Very Long Baseline Interferometry (VLBI) in the age of *Fermi* and *Gaia*

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This year marks the 10th anniversary of the launch of the *Fermi* satellite, which has been in continuous operation since 2008. This year also marks the release of the fourth γ-ray source catalog by the *Fermi*/Large Area Telescope, which comprises the analysis of eight years of continuous observations of the γ-ray sky. This catalog features more than 5000 objects, about half of which are active galactic nuclei (AGN). Within 3 months of launch of the mission, it was confirmed that radio-loud AGN, that are prominently known from VLBA monitoring campaigns, were detected at γ-ray energies. Since then, the VLBA has played a significant role in the physical interpretation of observed γ-ray emission in combination with observations ranging across the entire electromagnetic spectrum.

The second largest group among detected γ-ray sources are objects that have no known electromagnetic counterpart and are called "unassociated". The physical origin of these objects is unknown. In 2013, we started a radio survey of all unassociated objects from the previous two catalog releases. A new survey has just begun targeting over 1800 new unassociated objects found in the 8 year catalog. Observational evidence establishing the connection between known radio-loud AGN and the γ-ray sky led us to establish a statistical framework that allows us to obtain reliable associations of radio-loud AGN with unassociated γ-ray objects. The method relies on observations at VLBI resolution in order to probe the presence of compact, parsec-scale emission. With this we discovered over 200 new γ-ray loud AGN and refined astrometric positions of radio counterparts to known γ-ray objects. We also indirectly provide candidates for Pulsar counterpart searches and candidates for searches for exotic objects among others.

This year also marks the fifth anniversary of the launch of the Gaia satellite. The aim of this mission is to provide a three-dimensional map of the stars in our galaxy. To do so, Gaia is conducting positional measurements for about one billion stars in our Galaxy and Local Group. Comparison of VLBI and Gaia positions revealed that the VLBI/Gaia position offsets of bright AGN have a physical, source intrinsic, preferred direction that lies along the axis of its relativistic outflow. This effect is interpreted as a manifestation of optical structure at scales of 1–100 mas. Investigation of optical structure at these scales is now possible with synergism of VLBI and Gaia and is expected to become a hot topic over the next 5 years.

We will present a summary of the three areas that were outlined above. This includes a discussion of the connection between the radio and γ-ray sky, the method and results from associating γ-ray sources with AGN using VLBI, and the conclusions from comparison of Gaia astrometry with that of VLBI. Altogether, we will illustrate the importance and relevance of VLBI supporting today's space-based γ-ray and optical astronomy, where the VLBA has made and is continuing to make invaluable contributions.