to refit the schedule every night, almost in real time, according to the meteorological conditions – excellent seeing or low atmospheric vapour content, for example – prevailing at the observatory. Technically, such a mode of operation evidently requires that on the telescopes having various focal-plane instruments, one is able to execute any change-over without loss of observing time.

Flexible Scheduling of the NTT in the Second Half of 1991

Ground-based telescopes of the new generation, like the NTT, have their auxiliary equipment especially designed for this mode of operation. This is why ESO will start implementing flexible scheduling – although not at the ideal level described above – on this telescope as from Period 48 (1 October 1991 – 1 April 1992). The available instruments being EMMI, IRSPEC and SUSI, in a first stage the following policy has been proposed to and discussed with the OPC by the Director General. Three categories of programmes are considered.

(A) Programmes presented for observations with EMMI which explicitely include a back-up programme to be conducted by the observer with SUSI, should the seeing conditions become superb during his/her EMMI run.

(B) Programmes requesting either EMMI or IRSPEC exclusively, not capable of using superb seeing for decisive scientific advantage and which should be considered as "programmes with risk interruption", because if optimum seeing conditions appear, the astronomer-in-charge on La Silla is able to decide to interrupt such a programme in order to carry out a programme of type (C) with SUSI (by service mode). To compensate for the risk, such programmes should be allocated a minimum of three nights in order to ensure that these can still be carried out with some success even when interrupted.

(C) Programmes requiring direct imaging with excellent seeing conditions and hence SUSI exclusively. As these kinds of observations are unpredictable, they will be conducted in service mode. Typically, hours rather than whole nights will be requested. However, if applications for SUSI observations cannot be conducted during the requested period they will not be carried over to the next observing Period.

A Gain of Experience for the VLT

The flexible scheduling experiment described above aims at the best possible use of La Silla's best nights at the NTT. It will also contribute to establish detailed rules required for an efficient implementation of flexible scheduling in the future.

SUSI's deep high-resolution images of the sky will provide important information, new ideas, ancillary and complementary observations to the Space Telescope, transforming our paradigms of direct imaging.

The use of EMMI, IRSPEC and SUSI in a flexible mode will certainly contribute to achieve familiarity for the future use of the VLT with regard to instrumental design, operations mode and observing schedule optimization.

PROFILE OF A KEY PROGRAMME:

The Distance of the Centaurus Group – a Test for Various Distance Indicators

G.A. TAMMANN[1], B. BINGGELI [1], M. CAPACCIOLI[2], M. DELLA VALLE[3], E. GIRAUD[3], R. KRAAN-KORTEWEG[1], G. PIOTTO[2], A. SANDAGE[4], M.-P. VÉRON[5], P. VÉRON[5], S. WAGNER[6], R.M. WEST[7]

[1]Astronomisches Institut der Universität Basel, Binningen, Switzerland; [2]Osservatorio Astronomico di Padova, Italy; [3]ESO, La Silla; [4]Observatories of the Carnegie Institution, Pasadena, USA; [5]Observatoire de Haute-Provence, France; [6]Landessternwarte Heidelberg-Königstuhl, Germany; [7]ESO, Garching

Introduction

Extragalactic distances are not only important for the determination of the intrinsic properties of galaxies and clusters of galaxies, but also for the calibration of the (present) value of the Hubble constant H_o, which is one of the fundamental parameters of cosmology. This calibration has posed great difficulties in the past, mainly because of poorly controlled selection effects and because of the faintness of reliable distance indicators at the required distances. The NTT opens here new possibilities.

Background

Presently many extragalactic distance indicators are used without an objective judgement on the intrinsic merits of the specific method. For the Virgo Cluster more than eight different individual distance determinations (globular clusters[1], novae[2], supernovae[3], D_n-σ relation[4], Tully-Fisher method[5], planetary nebulae[6], $H\beta$-σ relation of HII-regions[7], surface brightness fluctuations,[8] etc.) are available, but the results are at least partially uncertain and discrepant, such that the Virgo distance is still considered to be controversial (with values between 15 and 22 Mpc)[9]. An objective analysis of the different methods and their uncertainties is very difficult here because of the relatively large distance of the Virgo cluster and the heterogeneity of the data.

In the present programme, therefore, the reliability of as many distance indicators as possible will be tested in a nearer group of galaxies, where also Cepheids – the most reliable distance indicators at present – are still accessible, and where the dependence of the distance indicators on galaxy type and galaxy luminosity can be studied.

