ADDITIONAL CONTRIBUTIONS

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NEW RADIO TELESCOPES

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ABSTRACT. Nearly all of the exciting discoveries in radio astronomy have come from new instruments or techniques which have provided new frequencies, high sensitivity, higher spatial or time resolution, or improved image quality. Since the last General Assembly a number of major new radio telescopes have been completed while construction of others have only just begun. At the same time telescopes of the more distant future are still in the conceptual stage. This paper summarizes a full-day meeting of Commission 40 on recently completed radio telescopes, new radio telescopes now under construction, and radio telescopes of the future.

1. RECENTLY COMPLETED RADIO TELESCOPES

1.1 The Gauribidanur T-Array

A multi-beam-forming receiver for the low frequency decameter wave radio telescope situated at Gauribidanur, India has been built. The receiver uses a DSB system. The quadrature samples are obtained by sampling the digitized I.F. signal by two clocks which are separated in time by one-fourth of the I.F. period. The visibilities required for one-dimensional synthesis are measured using 1-bit correlators. Maps at 34.5 MHz with a resolution of 26' x 41' (at zenith) and a zenith angle coverage of 10° have been made, and data analysis to obtain maps with a coverage of ± 50° zenith angle is in progress. N. Udaya Shankar

1.2. Nobeyama 45-m Telescope

The 45-m telescope has been in operation since 1982. The surface accuracy (including the sub-reflector and beam-guide system) was measured to be 0.2 mm rms providing 25% aperture efficiency at 115 GHz. The pointing accuracy was measured to be 3-5 arcsec rms in normal observing conditions and ± 10 arcsec for the wind speeds about 10 m/sec. To improve the pointing behavior the sub-reflector and the supporting stays were replaced and strengthened during July-August 1985. The new sub-reflector is a 3.8-m diameter Cassegrain dish made with CFRP (0.04 mm rms), resulting in the considerable reduction of the

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height and the wind load. The total stiffness against the wind was increased by a factor of three. We expect that the improved pointing accuracy is 2-3 arcsec rms, which will enable us to go to shorter millimeter-wave observations. The surface measurement and adjustment provided a surface accuracy of 0.18 mm rms by using a three-dimensional laser measurement system and remote adjusting system. Radio-holographic measurements are being made using the Japanese geostationary satellites CS-2A and CS-2B at a frequency of 19.45 GHz.

In 1985, about 50% of the telescope time was used for scientific observations in the best observing season (December-June). Sixty percent of the observations were made in the CO 1-0 line, the remainder for maintenance, development, and test observations. N. Kaifu

1.3. Nobeyama Millimeter-Wave Array

The millimeter wave synthesis telescope at Nobeyama is now operating at 22-GHz and will be tested at 115-GHz. It is composed of five, 10-m antennas with 0.07 mm rms surface accuracy. EW and NS baselines are 560-m and 520-m length, respectively, with 30 stations along each baseline. The maximum resolution is 4 arcsec and 0.8 arcsec at 22 and 115 GHz, respectively. The receiver temperatures at these frequencies are 100K and 1000K. The 115-GHz receiver will be improved by introducing SIS receivers under development at Nobeyama. The FFT-type spectrocorrelator is working satisfactorily and is being tested by observing the H_2O and NH_3 lines at 22 GHz. The bandwidth of the spectrometer is limited to 80 MHz because of the A/D convertor, but will be increased to 320-MHz within one to two years.

22 GHz observations have been made from July 1984 to June 1985 for Sgr A, M82, CYG A, CAS A, Virgo A, W49, CEP A, and ORI A. The galactic center mapping with seven configurations revealed the existence of new features in the "mini-spiral" at the galactic center which were not seen with the VLA, especially the ring-like structure of the ionized gas. The dynamic range of the map is 280 after self-calibration and cleaning. The phase stability on the 100-m baseline was 5° rms under good weather conditions. N. Kaifu

