

## 6 Technological Developments

### 6.2 Participation in Design Studies

#### 6.2.1 SKADS, PrepSKA [W. van Driel, S. Torchinsky]

More than fifty years ago, Jean Heidmann at the Observatoire de Paris pointed out that a radiotelescope with nearly a square kilometre of collecting area was the next logical step in radioastronomy (Heidmann 1966). The Nançay Radio Telescope was just beginning operations and was the world's largest collecting area for neutral hydrogen observations, but Heidmann already understood that a much bigger instrument was necessary in order to make cosmological surveys. He mentioned the possibility of cataloguing tens of millions of sources. This was visionary, and today the catalogue of a billion galaxies for cosmological studies remains a driving key project for the SKA.

When the International Astronomical Union (IAU) created the working group for a large radio telescope in 1993, French astronomers were active participants, and this effort continued through to the formal creation of the SKA Project by the IAU in 2000.

The most significant mobilisation of French effort for SKA began in 2004/5 with the submission and start of the Square Kilometre Array Design Studies (SKADS). SKADS was funded by the European Commission Framework Programme 6 and had 26 international partners from 13 countries. Observatoire de Paris was a major partner in the SKADS consortium, having responsibility for one workpackage, the vice-chairmanship of the Board, and a seat in the Management Team with the Project Scientist provided by Observatoire de Paris.

SKADS focussed on technological development for an aperture array implementation of SKA and also included science simulations to help inform the design process. The resulting "SKADS Simulated Skies" was the work of a number of PhD theses, including in France, and the papers produced by SKADS continue to be cited today (see for example, Baek et al 2009, Levrier et al 2009). The technology development led to the first astronomically capable dense aperture array for radio astronomy called EMBRACE (Kant et al 2011, Torchinsky et al 2016). In particular, the EMBRACE prototype and the future Mid Frequency Aperture Array (MFAA) for SKA relies on integrated analogue beamforming technology developed at the Nançay Radio Observatory (Bosse et al 2010) which was produced as part of the SKADS project. An overview of the SKADS project and results is published in the proceedings of the final conference (Torchinsky et al (eds) 2009).

When the EC-FP6 funding ended for SKADS at the end of 2009, the EC-FP7 project PrepSKA was already underway, and SKADS partners naturally joined this effort. Much of the SKADS technical development evolved into the Aperture Array Verification Programme and was integrated to PrepSKA. The Observatoire de Paris maintained its leadership with the EMBRACE prototype testing, and developed EMBRACE into a functioning astronomically capable radio telescope with a long term observational programme (Torchinsky et al. 2016). The scientific efforts also continued, and French efforts in PrepSKA were instrumental in laying the groundwork for the next major step towards the SKA.

Unfortunately, at this time France could not join as a full member of the new SKA Organisation. Nevertheless, French scientific and technical involvement continues with significant contributions to the SKA Science Working Groups, and as a leading partner in the SKA Mid Frequency Aperture Array Consortium. Engineers from Nançay and Bordeaux provide the key technology of analogue integrated receiver, beamforming, and digitization, and Observatoire de Paris provides the scientific leadership for SKA/MFAA with the Project Scientist having this rôle since more than a decade.

Since 2015/16, involvement has ramped up in other SKA workpackages, including the Low Frequency Aperture Array (LFAA), and the Wide Band Single Pixel Feed (WBSPF). Engineers at the Laboratoire Astrophysique de Bordeaux are developing wide band digitizers for WBSPF while scientists at Observatoire de la Côte d'Azur are developing algorithms for image processing the LFAA data. Meanwhile, French scientists from multiple laboratories continue to participate in the SKA Science Working Groups, with at least one French scientist in

each working group.

#### References:

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