The Key Programme intends to determine the distance of five members (2 early-type, 3 late-type galaxies, covering a wide range in luminosity) of the Centaurus group using Cepheids, novae, globular clusters, planetary nebulae, brightest stars and others as far as possible. This group is 2 to 4 times nearer than the Virgo cluster and the observational limitations are therefore much less severe. On the other hand the group is distant enough that CCD frames cover a significant fraction on individual group members.

The Centaurus group not only provides an excellent intercomparison and international-consistency test for various distance indicators, but also the mean distance of the group (containing the unique galaxy NGC 5128 = Cen A!) is particularly uncertain – with estimates ranging from 3 Mpc[11] to 7.9 Mpc[12] – and deserves a special effort.

Scientific Aim

The following results are expected from the Key Programme:

(1) An accurate distance to the Centaurus group from various distance indicators will establish the most distant reliable milestone in the Universe.

(2) The Cepheids in one large Sc galaxy and two small Im galaxies will directly exhibit the metallicity effect on the period-luminosity (P-L) relation, which is crucial to derive a first-class LMC distance from Galactic Cepheids.

(3) An intercomparison of the results from Cepheids and other distance indicators (novae, globular clusters, planetary nebulae, brightest stars) is obtained. This will allow to assign proper weights to the distance indicators of the Virgo cluster. With the cluster velocity with respect to the Machian frame now at hand[10], this will lead to a high-accuracy determination of H_o.

(4) The Centaurus group is prolific in supernovae and its distance will provide a fundamental calibration of the luminosity of supernovae of type Ia as standard candles (opening a direct, *independent* route to H_o)[13] and other supernovae.

(5) There is presently no distance from primary distance indicators known for an E or S0 galaxy (with the exception of the peculiar E galaxy M32). The two S0 galaxies of the group should be important to calibrate the $D_{\square}$-σ relation[4] and the surface brightness fluctuation method[8].

(6) The gravitational pull of a galaxy on the Local Group is proportional to its *apparent* luminosity (if M/L = const.). Because Cen A is roughly as bright as the integrated Virgo Cluster, its decelerating effect of $\triangle v = H_o r - v_{obs}$ (where r is the distance of the Centaurus group and v_{obs} the observed mean velocity of that group [v_{obs} = 273 km s^{-1}, corrected for Virgocentric infall]) is expected to be of the same order as the local infall into the Virgo cluster[10]. A confirmation would greatly contribute to our understanding of the correlation between (visible) density fluctuations and peculiar velocities.

Strategy

For an evaluation of the feasibility of the Key Programme a relatively large distance is *assumed*, i.e. $(m-M)_{AB} \sim 29.0$ and $(m-M)^{\circ} \sim 28.8$ (5.8 Mpc). The angular separation of the galaxies, which agree closely in redshift, suggests a depth effect – sphericity assumed – of $0^{m}.4$, but the multiple distance information and the apparent association of NGC 5128/UKS 1324–41 and NGC 5236/NGC 5264 will offer a good handle to solve for any appreciable depth effect.

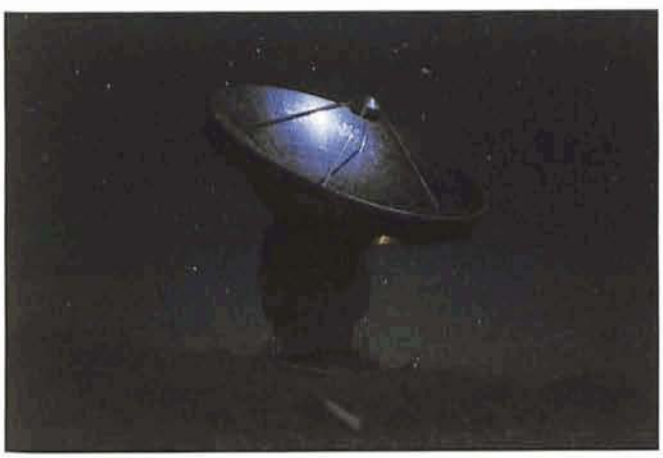
The Key Programme will rely primarily on the following distance indicators:

(1) Cepheids. The three late-type galaxies will have an ample number of Cepheids with $P > 10^4$ within one suitably placed frame. 24 exposures in B, taken at 2-day intervals (except during bright time) are needed for the period determination. The Cepheids have mean magnitudes $\langle m_B \rangle \leq 26.1$ (requiring a *detection* limit of 27.0 at minimum) and $m_B(max) \leq 25.2$. If the group is (improbably) more distant than assumed, the P-L relation at maximum light can be used solely with little loss of accuracy[14]. For optimal control of international absorption additional plates in V, R and I are needed, but because the amplitudes are progressively smaller at longer wavelengths 6, 6, and 4 exposures, respectively, are here sufficient to obtain reliable mean and/or maximum magnitudes[15].

