

HISTORY OF RADIO ASTRONOMY

basic facts

milestones

1900 Olivier Lodge, England, Charles Nordmann, France, Thomas Edison, USA
unsuccessful attempts to detect Solar Radio Emission

1931 Karl G. Jansky, Bell Telephone Laboratories, Holmdel, New Jersey, USA,
antenna 30 m x 4 m, 20.5 MHz ($\lambda = 14.6$ m), $\theta = 30$ deg, results published in
1932, 1933 and 1935, proposal for 30m parabolic antenna as a future instrument
was made.

1937 Grote Reber, Wheaton, Illinois, USA, transit parabolic reflector 9.5 m
working at 3,3 GHz ($\lambda = 9.1$ cm) an attempt to detect thermal emission from the
Sun at 910 MHz ($\lambda = 33$ cm), 160 MHz ($\lambda = 1,87$ m), $\theta = 12$ deg
1939 first complete measurements of the Milky Way (Our Own Galaxy), 1940,
described a radio telescope as the bolometer, maps of radio emission from the
Galaxy published in 1944, together with report on earlier solar emission detection

1942 Stanley Hey, UK, detection of radio emission from the Sun ($\lambda = 4$ and 8m),
published in 1945 and 1946

1944 Hendrick van de Hulst, Leiden, Holland, (idea of Prof. Jan Oort)
theoretically predicted radio transmission of HI at (1420 MHz, $\lambda = 21$ cm)

1946 Hey, Parson and Phillips, Malvern, UK, sky survey at 176 MHz, found
strong scintillating point source in Cygnus constellation

1948 Bolton and Stanley, Sydney, Australia, built a cliff interferometer, and found
position of Cyg A source and its diameter $< 8'$

1948 Ryle and Smith, Cambridge, UK, made two element interferometer, and
derived positions of Cyg A i Cas A with higher accuracy

1948 Reber, Galaxy maps at 480 MHz ($\lambda = 62.5$ cm), he made a proposal for 67 m
fully steerable parabolic reflector.

1948 John G. Bolton, Sydney, identification of Tau A with „Crab” nebula - M1

1950-1960 Radio Interferometers and aperture synthesis developed at Cambridge
University, UK, Martin Ryle led team.

1951 Graham Smith, at Cambridge UK, finds position of Cyg A ($< 1'$), Walter Baade makes photo with Palomar 5m telescope and concludes the object as a colliding galaxies ?

1951 Ewen H.I. and Purcell E.M., Harvard University, USA, Muller and Oort, Leiden (1951), Christiansen and Hindman (1952) detect independently HI emission line at 21 cm wavelength

1954 Baade and Minkowski, Caltech, USA, publish results on identification and distance (from the spectrum) to Cyg A (200 M l.y.)

1954 Hagen and McClain, U.S. Naval Research Laboratory, detection of HI absorption line

1954 First observations of solar radio emission during solar eclipse (WAT, in Bemowo near Warsaw, Dzieciołowski, Gawronski, Komarzyński, Tomaszewski, Żelazowski), reviewed by Masłowski, AcA, Vol.7, 1957, also in parallel, an unsuccessful attempt to detect solar radio emission in OA UJ, Kraków, Poland, O.Czyżewski, A.Strzałkowski and J.Demezer, 5m antenna at $\lambda = 90$ cm

1957 Commission of 76m radio telescope at Jodrell Bank, Manchester Univ. UK

1956 Radio Astronomy Team, to build solar radio interferometer, was created by W.Iwanowska at Torun Astronomical Observatory UMK (ing. K.Grzesiak – radio engineer, mgr.H.Iwaniszewski – astronomer, mgr.S.Gorgolewski – physicist)

1956 H.Iwaniszewski, 3 month visit to USSR radio observatories (Crimea, Yerevan, Moscow), organised by W.Iwanowska in a frame of PAN and Russian Academy cooperation, first polish radio astronomer studies abroad.

1957 August construction of the first radio telescope at Toruń, Poland – RT1, 26x12m parabolic cylinder with two separated sections connected as an interferometer, S.Gorgolewski, H.Grzesiak, H.Iwaniszewski, J.Manczarski, J.Groszkowski.

1957 October Cracow Observatory started solar daily monitoring program at 810 MHz with 5m antenna (enlarged to 7m 1959). Zięba St.,Kozieł K., Czyżewski O..

1958 First detection of solar radio emission at Toruń in February 6th with RT-1 at 127 MHz. S.Gorgolewski, H.Grzesiak, H.Iwaniszewski, help from J.Groszkowski

1958 A new 12m RT-2, operating also at 127 MHz was constructed and put in operation in August 1958, RT-2 was used (1959-1960) as main instrument to monitor daily solar radio emission. Torun become involved in joint efforts of the International Geophysical Year. Later (1960) a two element solar interferometer replaced RT-2 for regular daily monitoring, the interferometer was used till 2020.

1958-1959 The British Council grant for S. Gorgolewski to study radio astronomy at Cambridge University under supervision of prof. Martin Ryle and dr A. Hewish. It had been a fundamental experience, effectively used for the decisive development of radio research in Torun.

1960 first Ph.D. in radio astronomy in Poland (S. Gorgolewski), based on scientific materials gathered from Cambridge interferometers.

1960 First use of **VLBI** in Canada and USA

1961 Bennett, Cambridge, published the fundamental 3CR catalogue, fluxes measured at 178 MHz

1961-1971 Three element interferometer working at 32,3 MHz antenna with separation 1400m - 914m was built and used for solar corona scattering studies. Occultation of Tau-A (Crab nebula) allowed measurement of fringe visibility function thus source angular diameter, as a function of solar distance, (S. Gorgolewski, B. Krygier).