1.4. IRAM 30-meter Diameter Radio Telescope

The telescope was accepted from the manufacturer in August 1985 and has been used in the 3-mm waveband by several groups of visiting European astronomers. The measured aperture efficiency at 1.3 mm wavelength is about 25%, corresponding to an effective rms surface error of about 90 microns. Absolute pointing errors under calm conditions are about 3 arcseconds rms over most of the sky; tracking errors are less than 1 arcsecond in a 10 m/s wind. Cooled Schottky [T_{RX}(DSB) ~ 300K] and SIS (100-250 K) receivers are available in 3 mm band, and cooled Schottky (≈ 350 K) in the 1.3 mm band. Two filter banks (512 x 1 MHz, 256 x 100 KHz) are operational with a 16 times spectrum expander for 6 KHz resolution. A 2048 channel autocorrelator (bandwidth 320 MHz) is under development. Plans call for SIS receivers in the 2 mm and 1.3 mm bands. A bolometer and F.T. spectrometer are under test for 1 mm observations. Continuum measurements can be made with a rotating sector (6 Hz) beam switch. D. Morris

1.5. R.R.I. 10.4 m Millimeter-wave Telescope

A 10.4 meter diameter radio telescope for operation at millimeter-wavelengths has recently been completed and installed at the Raman Research Institute Campus at Bangalore in India. The 10.4 meter dish is a copy of the Leighton dishes in use at the Owens Valley Observatory, fabricated in India using the Caltech design and procedures. The telescope has been installed on top of a building, and the dish was assembled on top of the mount piece by piece with the help of a scaffolding. Estimated surface accuracy of the dish is 65 μ, and measurements are in progress to determine the actual value.
R. Bhandari

1.6. OVRO 3-mm Interferometer

The Owens Valley Millimeter Interferometer consists of three, 10.4 meter telescopes which can be positioned on baselines presently extending to 200 E-W and 380 N-S. The telescopes are equipped with cryogenically cooled SIS receivers with noise temperature (SSB) of 150 to 200 K in the 3.4 to 2.6 mm band. The instrument has been used for mm-line interferometry of molecules in star formation regions in our own galaxy and in nearby galaxies, in the circumstellar envelopes of evolved stars, and in planetary atmospheres. The instrument is open to external scientists outside Caltech. N. Scoville

1.7. The NRAO 12-Meter Telescope

The 36-foot millimeter-wave telescope on Kitt Peak has been converted to be the 12-meter telescope by replacing all the structure and surface above the elevation axis by a new steel back-up structure and aluminum surface panels provided by ESSCO. This surface has been measured and set using two quite independent methods, a mechanical method using a template, and holography using the LES-8 satellite. Since November 1984, the telescope has been operating in the Cassegrain mode at frequencies up to 345 GHz. At this frequency the telescope has quite a good beam shape and an aperture efficiency of about 15%.
J. Findlay

1.8. RATAN-600

All 3000 degrees of freedom of the main surface panels are now connected with a mini-computer. A holography method is in use and will allow real time corrections of thermal deformations if necessary. For operation in the short millimeter-wave region, 2000 m^2 of the main surface now have panels with rms error 0.082 mm. A new special secondary mirror will collect all of the available surface (14000 m^2) near the zenith. This mode of operation increases the sensitivity and resolution (1"7 at 8 mm). Extra "screens" below and above the elements are being installed to minimize the system temperature and to extend the operating wavelength to one meter. Y. Parijskii

1.9. Cambridge Low Frequency Telescope

The low frequency synthesis telescope at Cambridge has been in full operation for two years. It is designed for deep mapping over wide fields and operates initially at 151 MHz where the resolution is

71 arcsec over fields of 5°-10°. The layout is conventional for an east-west earth rotation synthesis telescope, but is unusual in having 60 antennas arranged to give 778 simultaneous baselines at uniform intervals of 3λ up to the maximum baseline of 4.6 km. The largest missing baseline is 9λ, which enables mapping of very large areas free of the usual problems associated with short baselines. Each antenna comprises four, 10-element Yagis, giving an overall collecting area of the telescope of 2000 m^2. The system temperature is dominated by the galactic background radiation, and the sensitivity achieved in practice at high latitudes is 20 mJy rms noise in a 12 h observation.

