PROJECT SUMMARY

An accurate knowledge of the physical properties of high mass stars is important in order to understand the evolution of these stars. It is also necessary in order to use our these luminous stars to learn about star formation processes (such as the universality of the initial mass function) and feedback mechanisms in the interstellar medium.

On the main-sequence, high mass stars are spectroscopically identified as O-type stars, which have very high effective temperatures (30,000°K to 50,000°K) and which radiate most of their light in the extreme ultraviolet. At later evolutionary times, massive stars become red supergiants (RSGs), with extremely cool effective temperatures (3,000°K to 4,000°K) and give off most of their light in the far infrared.

For both O-type stars and RSGs, it is necessary to have an accurate knowledge of their effective temperatures if one is to transform their observed properties (spectral type and photometry) into physical properties (bolometric luminosities, masses, radii). Because of their extreme temperatures, little of their radiation is in the optical, and their bolometric corrections are quite significant (-1 to -4 mag), with a very steep dependence on the effective temperatures in both regimes. The connection between the observed quantities and effective temperatures can best be made using stellar atmosphere models. Yet the physics of these stars are more complicated than ordinary stars, requiring the inclusion of stellar winds for the hot O-type stars, and molecular transitions for the red supergiants.

This proposal will determine improved effective temperature scales for both hot and cool massive stars using high quality optical data and the latest generation of stellar atmosphere models. For the first time, such calibrations will be determined as a function of metallicity, which is vital if one is to interpret data that is now being obtained in galaxies throughout the Local Group. Here is what this proposal will accomplish:

• **O-type stars.** Using data recently obtained by the PI, model fits will be made with Rolf Kudritzki's and Jo Pul's program FASTWIND, a stellar atmosphere code that includes the hydrodynamics of the stellar winds, and which includes full line blanketing. The spectra includes stars of spectral type O3 V to B5 I, i.e., the full range covered by massive stars on the main-sequence. As a check, a subsample of these stars will be independently fit using John Hillier's CMFGEN code, and the results compared. A similar analysis is underway (under NASA funding) by the PI for hot stars in the Magellanic Clouds, allowing a direct determination of the effect metallicity has on the effective scale of O-type stars.

• **Red Supergiant stars.** New fluxed spectra will be obtained for a sample of newly identified RSGs in the Magellanic Clouds, as well as a sample of Galactic RSGs. A grid of MARCS stellar atmospheres newly constructed by collaborator Bertrand Plez for cool stars will be compared to the observations in order to provide both an effective temperature calibration and as a check on the self-consistency of these models.

• **Broader impacts.** This work will involve the participation of both women and minority undergraduate students through the REU and MIT Field Camp programs. These groups are traditionally under-represented in the physical sciences. These students will be encouraged to present the results of this work at meetings of the AAS.