cussed. Calculation of the neutrino flux at Earth resulting from individual active galactic nuclei is described along with the cosmological integration to find the contribution to the neutrino background. The prospects for observing both individual active galaxies and the diffuse background with the proposed neutrino telescopes are discussed. The results are compared to recent work by Stecker *et al.* (1992), Biermann (1992) and Sikora and Begelman (1992).

Chapter 7 summarises the work presented in this thesis and briefly discusses some of the other consequences of particle acceleration in active galaxies. The application of this work to other astrophysical objects is also briefly discussed.

INVESTIGATIONS INTO RARE-EARTH SILICIDES AS INFRARED-SENSITIVE MATERIALS AND GENERALISED INFRARED ARRAY SYSTEMS

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This thesis has investigated the physics of some of the rare-earth silicide Schottky barrier contacts on silicon, in particular erbium silicide, and has attempted to determine whether they might be suitable for use as infrared detectors. To this end, yttrium silicide on *p*-type silicon and erbium silicide diodes on both *n* and *p*-type silicon were produced. The rare-earth silicides are of interest as they are the only known Schottky contacts that have a low barrier on n-type silicon and a high barrier on *p*-type silicon.

These diodes were then measured using current-voltage (I-V), current-voltage-temperature (I-V-T), and photoresponse techniques, for both forward and reverse bias. From these measurements the zero-bias and more fundamental flat-band barrier heights were determined for each diode produced. In the case of erbium silicide on *n*-type silicon, it was found that two types of diodes could be produced, either 'pitted' diodes with a barrier height of ~0.35 eV or 'smooth' diodes with a barrier height of ~0.28 eV. The 'smooth' erbium silicide diodes were then extensively studied, as they held the greatest promise as infrared detectors.

Using photoresponse measurements, the quantum efficiency of the low barrier 'smooth' erbium silicide diodes was determined to be ~0.52%. Although small, this value is comparable to such established infrared detector materials as platinum silicide on *p*-type silicon, therefore showing erbium silicide to have great potential application as an infrared detector material.

The conduction mechanisms in erbium silicide Schottky diodes on *n*-type silicon have been studied over a temperature range of 25K to 160K. Thermionic emission dominates carrier transport above 70K. Below this temperature, deviations are apparent in the zero-bias barrier height and ideality factor. However, the flat-band barrier height is shown to remain constant over the entire temperature range. The Fermi level is demonstrated to be pinned to the conduction band. A new quantity, the flat-band saturation current (L^f) is defined and used in plots of $n^*\ln(L^fT^2)$ versus 1/T, which give an excellent fit to the data over 28 orders of magnitude. From these plots the flat-band barrier height and the modified Richardson constant are obtained directly. This technique provides a completely self-consistent and more reliable way of obtaining these parameters than do previous methods. For low temperatures and low forward bias, recombination via tunnelling through surface states becomes the dominant conduction mechanism.

In addition to the work on the rare-earth silicides, a generalised imaging array control system has been developed in order to drive a wide range of infrared detector arrays. This system has been built for maximum flexibility, both in application and for future modification. The system is capable of driving almost any known imaging array.

EVOLUTION FROM AGB STAR TO PLANETARY NEBULA

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This thesis presents a theoretical and observational study of stellar evolution for low to intermediate mass stars (~ 1-8 $M_\odot$), from the asymptotic giant branch (AGB) phase to the planetary nebula (PN) phase.

In chapter 2 we have undertaken a series of theoretical calculations using the Mount Stromlo Stellar Structure Code to produce 22 stellar evolutionary sequences, complete from the main sequence phase through to the AGB phase. Models are calculated for initial masses 0.89, 0.945, 1.0, 1.5, 2.0, 2.5, 3.5, and 5.0 $M_\odot$, and metallicities 0.016, 0.008, 0.004, and 0.001 $Z_\odot$. These abundance and mass values were chosen to allow comparison with Galactic, and Magellanic Cloud stars. An important feature of these calculations is the inclusion of an empirical relationship between mass loss rate and pulsation period for AGB stars. The calculations lead naturally to a *superwind* phase, where the AGB is terminated by severe mass loss over the last 2–3 thermal pulse cycles. More precisely, the superwind phases occur towards the end of quiescent phases of helium shell flash cycles. The maximum AGB luminosities predicted from this work are in excellent agreement with those observed for Magellanic Cloud stars. The resulting initial-final mass relation predicts white dwarf masses ~0.1 $M_\odot$ larger than the observational calibration of the relation.

In chapter 3 we continue the calculations presented in chapter 2 into the PN regime. Mass loss has also been included here, using an empirical formalism derived from observations of PN nuclei available in the literature. The evolutionary rates during the PN phase are examined, and are compared with those available in the literature. The calculations fall into two distinct groups; those where shell He burning is dominant, and those where shell H burning is dominant, when a star leaves the AGB phase. Low mass models are more likely to leave the AGB burning He, as the results in chapter 2 indicate the mass loss rate to be greatest immediately prior to a themal pulse.

In chapter 4 we examine the hydrodynamic behaviour of the winds produced during the AGB phase. A preliminary investigation was conducted over one complete shell flash cycle. At a thermal pulse event, an increase in wind speed drives a shell into the slower, pre-existing, quiescent wind. Following from the thermal pulse event, there is a significant luminosity decrease which allows matter to fall back towards the stellar surface, and which results in the formation of a hollow circumstellar shell. These characteristics may have already been noted in observations previously presented in the literature.

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