due to the fact that at lunchtime, in Bochum, there was a group of us who played chess and simultaneously discussed science problems. Depending on the difficulty of the science problem, one was guaranteed to lose concentration on the chess game and thus lose the game—a ploy I suspect was often used by weaker chess players.

This ends my short overview of how it was to be involved via Reinhard in many of the astrophysical problems of the last few decades. I hope you enjoyed the short description as I had fun doing the writing thereof.

Conflicts of Interest: The authors declare no conflict of interest.