4/23/2008

Fourth, Last Exam, Friday May 2

Reading

Chapter 11 - all except 11.6, 11.7 Chapters 12, 13, 14 - all

Astronomy in the News -

Pic of the day - Moon and Venus over Mauna Kea where a significant portion of modern astronomy is done.



Worm Holes and Time Machines (Chapter 13)

Amazing mathematical developments in the context of Carl Sagan's *Contact* by Kip Thorne and Igor Novikov:

Einstein's equations allow the possibility of worm holes. To be stable, they must be held open by some imagined "substance" that anti-gravitates.

Highly curved space, but no singularity.

The Dark Energy gives a hint that such a "substance" could exist.





The mouth of a worm hole would be a 3D "object," the space inside highly curved.

3D hyperspace through hole

Embedding diagram of a worm hole in an "open" universe

The most amazing property discovered was that, in principle, worm holes would also be *time machines*!

Novikov Consistency Conjecture: physics will arrange itself so that there is no time-travel paradox - you cannot travel back in time and kill yourself before you enter the worm hole/time machine.

Thorne video