Official start of the Dwingeloo construction work

On December 12, 1995, with the tightening of a bolt, parting Chairman of the Board prof. Piet van der Kruit officially started the construction of the new building for the NFRA institute in Dwingeloo. The new building will house a growing number of NFRA employees, the Joint Institute for VLBI in Europe, and the Kapteyn Sterrenwacht Werkgroep which will move from Roden to Dwingeloo. The NFRA Board and staff, and friends from other institutes, celebrated this milestone. (photo: Harm Jan Stiepel)
Message from the Director

Harvey Butcher

At the end of December, after eight years and three months in harness, Piet van der Kruit stepped down as chairman of the ASTRON/NFRA Board. Piet took on the chairmanship of Board in 1988, when the "R" in NFRA still stood for "Radio". Right away, he guided the organization through a merger with the previous foundation ASTRON, and the "R" came to stand for "Research in". In 1992 he presided over a major reorganization of the management structure of the Foundation. He led the decision making process that led to the Westerbork Upgrade project now in full swing, and he oversaw the internal political discussions that made it possible for the Joint Institute for VLBI in Europe to come to Dwingeloo. He has to his credit the fine new building in Dwingeloo that we now watch daily becoming a reality, as well as the integration of the university based Kapteyn Sterrenwacht Wergroep with the Dwingeloo technical laboratory. And of course Piet was centrally involved in the discussions of thelast several years concerning longterm strategic planning for the community: participation in a synthesis array telescope project at mm wavelengths, and technical development leading to a very large facility at dm to m wavelengths.

It has been a busy and fruitful eight years by anybody’s measure, Piet. As you move on to other things, let me on behalf of our whole community thank you publicly for your very effective leadership, and to wish you the best in future.

On the first of January, Ed van den Heuvel assumed Piet’s tasks and responsibilities. Ed relinquishes the chairmanship of the space research organization SRON and also that of the Netherlands Committee for Astronomy (the coordinating committee for all activities in astronomy in the country) to make time for an active role in NFRA affairs. Welcome, Ed. We look forward to many years of enjoyable collaboration in making our ambitious plans a reality.

Millimeter arrays.

During the fall, NFRA and Leiden University formally submitted a proposal to our research council, NWO, for financing to participate in the Milli-Meter Array (MMA) project of the National Radio Astronomy Observatory in the USA. We discussed the possibility of joining that project for some months with NRAO prior to formally submitting a proposal, in the end concluding that our science and the capabilities and time scale projected for the MMA are an excellent match. The refereeing and selection process at NWO should conclude in early to mid-February. Formal negotiations at research council level can begin as soon thereafter as practicable (that is, as soon as the US Congress and NSF give the go-ahead).

We are also participating with IRAM, ESO and OSO in a project to study the possibilities for a very large (five times the collecting area of the MMA) European mm-array facility at sometime in the future. At a workshop in Garching on December 13 the scientific and technical specifications were discussed, our own role centering on the correlator requirements for such an array.

VLT Instrumentation: VISIR

Our plans to participate in the instrumentation program of the ESO Very Large Telescope came together during the fall. A proposal to ESO to develop a mid-infrared imager-spectrometer for the VLT (named VISIR by the project team) by Jan Willem Pel and colleagues at CEA Service d’Astrophysique, Saclay, was approved by ESO and plans were made to start detailed design and development early in 1996. The Dutch side of the collaboration will involve technicians from the former Kapteyn Sterrenwacht Wergroep in Roden, from NFRA and from the Netherlands Institute for Nuclear and High Energy Physics (NIKHEF) in Amsterdam. We were fortunate to be able to recruit Hoite Toloma as project manager and engineer; he begins work on 1 February. Jan Willem tells much more about the project elsewhere in this Newsletter.

Square Kilometer Array Interferometer (SKA1)

During the fall, recruitment of the core team to be charged with beginning the R&D for this project took place. Felix Smits joined our staff on 1 September as project engineer, Michel Arts and Pascal van Cleef came on board on 1 November and Antony Joseph is being loaned to us from the Raman Institute in Bangalore for an extended period. Together with interested groups elsewhere this team will start studying the application of adaptive phased array techniques to radio astronomy and SKAI, and simultaneously will start setting up laboratory infrastructure for future prototyping. As noted in Newsletter Nr. 9, adaptive phased array antenna techniques promise multiple, independently and electronically steerable beams on the sky, active suppression of external interference, and elimination mechanical moving parts from future generations of radio telescopes. Cost containment by mass production of components seems achievable as well. An enormous challenge, but it feels good to be getting started!

Program Committee

Year’s end also saw a changing of the guard in the NFRA/ASTRON Program Committee. This committee referees and selects observing proposals for all telescopes operated by NFRA: the WSRT and Dwingeloo telescope, the Isaac Newton Group of optical telescopes on La Palma and the JCMT on Hawaii. Committee chairman for the last eight years has been Frank Israel. Frank has seemed a constant in the running of our program, providing informality, spontaneity and healthy scepticism to the refereeing and telescope time allocation process. On January first he passed his baton to Thjis van der Hulst. Elsewhere in this Newsletter Frank reviews and comments on his tenure as chairman. Heartfelt thanks, Frank, for the years of effective effort for the community and for your collaboration with the technical and operations teams at NFRA.

The Program Committee is soon to be confronted with exciting new observational capabilities at each of our ground-based facilities and with space VLBI via the VSOP satellite, but also a year or two of dislocation in Westerbork as we implement the new hardware and software systems. In a previous life, Thjis was telescope astronomer in Westerbork, so we look forward to his help and guidance in maximizing the science
from the facility during the upgrade and maintenance activities. Welcome aboard, Thijs.

The Committee also bids farewell to members Gerry Gilmore, Bob Sanders and Huub Röttgering. Many thanks for your participation. New members are Penny Sackett and Paul van der Werf. Welcome, Penny and Paul. Replacing Gerry Gilmore, of course, is quite impossible, but we are actively looking for a foreign astronomer to serve on the Committee. Suggestions to Thijs are welcome.

Projects and programs

Each fall, NFRA calls for research proposals from Dutch university researchers. Two sorts of proposals are considered: small scale “projects”, to be financed at the level of one PhD student or postdoc for several years, and larger “programs” involving several PhD students and postdocs for typically up to 5 years. Grants are made following a process of peer review, the committee for which this fall was chaired by Marijn Franx. Of twelve proposals for projects and two for programs, three projects and both programs were selected for funding. Penny Sackett and Jan Willem Pel will study light and color curves of galactic gravitational lens events at high time resolution, among other things to look for planets; a team led by Ger de Bruyn will develop VLBI techniques for the astrometry of pulsars; and another led by Koen Kuijken will investigate the phenomenon of warps in spiral galaxy discs, both theoretically and using new data from the WHISP survey. Tim de Zeeuw receives funding for his program to study the formation, structure and evolution of elliptical galaxies; and Michiel van de Klis and Frank Verbunt will extend their program of work on the fundamental properties of neutron stars and black holes.

Anniversary books

Finally, as mentioned last Newsletter, celebration of the Silver Jubilee of WSRT operations during the summer and fall are to result in two publications. The first is a collection of essays by senior members of our community. These essays consider the history of the telescope and the scientific accomplishments it made possible, describe the current upgrade program and its goals, and look to the future, both of the WSRT itself and of radio astronomy in general. The manuscript is with Kluwer and should appear during the spring under the title, “The Westerbork Observatory: Continuing Adventure in Radio Astronomy”.

It seems increasingly probably the main epoch of galaxy formation in the early universe can be directly observed, given the right techniques and right instruments. Another event in the Westerbork anniversary celebrations was the workshop “Cold Gas at High Redshift” held in the village of Hoogeveen on 28 - 30 August 1995. Seventy-nine astronomers from 9 countries came to exchange ideas and new results in the field. The proceedings of the workshop are also being published by Kluwer, and with a bit of luck will also appear during the spring.

