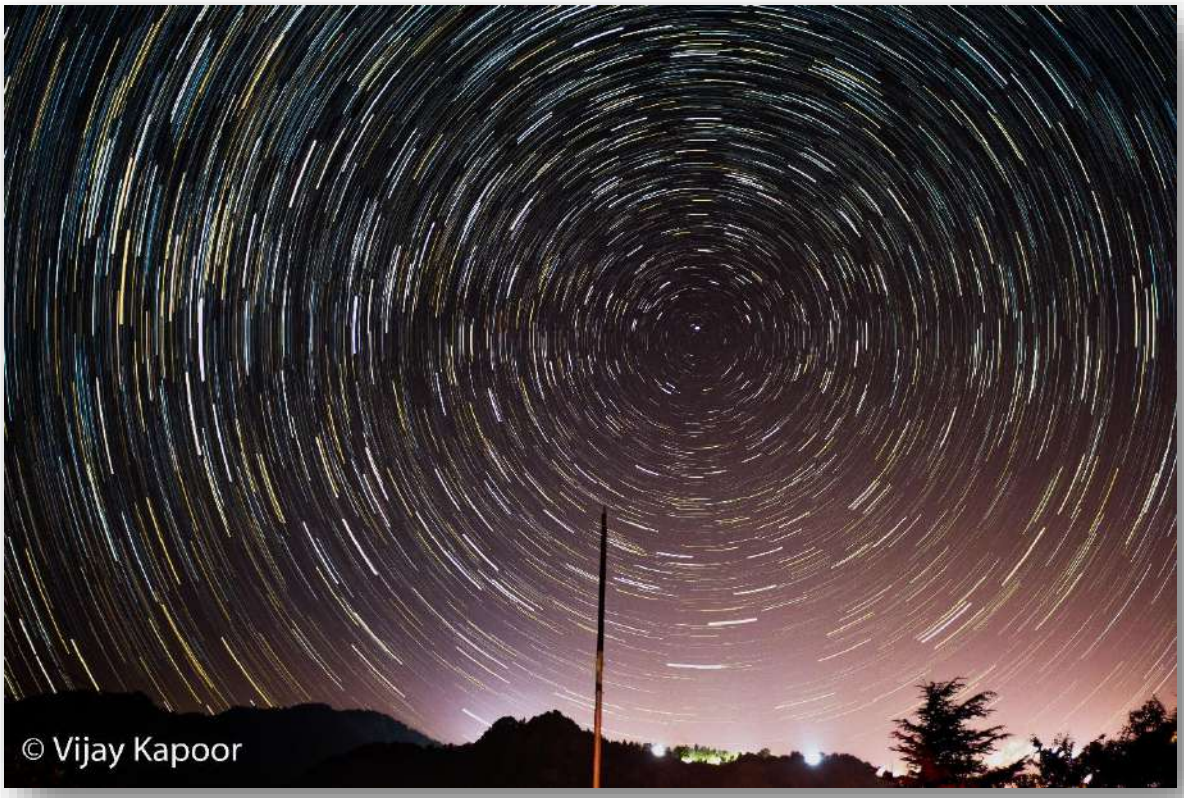
Cosmology Club of DTU

Educational Trip Dec. 2016

Technical Report



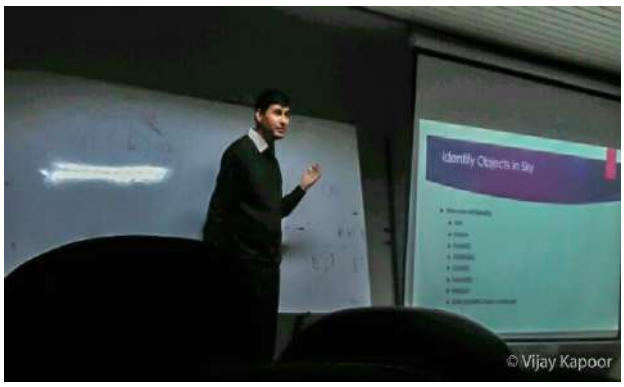
Pic description : *Star Trails around Polaris or North Pole Star, at the place of observations, due to Earth's rotation.*