1963 Arecibo 305 m Spherical Radio Telescope starts its operation

1963 Weinreb, Barrett, Meeks and Henry, NRAO, USA, make first molecule detection (OH in absorption towards Cas A)

1963 Redshift found to 3C273 - QSO, Maarten Schmidt, Caltech

1964 Kerr F.J. and Westerhout G., provides an evidence for the spiral structure of the Galaxy based on HI distribution

1965 Radio Astronomy Chair at IA UMK was established for doc. S. Gorgolewski. also first habilitation in radio astronomy in Poland, 1963.

1965-1967 4C survey published, Cambridge UK

1965 Arno Penzias and Robert Wilson, Bell Telephone Crawford Hill Laboratory, USA, Discovery of Cosmic Microwave Background 2.7 K, theoretically predicted by Alpher, Bethe and Gamow (in 1948) - **Nobel Prize in 1978**

1967 Hewish A. and Bell J., Cambridge UK, discover pulsars and interpret these as fast rotating magnetized neutron stars

1969 15m radio telescope construction completed at Astronomical Observatory, Jagiellonian University, Kraków. It had never been used for serious astronomical research studies. Served users as an experimental and educational facility only.

1969 One Mile Telescope at Cambridge commissioned, resolution $\theta < 1$ arcmin

1970 Ryle, Longair, Scheuer, Riley, Cambridge, explanation of AGN event, initial work on unification theory of AGNs

1970 Prof. S.Gorgolewski, visiting professor at CALTECH, USA, for one year. Important decisions were undertaken for Torun Radio Astronomy development. New idea occurred to change initial plan to construct 5x25m antenna interferometer to build one 32m class antenna instead to join international programme of VLBI. On return from Caltech S.Gorgolewski brought (legally) full documentation how to construct VLBI instrumentation (VLBI terminal). Work on new equipment started at Torun Radio Astronomy Observatory (TRAO) in 1972.

1971 100m radio telescope, MPIfR, Effelsberg FRG, starts operation

1972 Five Km Telescope completed, Cambridge UK, resolution $\theta \sim 2$ arcsec

1970-1973 Design and construction of electronics for 43MHz survey of circumpolar region Dec > 70 deg. Aperture synthesis of 700m dish, observations were made from January to June 1973, (A.Kus). First aperture synthesis in Poland.

1973 New building facilities, to commemorate Copernicus 500 anniversary were completed for Radio Astronomy Department. It had been the first step towards establishing of the National Radio Astronomy Centre equipped with 5 x 25m dishes of aperture synthesis interferometer.

1973 Launch of Copernicus 500 satellite equipped with 1-10 MHz spectrometer, Designed and prototype made at UMK, the flight unit build at Institute of Aviation Warsaw, (Gorgolewski, Hanasz).

1974 Martin Ryle and Anthony Hewish, **Nobel prize** in physics for radio interferometry, aperture synthesis, radio surveys, discovery of pulsars

1975 Cohen M., Kellermann K., Caltech, USA, discovery of SLM – Super Luminous Motion in quasars

1976 Cambridge UK and NRAO USA, evidence for isotropy of radio source distribution and their strong time evolution

1974-1977 Project and construction of RT-3, 15m parabolic reflector on equatorial mount, smaller copy of Westerbork design, (Turło, BIBROHUT, MOSTOSTAL). First light September 1978). Uncooled low noise receivers were made for 408, 609, 1420, 1660 MHz, and 5, 10.7 GHz bands. Important help from Astron, JBO and MPIfR. First professional radio telescope in Poland, equipped with advanced instrumentation.

1979 commissioning of 15m parabolic radio telescope – RT3, in Piwnice ,
1 X 1979 Minister MSz.W.N.T. przekształca Zakład Radioastronomii IA UMK w
samodzielną Katedrę Radioastronomii na Wydziale Mat-Fiz-Chem UMK.

1979 Discovery of first gravitational lens system 0957+561, Walsh, Carswell and
Weymann, Jodrell Bank, Manchester University, UK

1979 Dos Santos, NRAO, detects first H₂O megamaser in NGC 4945

1981 Commission of the most successful radio telescope, the **VLA**, NRAO, USA

1981 Poland, Toruń joined VLBI (June 29th), also first successful observations
of pulsars, HI and OH molecule on RT3 were made (Kus, Borkowski,
Gorgolewski, Krygier, Kępa, Mazurek, Pazderski, Usowicz, Mazurek, Gawronska)

1982 discovery of first exoplanets outside the solar system, orbiting around
pulsar PSR 1257+12 , on 305m SRT Arecibo Observatory by **Alex Wolszczan**.

1989 Hirabayashi, Moran et al., NRO, Japan, first evidence for presence of the BH
at the centre of NGC 4258 galaxy, (megamaser H₂O)

1993 Russell Hulse and Joseph Taylor, Princeton, USA, **Nobel prize**, relativistic
effects and gravitational waves from double pulsar PSR 1913+16

1995 discovery of anisotropy of Cosmic Microwave Background - „COBE”
satellite

1996 RT4, 32m radio telescope completed in Oct 1994 at Piwnice near Toruń,
starts full operation in 1996. First VLBI fringes in May 1996. Regular pulsar
monitoring, radio spectroscopy, radiometry and polarimetry had started. Studies
were centred at several frequencies: 1.429, 1.7, 5 GHz, later (2000) at 30 GHz
OCRA when radio camera was added.

1997 VSOP in orbit and working

1999/2000 New projects for the 21st century: SKA, ALMA, SVLBI, **OCRA**

AJK - 2000