---

New spectral windows for the WSRT

**Ger de Bruyn**

**Introduction**

At the end of 1996 the WSRT will be outfitted with 14 new Multi-Frequency Front Ends (MFFE’s) described in previous Newsletters (see e.g. the articles by G.H. Tan in Newsletter Issue 7, August 1994 and Issue 9, August 1995). The upgrade will proceed in a number of stages spread over a period of about 1-1.5 years. In the first phase of this upgrade the MFFE’s will be equipped with two receivers covering the frequency ranges from about 260-450 MHz (the so-called UHF-high window) and from 700-1200 MHz (the UHF-high window). This is the first time that such wideband low frequency tunable receivers are being offered on an interferometric array.

In addition to the installation of these new receivers we also hope to make a start with the commissioning of the first module of the new WSRT backend, the DZB. It may, however, not be available for use until the beginning of 1997.

The prototype of the UHF receivers was tested extensively on a single telescope of the WSRT in the summer of 1994 and found to be behaving as expected (although several important modifications are being made in the series production). Commissioning tests in an interferometric mode will begin in October 1996 and it is hoped that soon thereafter regular astronomical observations with these receivers can commence.

Proposals to use these receivers are welcome and should be received before the March 15, 1996 deadline (see the announcement elsewhere in this Newsletter). Proposals that are well-suited to test the performance of these systems and which may be useful in helping to debug the hardware and software may be given priority in the scheduling if the proposers are prepared to carry out such tasks immediately following the observations.

Below we will describe some of the properties of the UHF receivers and the backend(s) and provide you with an estimate of the sensitivity that can be expected.

**Frontends**

The new UHF receivers were designed primarily for redshifted 21 cm or OH line work although they can also be used for continuum work, for example for pulsars or polarization studies. The off-axis polarization performance of these wideband
receivers may, however, seriously limit the quality of wide-field continuum and polarization work. The frequency range over which the receivers can be tuned runs from approximately 260-450 MHz for the UHF-low receivers and 700-1200 MHz for the UHF-high receivers. The performance at the edges of these bands is still poorly known. In the future the user will have a choice between two IF-bands: a narrow band of 10 MHz to be used for targeted studies or for studies in hostile EMI environments, and a wide band of 80 MHz, useful for (blind) survey work. In the first stage, now opened for proposals, only the 10 MHz option is available because of the available IF and correlator systems (see below).

Since the receivers operate well outside the bands allocated to radioastronomy problems may be expected due to both external and internal interference. The external interference, however, has a dynamic character and we have good hopes that a large fraction of the bands covered by these receivers will be useful at least part of the time. It is obvious that certain parts of these bands are relatively clean while other parts are almost useless for astronomical observing. For example, the frequency range from 935 to 960 MHz, allocated to mobile telephone communication, is probably useless nearly all the time. The region from 700-800 MHz is also known to be much poorer than the region from 800-1000 MHz. Not much is known about the upper range from 1000-1200 MHz. For specific information about the interference conditions at frequencies within these bands users may contact Dr. Titus Spoelstra (spoelstra@ntra.nl).

Laboratory tests with the prototype receivers indicate that system temperatures should be around 80-100 K in the UHF-high band and about 150-250 K in the UHF-low band with the lower values at the upper side of the respective bands. The large increase at the lowest frequencies of the UHF-low band is due to the rapidly increasing galactic background. In the galactic plane these values will therefore be substantially higher.

The feed systems of these receivers are somewhat unconventional with a pair of folded dipoles for each of the two orthogonal polarizations. The primary beam patterns are therefore different from the nearly Gaussian beam derived for the normal WSRT feed systems.

**Backend specifications**

The main use of the new UHF receivers will be for spectral line work (21 cm line, OH-line or recombination lines). The current line backend (the DLB) will be available, as well the continuum backend (DCB). The DLB has a limited number of channels (2560 complex channels), but when narrower bands are used recirculation (via the DXB) can be used to increase the number of complex channels of a factor 10/B, where B is the bandwidth in MHz. The maximum number of channels is limited to 40000 channels.

However, it is expected that sometime towards the end of the first astronomical observing session with the UHF-receivers the first module of the new WSRT backend (the DZB) will become available.

The DZB has a total of 32768 complex channels, which is more than an order of magnitude larger than that offered by the DLB for the same bandwidth of 10 MHz and will eventually be the preferred backend for use with the UHF-systems. The maximum bandwidth of the DZB will initially be limited to 10 MHz, just as the DLB, by the available IF-system. Filters to select narrower bands in steps of a factor 2 down to 156 kHz will be offered. When distributed over 2 polarizations and 91 IFRS the DZB will offer a spectral resolution of 10/128 = 78 kHz. At 1000 MHz this corresponds to a velocity resolution of 28 km/sec with uniform taper. If all cross-correlations are required for polarimetry this will be a factor two less.

The DZB too will have to go through an extensive commissioning phase which will overlap with the commissioning of the UHF receivers. Proposals that require the DZB may therefore be deferred to later in the session and run the risk of not being observed until sometime in 1997.

For those experiments where a much higher spectral resolution (down to 1 km/sec) over a large bandwidth is required the *Compound Interferometer* mode can be used. For more details we refer to a companion article elsewhere in this Newsletter.

**Sensitivity**

For observations with the channel-limited DLB with 10 MHz bandwidth the noise levels in a 1 x 12 hour continuum synthesis in the UHF-high band will be about 0.20 mJy. For line work with 32 channels spread over 10 MHz the noise level per channel will be about 5 times higher, i.e. 1.0 mJy. For the UHF-low band these values will be larger by a factor 2-3 depending on the frequency.

Because of the much larger number of channels offered by the DZB its sensitivity will be about a factor 2 better (due to both 2-bit correlation and the possibility to record all 91 IFRS rather than the standard 40). In addition, the DZB will offer better spectral resolution. So for 128 channels across 10 MHz the DZB will yield a sensitivity of about 1.0 mJy per spectral channel.

**Proposals, reduction and calibration aspects**

In the course of this year a series of documents will be released on various aspects of the observational setup, data reduction and calibration procedures. Interested users with questions about the use of the low frequency systems on the WSRT should check the WWW page of the NIFRA for more details on where and when these documents are available or contact the author directly.
Electronic submission of WSRT proposals - a forward look

Marco de Vos

Years ago the SCASIS team was granted a Long Term Status for observations on the William Herschel Telescope. I still vividly remember the enormous relief I felt when the news reached me. This was not so much due to the amount of time allocated - it wasn’t that much after all - but merely because it would save me from meeting PATT-deadlines for the next two years. Proposals on paper usually have to leave your hands two days before the deadline. An electronic proposal could be mailed two minutes in advance. This may well be a major drive behind the general call for electronic submission of observing proposals...

The context
WSRT users and especially the new chairman of the Program Committee have been asking for the option to submit proposals for WSRT observations electronically. So we started working on it. Proposals for observations usually have two aspects. The first is what I will call the "scientific proposal". Here you try to convince your fellow astronomers in the PC that your proposal is worthwhile. The second aspect is the "technical specification", in which you try to convince the facilities staff that your proposal is technically feasible. There is not much discussion about the scientific proposal. It should be stated in terms of scientific goals, a justification, references to earlier work etc. For the technical specification the situation is less clear. For many institutes, in particular for optical telescopes, it may be sufficient to state what instrument and detector you want to use. You fill in the details when you arrive at the telescope site to do the observations. For the WSRT we need to know a lot more, since observations are done in service mode. In the end we need to know every detail about the instrumental setup. Of course not all of this is needed before the PC meeting, but some of the information is essential in verifying the technical feasibility.