Details of the Trip:

- **Duration**:
  2nd December 2016 to 4th December 2016.
- **Location**:
  Aryabhatta Research Institute of Observational Sciences (ARIES)
  Manora Peak
  Nainital-263002
  Uttarakhand (India)

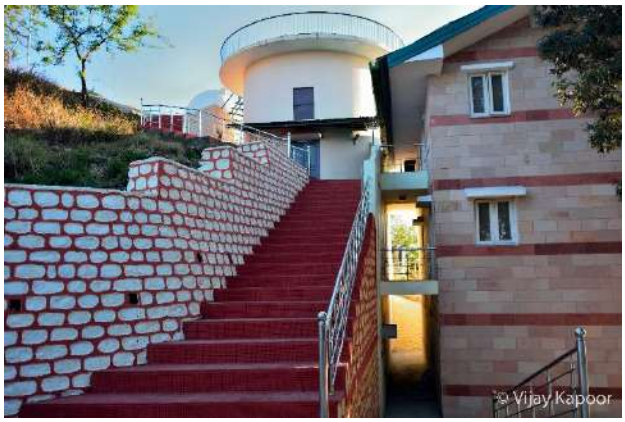
The Cosmology Club organized its first educational trip: "Basics of Practical Astronomy (visual) and Astro-Photography" to ARIES Observatory at Nainital. Besides the club members, the response from non-club members was higher than expected which resulted an increase in the number of people going to the trip from 25 to 49 in total.

This trip was under the guidance of the founder of Delhi Astronomy Club – Mr. Vijay Kapoor (an Amateur Astronomer), who was our expert advisor about the trip, along with his two Telescopes and various other required equipment. This trip was planned and executed successfully for both flavours of Astronomy: Star Gazing (visual astronomy) and Astro-Photography with dedicated equipment.



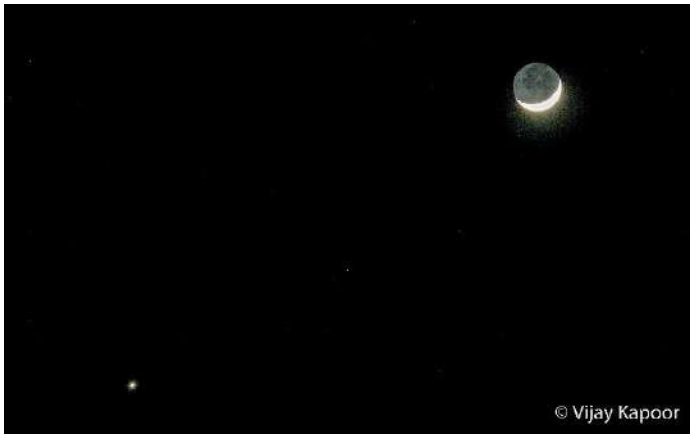
Before starting journey to Nainital, lectures were conducted by Mr. Vijay Kapoor (as shown on the left-hand side photo) on "Basic and Advanced Topics in Practical Astronomy" for all participants of the trip. That helped them with both theoretical and practical aspects of Astronomy. After the series of lectures, the participants were well prepared with Do's and Don'ts of the planned session and things to be taken care of at the time of observations.

Basic and advanced aspects of Astronomy were discussed such as types of objects in night sky- Moon, Satellites, Meteor showers, Asteroids, Galaxies, Nebulae; types of celestial coordinate systems; types of telescopes and their working; types of equipment used in astro-photography.



The place of observation or star gazing was an open circular-base tower (as shown on the left-hand side photo) on the roof of Science Centre at ARIES. The tower proved to be an excellent place for the planned session in night.

Before we reached at the gazing spot, we captured Moon-Venus conjunction (a conjunction refers to when two or more objects appear close together) on the way with 20mm prime lens and camera only (as shown below).



An interesting phenomenon known as Earthshine is demonstrated in the left-hand side photo (zoomed version of Moon-Venus Conjunction).

