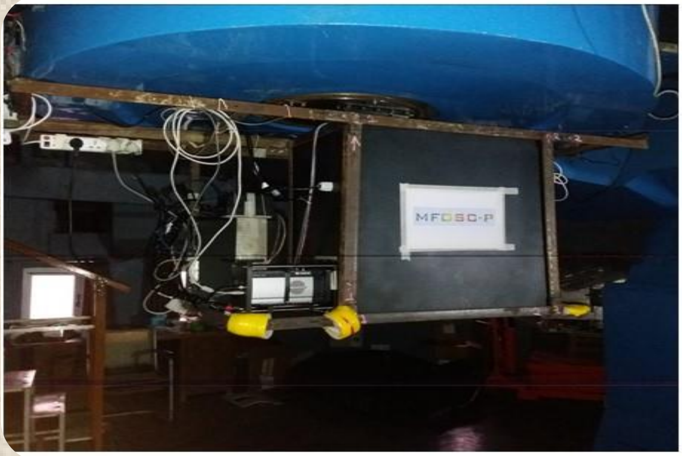
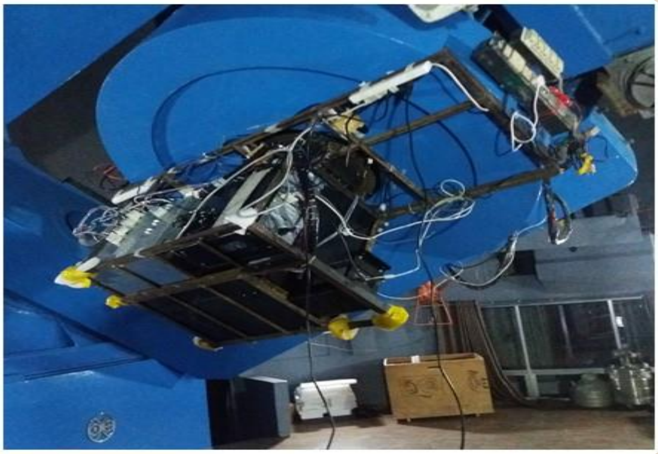
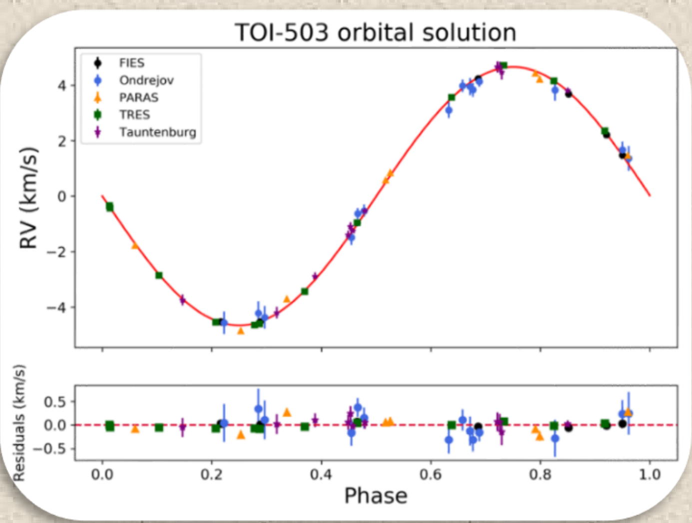
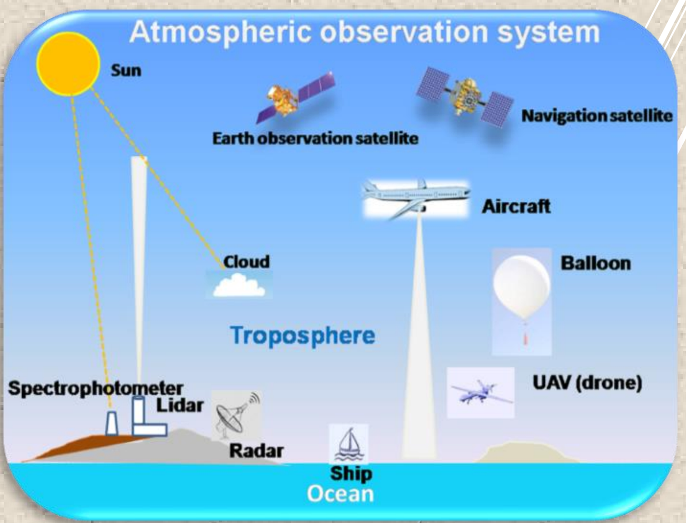
PRL NEWS – THE SPECTRUM

