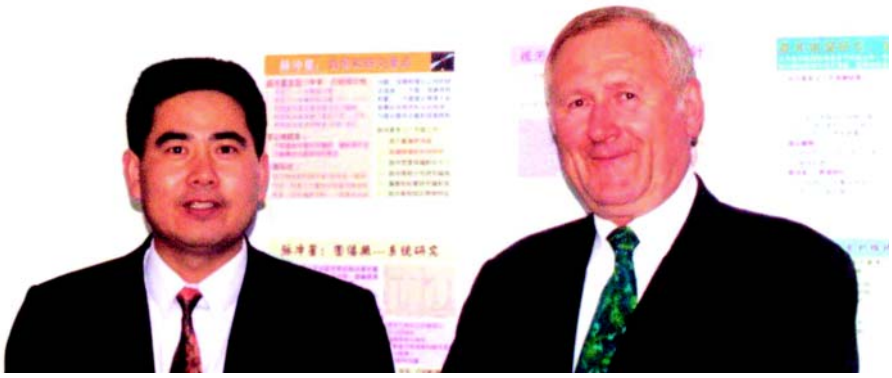
# MPS/CAS Partner Group on Radio Astronomy



Professor Han Jinlin and Professor Richard Wielebinski at National Astronomical Observatories of CAS, Beijing.

## Beijing-Bonn

**The Partner Group does research on cosmic magnetic fields using radio astronomy methods. Magnetic fields are found in every astronomical object: the Earth, the Sun, planets, stars, pulsars, the Milky Way, nearby galaxies and in distant radio galaxies. The role of the magnetic fields in the cosmic universe has not been well investigated, mainly because of the difficulties of their observation.**

**The Partner Group has executed several successful observational projects using the 100m radio telescope in Effelsberg, the Very Large Array in the USA and the Australia Telescope National Facilities to collect polarization data tracing the magnetic fields in the Milky Way. The group further plans to install a 6cm receiver system in a 25m radio telescope in Urumqi next summer to make polarization observations that give an unambiguous picture of magnetic field structures emerging from the disk of the Milky Way.**

Reported by Group Leader Han Jinlin

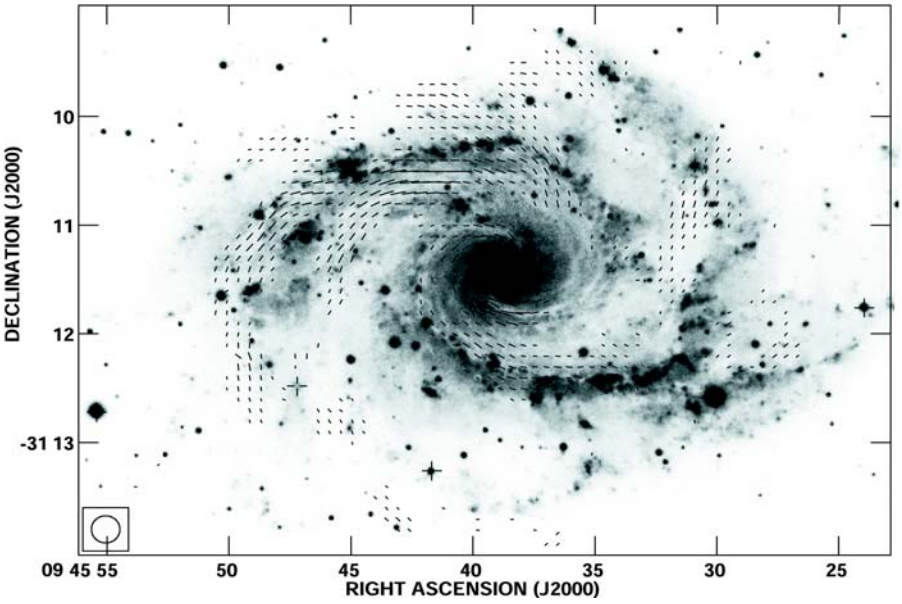
### Present Status

The Partner Group of the Max Planck Institute for Radio Astronomy (MPIfR) at the National Astronomical Observatories of the CAS (NAOC) in Beijing is active in studying magnetic fields, in particular of the Milky Way. The collaboration between the MPIfR and the NAOC has resulted in joint observing projects at top radio facilities as well as the organization of international conferences.

The studies of magnetic fields of galaxies have been pursued since the beginning of the collaboration a few years ago. The magnetic fields of NGC2997, M31 and M101 have been studied by radio polarization mapping. In particular, the question of 'magnetic arms' in NGC 2997 has been investigated. The extent of the magnetic fields around M31 was studied by determining the rotation measure of distant extragalactic radio sources observed through the magnetic interstellar medium of M31. An invited review on cosmic magnetic fields has been published (see publication list).