Moon is a spherical object; hence it is always half-illuminated by sunlight and Earthshine is the dull glow which lights up the unlit part of the moon because of the light from Sun which gets reflected from the Earth's surface back on the Moon's dark area. Hence, Earth-Shine.

Before starting the main night session, i.e., before opening telescopes, small instructions (as a precautionary measure for safety of self as well as equipment) were given to everyone on the spot to learn and enjoy the Astronomy.

During the session, students learnt following things:

1. How to use mobile applications like "SkyMap" which uses your location co-ordinates and time-zone to become a hand-held planetarium for your device which is used to locate and identify stars, planets and other astronomical objects.
2. Set up of a Telescope:
    a. Assembly of different parts: Tripod, Mount and Telescope; this process took approximately 30 minutes.
    b. Polar Alignment of the Mount, this process took around 15-20 minutes.
    c. Collimation of Primary and secondary mirrors of Newtonian Telescope; this process took around 25-30 minutes.
    d. Sky Aligning telescope, this process took around 10 minutes.

A ***mount*** is an electro-mechanical device used to align the ***telescope or camera*** with an object in night sky to be zoomed in. It rotates the telescope or camera for matching earth's rotation speed for long exposure photography of fainter deep sky objects. Celestron Advanced VX Mount was used for this session.

In polar alignment, we align the mount to Pole Star and in sky alignment, we feed the location, date and time of observation and the name of astronomical object of interest to mount. Then the mount automatically aligns the telescope or camera to face in the required direction. Collimation refers to proper alignment of the mirrors for image formation.

After performing all above steps, we were ready to observe and click photos of the astronomical objects. Moreover, the observation night was a ***moonless night*** of 3rd December 2016 to our advantage.

Two different telescopes were used in the session:

1. Newtonian Telescope
   It is a type of reflecting telescope-a telescope which uses parabolic mirrors to reflect light and form image. Used usually for Deep Sky Objects.

2. Maksutov-Cassegrain (MAK) Telescope
   It is a type of catadioptric telescope-a telescope which uses both mirror and lens to form an image. Used usually for Planetary objects.

Visual Report:

- **Planets and Solar System Objects seen through Planetary Telescope-MAK:**
  Moon
  Jupiter and its 4 moons- Ganymede, Callisto, Europa, Io.
  Uranus
  Saturn (This was not visible on the observing night as it rises in the sky during the day time, however, students were keen to see it's ring system)
- **Milky Way Spiral Arm was seen with naked eyes.**

- **Following Meteor Shower were also seen through naked eyes:**
  Puppid-Velids
  Sigma-Hydrids
  Northern Taurids

Following Messier Objects and Deep Sky Objects were seen through Newtonian telescope:

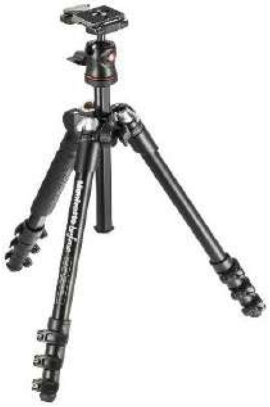
Messier Number	Common Name	Object Type	Constellation
M1	Crab Nebula	Supernova Remnant	Taurus
M31	Andromeda Galaxy	Spiral Galaxy	Andromeda
M42	Orion Nebula	Nebula	Orion
M45	Pleiades	Open Cluster	Taurus
M52	-	Open Cluster	Cassiopeia
M96	-	Spiral Galaxy	Leo
M97	Owl Nebula	Planetary Nebula	Ursa Major
M103	-	Open Cluster	Cassiopeia
M110	-	Dwarf elliptical Galaxy	Andromeda
NGC 2244	Caldwell 50	Open cluster within nebula	Monoceros
NGC 6543	Cat's Eye Nebula	Planetary nebula	Draco

Following Double stars were also seen through telescope:

- Zeta Piscium
- Psi Piscium
- Eta Cas

Astro-Photography:

