Checking the Base of the Flux Density Calibration Scale

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The sensitivity of large radio telescopes cannot easily be calculated theoretically. Therefore, the flux density calibration of radio astronomical observations at centimeter wavelengths is usually done by comparing the observed antenna temperatures of selected sources („calibrators") with their assumed flux density. The probably most influential flux density scale in use is the one of Baars et al. (Astronomy & Astrophysics **61**, p. 99, 1977). It is primarily based on the measurements of four strong radio sources, namely Cas A, Cyg A, Tau A, and Vir A, which have been observed using antennas with well known characteristics (e.g. horn antennas, dipoles). In a second step, the flux densities of these sources have been connected to observations of a set of weaker and more compact secondary calibrators that are better suited for large and sensitive radio telescopes. This set is now commonly used for the flux density calibration of large radio astronomical antennas.

The high intensity and extended spatial structure of the primary radio astronomical flux density calibrators are the main reasons why they are only infrequently observed by large radio telescopes. Nevertheless, the primary calibrators are still important for the flux calibration of smaller antennas which do not have sufficient sensitivity to use secondary calibrators. It is known, however, that e.g. the flux density of the strongest extra-solar radio source in L-Band (Cas A, an expanding supernova remnant) is changing non-uniformly with time, which requires regular monitoring to update its current flux densities at different frequencies.

We describe the roles of the primary and secondary radio astronomical calibrators in the derivation of an absolute radio astronomical flux density scale for the calibration of radio astronomical antennas. Our focus is on the presentation of new observations of the primary flux density standards on several different bands covering a frequency range from 1.4 to 32 GHz. We have calibrated their flux densities using selected and well-determined reference sources from the catalogue of secondary calibrators. Furthermore we compare the observed values to the ones in the literature and test and improve the models that had been derived to describe the spectrum of the primary calibrators and the temporal variability of e.g. Cas A.