is being carried out. It is intended that a formal proposal be submitted to ESO Council for approval by the end of 1999.

Meanwhile, in Japan there is another millimetre array project, the "Large Millimetre and Submillimetre Array" (LMSA), and it has recently been decided that the LMSA will also be located in the Chajnantor area, less than 10 km from the LSA/MMA. As a result, the two most likely scenarios are (1) a "handshake" arrangement in which the LMSA and LSA/MMA remain independent but sometimes work together in a single large configuration, or (2) a complete merger of all three projects into a "World Array". This should be decided sometime this year. Still other countries are also interested in participating, and would likely do so under the umbrella of one or another of the major partners.

4. Conclusion

It now seems virtually certain that there will be a large millimetre and submillimetre array located in northern Chile. In view of the outstanding scientific potential of this new telescope and the strong synergy with the VLT, the participation of Europe, both scientifically and technically, is highly desirable. Whether it does participate should be known by the end of next year. The telescope will most likely be built in the period 2003–2008, and become incrementally operational over that period.

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The LSA would not be ESO's first venture into millimetre astronomy. ESO has been involved in this field for well over a decade, through its participation in the Swedish-ESO Submillimetre Telescope (SEST). The following papers summarise some of the recent scientific developments and results from the SEST.

SEST UPGRADES AND REPORTS FROM SEST OBSERVERS

SEST Upgrades

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The Swedish-ESO Submillimetre Telescope (SEST) has been in operation successfully for close to 10 years, the first scheduled observations having taken place in April 1988. It has served not only the Swedish-ESO community, but 10% of the Swedish observing time has been used by Finnish astronomers and, recently, Australia has signed an agreement with Sweden, also for 10% of Swedish observing time. The SEST receivers have been upgraded on a regular basis during the past decade, but the original control system is still in place. However, during the past couple of years an in-house project to replace this control system as well as the old computers has been in progress, while continuing normal observations. The project is being carried out by the SEST engineers with assistance from the staff at Onsala Space Observatory and will be completed during 1998. This article will describe the present instrumentation, the new control system and give a brief overview of the plans for the SEST during the coming years.

1. Current Status

The SEST instrumentation presently consists of state-of-the-art SIS receivers covering the 3, 2, 1.3, and 0.8 mm atmospheric windows, and a single-channel bolometer covering the 1.3 mm window. Receiver temperatures are typically on the order of 100–150 K (Single Side Band, SSB), except for the 0.8 mm receiver, which has a receiver temperature of about 300–400 K (SSB). Three Acousto Optical Spectrometers (AOS), two wide band (1 GHz) and one narrow band (86 MHz), each with about 2000 channels, can be used in different combinations with the 3 and 2 mm receivers or the 3 and 1.3 mm receivers simultaneously. During 1997 the three AOS were upgraded with new CCD and electronics by the group from the University of Cologne who designed and built them. This upgrade was needed to ensure ongoing maintenance support, improve the performance of the AOS and prepare them for the new control system.

The telescope, its receivers, spectrometers and other instrumentation are presently controlled by HP1000 computers via HP/IB interfaces and CAMAC controllers. The current control system is very slow due to the old computers and there are other operational limitations; e.g. because there is insufficient computer memory, only two spectrometers can be used simultaneously.

More detailed information about the SEST and its performance can be accessed through the SEST homepage, which is constantly being updated:

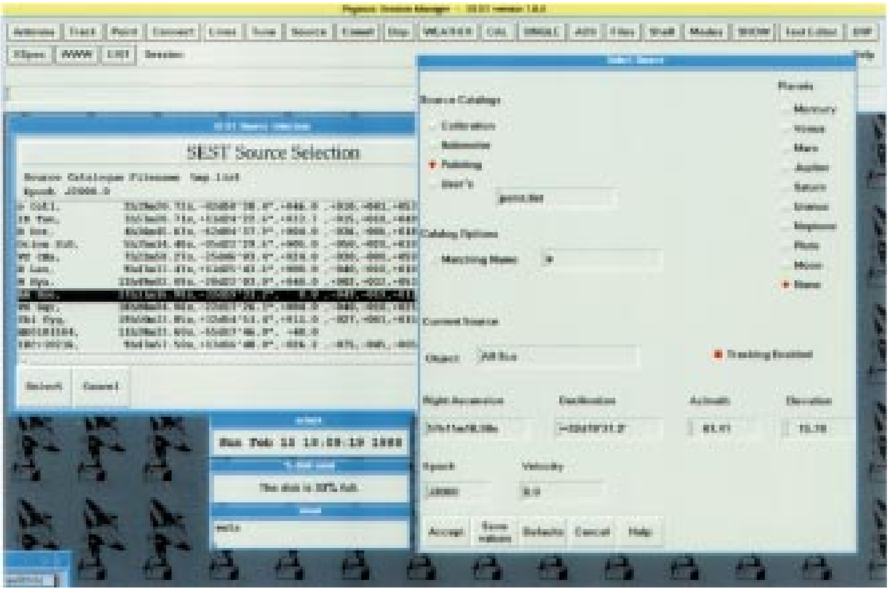
http://www.ls.eso.org/lasilla/Telescopes/SEST/SEST.html

2. The Control System Upgrade

The system upgrade essentially consists of replacing the HP1000 computers with a fast HP/B132L workstation and the CAMAC controllers, for telescope and subreflector control, with VME systems. The spectrometers will be controlled by a PC running Linux. The new user interface, *Pegasus,* is a graphical user interface (gui) developed at CFHT (Canadian-French-Hawaiian Telescope). It is used to control the 20-m telescope at Onsala Space Observatory in Sweden, thus a large part of the software developed there has been transferred and adapted to the SEST. The new system will be considerably faster and it will be possible, for example, to use all three spectrometers simultaneously in different combinations with the receivers.

