Thursday 4/16/09

GW

Agenda

- Schedule Projects for Next week
- Observation Tuesday
- Gravitational Wave Astronomy
- *Einstein's Messengers*
- GW Lab

Schedule for Next Week

- Tuesday:
  - **Alicia** versus **Lucille**: Global Warming Caused by Mankind
  - **Melissa**: Won't be visiting/colonizing other planets
  - **Meagan**: Extraterrestrial Life Exists
  - **Krissy**: Creationism versus Evolution
- Thursday:
  - **Caitlin**: Stop Animal Testing
  - **William**: We should build on the moon
  - **Nick**: No Nuclear Power
  - **Jennifer**: Against Missile Defense

Gravitational Wave Astronomy

- Einstein's Theory surpassed Newton's
- Introduced time to gravity→gravity waves
- GW unlike X-rays, Gamma rays
  - Electromagnetic radiation (light) has various bands
  - GW is entirely separate spectrum

Information Carried

- Large masses moving fast…strongest sources
- Once produced, GW hard to disturb…important for clear "pictures"
- Unlike EM, GW arise from central regions of astrophysical systems
- Very weak signals!

Effect of Passive GW

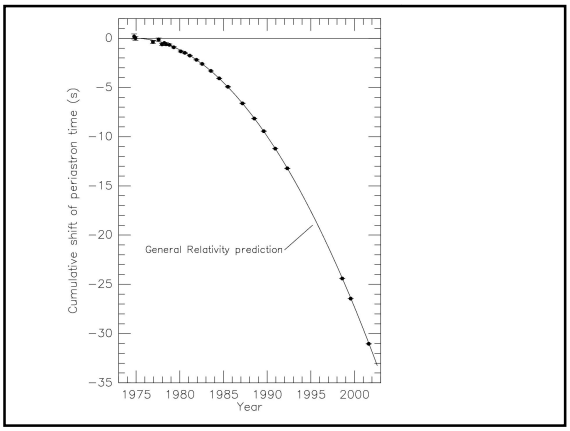
- Alternating stretching/pulling of space
- Like a wave on a pond…get weaker as they spread out
- Rulers change length…change in length proportional to total length
- Small changes…less than diameter of an atom for a meter stick!
- Because of this, detectors designed BIG!

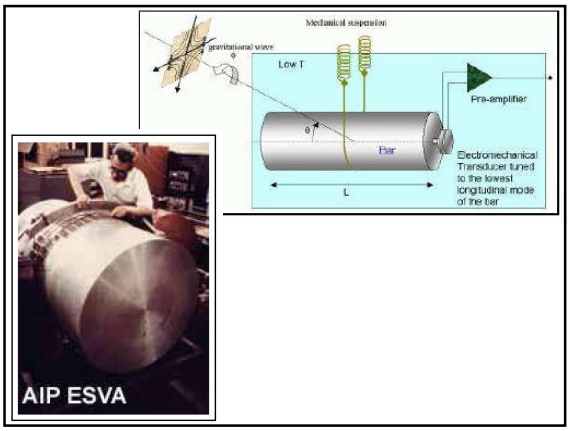
Hope to learn…

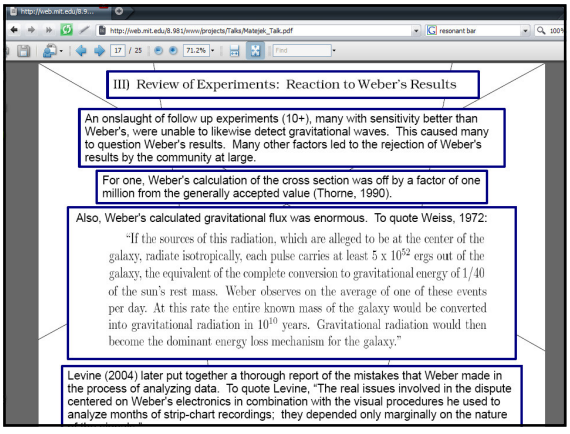
- Periodic sources….compact binaries
  - Compact objects: neutron stars, white dwards, black holes
- Burst sources
  - Merging binaries
  - Supernovae
  - AGN, GRB, etc…BH engines
- Totally unexpected stuff…like Galileo pointing the telescope up!

Attempts to Measure

- Indirect:
  - Hulse & Taylor—energy loss from GW; Nobel Prize
- Direct:
  - Resonant Bar—somewhat controversial
  - Interferometers
    - LIGO and ilk on Earth
    - LISA (proposed): space based






III) Review of Experiments: Reaction to Weber's Results

An onslaught of follow up experiments (10+), many with sensitivity better than Weber's, were unable to likewise detect gravitational waves. This caused many to question Weber's results. Many other factors led to the rejection of Weber's results by the community at large.

For one, Weber's calculation of the cross section was off by a factor of one million from the generally accepted value (Thorne, 1990).

Also, Weber's calculated gravitational flux was enormous. To quote Weiss, 1972:

"If the sources of this radiation, which are alleged to be at the center of the galaxy, radiate isotropically, each pulse carries at least 5×10^{52} ergs out of the galaxy, the equivalent of the complete conversion to gravitational energy of 1/40 of the sun's rest mass. Weber observes on the average of one of these events per day. At this rate the entire known mass of the galaxy would be converted into gravitational radiation in 10^{10} years. Gravitational radiation would then become the dominant energy loss mechanism for the galaxy."

Levine (2004) later put together a thorough report of the mistakes that Weber made in the process of analyzing data. To quote Levine, "The real issues involved in the dispute centered on Weber's electronics in combination with the visual procedures he used to analyze months of strip-chart recordings; they depended only marginally on the nature