FWF T 697: Summary for Public Relations

PI: Dr. Hana Krásná

The project "Earth-based VLBI in the Galactic Frame" covered research for a better estimation of extragalactic radio source positions. Very Long Baseline Interferometry (VLBI) is a space-geodetic technique that directly connects the terrestrial reference frame realized by positions of Earth-based antennas with the celestial reference frame defined by a set of radio sources. In 2018, the third all-sky realization of an extragalactic frame at radio frequencies, designated as ICRF3, was published by the ICRF3 working group established by the International Astronomical Union. The importance of a precise celestial reference frame is in providing a stable grid to navigate space missions, to monitor Earth orientation in space with extreme accuracy, or to study the plate tectonics on the Earth, and thus it allows a better understanding of the natural hazards from, e.g., earthquakes.

This project supported the realization of the ICRF3 in its both novel features: 1) modeling of the Galactic acceleration in the VLBI data analysis, and 2) determination of source positions in several radio bands. In this project, a new method to detect the Galactic acceleration from VLBI measurements was developed. This method is based on fitting the Earth scale factor corrections estimated for each individual radio source within a global VLBI adjustment. These findings carried out within a working group on Galactic Aberration of the International VLBI Service for Geodesy and Astrometry served as a basis for our recommendations to the ICRF3 working group.

ICRF3 includes for the first time position of extragalactic sources at several radio frequencies. In addition to the classic 8.4 GHz, positions of several hundreds of sources are reported at 24 GHz and 32 GHz. The reasons for including more radio frequencies is the different impact of the source structure on the apparent source position, or the fact that for applications lacking dual-frequency observations for ionosphere calibrations, moving to higher frequencies quickly reduces charged particle effects. In this project, analyses of VLBI measurements at the newly established 24 GHz frequency were carried out providing a basis for the inclusion of the data in the arising celestial frame.

Furthermore, in this project, research of astronomical VLBI data at 15 GHz from a so-called MOJAVE program was carried out. It has been shown that this astronomical VLBI program with its differences to a geodetic one is feasible for studying source structure contribution to the observed path delay relevantly for geodetic applications. The findings of this research will contribute to a further refinement of the next celestial reference frames.