Scientific proposal by e-mail
Given this situation, how should we implement electronic submission of proposals for the WSRT? Proposals for PATT and ESO are made by writing a LaTeX document using a macro package supplied by PATT or ESO. Such a document will be the basis for electronic submission of WSRT proposals as well - we like to be a unique facility, but preferably not in this kind of details. You will have to get a LaTeX style file and a template proposal from our ftp-server or from the WWW. In the template you fill in all kinds of categories, like scientific goal and justification. Then you send in the proposal by e-mail. You will receive notification that the proposal has been accepted for submission. It may be rejected, e.g. when you did not fill in your name or the scientific justification. Both the PC chairman and WSRT staff will be informed about your proposal. WSRT staff will check its technical feasibility. We may come back to you with more detailed questions. The final technical assessment will be reported to the PC chairman. This report and the assessments from the referees serve as an input for the PC meeting. The e-mailed document covers all of the scientific proposal and part of the technical proposal. As I mentioned before, service mode observations require a complete specification in advance. Up till now, the detailed technical specification was sent in on the so-called "Project Information Sheet." The current sheet is long outdated, and we did not want to make a revised version of it on paper. To put the detailed specification in a LaTeX document would be highly inefficient. Detailed specifications of WSRT observations should be handled interactively. Only then we can supply context sensitive help and fast feedback on inconsistencies. Enter Scissor.

Technical specification through Scissor
When your eMailed LaTeX document is accepted for submission, part of its contents will be extracted into the Scissor database. These parts are typically concerned with the technical specification. They serve as a starting point for the detailed specification. Again, we do not want to have all those details in the LaTeX document since this would become impossible to read, and would also need to be updated for each new observing mode. Scissor will create an (incomplete) WSRT observing project for your proposal, with status set to submitted. The reply you receive on your mail message will contain the proposal number as Scissor knows it, together with access information, say a Project Information Number. The access information will allow you (and only you) to add details to the specification. You can do so with any WWW browser that supports HTML forms (typically Netscape). Just go to the appropriate Scissor page, enter the proposal number and your PIN code and off you go. By the way: you will not be able to change things like the scientific justification. You’re supposed to have that in perfect state before submission...

The WWW interface will guide you through a hierarchy of screens asking for simple things like source positions and frequencies. Eventually you may get to more obscure items like back-end modes or mosaic patterns. The whole idea behind this is that you are not bothered by things that are not relevant to you (though I’m pretty sure that we won’t reach that goal in the first release). The WWW interface can also be used to get an idea of the possibilities of the WSRT by entering "dummy" proposals. You can do this now already, by getting to the Scissor homepage (http://www.nfra.nl/scissor) and clicking on the link to "Submission of proposals." The version of the forms behind that link is under development, but it gives a basic idea.

Timescales for release
To summarize, electronic submission of WSRT proposals will have two components: - A LaTeX document submitted by e-mail, containing the information needed by the referees and the PC meeting. - A WWW facility for the detailed specification needed by the WSRT staff.
Most of the implementation for all this is done by Henk Vosmeijer. We plan to have a beta-release ready next month. We will invite some specific users to evaluate this release for the coming PC deadline. The production release will be made after the PC meeting, and from then on electronic submission will become the standard approach.

Parallel to all this, we are making minor modifications to Scissor. Do not hesitate to bother us with requests or complaints. You should expect some delay in the handling of requests. This is due to our activities for electronic submission, which has now the highest priority. After all we need to have the thing ready well before the second PC meeting this year. Yet another PC deadline to meet...

VISIR

Jan Willem Pel

A few months ago the ESO Finance Committee gave the green light for the VLT-instrument "VISIR", with a total budget of MDM 5.5. It is expected that the final details of the contract between ESO and the VISIR consortium can be settled within weeks. This means that the rather long preliminary design phase of VISIR has now ended and that at the beginning of this new year the project has entered "Phase B".

VISIR is the name of the instrument for "VLT Imaging and Spectroscopy in the mid-InfraRed". In the coming 4.5 years, VISIR will be built for the second VLT 8-meter telescope by a French-Dutch consortium consisting of "Service d'Astrophysique" (SAP, part of CEA/DAPNIA at Saclay, France) and the NFRA. This very ambitious instrument will provide exiting new observing facilities in the infrared atmospheric windows at wavelengths of 7.5-14 and 16-28 microns.

Main characteristics of the instrument

VISIR will provide diffraction-limited imaging and spectroscopy in both the "N" (7.5-14 microns) and the "Q"-band (16-28 microns) at the Cassegrain focus of the second 8-meter telescope of the VLT. The VISIR design consists of two optical sub-systems, one for a camera with variable image scale and one for a spectrometer with a wide range of spectroscopic resolutions. The figure gives a schematic 3-D view of the optical layout according to the preliminary "Phase-A" design. It should be noted that details of this layout are likely to change during the final design phase.

Schematic 3-D view of the optical layout of VISIR. Only the main optical elements have been indicated. The distance from A1/A3 to B1/B3 is about 90 cm.

W ........ cryostat entrance window
S ........ spectrometer entrance slit
A1-A2-A3 .... 3-mirror collimator/camera for the high
.............. resolution spectrometer arm
E ........ duo-echelle grating
B1-B2-B3 .... 3-mirror collimator/camera for the low/medium
.............. resolution spectrometer arm

G ........ low/medium resolution grating
SD ......... spectrometer detector
L1 .......... collimator lens wheel
FW .......... filter wheel
L2 .......... camera lens wheel
CD .......... camera detector
The camera, which will be built by the French group, is based on an array detector of 512x512 50-micron pixels. Three sets of refractive imaging optics provide image scales of 1.5, 2.5 and 4.0 arcseconds per millimeter, corresponding to field diameters of 38, 64 and 80 arcseconds. A filterwheel with many (30) filter positions offers maximum filtering flexibility.

The Dutch contribution to VISIR consists of the spectrometer sub-system, which is in fact a dual spectrograph, with one arm for the low- and medium- resolution modes and one for high resolutions. The low/medium-resolution system provides spectroscopic resolutions of from 150 to 10000 in the N-band and 1000-2000 in the Q-band. In the high-resolution arm two large echelle gratings, mounted back-to-back, are used to achieve R-values of 20,000-30,000 in the N-band and about 10,000 in the Q-band with the highest possible efficiency. All spectroscopic options can be used in "long-slit" mode, with slit lengths of up to 40 arcseconds.

Apart from the unavoidable filters, all spectrometer optics is fully reflective. This is not only an advantage in view of throughput, image contrast and spectral purity, but it also allows to do the complex optical alignment with visible light. Both spectrometer arms use the same detector, which again is a 512x512 50-micron pixels array.

An important consequence of the excellent seeing conditions on Cerro Paranal is the fact that, apart from image motions, the performance of the 8-meter mirrors will be diffraction-limited at wavelengths of ten microns and longer. Since the VLT secondary mirrors are designed to provide "tip-tilt" corrections to "freeze" the image motions. Therefore, most of the nights we can expect the VLT telescopes to be fully diffraction limited in the infrared. For this reason VISIR has been designed such that diffraction-limited performance is preserved throughout, both in imaging and in spectroscopy. Obviously this very high spatial resolution (the VLT Rayleigh limit at 10 microns is 0.3 arcsecond !) is a very important factor in the overall "figure of merit" of the VLT-VISIR combination.

The instrumental properties of VISIR, in combination with the VLT, the superb atmospheric conditions on Paranal and the new infrared array detectors that are becoming available right now will allow a big step forward in a wavelength domain that has hardly been explored so far. The 20-micron window in particular, which is accessible only from exceedingly dry mountaintops like Paranal, is mostly new territory. The basic VISIR design that has been developed during the past 1.5 years of Phase-A design study puts VISIR in an excellent position in comparison to similar instruments that are under way for other big telescopes. It also makes VISIR the ideal follow-up instrument for the ISO infrared satellite which has just had its very successful launch.