Ionosphere waves, typically with periods of 20 minutes and wavelengths of 100 km, giving phase variations of ~30 day rms at 4 km baselines, are an important influence on the performance of the telescope, and are corrected continuously by observations of the apparent positions of bright point sources in the large field of view. The approximation that the ionosphere phase is proportional to baseline is very good for this telescope and normally allows a 30 dB dynamic range to be reached. For conditions of strong ionosphere scintillation, phase correction methods fail because of the very small scales of variation across the telescope and in angle in the sky. Such data are discarded. These methods provide straightforward and rapid reduction of the data, and an important aspect of the telescope is that a low resolution map from the data is available automatically within four minutes of the end of an observation, and fully reduced maps can normally be made within 1-2 hours. J. Baldwin

2. RADIO TELESCOPES UNDER CONSTRUCTION

2.1. Australia Telescope

The Australia Telescope, due to begin operating in 1988, will consist of a 6 km east-west array of six, 22 m diameter antennas, and a long baseline array in which the 6 km array is linked to another 22 m diameter antenna 115 km to the south, and to the Parkes 64 m diameter antenna 321 km south-southwest. The seven new antennas will be good to 50 GHz with the central 15.3 m useable to 115 GHz. The long baseline array will use U.S. VLBA compatible tape recorders. The 6 km array design is optimized for wide field mapping and spectral line studies. The maximum 2-bit bandwidth will be 128 MHz, and the maximum number of channels 8192 (for each of 15 baselines). The rail track and the 37 stations are completed. The first antenna is due in November 1986, and the last one in December 1987. Construction of feeds and receivers for the bands 1.25 to 1.8 GHz, 2.2 to 2.5 GHz, 4.4 to 6.1 GHz, and 8.0 to 9.2 GHz is underway. J. A. Roberts

2.2. The Very Long Baseline Array

The VLBA will consist of ten, 25-m diameter antennas located at sites throughout the United States, ranging from Hawaii to the Caribbean, and will operate at wavelengths as short as 3.5 mm. Each antenna will be equipped with dual-polarized, low-noise receivers in nine separate frequency bands from 327 MHz to 43 GHz. Control of the

VLBA will be from an Array Operations Center located in Socorro, New Mexico, via leased telephone lines. Intermediate frequency signals at each antenna, after conversion to baseband, will be recorded on magnetic tape using a Honeywell Model 96 recorder modified to record up to 32 independent tracks, each 20 microns width. Up to 28 passes of the magnetic tape across the headstack will permit uninterrupted recordings of 8 to 12 hours on a single reel of magnetic tape. Both 2-level and 4-level recording will be supported. The magnetic tapes from each station will be replayed, using a correlator designed to support up to 20 stations with a bandwidth up to 128 MHz. Thus, as many as 10 external antennas may be used together with the 10 dedicated VLBA elements to further increase the sensitivity and resolution. The correlator can be modified to accept baselines between earth and space. K. I. Kellermann

2.3. Caltech Submillimeter Telescope

The Caltech Submillimeter Observatory consists of a 10.4 diameter telescope housed in an astronomical dome fitted with 11 m shutter doors, and sited at about 4,100 M altitude on Mauna Kea, Hawaii. The Observatory is under construction with an anticipated completion date in the spring of 1986. At present, work is proceeding on the mountain top, where the dome is about 70 percent complete, and the telescope mount is in place inside the dome. The telescope primary surface has accuracy of 10 microns, and will be placed on the mount in March 1986. Receivers, backends, and other items are under construction in Pasadena, and will be put in place in the Observatory during the commissioning period in 1986. The expected wavelength operating range of the telescope is 2 mm to 350 microns. Tom Phillips

2.4. Status of the MPIfR/UoA 10-m Submillimeter Telescope

An all carbon-fiber dish is now being manufactured by MAN according to an MPIfR specification. The steel drive sections will be supplied by Krupp. The panels will be made also in carbon-fiber material using molds made by Steward Observatory. There will be three rings of panels, requiring three different molds. The test mold has a surface accuracy of $\sigma \sim 2$ μ rms. The surface accuracy of the panels is expected to be $\sigma \sim 4$ μ rms. The telescope should work well down to 350 μ wavelength.

The preferred site for this telescope is Mt. Graham. This site is at present subject to approval which we hope will come early 1986. The Steward Observatory has designed a co-rotating building of the "cow barn" type. For observations the building will open giving a clear view of the sky. The telescope should be commissioned in 1987. R. Wielebinski

2.5. The Swedish-ESO Submillimeter Telescope (SEST)

The SEST project is a collaboration between Sweden and the European Southern Observatory (ESO) to place an IRAM design 15 m telescope for the millimeter and submillimeter wavelength range on the ESO site of La Silla in Chile. This site has a well-developed infrastructure, and the telescope is well-matched to the meterological conditions (water vapor, wind, and temperature) according to recent measurements. The telescope is identical to those of the Plateau de Bure interferometer, and the Institut de Radio Astronomie Millimetrique (IRAM) is responsible for the construction under contract. The Onsala Space Observatory is responsible for the management and the instrumentation, which will consist of Schottky and/or SIS mixers at 80-120 GHz and 220-260 GHz, and later at 330-360 GHz, IF systems centered at 4 as well as 1.5 GHz, and acousto-optical spectrometers (B = 100 and 500 MHz, ΔB = 50 and 500 kHz). The completion of the telescope, control building, and first receivers is scheduled for October 1986, followed by a period for surface setting and system tests. B. O. Ronnang

