Physics of the Parsec–Scale Structures in the Quasar 3C 345

by
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dissertation submitted in partial fulfillment
of the requirements for the degree of Doctor of Philosophy
in the subject of Physics

NEW MEXICO INSTITUTE OF MINING & TECHNOLOGY
SOCORRO, NEW MEXICO

May 1996

Abstract

We present a combined study of kinematical and spectral evolution of the compact regions in the quasar 3C 345. The study is based on more than 60 VLBI and VLBA observations of the source, of which 17 have been made, and 15 others have been reanalysed in the course of the thesis work. We introduce a method for fitting the broadband synchrotron spectrum, and apply it to VLBA images to obtain the distribution of the turnover frequency, peak flux density and integrated flux. Long-term evolution of bright superluminal components observed in the jet of 3C 345 is studied. The changes of the component speeds, flux densities, and spectral properties are traced along the jet. The distribution of the magnetic field is measured in the most compact regions of the jet. We discuss various aspects of spectral imaging, and show the importance of correcting the VLBI images for the frequency dependent shift of observed VLBI core position. On the basis of gathered observational data, several models of compact relativistic jets are discussed. We show that the observed bright features in the jet must be accelerating in the rest frame of the jet. The emission and spectral properties of the strongest jet component are found to be consistent with relativistic shocks. We show an evidence for the presence of Kelvin-Helmholtz instabilities in the jet, and for interactions between relativistic beam and non-relativistic plasma outflow. In conclusion, we suggest that, in compact jets, there can exist a transition from the shock-dominated to plasma interaction-dominated emission mechanism.

Acknowledgements

As the last pages of the dissertation are finding their way to the printer, I cannot help recalling the three years that separate this moment from my first day at the NRAO. I am deeply grateful to the Observatory for supporting my work, and most of all for the chance to meet so many new people and friends. I wish to thank all the people at the NRAO for their friendliness and help!

It has been my pleasure to work with Toni Zensus, who has never restricted my freedom to select the goals for myself, and seek the ways to achieve (or evade) those goals afterwards. And even though formal circumstances unrelated to science have prevented Toni from being the official advisor, he is the one I am deeply grateful to for bringing me the opportunity to work on the subject of the dissertation, and supporting this work during its entire course.

I feel indebted to many people at NMIMT and NRAO for the consideration they have shown to my problems, and for the quick and timely resolution of those. I wish to thank Alan Blyth, Miller Goss, Jim Weatherall, and Dave Westpfahl for their assistance and help in resolution of formal issues related to my degree. I am very grateful to my advisor Jean Eilek, and to my NRAO contact person Phil Diamond for their assistance in many different aspects of making this dissertation.

For the last six years, Leonid Gurvits has always been around and ready to help, no matter what side of the Atlantic each of us would be at the times. Without him, this dissertation would hardly ever become anything bigger than a hope.

Discussions with many different people made a significant contribution to the dissertation work. I wish to acknowledge Jacques Roland, Ken Kellermann, Alan Marscher, Kari Leppänen, Philip Hardee, Carlos Rabaça, Thomas Krichbaum, Rick Perley, Jean Eilek, and Igor Novikov for sharing their thoughts and experience with me.

Finally, I wish to thank all of my friends for making life a cheerful event! I am grateful to the Cliffwalkers Society which helped so many of us through the edges of life in Socorro. Special thanks to Dave Moffett, for repeatedly sheltering us from the reality above the basement; to Cathie Moffett, to Kari Leppänen, to Maggie and Tom Tongue, to Raquel Tun and Angelos Vourlidas, to Dan Briggs, Ketan Desai, the Kogans family, to Mark Swain, Dave Frayer, and Dave Murphy for keeping the nice company.

Thank you all!