Some practical details
As is usual for VLT instrumentation which is developed by astronomical institutes in the ESO memberstates, the VISIR budget covers only the cost of components plus at most a small amount of externally contracted labour. The manpower contribution by the instrument-team, in the case of VISIR some 105 man-years in total, is rewarded by ESO in the form of guaranteed observing time after completion of the project.

Within the VISIR consortium the division of tasks is roughly as follows. About two-thirds of the project will be provided by Service d’ Astrophysique. This covers the camera subsystem, detectors, electronics, software, the cryostat with all cryogenic and vacuum equipment and the overall project management and documentation. This considerable task, to be delivered by a group of about 15 persons, involves a manpower effort of about 70 man-years and MDM 3.7 of the instrument budget. Responsible for the VISIR project management are: Pierre Olivier Lagage (principal investigator), Yvon Rio (project manager), Gilles Durand (system engineer).

The NFRA is responsible for the spectrometer section of VISIR, corresponding to a manpower effort of about 36 man-years and MDM 1.8 of the VISIR budget. The Dutch contribution will be mostly in the opto-mechanical area, with relatively minor electronics and software components. Key-persons on the Dutch side are Jan Willem Pel (co-PI), Hoite Tolsma (spectrometer project manager), Rens Waters (chairman Dutch VISIR science team), Thijis de Graauw (calibration scientist).

The main VISIR milestones are planned as follows:


This means that the entire project has to be completed within only 4.5 years from now! The Dutch VISIR contribution was originally planned on the basis of the capacity of the Kapteyn Observatory Working group in Roden. It turns out, however, that even after the integration of the KSW with the NFRA it will be impossible for the NFRA to complete the project within this very short time without external help. Arrangements have therefore been made to sub-contract some VISIR work-packages to SRON-Groningen and to NIKHEF at Amsterdam. Thanks to the contacts with NIKHEF it has also been possible to find an excellent candidate for the position of Dutch VISIR project manager in the person of Hoite Tolsma. Hoite is presently still working as technical physicist at NIKHEF, but he has been appointed on the VISIR project by the NFRA starting February 1996. With these reinforcements of the Dutch VISIR team it should be possible to bring this challenging project to a successful completion.
## Allocations PC 95-02

### New WSRT Allocations Period January 1996 - June 1996

<table>
<thead>
<tr>
<th>WSRT No.</th>
<th>First proposer</th>
<th>Subject</th>
<th>Wavelength (cm)</th>
<th>Time allocated (hours)</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>WENSS</td>
<td>de Bruyn</td>
<td>Sky Survey</td>
<td>92</td>
<td>18x12</td>
<td>I</td>
</tr>
<tr>
<td>WHISP</td>
<td>van Albada</td>
<td>Spiral Galaxy Survey</td>
<td>21L</td>
<td>25x12</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25x12</td>
<td>II</td>
</tr>
<tr>
<td>W1140.1</td>
<td>Hanlon</td>
<td>Gamma Ray Bursters (if burst only)</td>
<td>any</td>
<td>80</td>
<td>I</td>
</tr>
<tr>
<td>W1207</td>
<td>Konovalenko</td>
<td>Radio Recombination Lines</td>
<td>21</td>
<td>4x12</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>92</td>
<td>defer</td>
<td></td>
</tr>
<tr>
<td>W1208</td>
<td>Deich</td>
<td>Pulsar Polarization</td>
<td>92L</td>
<td>6x12</td>
<td>II</td>
</tr>
<tr>
<td>W1209</td>
<td>de Bruyn</td>
<td>Galactic Foreground</td>
<td>92</td>
<td>6x12</td>
<td>I</td>
</tr>
<tr>
<td>W1210</td>
<td>Spoelstra</td>
<td>Galactic Continuum</td>
<td>92</td>
<td>6x12</td>
<td>II</td>
</tr>
<tr>
<td>W1174.2</td>
<td>van der Hucht</td>
<td>Cyg OB2</td>
<td>21</td>
<td>6x12</td>
<td>II</td>
</tr>
<tr>
<td>W1211</td>
<td>Verheijen</td>
<td>NGC 3998</td>
<td>21</td>
<td>4x12</td>
<td>I</td>
</tr>
<tr>
<td>W1212</td>
<td>Koopmans</td>
<td>Gravitational Lenses</td>
<td>21</td>
<td>4x6 + F</td>
<td>II</td>
</tr>
<tr>
<td>W1213</td>
<td>Voûte</td>
<td>Pulses B1937+2A</td>
<td>49</td>
<td>12</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>92L</td>
<td>12</td>
<td>II</td>
</tr>
<tr>
<td>W1172.1</td>
<td>Chengalur</td>
<td>High-z Absorption</td>
<td>92L</td>
<td>2x12</td>
<td>I</td>
</tr>
<tr>
<td>W1172.2</td>
<td>Chengalur</td>
<td>High-z Absorption</td>
<td>92L</td>
<td>5x4</td>
<td>II</td>
</tr>
<tr>
<td>W1197.1</td>
<td>Schoenmakers</td>
<td>Giant Radio Galaxies</td>
<td>21</td>
<td>20x1</td>
<td>I</td>
</tr>
<tr>
<td>W1214</td>
<td>van Paradijs</td>
<td>Sco X-1</td>
<td>92</td>
<td>1x8</td>
<td>II</td>
</tr>
<tr>
<td>W1043</td>
<td>van der Hucht</td>
<td>WR Monitor</td>
<td>any</td>
<td>pm</td>
<td>F</td>
</tr>
<tr>
<td>W1140.2</td>
<td>Hanlon</td>
<td>GRB 94031</td>
<td>92, 21</td>
<td>pm</td>
<td>F</td>
</tr>
<tr>
<td>W1185.2</td>
<td>Pogrebenko</td>
<td>QSO 2022+1708</td>
<td>21</td>
<td>pm</td>
<td>F</td>
</tr>
</tbody>
</table>

Note: allocated in priority 1: 54 %; in priority 2: 42 %. Oversubscription rate: 115/92 = 1.25

### JCMT Allocations February 1996 - July 1996

<table>
<thead>
<tr>
<th>JCMT No.</th>
<th>First proposer</th>
<th>Subject</th>
<th>Receiver</th>
<th>Time allocated (8 hr shifts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N01</td>
<td>van Dishoeck</td>
<td>Starforming regions</td>
<td>C/B/A</td>
<td>10</td>
</tr>
<tr>
<td>N02</td>
<td>Israel</td>
<td>Cl and CO galaxy centres</td>
<td>C/B</td>
<td>6</td>
</tr>
<tr>
<td>N04</td>
<td>Israel</td>
<td>CO M33 disk</td>
<td>A</td>
<td>4</td>
</tr>
<tr>
<td>N05</td>
<td>Boogert</td>
<td>Icy YSO's</td>
<td>C/B/A</td>
<td>8</td>
</tr>
<tr>
<td>N06</td>
<td>Waters</td>
<td>Post AGB stars</td>
<td>C/B/A</td>
<td>6 with N07</td>
</tr>
<tr>
<td>N07</td>
<td>de Jong</td>
<td>IRC+10216</td>
<td>C</td>
<td>1 with N06</td>
</tr>
<tr>
<td>N08</td>
<td>Burton</td>
<td>CO(3-2) Cen A</td>
<td>B</td>
<td>4x0.5</td>
</tr>
<tr>
<td>N09</td>
<td>Israel</td>
<td>CO(3-2) dwarf galaxies</td>
<td>B</td>
<td>4</td>
</tr>
<tr>
<td>N10</td>
<td>Wesselius</td>
<td>Cl in L183</td>
<td>C</td>
<td>1</td>
</tr>
<tr>
<td>N12</td>
<td>Stark</td>
<td>Cl in protoplanetaries</td>
<td>C</td>
<td>2</td>
</tr>
<tr>
<td>N13</td>
<td>Waters</td>
<td>Variability Be stars</td>
<td>U</td>
<td>(2)</td>
</tr>
</tbody>
</table>

