Radio galaxies with LOFAR:
Relic emission from opposites scales

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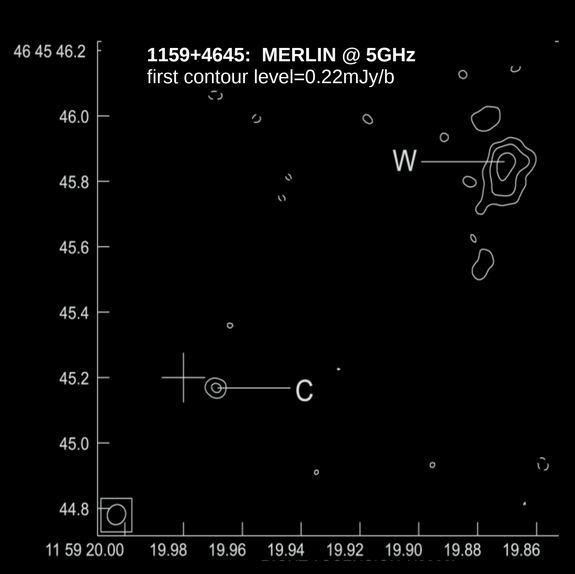
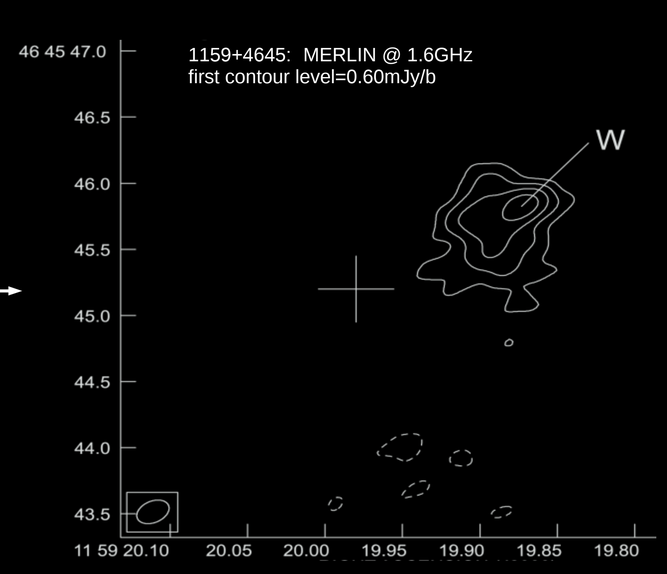
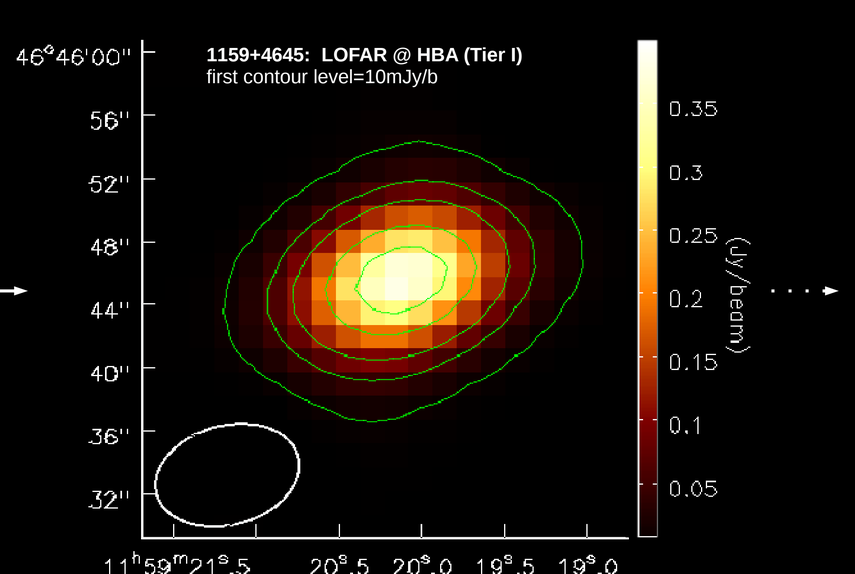
Divers in their age, scale and distance, the radio galaxies (RGs) are one of the imprints of the AGNs. One of the open questions regarding these objects is the phase of their activity. Because of their characteristic synchrotron emission, it is necessary to go to low frequencies in order to detect possible diffuse and extended emission. Indeed this emission would be the remaining of a previous activity, and, hence, show a steeper spectrum. New generation of radio telescopes such as LOFAR are, thus, extraordinary tools, which enable us to achieve our main goal and analyse different steps of RGs' evolution.