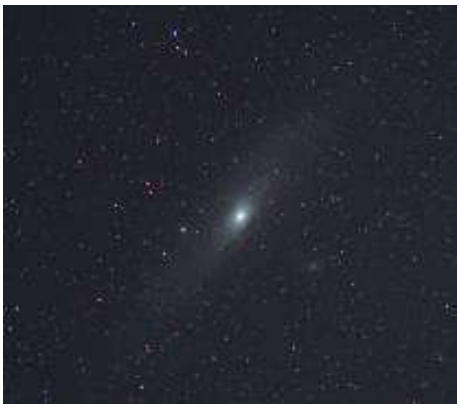
For Deep sky Astro-Photography, a Mount (iOptron SkyTracker Pro, in red color) was used along with a ***tripod*** (Manfrotto Tripod), which is used to provide stability to camera in astro-photography. Both items are shown below:



Following were captured with camera lens and mount-tripod system and processed in Adobe Lightroom software after stacking of different frames with different exposure time in Deep Sky Stacker software:

- Star Trails over North Pole Star (Polaris); Camera Still on Tripod, SkyTracker (mount) is not required.
- Milky Way Spiral arm over the wide night sky.
- Andromeda Galaxy (M31) along with its satellite galaxies (M32, M110).
- The Pleiades or Seven Sisters (Messier 45 or M45).
- Part of Orion Family including: M42, M43, Orion Belt Stars, NGC 1976, NGC 1977, NGC 1975, NGC 1973, NGC 2024, Horsehead Nebula: Barnard 33, *The Running Man Nebula* and Sharpless Catalog 279.
- M51, Whirlpool Galaxy in Canes Venatici constellation, NGC 5194
- Photos of the students' group along with Telescope and wide angle night sky with few Deep Sky Objects visible in the photo.

Single Image (Left) Vs. Stacked & Processed(Right) image of M31 or Andromeda Galaxy

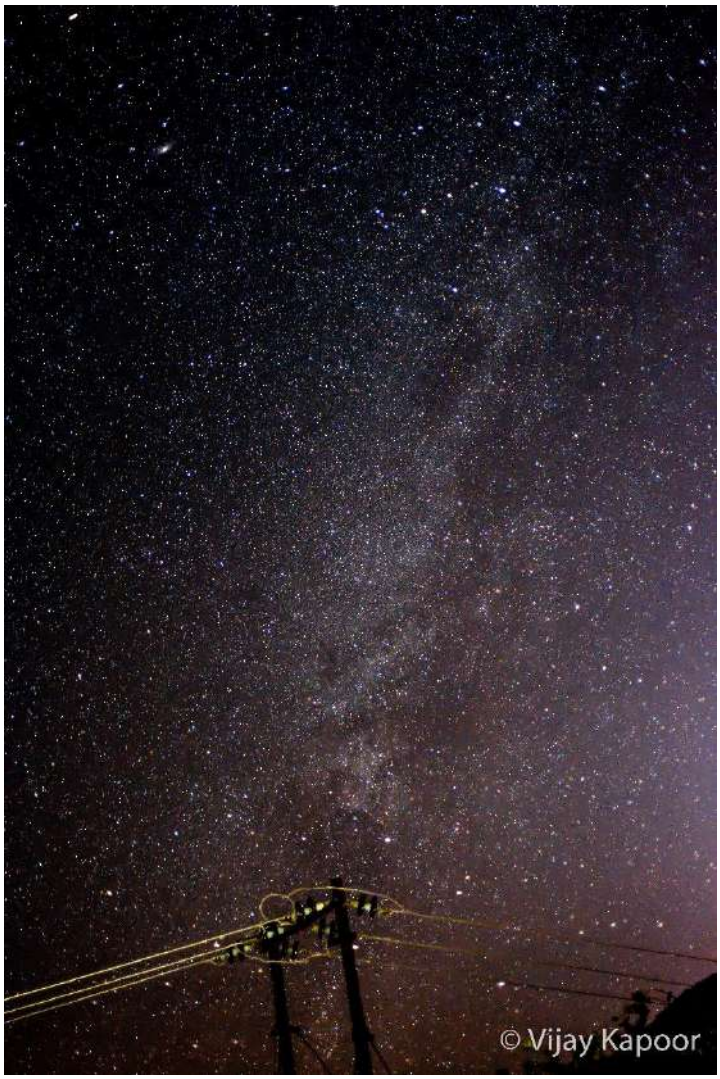


We can clearly notice the difference between single captured image vs. stacked & processed image. **Stacking** simply means combining different frames or clicks of a camera to generate a final image and **Processing** refers to further enhancements in image quality to see features of the object.
Obviously, for stacking, data is required and the collection of that data is precisely what is known as **Astro-Photography**. All the Astro-Photography and processing was done by our expert advisor Mr. Vijay Kapoor, with his equipment. The above two images were taken at the place of observation.