Note: NL JCMT Oversubscription rate: 99/46 = 2.2. In semester 96A we expect commissioning of the new receivers B3 (replacing B3i), W (replacing receiver C2) and SCUBA (replacing UKT14). Proposals allocated to receivers B3i and C2 will be carried out on the new receivers if these are available. No observing will be carried out with SCUBA in semester 96A. However, we expect restricted shared-risk observing to be offered in semester 96B. Most likely, SCUBA requests for semester 96B will be invited with a separate deadline, probably around August 1996. Interested members of the community are advised to add their name to the address list of the JCMT e-mail exploder (contact Graeme Watt (gdw) or Remo Tilanus (rpt) at jach.hawaii.edu).
WHT Allocations February 1996 - July 1996

<table>
<thead>
<tr>
<th>WHT No.</th>
<th>First proposer</th>
<th>Subject</th>
<th>Time allocated</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>N01</td>
<td>van de Weygaert</td>
<td>Coma cluster infall</td>
<td>1D+1G</td>
<td></td>
</tr>
<tr>
<td>N02</td>
<td>Franx</td>
<td>Galaxy evolution</td>
<td>3D</td>
<td></td>
</tr>
<tr>
<td>N03</td>
<td>Smette</td>
<td>High-z quasars</td>
<td>2G</td>
<td></td>
</tr>
<tr>
<td>N04</td>
<td>Röttgering</td>
<td>High-z galaxies search</td>
<td>2D</td>
<td></td>
</tr>
<tr>
<td>N10</td>
<td>Briggs</td>
<td>Damped Ly-α system</td>
<td>2G</td>
<td></td>
</tr>
<tr>
<td>N12</td>
<td>van Woerden</td>
<td>HVC distances</td>
<td>2B</td>
<td></td>
</tr>
<tr>
<td>N13</td>
<td>Oudmaijer</td>
<td>IC+10240</td>
<td>1.5B</td>
<td>3x0.5 service</td>
</tr>
<tr>
<td>N14</td>
<td>Jaffe</td>
<td>H2 in cooling flows</td>
<td>2B</td>
<td></td>
</tr>
<tr>
<td>N15</td>
<td>Verbunt</td>
<td>Binary circulization</td>
<td>1B</td>
<td></td>
</tr>
<tr>
<td>N16</td>
<td>van Paradijs</td>
<td>Dwarf novae</td>
<td>2B</td>
<td></td>
</tr>
<tr>
<td>N17</td>
<td>Rutten</td>
<td>AM CVn</td>
<td>1G</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>7D + 6G + 8B</td>
<td></td>
</tr>
</tbody>
</table>

Note: Oversubscription rates: D: 19/7 = 2.7; G: 14/5 = 2.8; B: 13/8.5 = 1.5; Overall: 46/20.5 = 2.2

INT Allocations February 1996 - July 1996

<table>
<thead>
<tr>
<th>INT No.</th>
<th>First proposer</th>
<th>Subject</th>
<th>Time allocated</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>N02</td>
<td>Balcells</td>
<td>WHISP galaxies</td>
<td>6D</td>
<td>Final allocation</td>
</tr>
<tr>
<td>N06</td>
<td>Sprayberry</td>
<td>HI galaxies</td>
<td>2D</td>
<td></td>
</tr>
<tr>
<td>N09</td>
<td>Groot</td>
<td>Accretion disks</td>
<td>3G + 3B</td>
<td></td>
</tr>
<tr>
<td>N11</td>
<td>Schoenmakers</td>
<td>Giant radio galaxies</td>
<td>4G</td>
<td></td>
</tr>
<tr>
<td>N12</td>
<td>Lepoole</td>
<td>Pulsations early type stars</td>
<td>8B</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>8D + 6G + 11B</td>
<td></td>
</tr>
</tbody>
</table>

Note: Oversubscription rates: D: 23/8 = 2.9; G: 27/7 = 3.9; B: 6/11 = 0.6; Overall: 56/26 = 2.2

JKT Allocations February 1996 - July 1996

<table>
<thead>
<tr>
<th>JKT No.</th>
<th>First proposer</th>
<th>Subject</th>
<th>Time allocated</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>N01</td>
<td>van Paradijs</td>
<td>Cataclysmic variables</td>
<td>6D</td>
<td></td>
</tr>
<tr>
<td>N02</td>
<td>Schoenmakers</td>
<td>High-z radio galaxies</td>
<td>4D</td>
<td></td>
</tr>
<tr>
<td>N03</td>
<td>Dieters</td>
<td>Black hole candidates</td>
<td>4G</td>
<td></td>
</tr>
<tr>
<td>N04</td>
<td>Jaffe</td>
<td>Educational images</td>
<td>2G + 1B</td>
<td></td>
</tr>
<tr>
<td>N05</td>
<td>Lepoole</td>
<td>Hipparcos binaries</td>
<td>9B</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>10D + 6G + 10B</td>
<td></td>
</tr>
</tbody>
</table>

Note: Oversubscription rates: D: 14/10 = 1.4; G: 18/6 = 3.0; B: 10/10 = 1.0; Overall: 42/26 = 1.6

New proposals for the WSRT, ING and JCMT should be received before noon 15 March 1996 at the address below.
Dr. J.M. van der Hulst, PC-Chairman
Kapteyn Laboratorium
P.O. Box 800
9700 AV Groningen
The Netherlands
Looking Back on the NFRA Program Committee 1988 - 1995

Frank Israel, Sterrewacht Leiden

Early 1987 I became a member of the WSRT program committee, which was then chaired by P.C. van der Kruit. Very soon, after a PC chairmanship of just over a year, Van der Kruit succeeded Van der Laan as chairman of the NFRA, and I was asked to take his place as PC chairman. Now, eight years later my term as PC chairman has come to an end. This is a long time, but the record is held by H. van Woerden (69-74; 76-79). From the first of January, J.M. van der Hulst has taken over the chair, which thus has again returned to Groningen.

When I started, the PC allocated time on the WSRT only, although we occasionally had also requests for time on the Dwingeloo 25 m telescope, usually for prolonged periods. PC meetings were held at irregular intervals, often three times a year, depending on proposal pressure, and changes of telescope operating frequency etc. Each meeting generally dealt with 25 - 35 proposals. Quite a large number of people used to attend the PC meetings: in addition to regular members, several NFRA experts would take part, so that it was not unusual to find a dozen of us huddled together in the Dwingeloo meeting room.

It is perhaps in the human nature to become dissatisfied with the way things are done, and attempt to change it. Not being an exception, I changed the order of discussion of proposals starting with PC 89-3. We had a natural tendency among us to spend more time discussing a proposal the earlier in the meeting it was; by the time the afternoon was coming to an end everyone would become progressively more tired and more hurried in the discussion regardless of the size of the request. It therefore made sense to start with the largest requests and work our way down to the more modest proposals. Although all proposals were and are considered carefully, it is certainly true that large requests are judged more critically than smaller ones, asking for only 12 hours or less.

