averaged surface brightness and corresponding high integrated metal production of this flat-spectrum population that we discussed above do suggest that this is a phase that a substantial fraction of galaxies must go through, and that by studying these objects we are looking at a cosmologically significant episode of activity.

4. Towards a Unified View of the Universe at Z ~ 3

Our picture of objects at high redshift is still very patchy, with just a few objects found by diverse but nevertheless highly pre-selective methods. Whether the objects are found through their strong radio emission or their vigorous star-formation as discussed here, or through high column densities of neutral gas as in the systems producing quasar absorption lines, or through being associated with luminous quasars, we can be sure that strong selection effects are present. It is therefore premature to attempt to fit these sparse data into any comprehensive picture of galaxies at high redshift. Nevertheless, our progress in just the last few years has been dramatic.

We will need more objects found by these various techniques and the development of new techniques, so that the base of our knowledge is widened. Once further objects at high redshift are found, high resolution imaging in both the optical and infrared wavebands will be essential before we can begin to understand these galaxies at high redshift and hence solve the puzzle of galaxy formation from a direct observational stand-point. There is little doubt that CFHT will play a major role in this effort.

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LATEST NEWS ON INSTRUMENTATION

Completion of the Data Acquisition Computer Upgrade Project

1. Overview

The new computers, and the new software architecture that goes with them, are fully released and operational at the summit. All of the currently available CFHT instruments and many of the visiting instruments are supported. The list of directly supported instruments includes:

- FOCAM – full support
- UVPrime – full support
- Herzberg – full support
- TIGER – full support
- Multi Object Spectrograph – full support with object selection punch machine and long slit mode
- Coudé – Reticon and CCD
- Fourier Transform Spectrometer – full support
- Fabrey Perot – full support
- Shearing Interferometer – Detector and data management
- High Resolution Camera – Detector and data management
- CIRCUS – network disc and tape services

2. Consistency

The key to all of the above mentioned environments is consistency. All observing accounts look and feel the same. The exposure management is the same. The file formats are the same. Quick look and tape management are the same. The only things which appear different are those features which are unique to the current instrument. And even these features are presented in a standard fashion in the observing environment screen forms.

Consistency is important for three reasons: visitors often use many instruments over time, support astronomers must support several instruments each, and the computer support team can leverage much of its work. A best case example from the computer team point of view was the Fabry-Pérot session. It was decided on fairly short notice to support a scanning Fabry-Pérot run. We needed a custom log in session, instrument control, user interface forms, FITS cards, and automatic scanning during iterative exposures. The total amount of work was three normal days for two people.

3. Hardware Behind the Scenes

The final hardware solution is slightly different from the originally envisioned set-up described two issues ago. Two influences are responsible: IRAF has been successfully ported to our HP-9000 UNIX machines, multiple simultaneous instrument support has increased. The first influence will allow the summit SUN machine to migrate to Waimea where it is badly needed while at the same time reducing out summit computer support problem to one vendor. The second influence requires an example. The June 1989 FTS run includes the sharing of each night with a few scattered hours of CCD shearing interferometer work. Also the final day of this run needed to support Reticon/Coude set-up. (This is not only three different instruments, but three different detector control technologies). While the software architecture and instrument control hardware supported this type of sharing, we found we did not have sufficient displays in all the right places to support the interactive user sessions.

Our final hardware solution is composed of:

- A large, fast, fully configured HP-9000 S800 UNIX machine called *moe*. This machine has all of the instrument control hardware connected to it. It also runs all of the data acquisition software, even when there are multiple sessions. However, it does not have a display. We find that we get higher performance if we use networked displays, since we then have more CPU's working for us.

- A smaller less fully configured HP-9000 S800 UNIX machine called *curly*. This machine serves two purposes. It acts as a backup computer in case *moe* fails. It also has a high resolution bitmap screen which is used through the network to provide one of the user environments. The *curly* display is in the main observing room.
- A smaller HP-9000 S300 UNIX machine called *shemp*. This machine is primarily a smart bitmap display server needed to provide a user environment in the old observing room. For instance, FTS observers must remain in the old observing room to be near the control electronics. Think of *shemp* as a very smart windowed terminal to *moe*.
- A second small HP-9000 S300 UNIX machine called *larry*. This machine is like *shemp* except that it is placed in the third floor observing area to provide a user environment for coudé. Think of this machine also as a very smart windowed terminal to *moe*.