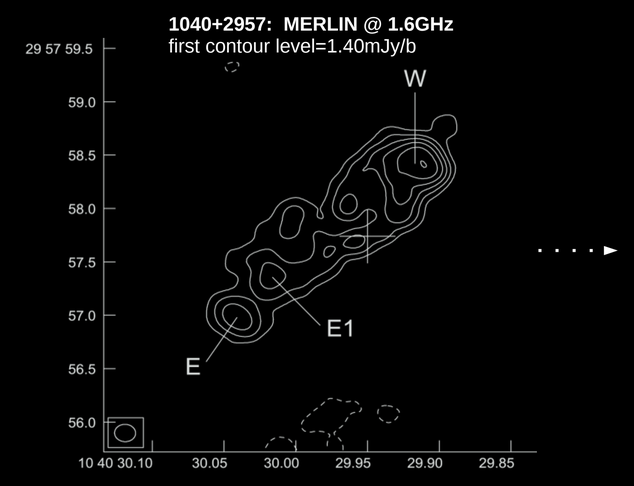
Here we present our current work, which is focusing on the study of individual objects belonging to the two extremes of the RGs, with the principal use of this European radio interferometer.



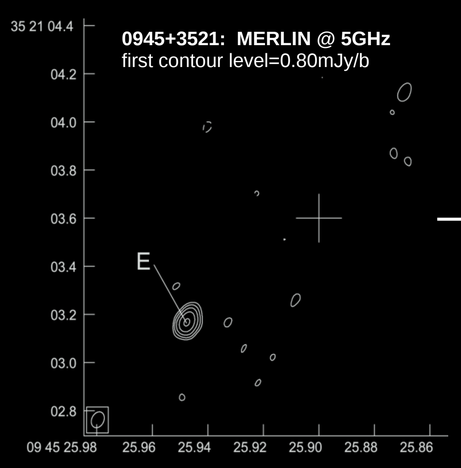


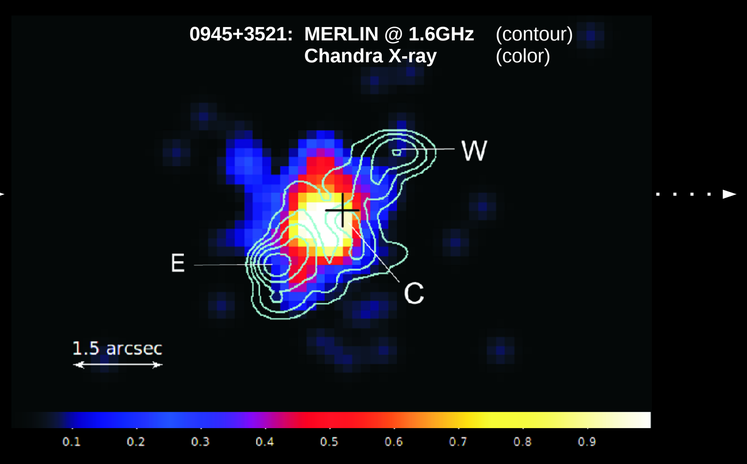


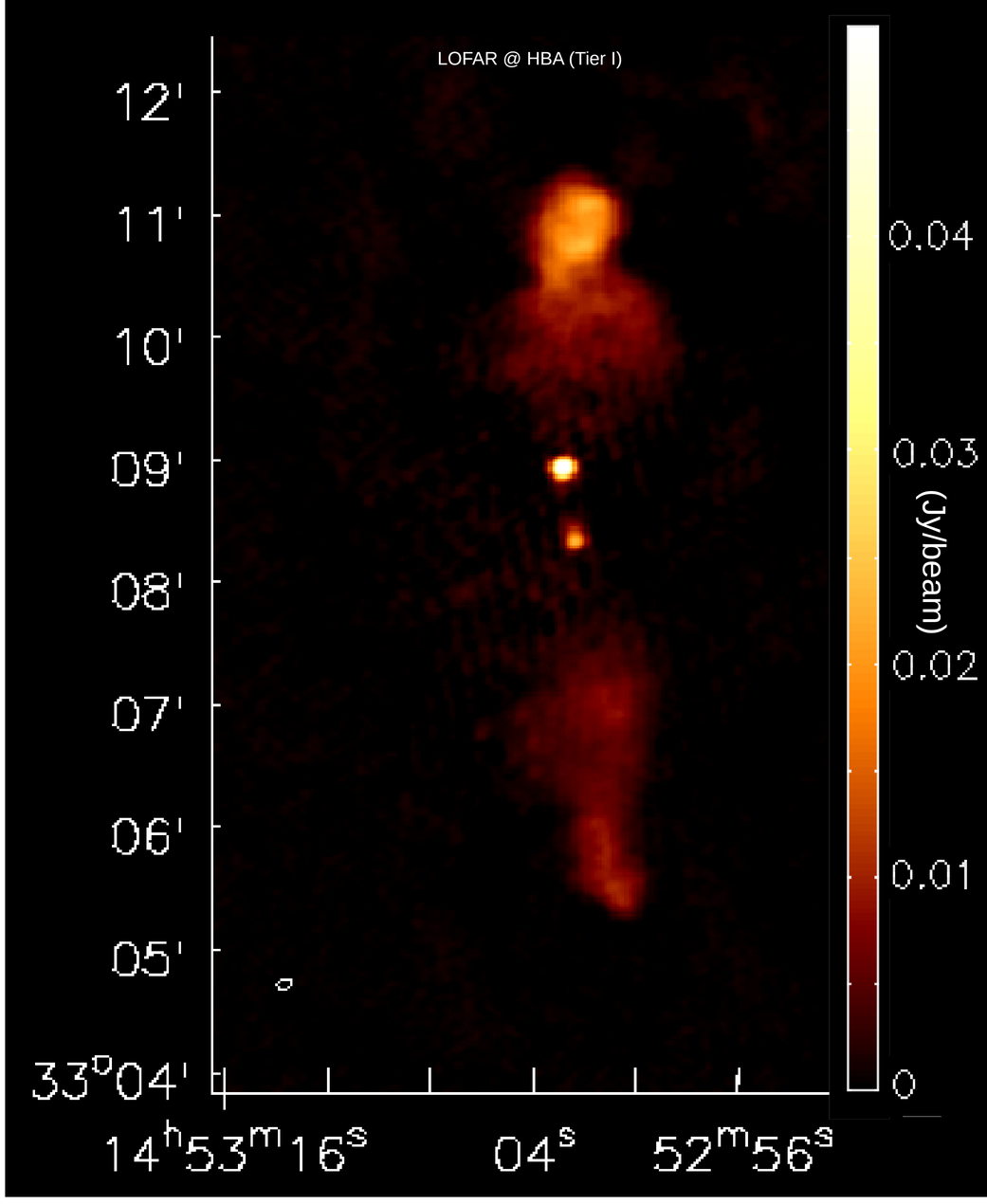
The GHz-peaked spectrum (GPS) and compact steep spectrum (CSS) sources form a well-defined class of young compact radio objects and are considered to be entirely contained within the host galaxy. During their evolution, the radio jets expand and start a dramatic process of leaving the host galaxy. When developing in dense environment the weaker jets are more vulnerable for instabilities and disruption. Such interactions may seriously change the morphology of young radio sources or even halt the jet propagation. Some of them can start to fade away although the probable episodic nature of the radio activity can bring them back to life after this quiescent period.



