

Cape Cod Astronomical Society - Minutes of the August 6, 2015 meeting

Attendance: 24 members and 3 guests

The meeting was held at the Dennis-Yarmouth High School Library.

Tonight's speaker is a member of CCAS: Jim Lynch of Woods Hole Oceanographic Institute. Dr. Lynch is the recipient of the Robert W. Morse Chair for Excellence in Oceanography, and is a senior scientist in the Applied Ocean Physics and Engineering Department at WHOI.

In addition to Jim's presentation, below, the following items were discussed:

- Peter welcomed the new members, and reminded everyone that dues should be paid.
- Mike stated that anyone who would like to participate in Observatory maintenance is welcome. (Update: we are having a maintenance session on Tuesday, August 25).
- Mike announced the results of the brief survey asking last month's attendees what they would like for speaker's topics: cosmology, astrophysics, technology of observing and astrophotography, and any up-to-date science.
- Upcoming topics:
 - Celestial navigation (September)
 - Mechanics and hardware of observation (October)
 - Space exploration / exoplanets (November)

Title of Jim's presentation:

General Relativity and Cosmology

- Before Einstein, things were simple: absolute separation of space and time (Euclidian). We just wanted to get from point A to B.
- Special relativity refers to inertial reference frames. Consequence: at speed clocks run slow and the length of an object contracts along the direction of motion. Space and time become a singular entity: spacetime.
- We live within the "lightcone", defined by Einstein's speed limit.
- Scaler – Quantity; Vector – Magnitude and Direction; Tensors – Invariant; Matrices – Rank 2 Tensors.
- A metric tells how to measure distance between two points in space. Metric tensor is a major component of relativity.
- General relativity deals with non-inertial reference frames. Gravitational and inertial mass is the same.
- Thought experiments: falling apple in the elevator; beam of light bent in elevator (=curved spacetime); deflection of starlight by the sun.

- “Matter tells spacetime how to curve, and spacetime tells matter how to move.” John Wheeler
- (Secretary’s note: what followed in Dr. Lynch’s presentation was some mostly college level mathematics describing spacetime and the characteristics of general relativity that far exceeds this recorder’s knowledge level. So, I am taking the liberty of skipping most of that math and move to some summary slides).
- Einstein wanted to predict the then defined static universe, so he added the cosmological constant, then withdrew it after Hubble showed an expanding universe. DeSitter used the constant to explain an exponentially expanding universe (turned out to be correct).
- His constant later fit the idea of dark energy perfectly.
- Metrics discussed: Schwartzchild, Kerr, Reissner-Norstrom, Minkowski, Robertson-Walker (the latter: universe homogeneous and isotropic on large scale).
- At Einstein’s death in 1955, the universe was described as Einstein-DeSitter. Now it is the Lambda-CDM model, which has dark and light matter, dark energy and radiation (i.e., radiation dominated for the first 50 thousand years, matter for the next 9.8 billion years, and dark matter current (beyond) that.

After Jim’s presentation and question and answer period, Joel mentioned that there would be a new moon for next Thursdays star party, and Peter briefly discussed the Perseids on the 11th and 12th in the northeast.

The meeting was adjourned at 9:10 PM.

Next meeting: September 3, 2015.

Respectfully submitted,
Gus Romano, CCAS Secretary