July 2020









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Science Highlights

Arvind Rajpurohit

First Results from MFOSC-P : Low Resolution Optical Spectroscopy of a Sample of M dwarfs within 100 parsecs

(A. S. Rajpurohit, Vipin Kumar, Mudit K. Srivastava, F. Allard, D. Homeier, Vaibhav Dixit and Ankita Patel)

(February 11, 2020)

Mt Abu Faint Object Spectrograph and Camera (MFOSC-P) is an in-house-developed instrument for the Physical Research Laboratory (PRL) 1.2 m telescope at Mt Abu, India, commissioned in 2019 February (Fig. 1). Here we present the first science results derived from the low-resolution spectroscopy programme of a sample of M dwarfs carried out during the commissioning run of MFOSC-P between 2019 February and June. M dwarfs carry great significance for exoplanet searches in the habitable zone and are among the promising candidates for the observatory's several ongoing observational campaigns. Determination of their accurate atmospheric properties and fundamental parameters is essential to constrain both their atmospheric and evolutionary models. In this study, we provide a low-resolution ($R \sim$ 500) spectroscopic catalogue of 80 bright M dwarfs ($J <$ 10) and classify them using their optical spectra (Fig. 2). We have also performed spectral synthesis and c^2 minimization techniques to determine their fundamental parameters regarding effective temperature and surface gravity by comparing the observed spectra with the most recent BT-Settl synthetic spectra. The spectral type of M dwarfs in our sample ranges from M0 to M5. The derived effective temperature and surface gravity range from 4000–3000 K and 4.5–5.5 dex, respectively. In most of the cases, the derived spectral types are in good agreement with previously assigned photometric classifications

Source/Reference of the Work:- 10.1093/mnras/staa163

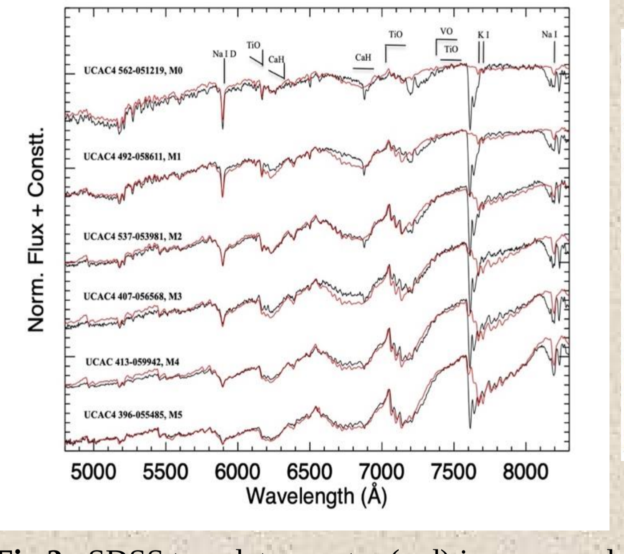


Fig 2: SDSS template spectra (red) is compared with observed spectral sequence of M dwarfs (black). Representative spectra of different subclasses from our sample are chosen to show the match. The most prominent spectral features along with the derived spectral type are also labeled.

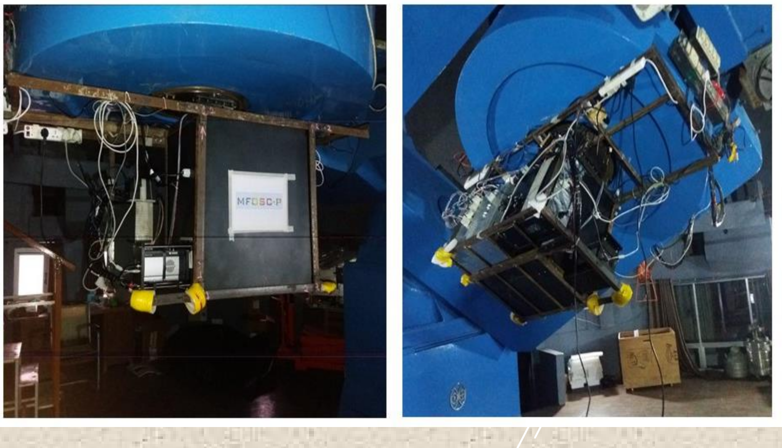


Fig 1: - MFOSC-P instrument mounted on PRL 1.2m telescope

Science Highlights

Lokesh Sahu

***Review Article*:**

Observations of Trace Gases in the Earth's Lower Atmosphere: Instrumentation and Platform