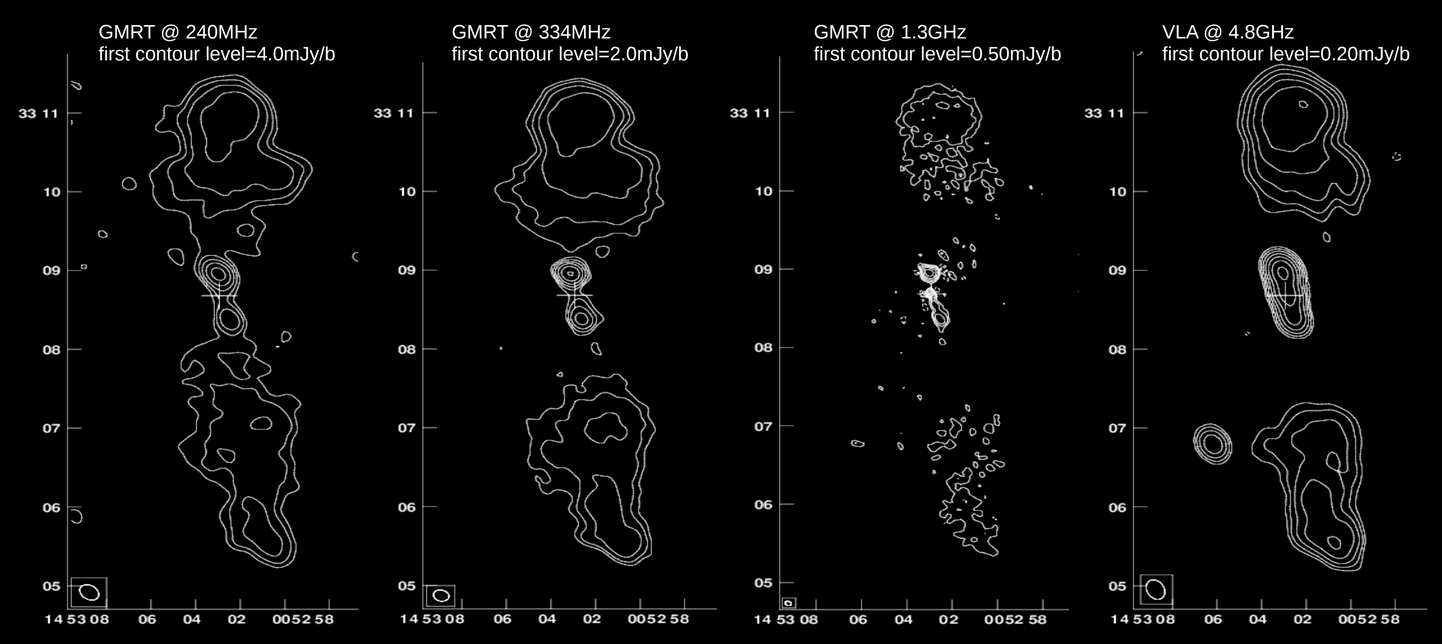
The capabilities of LOFAR will allow to assess the impact of shocks from the early phases of radio source evolution and their importance for evolution model of the whole population of radio-loud AGNs, as proved by the map of **1159+4645** shown here.
Indeed this CSS was already observed in the frame of the Tier I survey, and the FACET pipeline enabled us to reach easily the upper limit for the noise required by this survey. Furthermore, observations with the international baselines are already available, which will help us to have a great insight inside this object, thank to the sub-arcesond resolution they offer.
Similarly we will soon be able to complete the pictures we obtained from higher frequencies for two other CSS/GPS of our sample, **0945+3521** and **1040+2957** which will be observed with all LOFAR's stations during its cycle 8.







On the other end, once the jets exited the host galaxy, radio galaxy can develop themselves to impressive scale up to the so called giant radio galaxies (GRG commonly defined by a linear/projected side of above 10Mparsec). At this stage the interactions with their environment involve the intergalactic medium. Nevertheless the phenomenons happening closer to their core can have huge impact on their global morphology. Indeed as for the GRG **4C33.33**, and at different stage of their life, radio galaxies can exhibit signs of reactivation phases by, e.g., showing a second pair of lobes (they are then called Double-Double Radio galaxies). This is letting suspect that a relic emission from the previous activity cycle could be present and be observable at low frequencies, such as the one reachable by LOFAR.
In the case of 4C33.33, the FACET pipeline is now able to faithfully retrieve the features observed at higher frequencies, while the quest for the faint and diffuse emission is remaining an exhilarating challenge.



(GMRT and VLA maps: from Konar et al. 2010)

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