By 1990, WSRT proposal pressure had slowly dropped to about 15 - 20 proposals per meeting. This caused a shift in PC attitude. Without sacrificing the quality standards that proposals had to meet, the PC became more willing to grant relatively large blocks of WSRT time to excellent requests, especially in areas where the WSRT was internationally strong. The first to take advantage of this new policy were A.G. de Bruyn (Dwingeloo) and G.K. Miley (Leiden) who proposed to produce a catalogue of radio sources over a period of 3 - 4 years containing several hundred thousand entries. They aimed for a very large sky coverage at 92 cm, and a somewhat more limited coverage at 49 cm to obtain spectral information. Although the proposal for a Westerbork Northern Sky Survey (WENSS) was well received, the PC did balk at the idea of allocating in effect fully half of the available WSRT time to a single project, and concluded that it had to proceed at a somewhat slower pace than envisioned by its proposers. Nevertheless, the first WENSS allocation (PC 90-2) was 63 full days on the WSRT! The fact that initially at least scheduling of WENSS observations could take place extremely efficiently was a great help. As it turned out, in the years after, the WENSS project obtained on average about a third of the available time. At the time of writing, the 92 cm survey is practically finished, but the 49 cm survey has fallen to a clear second place, and will probably not be completed to the level originally planned.

At the end of 1991 it became clear that there was no longer a need for more than two PC meetings per year, and we decided that, starting in 1992, it would operate with fixed deadlines at March 15 and September 15. In order to maintain flexibility, the standing policy of accepting small (generally 12 hours or less) requests at the discretion of the chairman was reiterated.

A look through the meeting reports brings a few other developments to light. The PC 92-1 report notes that Kolkman (Groningen) is working full time on the new WSRT manual, which was in fact long overdue. The PC stressed the need for support of novice WSRT observers; indeed the NFRA observing group has since initiated a user service program, notwithstanding the grumblings of some old Westerbork hands that an observer not fully familiar with the WSRT and its observing techniques was not worthy of getting time allocated ... It was also decided that there was no real need to have several experts in attendance at each meeting, and that the normal procedure henceforth would be to have only the NFRA head of observing present. This procedure has indeed worked very well, thanks to the efforts of T. Spoolstra to keep the PC fully informed of all relevant information.

Two complaints occur with some regularity in the meeting reports. Many proposers apparently only start writing their proposal at the deadline, instead of before. Although explanations for late submission often are extremely compelling and sometimes very creative, the practice results in quite a lot of extra work for the PC and is viewed without pleasure. Not only proposers are noted to be at fault: a similar complaint is heard with some regularity about PC members who return their proposal assessments well beyond the assigned date, sometimes as late as the day of the meeting.

Another important event took place in 1992, PC meeting 92-2, for the first time in its history, not only allocated time on the WSRT, but also on the JCMT. Till that date, Dutch JCMT time had been decided upon by the UK JCMT Time Allocation Group, part of the (then SERC) Panel for the Allocation of Telescope Time. To this end, a Dutch member was nominated to the JCMT TAG. The TAG considered all UK, Canadian and Dutch proposals. For several years, unease about this procedure had been growing. The need to look at all proposals placed a heavy burden on the TAG members (120 proposals per meeting!). In addition, some friction was clearly present caused by differences in appreciation of the scientific value of various projects along national lines. Also, continuity of effort, especially desired for Ph.D. related research, was difficult to guarantee. For years, I had been in favour of having our own PC handle all Dutch telescope time. After all, we had almost two decades of experience in handling requests for time on a world-class facility. Not everyone agreed, but gradually support for this idea grew especially when the Canadians started
developing similar notions. It was finally agreed to let the three parties involved in the JCMT make their own provisional allocations, and charge an International Time Allocation Committee (ITAC) with coordinating the final allocation. Although labeled an experiment for only a year, the procedure turned out to be so satisfying to all three parties involved that it smoothly became SOP. The addition of JCMT to WSRT proposals brought the workload of the PC back to the level of five years earlier: typically 30 proposals per semester.

Although I had wanted to include time on the optical telescopes on La Palma as well in this arrangement, at the time this was clearly a bridge too far. The success of the JCMT arrangement, however, soon convinced most sceptics that a similar procedure might work as well for the optical telescopes, and in 1994 we could also include the Dutch requests for time on the William Herschel Telescope, the Isaac Newton Telescope and the Jacobus Kapteyn Telescope on La Palma in the workings of the PC. This doubled once more our workload, to about 65 proposals per meeting. It took a while to hit our stride, but now the PC efficiently deals with the whole load in a day. A factor of great help in this is that many Dutch astronomers started out as radio astronomers have over the years broadened their observational interests to include optical and infrared astronomy, and so are almost equally at ease with WSRT or La Palma proposals.

After each deadline, the proposals are administrated and sent out to the PC members; each proposal is assessed by two PC members. Copies are also sent to the respective observatories for technical assessment. In addition, all members send in a rating for all proposals. The assessment reports are distributed to all members. The PC chairman uses the assessments and the ratings to draw up a provisional allocation which is the basis for discussions at the meeting. If necessary, proposers are contacted for clarification of issues arising during this process. After the meeting, WSRT allocations are final, but allocations on the JCMT and the La Palma telescopes are provisional, pending approval on the PATT meeting which usually takes place in early June and early December. Especially the optical allocations require at times a complicated give and take with our British colleagues, because of constraints imposed by right ascension, instrument schedules and phase of the Moon. Here, I must acknowledge the excellent performance of H. Henrichs, who has been representing PC interests at the PATT ING TAG since we started allocating optical time, and who has been instrumental in making it a success.

Returning to the WSRT, a second major project was accepted in 1992: proposed by a Groningen team led by T.S. van Albada, the Westerbork HI Survey of Spiral Galaxies (WHISP) has the ambitious goal of obtaining HI data cubes of 500 - 1000 northern galaxies. This will result in a catalogue of HI distributions and velocity field which will serve as a basis for research in areas such as dark haloes and the effects of environment on structure and growth of HI disks and galaxy distances. Block scheduling was very efficient initially, but the pace has slackened because of the inhomogeneous distribution of galaxies in right ascension. Nevertheless, data cubes on several hundred galaxies have already been obtained, and the reader of the Newsletter will certainly hear more about this project in the future. Like WENSS, WHISP on average uses about a third of the available WSRT time.

What can we expect for the future? In addition to WENSS and WHISP results becoming available, the pulsar backend on the WSRT is expected to yield exciting new data in a field rather new to Dutch observational astronomy. The WSRT has reached the venerable age of 25 years and is undergoing a major upgrade, both as regards its mechanical aspects as well as its frontends and backend. The new multifrequency frontends are expected to become available in the near future, and will give the telescope a renewed lease on life. The JCMT will be equipped with new, extremely sensitive receivers which likewise await commissioning in the near future. In particular, we should mention the SCUBA array which will revolutionize millimeter continuum astronomy. On the optical telescopes, several excellent instruments are already available. Without intending to shortchange anybody, I would like to single out the Utrecht Echelle Spectrometer (UES) which was constructed wholly in the Netherlands, and which is one of the most popular instruments on the WHT.

Thus, it can be seen that in the coming years, the PC will continue to have the difficult, but pleasant task to select the very best proposals from a plethora of exciting science programs covering almost the full range of astronomical research. With available time routinely oversubscribed by factors of 2 - 3, the Dutch astronomical community continues to prove its vigour. For me, the equally pleasant task remains to thank all PC members and telescope secretaries for a very constructive and productive collaboration, and to wish my successor all the best in his by no means easy but gratifying duties.

New proposals for the WSRT, ING and JCMT should be received before noon 15 March 1996 at the address below.

Dr. J.M. van der Hulst, PC-Chairman
Kapteyn Laboratorium
P.O. Box 800
9700 AV Groningen
The Netherlands
The WSRT Compound Interferometer Mode

Jayaram Chengalur and Ger de Bruyn

The WSRT Compound Interferometer (CI) mode is a new mode primarily intended for astronomical studies for which (i) a large instantaneous bandwidth is required, (ii) a large number of spectral channels are required and (iii) the source of interest is not resolved by the WSRT synthesized beam.