2.6. The IRAM Interferometer

The IRAM interferometer is at Plateau de Bure, 90 km south of Grenoble, France, at an altitude of 2550 m. The interferometer will have at least three 15 meter dishes, each with a 50 micron rms surface accuracy operating in the frequency range 70 to 350 GHz. Each antenna is movable to 26 different stations in steps of 8 m or 16 m along a T-shaped track 160-m long, approximately N-S, and 288 m long, approximately E-W. The system will operate in continuum with a 500 MHz bandwidth, using 4-bit digital delay lines and correlators, and in spectral-line mode with a digital cross-correlator providing 256 frequencies per antenna pair. All antennas may, in addition, operate independently in single-dish mode, in which case filter banks of 512 x 1 MHz and 256 x 100 kHz are available. Two receivers per antenna, differing in polarization and in frequency, will operate simultaneously. As of December 1985, the cable car access and all buildings, including the antenna assembly hall and living quarters, are complete. The tracks and stations are finished, and all three antenna mounts are commissioned on the Plateau. The first two reflectors are to be assembled on site in early and mid-1986, the third in mid-1987. Receivers for 3 mm and electronics for the first two antennas are to be ready by mid-1986. The control computer (PDP11/44) and data reduction computer (VAX 730) are already installed on site, and the telescope control software is currently being tested on site with the first antenna mount. Darrel Emerson

2.7. The UK-NL-James Clerk-Maxwell Millimeter Telescope

The James Clerk-Maxwell Telescope is nearly completed on Mauna Kea, Hawaii, and it is expected that first tests will be carried out during spring 1986. The aim of the design is to produce a 15 m diameter telescope with useable performance at frequencies up to 690 GHz under favorable conditions. The design targets are for a 35 μm rms overall surface accuracy with 1 arcsec pointing relative to nearby calibrating sources, and with an absolute pointing of 3 arcsec. The telescope is housed in a steel framed building which rotates with the telescope, with sliding doors and roof to provide an unobstructed aperture. This will normally be covered with a thin PTFE membrane which both removes wind stresses on the telescope and allows good thermal control of the building and telescope. The membrane has better than 95% transmission at 1 mm wavelength, and nearly 90% down to 0.4 mm.

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The surface is composed of 276 panels of thin aluminum sheet glued to press-formed aluminum honeycomb. Each is attached to the backing structure by thermally insulating supports on three motor driven jacking screws. The backing structure is of a highly symmetrical design to allow homologous deformation of the dish surface under gravitational stresses. The initial setting of the panels will be carried out with a purpose-built laser interferometer and will be followed up by holographic methods. J. Baldwin

2.8. Soviet VLBI Network

Three new 70 meter antennas are being built as part of the USSR Deep Space Tracking Network. The first of these near Evpatoria is already in operation; the second near Usurisk in the Far East is under construction; and the third near Tashkent will be complete by 1990. Each antenna will be equipped with low noise radiometers at 1.3, 6, 18, and 75 cm for use as VLBI stations. By 1992, the antenna near Tashkent is expected to operate at wavelengths as short as 1.3 mm with the aid of motor driven panel adjustments. L. Matveyenko

3. RADIO TELESCOPES OF THE FUTURE

3.1 Giant Meter Wavelength Radio Telescope - GMRT

A plan to construct a Giant Meter Wavelength Radio Telescope in India during 1985-1992 has been recently approved. It will make high resolution maps of galactic and extragalactic radio sources, as well as search for (i) the redshifted 21-cm line radiation from neutral hydrogen clouds that might have existed before the formation of galaxies, and (ii) short-period pulsars. According to the original proposal, the GMRT is to consist of 34 steerable parabolic cylinders, each of size 92 m long and 35 m wide. Sixteen of the antennas are to be placed in a central 4 x 4 square array of about 1 km in size. The other 18 antennas are to be placed along the 3 arms of a Y-shaped configuration, with each arm being 14 km long. The reflecting surface is 2 cm mesh. By mounting different dipole arrays on the four faces of a rotatable square steel truss placed along the focal line of the parabolic cylinders, it is proposed to operate the GMRT at 38, 151, 325, and 610 MHz. Govind Swarup