All of our machines are connected together via (and only via) a summit network. This network connects to our Waimea development machines to provide fast debug turn around and efficient monitoring of user state. The network also provides for automatic data storage in Waimea moments after the data is acquired.

4. Remote Observing

The above hardware description points out that all observing at CFHT is actually remote observing from the computer point of view. Since the main data acquisition machine *(moe)* has no screen, a second computer (sometimes small, sometimes large) is used to provide the display hardware through the network. This means that logging into a Waimea bitmap screen as 'focam' is technically identical to the summit situation. Remote observing is now reduced to non-computer issues.

5. The Live Wire/Fire Drill Dilemma

A 'Live Wire' analogy was developed by the computer group. By this we mean that our systems are in use constantly. Any maintenance or changes, let alone real progress, must be done without interrupting service. This analogy is probably appropriate for the whole company. As we were redesigning our computer architecture we had a new opportunity to tune our solution with this in mind. The 'Fire Drill' is the other horn to our dilemma. We can not just fill the computers full of epoxy and never touch them. Every few days the telescope undergoes a transformation into an entirely new tool. Also, each time an observer comes to CFHT a new feature may be required. The problem then is to provide a malleable but rugged software environment. Rugged in this sense means internally rugged.

The main solutions to this problem are:

- The use of many separate processes. This allows us to know and prove that the majority of the software is untouched for any given change. Even recompiling untouched code is risky.
- The separation of user interface and specific functionality. Most of our user interface is handled by separate processes that in turn invoke the real process. This allows us to change either without affecting the other.
- Stateless programs. Most of our programs do not hang around and keep state in their data structures. Instead they run to completion and keep any state in

a separate file which can be modified by the computer group to change behavior without recompiling.

- Reusable code. A lot of attention has been given to both high level and low level tools. A user interface language was developed to handle forms and invoke runtime control packages. Device control libraries were developed to take care of the tedious details. (These features are what allowed us to create the Fabry-Pérot session in three days.)
- One source code tree. Using the T1 network between Waimea and the summit allowed us to keep a single copy of the up to date source code. This guaranteed that we never used an old version by mistake. Nor were we making changes in two different places that then had to be reconciled.
- Multiple releases. A release technology was created that allowed us to make formal releases. By having multiple releases on the system we could engineer in radical changes without affecting current operation.

In summary, there has been a very low rate of problems caused by computer change. At the same time, the computer group has felt free to service custom needs as well as make progress in whatever direction was required.

6. The Future

While first semester 1989 has seen the completion of the original data acquisition and computer upgrade project, it should not be thought of as a static situation. There are not only new features being requested, but there are new instruments on the horizon. What we have created is a foundation and technology that not only supports our past and current endeavors, but our future plans as well. Of course, these projects will continue to be in addition to the daily challenge of acquiring data.

Jon Brewster

Le Reducteur Focal du CFHT: Modes Longue Fente et PUMA

Le réducteur focal du CFHT utilisé jusqu'alors en mode multi-spectroscopie PUMA a été doté d'un mode longue fente à la fin 88 et utilisé avec le CCD PHX1 de 7 e^- de bruit de lecture en Juin 89. A cette occasion nous rappelons les principales caractéristiques de cet instrument spécialisé pour la spectroscopie d'objets faibles tout en offrant une capacité d'imagerie. Une description complète de l'instrument et de son fonctionnement est donnée dans le 'User's manual for long slit and multi-spectroscopy with the focal reducer and PUMA,' disponible sur demande.