Some Processed Images of the trip

For all the images with details, please go through our Club's fb page: https://www.facebook.com/cosmosdtu

1. **One of the visible spiral arms of our home galaxy-The Milky Way galaxy**



2. Andromeda Galaxy (M31) along with its satellite galaxies (M32, M110)

Image Details:

Andromeda Galaxy (M31) along with its satellite galaxies (M32, M110)

The Andromeda Galaxy, also known as Messier 31, M31, or NGC 224, is a spiral galaxy approximately 780 kiloparsecs (2.5 million light-years) from Earth. It is the nearest major galaxy to the Milky Way and was often referred to as the Great Andromeda Nebula in older texts.

Equipment used:

Nikon D7100, Nikkor Ai-s ED 180mm f/2.8 lens, iOptron SkyTracker Pro, Manfrotto Tripod.

Data & Processing Details:

15 Minutes of exposure

Subs: 30 frames * 30 sec. each

Flat: 10

Offset Bias: 10

Dark: 12

ISO-1600

Stacked in DeepSkyStacker, Processed in Lightroom

Sky Conditions:
Bortle scale of 2 or 3 (maybe)

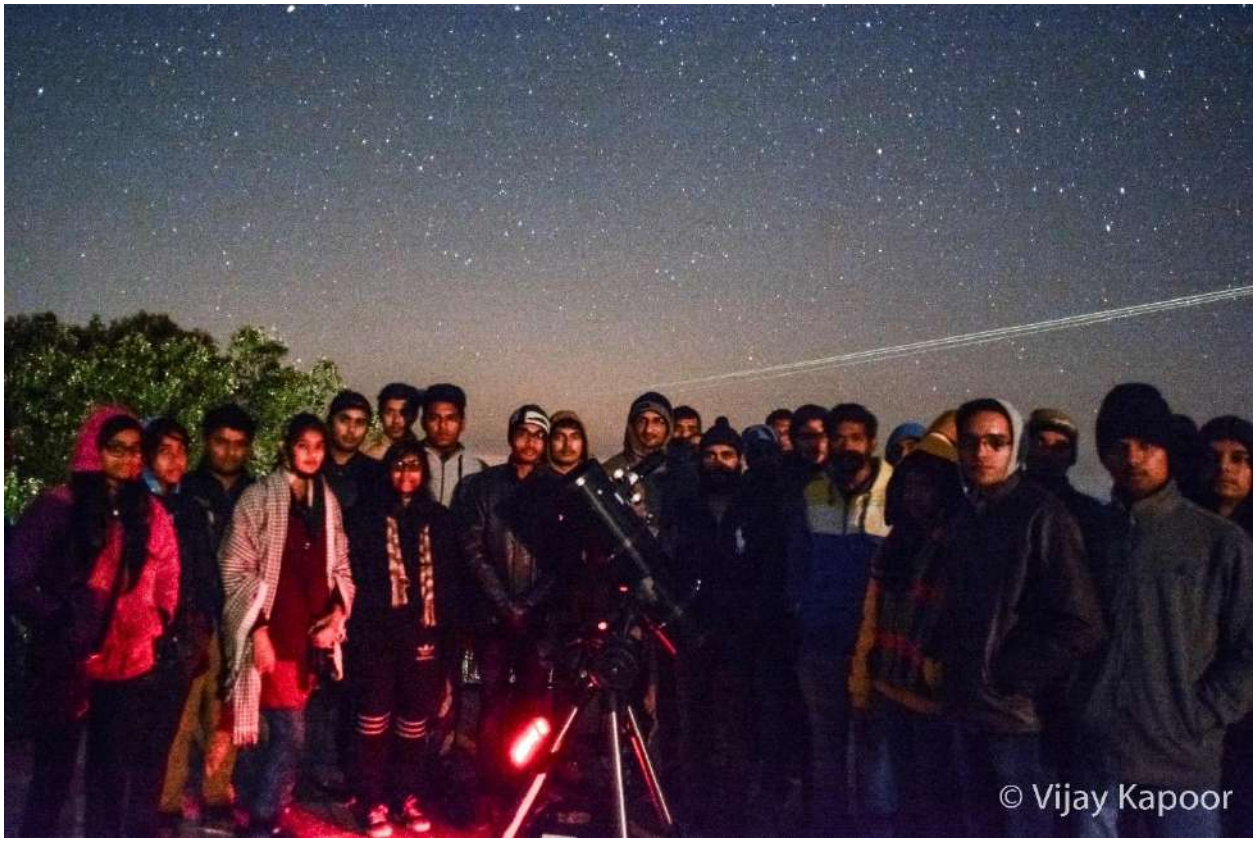
Seeing conditions and transparency:
9 out of 10