The magnetic fields of the Milky Way can be studied by a few radio astronomy methods. The radio continuum polarization is an immediate indicator of the magnetic field distribution. For this purpose, the Effelsberg 100m radio telescope has embarked on a medium latitude survey at 21 cm wavelength. Students from Beijing have actively participated in the development of software for this survey. The software will also be transferred to the radio telescope in Urumqi for a continuation of mapping at 6cm wavelength. To obtain the magnetic field orientation, it is necessary to correct for the foreground Faraday effects that take place in the magnetic interstellar medium. This will be done by the 6 cm polarization data, which have to be obtained with the 25 m radio telescope in Urumqi, Xinjiang Uygur Autonomous Region, China, with the same angular resolution, thus, tracing the same magnetic field structure.

Another method to study galactic magnetic fields is to observe pulsars and extragalactic radio sources through the magnetic interstellar medium of the Milky Way. The Faraday rotation effects made by galactic magnetic fields and thermal electron density can be observed as an integrated quantity, *rotation measure*, and thus, the inverted process gives us a model of the galactic magnetic fields. In particular, pulsars, which give us an observable *dispersion measure*, can give us directly the estimated values for the average magnetic field as the contribution from thermal electrons is measurable. The Partner Group was involved in observations both in Effelsberg and in Australia to collect valuable pulsar data. While the data from Australia added new information on the magnetic fields of the inner Galaxy, the Effelsberg observations could contribute to the clarification of some local effects towards the Perseus (anticenter) spiral arm of the outer




**The magnetic fields in the galaxy NGC2997 follow the spiral arms very well, as concluded from the cooperation between MPIfR and NAOC. The Milky Way, the galaxy we live, looks very like this grand-designed spiral galaxy. The Partner Group had found that the global magnetic field structure in our Milky Way is possibly similar to that in this nearby galaxy. On-going projects are to reveal the magnetic field structure of our Milky Way more precisely, which is the crucial information for high-energy cosmic-ray research and the important knowledge about the "motherland" of our galaxy.**

Galaxy. A survey for the rotation measures of 1800 extragalactic sources has been recently carried out by the Partner Group using the Effelsberg 100 m telescope. The combination of all these data is essential to be able to reveal the structure and strength of the magnetic fields in the Milky Way. Some preliminary results have been published. A great step forward is expected as soon as all the data now being collected are analyzed.

Through these scientific projects, the Partner Group has also been extensively developing the research capacity for radio astronomy in China. The team has been enlarged quickly in the last three years. In addition to the chief scientist and associated researchers, eight Ph. D. students have joined the group. Some of them will be co-supervised bilaterally by Chinese and German senior scientists. No doubt that they are the real future for Chinese radio astronomy.

### *Selected publications*

1. Han, J. L. & Wielebinski, R.: Milestones in the observations of cosmic magnetic fields. *CHINESE JOURNAL OF ASTRONOMY AND ASTROPHYSICS* 2, 293 – 324 (2002).
2. Han J. L., Sun X. H., Yang J. & Wielebinski, R. (eds.): Radio studies of Galactic objects, Galaxies and AGNs. *ACTA ASTRONOMICA SINICA* 44, Supplement Issue (2003).
3. Uyaniker, B., Reich, W. & Wielebinski, R. (eds.): The Magnetized Interstellar Medium. (Copernicus GmbH, Katlenburg-Lindau, 2004).

## Info

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| **MPS/CAS Partner Group for Radio Astronomy** | |
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### Future Plans

During the past two years, a 6 cm receiving system with a polarimeter has been under construction in the Effelsberg Observatory. Chinese engineers took part in the construction and will be responsible for the system operation at the Urumqi radio telescope. The system is being tested now at Effelsberg and will be transferred to Urumqi in April 2004. It is a cryogenically cooled, state-of-the-art, two-channel system and should allow excellent polarization observations. The system is so designed to be usable also in the VLBI observations enabling Urumqi to have the polarization capability in the framework of the European VLBI Network. The Urumqi telescope is at a good site for 6 cm polarization mapping observations: 2200 m altitude, dry and cold in the winter. The supposition of conditions is unique in the world, allowing the best 6 cm polarization observations.

The Partner Group intends to make a 6 cm polarization measurement for the Milky Way using the Urumqi telescope with the newly-armed receiver system. The measurements have the same angular resolution as the Effelsberg 21 cm survey does, which allows immediate comparison of the data and a very clear delineation of the magnetic field structures emerging from the spiral arms of our Galaxy.