(2) Novae. NGC 5128 produces ~30 novae per year[16]. The search will be done on V exposures because of their large field and the high quantum efficiency. Essentially all of the novae are contained in four V frames, two on either side of the dust lane. 45 exposures of the four frames, spaced by 2 days (incl. some grey time), will yield ~7 novae. These novae will be searched for in real time and must be followed in B (five plates each, spaced by 2 days), because the luminosity-decline rate relation is locally calibrated only in B[17]. The fainter novae must be followed down to $m_B = 25.0$ with S/N = 10. No nova rate is available for NGC 5236. If its distance is as small as 3 Mpc, its absolute magnitude would be only ~–19.5 and the nova rate would be correspondingly low. A search programme is therefore postponed until a more accurate distance is known, which will allow to predict the success rate.

(3) Globular clusters. NGC 5128 has a

Idyllic La Silla!



Not all visiting astronomers are so engulfed in their observational work that they have no time to enjoy the beautiful night sky at La Silla. Susanne Hüttemeister from the Max-Planck-Institut für Radioastronomie in Bonn (Germany) is one of these and during an observing trip to the SEST in late September 1990, she took the two photos shown here. On a moonlit night, the light from that orb is reflected in the SEST, and the southern latitude of La Silla is indicated by the fact that the north celestial pole is below the horizon.

total population of 900 globular clusters within 16'.1[18]. For a good distance determination they should be followed 2 mag beyond the peak of their luminosity function[1,19], i.e. $M_B = -5$ or $m_B = 24.0$. Their identification will rest (a) on statistical subtraction of foreground stars and background galaxies, and (b) on (partial) resolvability. Because of the relatively large number of foreground stars, a large field must be surveyed, particularly since it is not yet known down to which magnitude the clusters will appear to be resolved with the NTT. 16 blue frames are needed, of which the inner six are expected to be available from the nova follow-up. Almost the entire field will be covered by 6 V frames that are needed for colour information. Scaling by luminosity, 350 clusters within 10'.0 are expected for NGC 5102. This requires 9 blue and 4 V frames. The cluster population of NGC 5236 must be much smaller (~80?). Here the cluster indentification depends entirely on resolution. Nine blue frames are requested under optimal observing conditions for later follow-up spectroscopy (this not being part of the present proposal). Eventually the globular clusters in this Sc galaxy are decisive to test whether their luminosity function depends on galaxy type.

(4) Planetary nebulae. To establish the luminosity function of planetary nebulae for *different galaxy types* one central frame in each of the five programme galaxies is needed. For a reliable identification four exposures in the red channel are required: [O III] λ5007Å-on, λ5007Å-off, Hα-on, and Hα-off. Judging from the luminosity functions presented for the Virgo Cluster[6], the photometry should be carried out down to 26.5 mag. Because of the narrow filters grey time is permissible.

(5) Brightest stars. The B and V frames under (3) of the two S0 galaxies are likely to resolve the brightest stars of the red-giant tip; they will be valuable as future distance indicators for E and S0 galaxies. Additional distance information will be obtained from the brightest blue and red stars[20] of the three late-type galaxies. They will be identified from B, V colour magnitudes diagrams. The necessary frames are obtained under (1) and (3); only four additional V frames are needed for NGC 5236.

Conclusion

The first nine half-nights have been allotted to the Key Programme, beginning in April, 1991. They will be devoted almost entirely to the Cepheids. The decisive test is to demonstrate that they appear within the expected magnitude range. In the positive case, even a preliminary Cepheid distance of the Centaurus Group will allow to further optimize the strategy for the other distance indicators.

Until the new generation of instruments will become available on Space Telescope, the NTT is probably the only telescope with which the present project can be carried out. If successful, the project should also outline future avenues of the VLT.

It is obvious that the present programme would have little hope of success without the institution of the Key Programme.

References

(1) Harris, W.E. 1988, in *The Extragalactic Distance Scale*, ASP Conference Series No. 4, eds. S. van den Bergh and C.J. Pritchet (Provo: Brigham Young Univ. Press), p. 231.