Location:
ARIES Observatory, Nainital, Uttarakhand, INDIA

So, what we did there is we clicked 30 frames, each of 30 seconds' exposure time (hence, total exposure time equals 15 minutes) and stacked in DeepSkyStacker software and then processed in Lightroom.

The Bortle scale is a 9-level numeric scale which measures the astronomical observability of celestial objects in night sky of a location. The scale ranges from 1, best observability at darkest skies available on Earth to 9, inner-city skies.

The club members: and our faculty supervisor-Mr. Pankaj Kumar, a Research Scholar in the Deptt. Of Applied Mathematics, DTU on the night of observation: 3^{rd}– 4^{th} December 2016 with a Newtonian Telescope in the centre.



The objective of this trip was to teach students how "***the inference of cosmic data***", i.e., Astronomy-the scientific study of celestial objects and phenomema in order to explain their origin and evolution, is pursued and how "***the collection of cosmic data***", i.e., Astro-Photography is pursued which comprises of setting up of Telescope (Mount-Tripod system), tracking of celestial object of interest and stacking, processing of images taken.

But more importantly, the objective was to teach them the basics of star gazing-an activity quite forgotten in modern society and share with them-**the most astounding fact about the Universe** shown on the next page.

What is the most astounding fact you can share with us about the Universe?

As answered by Dr. Neil deGrasse Tyson (American Astrophysicist):

“

The most astounding fact is the knowledge, that the atoms that comprise life on Earth, the atoms that make up the human body are traceable to the crucibles that cooked light elements into heavy elements in their core under extreme temperatures and pressures.

These stars, the high mass ones among them went unstable in their later years, they collapsed and then exploded scattering their enriched guts across the galaxy; guts made of carbon, nitrogen, oxygen and all the fundamental ingredients of life itself. These ingredients become part of gas cloud that condense, collapse, form the next generation of solar systems stars with orbiting planets, and those planets now have the ingredients for life itself.

So, that when I look up at the night sky and I know that yes, we are part of this universe, we are in this universe, but perhaps more important than both of those facts is that the Universe is in us. When I reflect on that fact, I look up – many people feel small because they’re small and the Universe is big – but I feel big, because my atoms came from those stars.

There’s a level of connectivity. That’s really what you want in life, you want to feel connected, you want to feel relevant you want to feel like you’re a participant in the goings on of activities and events around you That’s precisely what we are, just by being alive.

”

__ ClearSky

Cosmology Club (DTU)

International Astronomical Search Collaboration

March 20 — April 19, 2017

Apoorv Choubey

Cosmology Club - Delhi Technological University

IN RECOGNITION OF VALUABLE CONTRIBUTIONS TO
OBSERVATIONS OF NEAR-EARTH OBJECTS AND MAIN BELT
ASTEROID DISCOVERIES BY PARTICIPATING IN THE ANALYSIS
OF IMAGES FROM PAN-STARRS.

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