History of Technology Development at NRAO

Telescopes and Optics:

1962 First observations with 300-foot telescope.

1965 140-foot telescope.

1967 Introduction of homologous telescope design. (von Horner)

1967 Three-element interferometer operational in Green Bank.

1968 36-foot millimeter-wave telescope at Kitt Peak, AZ.

1978 VLA opens for observations.

1979 Deformable subreflector for the 140-ft. telescope. It corrected to a large extent the astigmatism of the telescope. (von Horner, Wong, Lacasse)

1984 First observations with Kitt Peak 12-m telescope – the 36-foot telescope fitted with a new main reflector.

1992 1.5 GHz optical modulator for laser metrology system (Bradley, Payne, Parker)

1993 First observations with all 10 VLBA antennas.

1995 Optical distance measuring system for setting telescope pannels patented. (Parker, Payne)

1995 Development of the Active Surface for the Green Bank Telescope. This is the first instance of real-time surface-deformation-compensation in a radio telescope.

2000 First light with the Green Bank Telescope.

2002 Physical optics analysis capability for shaped reflectors like the VLA and VLBA antennas. (Srikanth)

2003 Wide band (2:1) compact corrugated horns developed for EVLA secondary focus. (Srikanth)

2004 EVLA obtains first fringes.

2007 Simulation of wide-angle sidelobes and backlobes of the Green Bank Telescope at L-band. (Srikanth)

2011 ALMA – the partially completed Atacama Large Millimeter Array commenced observations.

Receiver Development:

1968 Parametric ampifier receiver for L-band. (Edrich)

1970 Phase-lock system developed for millimeter-wave klystron oscillators. (Weinreb)

1974 Introduction of cryogenic Schottky diode mixers for radio astronomy. (Weinreb, Kerr)

1974 The "multiple reflection" method for accurate analysis of strongly nonlinear diode circuits. (Kerr)

1977 Tunable cryogenic resonant-ring directional filter for local oscillator injection. (Davis)

1997 Noise temperature definitions for quantum-limited receivers (Kerr)

1997 Understanding the behavior of HFETs in a strong magnetic field (Bradley, E. Daw [MIT])

1997 Development of extremely broad band short backfire antenna feeds (Srikanth)

1998 First beam-forming array for radio astronomy (Bradley, Fisher)

1998 Development of full waveguide band circular polarizer (Srikanth)

1998 Development of low-parasitic SIS mixer with wide IF (4-12 GHz). (Kerr, Pan, UVA)

1998 Demonstration of single-chip sideband-separating SIS mixer (Kerr, Pan, JPL)

2000 Demonstration of single-chip balanced SIS mixer (Kerr, Pan, UVA)

2000 Demonstration of integrated SIS mixer-preamp with wideband IF (4-12 GHz). (Lauria, Kerr, Pospieszalski, Pan)

2001 Design of single-chip balanced sideband-separating SIS mixer (Kerr, Pan, UVA)

2001 Theory of saturation in SIS mixers by CW and high level noise signals. (Kerr, Pan, D'Addario, Feldman)

2001 Sideband calibration procedure for sideband-separating mixers without knowing the USB and LSB source powers. (Kerr, Pan, Effland)

2002 Invention of a high-level broadband noise source for mm/sub-mm wavelengths. (Pan)

2002-2010 Design and production of all amplifiers for new EVLA and GBT receivers covering several bands from 200 MHz to 115 GHz. (Pospieszalski)

2003 Design of ALMA Band 3 (84-116 GHz) mixer. (Pan, Kerr, Pospieszalski, Lauria).

2003-2004 Development, with Jodrell Bank, of Ka- and Q-band amplifiers for Planck Satellite Low Frequency Instrument. (Pospieszalski)

2004 Design of ALMA Band 6 (211-275 GHz) sideband-separating sis mixer-preamplifier. (Kerr, Pan, Lauria, Pospieszalski)

2007 75-110 GHz corrugated waveguide phase shifter. (Srikanth)

2006 Superconducting 4-12 GHz 180-degree hybrid on a small chip for use in balanced SIS mixers. (Kerr)

2009 Development of compact full waveguide band (8-12 GHz) turnstile junction orthomode transducer. (Srikanth)

2009 Ring-Centered interface proposed for sub-mm waveguides. (Kerr, Srikanth)

2010 New formulation of allowable values of noise parameter for all microwave transistors. (Pospieszalski)

Signal Processing:

1963 First digital correlator built by S. Weinreb (future head of electronics at NRAO)

1964 Model 1 autocorrelator designed by Art Shalloway for the 140-foot telescope. System had 100 channels and a 5 MHz bandwidth.

POPS - people oriented parsing system.: A People-Oriented Parsing System. Written at the NRAO. Adopted for many other applications such as real-time industrial manufacturing, power generation, not to mention the 12m. Also the user interface adopted by AIPS.