Computational Astrophysics Tools for the GRID

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The newest generation of telescopes and detectors and large scale astronomical databases are delivering vast volumes of astronomical data and creating increasing demands for their analysis and interpretation. Methods for such analyses rely heavily on computer-generated models of growing sophistication and realism. These pose two problems. First, simulations are carried out at increasingly high spatial and temporal resolution and physical dimension. Second, the dimensionality of parameter-search space continues to grow. Major computational problems include ensuring that parameter-space volumes to be searched are physically interesting and match observational data efficiently and without overloading the computational infrastructure.

For the analysis of highly-evolved hot stars, we have developed a toolkit for the modelling of stellar atmospheres and stellar spectra. We can automatically fit observed flux distributions and/or high-resolution spectra and solve for a wide range of atmospheric parameters for both single and binary stars. The software represents a prototype for generic toolkits that could facilitate data analysis within, for example, a Virtual Observatory.

We introduce a proposal to integrate a range of such toolkits within a heterogeneous network so as to facilitate data analysis. For example, data-mining functions will combine new observations with data from established archives. A goal-seeking algorithm will use this data to guide a sequence of theoretical calculations. These simulations may need to retrieve data from other sources, atomic data, pre-computed model atmospheres and so on. Such applications using widely distributed and heterogeneous resources will require the emerging technologies of computational grids.