3.2. The Arecibo Upgrading Program

As a result of the first major upgrade completed in 1972, the Arecibo telescope currently has a short wavelength limit of about 9 cm. This will be reduced to less than 4 cm as a result of resetting the surface to 2 mm rms, which will be completed during the early part of 1986. A 60-foot screen running along the perimeter of the reflector has been designed to substantially reduce the spillover noise contribution when the antenna is used with 40-foot line feeds, and eliminate spillover noise when used with an offset reflector feed. The cost of this screen is expected to be $1.5M.

Design work is underway to replace the line feeds with a wide band multiple reflector feed providing an offset, slightly elliptical illumination of the main reflector. The reflecting feed will be supported inside a metal-covered radome with a transparent membrane facing the main reflector, and will allow wide instantaneous bandwidths, and with a change of simple point source horns, a frequency range from 300 MHz to 8 GHz. The pointing will be improved from 15" to 5" rms by introducing a ground-based reference system. This part of the upgrade will be in the $10-15M range.

As a result of these upgrades, the performance improvements will be gain at zenith of 12 K/J; instantaneous bandwidth of at least 15%; sensitivity at zenith for radio astronomy increased by a factor of 2; sensitivity for radar astronomy will be improved by a factor of 4 at zenith, and a factor of 30 at extreme zenith angles; and interference and clutter will be reduced by at least 20 dB by the radome shield.

These improvements will decrease the integration time in radio astronomy observations by a factor of 10; will allow for simultaneous observations of multiple features in molecular spectra; will bring several other molecular lines within the frequency range; will allow for much improved pulsar observations, including simultaneous multiple frequency observations with greatly reduced interference; and will improve radar astronomy sensitivity for distant targets such as the Galilean satellites. T. Hagfors

3.3. Upgraded ARO 37 m Antenna

The Canadian government has recently approved plans to upgrade the Algonquin Radio Observatory telescope to operate at wavelengths at least as short as 2.6 mm. The new surface will have an overall rms error of (160 microns), including panel accuracy (50 microns), setting accuracy (40 microns), gravity deflection (120 microns maximum), and wind/thermal effects (80 microns). Pointing errors will be reduced to 2 arcsec. The present surface will be replaced with an entirely new surface. The backup support structure will be enclosed to shield the structure from the sun and to permit air circulation. Heaters will be installed to prevent accumulation of ice. The telescope will be used for single dish spectroscopy and continuum observations, and as North America's largest millimeter antenna, it has the potential of being an important part of future millimeter VLBI observations. Completion is planned by late 1987. P. Kronberg

3.4. NRAO MILLIMETER ARRAY

The National Radio Astronomy Observatory is currently undertaking a design study for a synthesis array for millimeter wavelengths of the same class as the VLA at centimeter wavelengths. The configuration plan consists of 20 to 30 antennas, each 8 to 10 inches in diameter, along with a central element. The central element would consist of about 21, 3 to 4 meter dishes mounted on an inclined rotating structure, or a conventional single dish with a focal plane array. The maximum baseline will depend on the site chosen, but could be as long as 35 km. Operation would be in four or five wide bands between 30 and 345 GHz, with emphasis on the range 200 to 300 GHz. For wide fields the array would be operated in a mosaicing mode. Maps would be made of large fields by combining many pointings of the 10 meter dishes in the synthesis mode, one or more pointings of the central element, and data from the 10 meter dishes used as individual single dishes. F. Owen

3.5. Canadian Long Baseline Array

The original 1982 proposal for a nine-element array of 32-m antennas stretching across Canada, and a less costly, four-element array proposal have not yet been funded. One or both of the western provinces may provide sufficient seed money to induce the government in Ottawa to fund the project. John Galt

3.6. QUASAT

ESA and NASA have recently completed an Assessment Study of a collaborative mission to launch QUASAT, a free-flying satellite carrying a radio telescope in an elliptical orbit around the Earth. The project is now entering Phase A at ESA and NASA. The orbit has been optimized for high quality VLBI imaging of radio sources with ground-based VLBI networks in the USA, Europe, USSR, and Australia. The perigee altitude is 5700 km, the apogee altitude 12500 km, and the inclination 63°. The mission design lifetime is two years, but an operational lifetime of five years is expected.

