# *Astrophysics* — Spring Semester 2003

**Ever wondered:**

- **How stars shine?**
- **How did the Sun and planets form?**
- **How do stars and galaxies evolve over time?**
- **Why does the structure of the Universe appear the way it does?**
- **What is the history of the Universe and how did it come about?**

The Department of Physics & Astronomy at East Tennessee State University will be offering a 3 credit hour course entitled Astrophysics (ASTR-3415) for the **Spring 2003** semester (**Tuesday & Thursday 11:15 am – 12:35 pm**) and taught by Dr. Donald Luttermoser. The prerequisites for this course are Technical Physics I & II (PHYS-2110/2120) or *permission of instructor*.

In Astrophysics you will learn that the first of these questions is answered with the 4 ordinary differential equations of stellar structure (shown to the right):

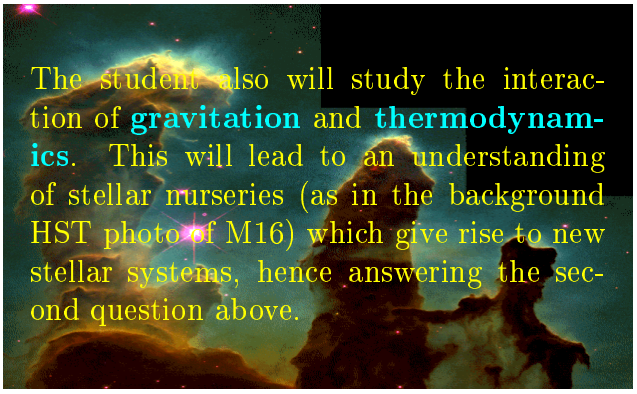
- **hydrostatic equilibrium**
- **continuity equation**
- **radiative equilibrium**
- **conservation of energy**

$$\frac{dP}{dr} = \frac{-GM(r)\rho(r)}{r^2}$$

$$\frac{dM}{dr} = 4\pi r^2 \rho(r)$$

$$\frac{dT}{dr} = \frac{-3\kappa(r)\rho(r)L(r)}{64\pi\sigma r^2 T^3(r)}$$

$$\frac{dL}{dr} = 4\pi r^2 \rho(r)\epsilon(r)$$

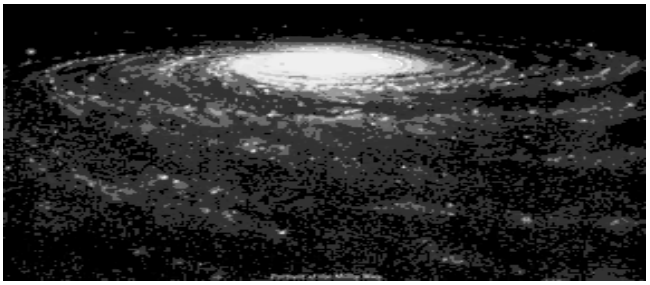


The student also will study the interaction of **gravitation** and **thermodynamics**. This will lead to an understanding of stellar nurseries (as in the background HST photo of M16) which give rise to new stellar systems, hence answering the second question above.

We will see that the last two questions can be answered from the following *simple looking* equation:

$$R_{\mu\nu} - \tfrac{1}{2}\mathcal{R}g_{\mu\nu} = 8\pi G T_{\mu\nu} + \Lambda g_{\mu\nu} \ ,$$

which are the **Einstein Field Equations** (roled up into this tensor equation) — in reality, **no easy task to solve!**



The third question posed above can only be answered with an understanding of **nuclear physics** (stellar evolution) and **gravitational N-body simulations** (galactic evolution). One thing is certain, **you will learn that nature changes over time** $\Longrightarrow$ **it evolves!**

Astrophysics is a problem-solving course $\Longrightarrow$ the mathematics used in this course requires a knowledge of calculus and basic differential equations. Upon the completion of this course, the student will have a firm footing in a basic understanding of the cosmos that surrounds us.