(2) Pritchet, C.J., and van den Bergh, S. 1987, *Ap.J.* **318,** 507. – Capaccioli, M., Cappellaro, E., Della Valle, M., D'Onofrio, M., Rosino, L., and Turatto, M. 1990, *Ap.J.* **350,** 110.

(3) Leibundgut, B., and Tammann, G.A. 1990, *Astron. Astrophys.* **230,** 81.

(4) Dressler, A. 1987, *Ap.J.* **317,** 1.

(5) Kraan-Korteweg, R.C., Cameron, L., and Tammann, G.A. 1988, *Ap.J.* **331,** 620. – Fouqué, P., Bottinelli, L., Gouguenheim, L., and Paturel, G. 1990, *Ap.J.* **349,** 1. – Pierce, M.J., and Tully, R.B. 1988, *Ap.J.* **330,** 579.

(6) Jacoby, G.H., Ciardullo, R., and Ford, H.C. 1990, *Ap.J.* **356,** 332.

(7) Melnick, J., Terlevich, R., and Moles, M. 1988, *M.N.R.A.S.* **235,** 297.

(8) Tonry, J.L., Ajhar, E.A., and Luppino, G.A. 1990, *A.J.*, in press.

(9) For reviews of the Virgo Cluster distance cf. e.g. Tammann, G.A. 1988, in: *The Extragalactic Distance Scale*, ASP Conference Series No. 4, eds. S. van den Bergh and C.J. Pritchet (Provo: Brigham Young Univ. Press), p. 231 – Tully, R.B. 1990, *Astrophysical Ages and Dating Methods*, 5th IAP Meeting, Paris, in press. – van den Bergh, S. 1989, *Astron. Astrophys. Rev.* **1,** 111.

(10) Sandage, A., and Tammann, G.A. 1990, *Ap.J.* **365,** 1.

(11) Tonry, J.L. and Schechter, P.L. 1991, in press.

(12) Sandage, A., and Tammann, G.A. 1975, *Ap.J.* **194,** 223.

(13) Branch, D., and Tammann, G.A. 1991, *Ann. Rev. Astron. Astrophys.*, in press.

(14) Sandage A. 1988, P.A.S.P. **100,** 935.

(15) Freedman, W.L. 1991, *Ap.J.*, in press.

(16) Ciardullo, R., Ford, H.C., Williams, R.E., Tamblyn, P., and Jacoby, G. 1990, *A.J.* **99,** 1079.

(17) Capacciolo, M., Della Valle, M., D'Onofrio, M., and Rosino, L. 1989, *A.J.* **97,** 1622, and 1990, *Ap.J.* **360,** 63.

(18) Harris, H.C., Harris G.L.H. and Hesser, J.E. 1988, in: *The Harlow-Shapley Symposium on Globular Cluster Systems in Galaxies*, eds. J.E. Grindlay and A.G.D. Philip, IAU Sympos. No. 126, p. 205.

(19) Wagner, S., Richtler, T., and Hopp. U. 1991, *Astron. Astrophys.*, 241, 399.

(20) Sandage, A., and Carlson, G. 1988, *A.J.* **96,** 1599.

(21) Zickgraf, F.-J., Humphreys, R.M., Sitko, M.L., and Manley, T. 1990, *PASP* **102,** 920.

SEST Users' Meeting and Workshop on Millimetre-Wave Interferometry

The second SEST Users' Meeting will be held at ESO Garching on Wednesday 22 May 1991, and it will be followed by a one-day workshop on current developments in millimetre-wave interferometry on Thursday 23 May. Further information can be obtained from the Secretariat of the Science Division.

STAFF MOVEMENTS

Arrivals

Europe:

ALBRECHT, Miguel (D), Astronomer/Data Archivist
BECKER, Joachim (D), VLT Project Manager/Head VLT Division
CAROLLO, Marcella (I), Student
CLASS, Shala (D), Laboratory Technician (Photography)
DE JONGE, Peter (NL), Construction Site Manager
DE RUIJSSCHER, Resy (NL), Technical Secretary
SILBER, Armin (D), Technician (Instrument Integration)

Chile:

ALTIERI, Bruno (F), Coopérant
GREDEL, Roland (D), Fellow
JORDA, Laurent (F), Coopérant

Departures

Europe:

FERRARO, Francesco (I), Fellow
PRUGNIEL, Philippe (F), Fellow
SCHLÖTELBURG, Martin (D), Fellow

Chile:

HUTSEMÉKERS, Damien (B), Fellow