The mode works running the output of the WSRT configured as a phased array (or two phased subarrays) into the digital line backend (DLB/DXB). In order to reduce interference sensitivity and to eliminate the need of total power calibrations it is advantageous to form not just one phased array but two phased subarrays and cross correlate the signal from the subarrays instead. For such a setup the largest instantaneous bandwidth is 40 MHz, (in 4 bands of 10 MHz each) the maximum number of spectral channels is 4096 in each of two (linear or circular) polarizations.

The formation of the phased array is done in the digital continuum backend, leading to the signal being quantized twice (once for the phasing process, and then again for the digital correlation), leading to a loss in sensitivity. Hence the CI mode is advantageous only in situations where high spectral resolution and/or large instantaneous bandwidth is truly essential, and will become less important when the new multichannel correlator (DZB) becomes available.

For reduction, the CI data can be ported into Analyz (the Arecibo data reduction package) or into IRAF. The steps required to reduce the data are essentially the same as that required in single dish spectral data analysis. The principal difference is that while a single dish measures the visibility at the origin of the UV plane, the CI output is the convolution of the sky (tapered by the primary beam) with the fan-beam response of the tied-array interferometer. Because this fan-beam is a function of frequency, bright background continuum sources will cause the measured spectrum to vary with frequency. This effect can be quite pronounced if, even after primary beam attenuation, the background source is brighter than the target source (Figure 1a). It might be possible to minimize this spectral variation by a judicious choice of telescopes that constitute the CI, however this will probably involve a trade off with sensitivity. However, given a model of the sky brightness distribution one could correct the spectral baseline (a process equivalent to UVSUB in AIPS or SUB-

![Figure 1a. Single 80 second CI Spectrum observed towards the high redshift radio galaxy 8C1435+63. b. The model spectrum for this source as derived from broad band continuum observations](image-url)
TRACT in NEWSTAR, Figure 1b). Software to do this along with software for data visualization, automatic RFI detection and editing, 'smart' data averaging and signal searching is also available as stand alone programs running from the Unix shell.

The CI mode is being currently used (Chengalur et. al., 1996, to appear in the proceedings of the 'Cold Gas at High Redshift' workshop) to make a blind search for HI absorption towards high redshift radio galaxies. Figure 2 shows a radio spectrum (covering a total redshift interval of $\Delta z = 0.74$ towards the one of the target radio galaxies, 8C1435+65. Observations in the CI mode are possible at all the available WSRT bands, for example one could make high resolution spectra of the HI or OH line (velocity resolution after hanning smoothing better than 1 km/s). At these frequencies the effect of background sources will be smaller both because of the decrease in sky density of sources and the smaller size of the primary beam.

In the next two years, the WSRT will see the phased installation of a new series of front ends, the Multi Frequency Front Ends, the first set of new receivers that will be available will be the UHF high and low receivers (see elsewhere in this newsletter). At this same time the WSRT telescopes will be undergoing mechanical maintenance, causing up to 2 telescopes to be simultaneously missing from the array. The CI mode, which has limited sensitivity to UV coverage is well suited for filler observations in this transition phase.

![Figure 2 Radio spectrum towards the high redshift radio source 8C1435+63. The source has a flux ~ 2.7 Jy at 350 MHz. The total redshift interval is $\Delta z = 0.74$, (~80 MHz) obtained from four observations with a bandwidth of ~ 20 MHz each. The total integration time per frequency setting was ~ 8000 seconds, the noise level is ~ 13 mJy. There are ~ 8000 spectral channels (a frequency resolution after smoothing ~ 25 km/s for redshifted HI), a factor of 2 less than the maximum attainable resolution.](image)

Radio astronomy at the World Radio Conference 1995

The WRC95 took place from 23 October to 17 November 1995 in Geneva. The most important agenda items were: i) The recommendations of the Voluntary Group of Experts (VGE) report to simplify the Radio Regulations. ii) New allocations to the Mobile Satellite Service (MSS), including feeder links.

Radio astronomy could achieve some improvements, even though not on the agenda, in the form of "consequential changes". It almost appeared that protection of radio astronomy was the least controversial topic of the conference. Of course, new allocations to the Radio Astronomy Service could not be made, as this would be a substantial change in the table of frequency allocations, which must be put on the agenda years before the conference. But protection of radio astronomy reached a new quality, as in several footnotes up to 15 GHz the detrimental effect of unwanted out-of-band emissions of satellite transmitters is pointed out.

In detail the results are:
1. All MSS (space-to-Earth) allocations below 1 GHz get a footnote (S5.2.08A), saying that radio astronomy in the bands below 1 GHz has to be protected from out-of-band emissions. ITU-R recommendation 769 is given as a source of information about interference levels.
2. The MSS (space-to-Earth) allocation in the band 2483.5 - 2500 MHz is charged with footnote S5.402 to protect radio astronomy in the band 4990-5000 MHz from second harmonic emission.
3. The methanol line at 6668 MHz, which was formerly unknown to the Radio Regulations, now receives protection by two footnotes: the band 6650 - 6675.2 MHz is included in footnote S.5149, which lists all shared radio astronomy bands, and the new MSS feeder link (space-to-Earth) allocation at 6700 - 7075 MHz is charged with footnote S.5458C to protect observations of the methanol line from unwanted emissions.

4. Similarly, the new MSS feeder link (space-to-Earth) allocation 15.4 - 15.7 GHz is combined with footnote S.511A, which contains a reference to Recommendation ITU-R 769 to protect the radio astronomy band 15.35 - 15.4 GHz.

5. The new article 29 (formerly article 36), which defines the "service" of radio astronomy, now contains a reference to ITU-R RA769 to point out the extreme sensitivity and vulnerability of radio astronomy.

6. The new recommendation COM5-A calls for sharing studies between radio astronomy and MSS in the bands 1610.6 - 1613.8 MHz and 1660 - 1660.5 MHz. The emphasis is on technical means to be adopted by MSS systems when operating within a coordination zone around a radio astronomy observatory.

---

**VLBI Space Observatory Program**

*Leonid Gurvis*

The coming year bears lots of expectations to those astronomers who are interested in studying the most compact celestial radio sources. After many years of preparations the first dedicated Space VLBI mission is scheduled for launch in September 1996. The mission involves the key component of the VLBI Space Observatory program (VSOP), a satellite dubbed "Muses-B." The Space-ground combination will achieve angular resolutions up to 3 times better than available with ground-based VLBI only.

The mission will be led by the Institute of Space and Astronomical Sciences (Japan). A broad international consortium of Space Agencies and Radio Astronomical Institutions participates in the implementation of this challenging project. Ground VLBI networks, the European VLBI Network (EVN) and the Very Long Baseline Array (VLBA) of the National Radio Astronomy Observatory (USA), are also involved. A number of individual radio telescopes in Africa, Asia, Australia, Europe and North America will also participate in the program.

The European VLBI Network (EVN) will participate in the mission by providing observing time on its radio telescopes. Most likely, this observing time will be utilized in three observing modes: joint EVN+VLBA, EVN-only, and the EVN as part of an array of large telescopes. The EVN is upgrading its Mk3 recording terminals to the Mk4 standard. This standard will include one of the VSOP modes. The first year of VSOP operations, correlation of data obtained in VSOP + EVN-only experiments can be done either at the NRAO VLBA Correlator (Socorro, NM, USA) or, for a limited number of experiments, at the VSOP correlator at the National Astronomical Observatory (NAO, Tokyo, Japan). We hope that the new EVN correlator at the Joint Institute for VLBI in Europe (JIVE, Dwingeloo, The Netherlands) will become available in 1998 and can take over its share of the correlation load.

As an affiliated member of the EVN, the Westerbork Synthesis Radio Telescope is going to play a major role in supporting two out of three operational frequencies of the VSOP mission (1.6 and 5 GHz).

