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Fast Radio Burst detections and discoveries with Apertif, and LOFAR

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Apertif, the wide-field receiver system currently operating on the Westerbork Synthesis Radio Telescope, offers an unprecedented combination of sensitivity and speed at 1.4 GHz. Its time-domain supercomputing back end (ARTS) performs real-time detection and localisation of Fast Radio Bursts (FRBs). In stand-alone mode, this SKA pathfinder is already the globally most productive 1.4 GHz FRB machine. It is, furthermore, directly connected to LOFAR. That unique combination of two world-class telescopes has recently allowed us to detect the same, repeating FRB over more than an order of magnitude in wavelength, down to 120 MHz, for the first time.

Fast Radio Bursts must be powered by uniquely energetic emission mechanisms. Identifying their physical nature arguably requires such good localisation of more detections, and broadband studies enabled by real-time alerting. We will describe ALERT, the Apertif FRB survey. It has discovered two dozen new FRBs so-far, each localised to 0.4-10 sq. arcmin. We will present our latest discoveries and detections of one-off and repeating FRBs. Four FRBs cut through the halos of M31 and M33. We demonstrate that Apertif can localise one-off FRBs with an accuracy that maps magneto-ionic material along such well defined lines of sight. The combination of detection rate and localisation accuracy from these Apertif/ARTS FRBs thus marks a new phase in which a growing number of bursts can be used to probe our Universe.

Using simultaneous Apertif and LOFAR multi-wavelength observing, we next showed that repeating FRB 20180916B emits down to 120 MHz, and that its activity window is both narrower and earlier at higher frequencies. Our detections establish that some FRBs live in clean environments that do not absorb or scatter low-frequency radiation, a prerequisite for future FRB applications to cosmology.

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Session Classification: What Can We Learn from a Growing Sample of Fast Radio Bursts?

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