La combinaison optique comprends les différents étages suivants:

- Plan focal F/8: longue fente ou masque PUMA peuvent y être insérés.
- lentille de champ, collimateur.
- Roue à filtres ϕ 75 mm à quatre positions.
- Roue à Grisms ϕ 65 mm à quatre positions (2 filtres + 2 Grisms).
- Objectif F/2.9.
- CCD.

Il est donc possible de sélectionner une configuration imagerie ou spectroscopie. Le tableau donne l'échelle spatiale et les dispersions mesurées en Å/pixel pour les 3 CCDs utilisables (cette table corrige celle du manuel d'utilisation distribué avant le 1 Juin 89).

Table 1

	Grism V150 λ_0 = 6100 Å	Grism B400 λ_0 = 5200 Å	Grism 0600 λ_0 = 5900 Å	arcsec/pixel
RCA4	6.4	2.5	1.8	0.31
TH1	9.8	3.8	2.7	0.47
PHX1	8.5	3.3	2.3	0.41

Il est possible d'insérer dans le plan focal une fente ou un masque multi-objets PUMA. La procédure 'insérer/retirer' la fente ou le masque s'effectue manuellement sur l'instrument. Le support de fente peut recevoir des fentes de 0".5 à 2".5 avec une longueur de 4'.5. Un mouvement fin en rotation permet un alignement précis de la fente avec les lignes du CCD.

Un logiciel a été développé pour la spectroscopie multi-objet avec la machine PUMA construite par l'Observatoire de Toulouse. Il permet entre autres la sélection grossière des objets avec le curseur sur une image du champ préalablement obtenue, suivi du calcul précis de leur positions, un contrôle des positions pour éviter un recouvrement des spectres, l'addition de trous sur le fond de ciel, l'envoi d'ordres de percage des trous à la machine PUMA. Les trous de ϕ 300 μm sont percés avec une précision de 10 μm dans un clinquant dont le support peut être ensuite inséré dans le plan focal F/8. Une procédure complète de selection des objets et création d'un masque prend environ 15 minutes.

Une procédure d'offset precis du télescope

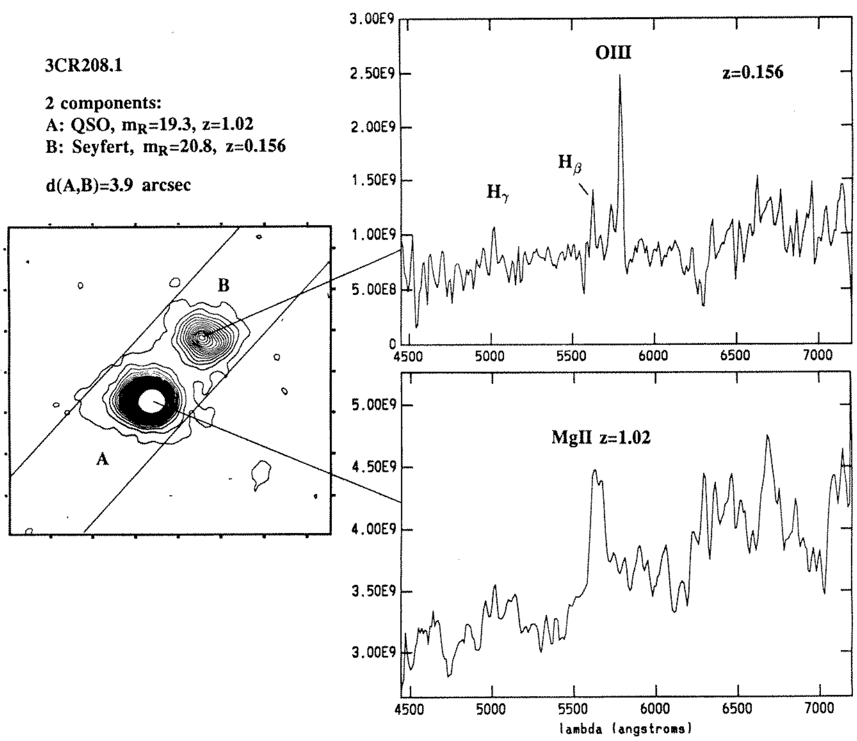

Figure 7