The *Pegasus gui* is very easy to operate and allows the observer to send *all* commands by opening control windows and using the mouse to click on control buttons. An example of what such a setup may look like is given in the figure. On the top of the screen the menu bar gives access to different windows, which can be selected by the observer. Thus, by simply clicking on different buttons in the menu, the observer can, for example, open source catalogues, track a source, choose the receiver/spectrometer setup, search the *Lovas* line catalogue, tune the receivers and then start mapping routines. Thus, the new system is very user-friendly and extremely easy to use and observers will be able to quickly adapt to the gui. The data obtained will be written in FITS format and various data reduction programmes, e.g. CLASS and DRP, will be available on-line.

In November/December 1997, we used a long maintenance period to do initial testing of the new telescope con-



trol system (TCS), the spectrometer control, and the *Pegasus gui.* At the end of this period it was possible through *Pegasus* to track and map a source using all three spectrometers simultaneously. The upgrade project will be finished during the second half of 1998, after which the new system will be in use.

3. The Future

During 1999, SEST will be equipped with a nutating subreflector, designed and built at IRAM (Institut de Radio Astronomie Millimétrique). This will be slightly smaller than the present subreflector and be insensitive to ground radiation spilling over the primary mirror. It means, however, that the telescope focal-ratio will be changed, necessitating a redesign of some of the receiver optics. The new subreflector will make it possible to use one of the new-generation bolometer arrays which, for reasons concerning the uniform illumination of all pixels, can only satisfactorily be operated with such a subreflector. Therefore, in 1999, we will install a 37-channel bolometer array receiver working at a wavelength of 1.3 mm. This will be built by Ernst Kreysa at the Max-Planck-Institut für Radioastronomie in Bonn, with support from the Astronomical Institute of the Ruhr-Universität Bochum and Onsala Space Observatory. Mapping will become much faster due to the large number of channels. The efficiency for mapping extended sources as well as for observations of point-like sources will also increase, because the sky noise added by the atmosphere is correlated between the channels and can thus be eliminated. This implies that it will be possible to work at the detector noise level even in marginal atmospheric conditions.

We also expect that the on-the-fly mapping mode will be available at the end of these upgrades. This is a fast mapping mode during which data is taken continuously while the telescope is scanning across a source, and thus the total mapping time will be decreased by at least a factor of three.

During 1999, SEST will also take delivery of a digital autocorrelation spectrometer (ACS) which will be built at the Australia Telescope National Facility as part of the new Swedish-Australian collaboration. It will have selectable bandwidths decreasing from 1 GHz to 64 MHz by factors of 2 and 2048 frequency channels. This will provide a flexible alternative to the AOS, but it will also be possible to use the AOS and ACS at the same time with different bandwidths.

Further into the future it is foreseen that an SIS heterodyne array receiver, working in the 1.3-mm window with up to 16 elements, will be installed at SEST. This also means that 16 spectrometers will have to be used in combination with the receiver, and thus the present spectrometers will have to be replaced, possibly through the Swedish-Australian collaboration.

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Molecular Lines in Absorption at High Redshift

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Abstract

Molecular absorption lines at high redshift (0.2 to 1) were discovered a few years ago, and they revealed a very precious tool for many purposes. They allow the detection of many molecules, and in particular those not observable from the ground at $z = 0$. such as water and molecular oxygen. The excitation temperature of molecules are often close to that of the cosmic background radiation, and can serve to measure it as a function of redshift. The absorption comes frequently from a gravitational lens in front of a quasar, so that they help to determine time-delays and the Hubble constant. The high spectral resolution of radio observations allows to put constraints on the variation of the fine-structure constant over a large fraction of the Hubble time. With the next-generation millimetre interferometers, many such systems would be observable, which will allow the exploration of young galaxies in the Universe.

1. Background

Absorption lines are a sensitive probe for studying the interstellar medium. Especially in distant objects, where emission lines become diluted with distance squared, whereas the detectability of absorption lines only depends on the observed flux of the background source. This is well known from optical spectroscopy, where the combination of sensitive detectors and large telescopes allows observation of very tenuous gas towards distant background QSO. In principle, absorption of molecular rotational lines can be used to probe the densest and coldest part of the ISM in distant galaxies, much in the same way as optical lines probe the warm and diffuse gas. Since new stars are formed in molecular clouds, a study of this ISM component traces the star-formation conditions and its history in galaxies. There are, however, several difficulties associated with the detection of such lines and it was not before 1993 that the first distant molecular absorption line system was detected. Since then a total of four such systems at redshifts between z = 0.2–0.9 have been observed.

2. Discovery of Molecular Absorption-line Systems

The 15-m Swedish-ESO Submillimetre Telescope (SEST) on La Silla has