QUASAT will not only give an increase in resolution, but will have a remarkably clean and circular point spread function. This beam is 10 to 50 times smaller in area than given by a ground system alone. Imaging of unprecedented quality at these resolutions will result. In addition, observations of just a few hours length provide sufficient information to allow reasonable quality images to be reconstructed, thus making it possible to follow the evolution of rapidly changing galactic objects.

The observing wavelengths will be 1.35, 6 and 18 cm in common with the standard wavelengths for the ground networks. The space-borne antenna will be capable of observing in both bands of circular polarization simultaneously at any two of the wavelengths, and will relay the received signals via a link directly to telemetry stations on the ground. A phase/frequency reference for the antenna in space, stable to about 10^{-14}, will be relayed directly to the satellite via a two-way link from the telemetry stations in turn. After transmission to the ground, the signal will be recorded on magnetic tape in digital form, and transported to the central processing facility of the European or U.S. VLB Array for correlation with similar tapes from the ground VLBI arrays.

Discussion of the requirements for a potential multi-nation space VLBI mission involving QUASAT, one of the RADIOASTRON VLBI satellites of the USSR, and a Japanese satellite, is going on under the auspices of a COSPAR Ad-Hoc Committee on Space VLBI. R. Schilizzi and B. Burke

3.7. RADIOASTRON

The RADIOASTRON project is a ground-space radio interferometer. One or two space radio telescopes in a high apogee orbit will receive signals from celestial radio sources together with radio telescopes on the ground. It will provide high angular resolution that cannot be achieved on the earth, and the rapid production and high quality images of active galactic nuclei, galactic H_2O and OH maser sources, as well as probe the interstellar medium.

Parameters of RADIOASTRON are: diameter - 10 meters; frequency bands - 0.61, 1.66, 5 and 22 GHz; the system noise temperatures - 35 to 100 K; maximum baselines - RADIOASTRON I: 77 x 10^3 km (period 24 hours); RADIOASTRON II: 46 x 10^6 km (period 12 hours); maximum angular resolution 40 microarcseconds (22 GHz); bandwidth - 2 or 32 MHz; sensitivity - 10 mJy (32 MHz BW) and 100 sec coherent averaging; pointing accuracy - < 5'; lifetime - two years; payload - 1000 kg; first launch - 1992. It is expected that there will be broad international cooperation in the RADIOASTRON project. L. Matveyenko

3.8. Smithsonian Submillimeter Array

The Smithsonian Astrophysical Observatory is planning to construct and operate a submillimeter array intended for synthesis mapping between 0.35 and 1.3 mm. The telescope concept is an array of six movable dishes, each six meters in diameter and mounted in a Y configuration. Initially the maximum baseline would be about 100 m to give a resolution of 1". The telescope would be used for studies of dust and molecular gas in the highest density regions of molecular clouds where stars are forming. It would also be used for studying nonthermal sources in the crucial spectral region where the radio-loud and radio-quiet sources begin to differ. Sites under consideration are Mauna Kea, Hawaii, and Mt. Graham, Arizona. S. Willner

3.9. The Large Deployable Reflector

The Jet Propulsion Laboratory has developed a "minimum" Large Deployable Reflector (LDR) concept. The objective is to meet the minimum science requirements defined for LDR by refining radio telescope technology. The resulting concept has a passive 20-m diameter f/0.7 primary reflector made up of 84 hexagonal panels, approximately 2-m across, made from lightweight composite structural materials. The primary is supported by a deployable "PAC truss" backup structure at the vertices of each hexagon. Deformations in the shape of the primary reflector are corrected at a 0.9-m diameter quaternary reflector which is at the optical image (exit pupil) of the primary. Diffraction-limited performance would be obtained at wavelengths longer than 50 microns. The entire optical assembly would be surrounded by a sunshade to permit viewing to within 90 degrees of the sun. A payload of four instruments plus cryogenics with a total mass of 3400 kg is envisioned. The telescope would be placed in a low-Earth orbit and assembled near the Space Station from components lifted in multiple shuttle launches. The estimated total cost would be approximately $700M. While submillimeter requirements have driven the design of the telescope, it will be equally suitable for millimeter (e.g., oxygen and water line) and centimeter (e.g., VLBI) wavelength observations. T. Kuiper