## Welcome to Physics 102

This class is a survey of our universe as seen by modern science and an exploration of concepts of a multiple universe reality. Physics 102 is designed for non-science majors. The course is conceptual and the use of mathematics will be limited.

- **motion**
- > String theory
- > Energy
- **➤** Gravitation
- > Rotational motion
- > Waves
- > light
- > electricity and magnetism
- > nuclear forces
- > Standard Model of particle physics

- **▶** The Big Bang
- > Dark matter

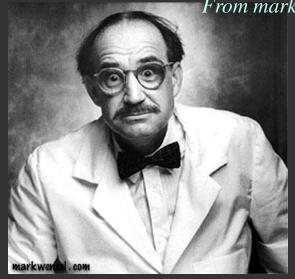
No previous physics instruction is assumed.

- > stellar evolution
- > Special Theory of Relativity
- > General Theory of Relativity
- > Quarks, leptons, gluons, baryons, mesons, etc.
- > cosmic microwave background
- > quantum mechanics
- > Heisenberg's Uncertanity Principle
- > radiation
- > nuclear bombs
- > at least 11 different multiple universe concepts

### Physics 102 – Visions of the Multiverse Spring term 2011, University of Rochester

This is an introductory course designed especially for students in the humanities and other non-scientific fields who are interested in learning about science, physics and concepts of a multiple universe reality. Topics include the nature of science, Newton's laws, relativity, light, quantum mechanics, the nature of particles and forces, and cosmology. In the course of surveying the modern scientific view of the universe, a number of serious concepts of a multi-universe reality will be examined, including the many-worlds view of quantum mechanics, inflationary and string-based cosmologies. There are no prerequisites, no background knowledge is required and the material will be presented with very little mathematics. Substantial use will be made of demonstrations. This course is intended to be equivalent to our Physics 100 course in terms of satisfying cluster requirements.

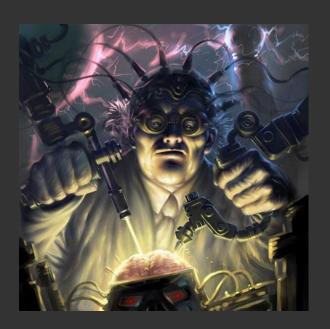
From markwenzel.com

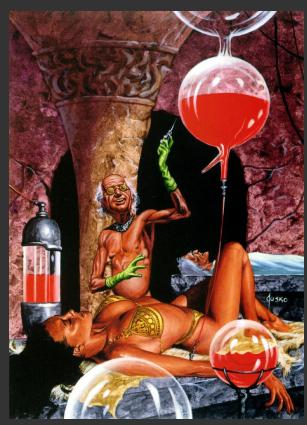


The nature of science



From cientifica.eu



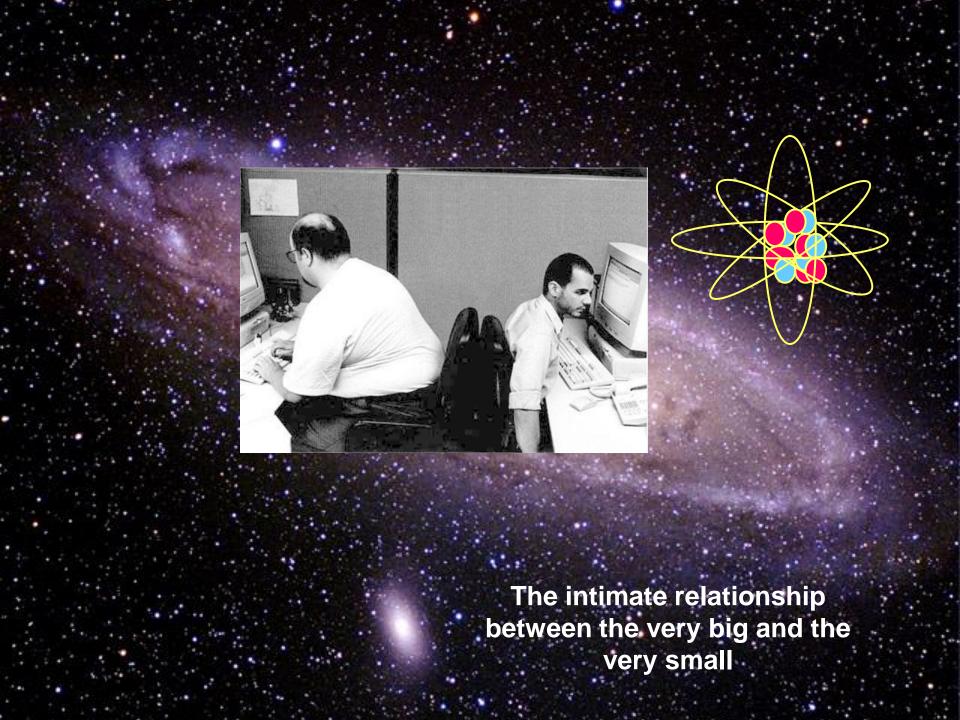


From theduogroup.com

From www.robertocampus.com



**Confronting Human bias** 





Concepts of the a multiple universe reality

J. Baum/SPL, from nature .com

### **Evaluation:**

Scheme	Exam 1	Exam 2	Final exam	Recitation
1		25%	35%	40%
2	25%	-	35%	40%
3	17%	17%	26%	40%

Each scheme calculated, best average sets your place on the numerical curve

Possible inter-exam normalization

I place grade boundaries on numerical curve Reading, recitations, lecture Note: no class this Monday

## No recitations until I send class announcement via email

# Professor Steven Manly B&L 203E 5-8473 steven.manly@rochester.edu

http://web.pas.rochester.edu/~manly/class/P102\_2011S/

## What is a universe?

# Max Tegmark's multiverse taxonomy

# Classified by level of abstraction/complexity



Cosmologist at MIT

### Level 4: Other mathematical structures Level 1: Regions beyond our cosmic horizon Features: Same laws of physics, different initial conditions Features: Different fundamental equations of physics Assumptions: Infinite space, ergodic matter distribution Assumption: Mathematical existence = physical existence - Microwave background meaurements point to Evidence: - Unreasonable effectiveness of math in physics flat, infinite space, large-scale smoothness - Answers Wheeler/Hawking question: Simplest model "why these equations, not others" Level 3: The Many Worlds of Quantum Physics Level 2: Other post-inflation bubbles Features: Same as level 2 Same fundamental equations of physics, but perhaps different constants, particles and dimensionality ssumption: Physics unitary Assumption: Chaotic inflation occurred Evidence: - Experimental support for unitary physics Evidence: - Inflation theory explains flat space, scale-invariant - AdS/CFT correspondence suggests that

even quantum gravity is unitary

Decoherence experimentally verified

- Mathematically simplest model

fluctuations, solves horizon problem and monopole

problems and can naturally explain such bubbles

Explains fine-tuned parameters

However if you do careful observations... even at "human" Scales nature has some surprises

bicycle wheel demo

Support Wheel not rotating Falls

wheel does

Not fall

rather moves

to the Side!

Surprise!