---

The Institute of Space and Astronautical Science (ISAS, Sagamihara, Japan) has released an Announcement of Opportunity and a call for observing proposals for the VSOP mission. The Announcement of Opportunity covers the first 17 months of the mission's in-orbit operation, effectively up to May 1998. As many as 150 observing proposals have been received. A preliminary estimate indicates this implies an oversubscription rate of a factor 2 to 4.

The Joint Institute for VLBI in Europe is ready to provide consultative assistance to VSOP users in Europe and worldwide. The VSOP regional help desk for Europe and China is accessible via e-mail at vsop_help@nfra.nl
Education at NFRA

NFRA Summer Research Program

David Thilker (NMSU) worked with Robert Braun on automated identification of expanding HI shells. They developed a completely automated method for locating expanding super-shells in HI datacubes of spiral galaxies. Their method not only locates the HI shells, but also returns the physical properties of each detection: the mean ambient density as well as the shell age, mass, kinetic energy and wind luminosity.

Wendy Hughes (Univ. of Victoria, Canada) worked with Jayaram Chengalur analysing VLA spectral line data for the highly warped/interacting galaxy NGC 5403. Earlier C array observations had shown the galaxy to be highly warped and possibly interacting. D array data analyzed during the course of the summer showed the warp to be extreme and highly extended and also confirmed that the galaxy was tidally interacting with a smaller companion galaxy.

Carlos de Breuck (Leiden Observatory) worked with Ger de Bruyn on the reduction and analysis of broadband (325-280 MHz) WSRT data of the galaxy NGC891. The aim was to study spectral ageing effects and polarization in the radio halo surrounding this edge-on spiral.

Tius Galama (University of Amsterdam) worked with Ger de Bruyn on the reduction and analysis of WSRT 21 cm and 92 cm (broadband) observations of a field centered at the position of the Gamma Ray Burst GRB940301. The goal was to search for delayed radio signals associated with the GRB.

Hong Xiaoyu of the Shanghai Astronomical Observatory (PR of China) worked with Leonid Gurvits on studies of compact structures of extragalactic objects, post-processing the data of a global MlIII experiment on the extremely distant galaxy 4C41.17 (z=3.8).

NOVA Autumn School

Last autumn, the third annual NOVA Autumn School was held in Dwingeloo, as part of NOVA's (Nederlandse Onderzoekschool voor Astronomie) goal to coach young astronomers to the highest scientific level and to promote (graduate) research in the Netherlands. The autumn school aims to broaden the knowledge of graduate students and to train them in giving presentations of their research. Twenty seven students from all Dutch institutes were given classes in two different fields:

*Galactic dynamics*, given by dr. K. Kuijken (RUG) and prof.dr. M. Franx (RUG).

*Mass loss through stellar winds*, given by prof.dr. H. Habing (RUL), dr. H. Henrichs (UvA) and dr. L. Kaper (MPI).

In the afternoons the students gave short overviews about their research. These presentations proved to be very useful as an exercise in communicating scientific results.

The JIVE VLBI Users School 1995

A 3 day VLBI School was held at JIVE in Dwingeloo between 14 and 16 September 1995. The program consisted of two and half days for lectures on practical aspects of VLBI data processing and an additional half day on Space VLBI.

Lectures were held before coffee in the morning and afternoon sessions, each followed by a demonstration of the processing steps required for the reduction of a real dataset by a demonstrator to a small group of participants at one of a number of workstations made available for the purpose.

Aspects covered included making a VLBI proposal and scheduling of a VLBI observation (including a practical demonstration of the latter), correlation and calibration of Mk3 continuum VLBI data, processing spectral line VLBI data, the art of VLBI imaging with lectures on self-calibration and the CLEAN algorithm, followed by an imaging demonstration, and the finer points of polarisation calibration and imaging, as well as the technique of VLBI phase-referencing. For those who had reached saturation point by the morning of the third day, a quick trip to Westerbork was arranged to look at the VLBI data acquisition equipment and the array, which many participants were likely to have used at some point in their VLBI observations. The final afternoon session concerned Space VLBI and the FakeSat space VLBI scheduling package.

Twenty eight participants attended the School from thirteen different countries, all the way from the United Kingdom to China. Approximately two-thirds were from non EVN-institutes. Just over 50% had had little or no VLBI experience, and the vast majority of the remainder had only Mk2 VLBI experience. A number of these had data from Mk3 VLBI observations waiting to be correlated but had no experience of reducing such data.

From feedback prior to end of the meeting, and from email contact after, most participants judged the School to be a very useful learning experience.

Approved new NFRA grants

Prof.dr. A.G. de Bruyn, prof.dr. R.T. Schilizzi, prof.dr. F. Verbunt: *Motion and birthplaces of pulsars through VLBI astrometry* (postdoc).

Dr. P.D. Sackett, dr. J.W. Pel: *Studying galactic microlensing through high temporal, multi band monitoring* (postdoc, Ph.D student and instrumental funding).

Dr. K. Kuijken, prof.dr. R. Sancisi, prof.dr. T.S. van Albada: *Warps in disk galaxies* (Ph.D student).

Prof.dr. P.T. de Zeeuw: *Formation, structure, and evolution of elliptical galaxies* (program grant of Dfl. 730,000).

Prof.dr. M. van der Klis, prof.dr. F. Verbunt: *Fundamental properties of neutral stars and black holes* (program grant of Dfl. 1,000,000).
WSRT maintenance schedule

Hans Kahlmann and Ger de Bruyn

The WSRT is undergoing a major maintenance and upgrade exercise. The dishes are lifted from the telescope construction and are reconditioned in order to survive another fifteen years of weather corrosion. (Newsletter 8 February 1995 gives the story on the try-out on RT 5). This process takes about three months for each dish. For 1996 we plan to upgrade the most critical telescopes, meaning RT A, RT B and RT 9. The work, however, started with RT 0 in order to replace the original dish of RT A with the reconditioned RT 0 dish. Since the first 12 dishes were constructed on the same template we don’t anticipate any major problems in this “dish-shifting”.

The schedule is as follows: RT 0 is not available for 1996 (possibly longer); RT A will be out of service for 3 weeks in the beginning of April; RT B will be out of service around June/July (3 weeks) and RT 9 will be dealt with around September/ October (also for 3 weeks).

If it turns out impossible to follow this schedule after all, we will completely reconsider the sequence of the operation. Probably, we will postpone RT’s A, B and 9, and decide to work on the fixed telescopes first.

Effect on the observations
Baselines involving telescopes 9, A and B are very important for the imaging of large scale structures. Especially baselines 9A, 9B and 8A are essential to image structures greater than 1-2 arcmin at 21cm wavelength. If the “swapping” of dishes between telescopes is possible then telescopes 9, A and B will only be out of operation for a period of a few weeks, namely the time needed to take the reflector off the telescopes and the time to re-install the improved dish from one of the other telescopes. The WSRT will then be without telescope 0 for most of 1996. This is the least damaging situation because it only leads to a reduction in the maximum baselines by 144 meters. We do not even create a gap in the UV-plane because signals on interferometers 0A and OB should be identical to those on interferometers 9C and 9D.

For spectral line observations, where backend limitations generally prevent us from measuring redundant baselines, the effect of missing 9, A or B is much more serious than for DCB continuum observations where the damage due to missing 9 A or B can be cured by including appropriate ‘redundant’ baselines in the imaging stage. The effects of this will depend on where telescopes 9, A and B are located. For example for a 9A-72m synthesis a proper synthesis without any missing short spacings is possible.

For point source detection programs the missing of 9, A or B, or any other telescope for that matter, is going to be very minimal. The effect of missing 9, A or B is also hardly noticeable when tied-array signals are being used such as in VLEI, pulsar and compound-interferometry (CI) observations.