L. K. Sahu, Nidhi Tripathi, and Ravi Yadav

25 June, 2020.

The earth's atmosphere is a complex mixture of many gases and their observations are incorporated in chemistry-climate models. Atmospheric observations have been the backbone of recent progress in atmospheric science, particularly about our understanding of the sun-atmosphere interaction causing chemical and radiative forcing linked to the environment and climate change. In terms of technology, there has been a significant progress in both in-situ and remote sensing measurements of various variables in the lower atmosphere. Among many variables, trace gases play important role in climate change and several environmental problems. The recent progress in both in-situ and remote sensing based instrumentations has enabled the researchers to investigate various atmospheric processes in great detail. For example, gas chromatography (GC) based instrumentation provides the detection from simple to complex species present in the atmosphere at very low concentrations. The laser-based spectroscopic instruments are emerging tools for fast response measurements of trace gases, which are important to understand rather short-term processes. The proton transfer reaction-mass spectrometry (PTR-MS) is regarded as one of the great technologies for the detection of numerous but specific types of trace gases namely volatile organic compounds (VOCs). However, there are advantages and disadvantages of any instrument in terms of quality of data, comprehensiveness, and cost. In this paper, we have discussed the recent progress in instrumentation used for the measurements of trace gases in the lower atmosphere using space, aircraft and satellite based platforms as well as some laboratory techniques. However briefly, we have also highlighted the progress during the past couple of decades, present status and future scenarios of trace gas measurements in the South Asia region. (https://www.currentscience.ac.in/Volumes/118/12/1893.pdf)

"The Air We Breathe": This review article has been selected for the Highlight of the issue (CURRENT SCIENCE, VOL. 118, NO. 12, 25 JUNE 2020, https://www.currentscience.ac.in/Volumes/118/12/1862.pdf).

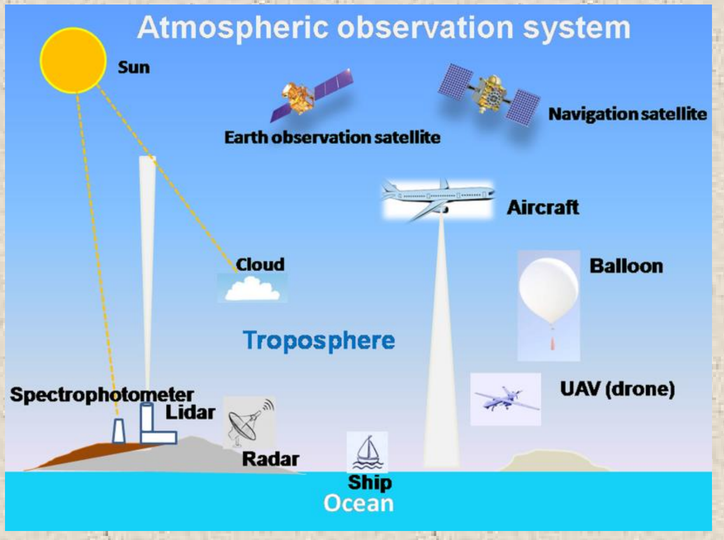


***Figure 1**: A pictorial representation of the atmospheric observation system consists of a multitude of individual surface-, air-, and space-based instruments used for the in-situ and remote sensing measurements of trace gases in the lower atmosphere. The integrated national and international strategies will be necessary to make comprehensive measurements of trace gases in the Earth's lower atmosphere.*

Science Highlights

TOI-503 b: The First Known Brown-dwarf from the TESS Mission & PARAS

(Rishikesh Sharma, Abhijit Chakraborty, Priyanka Chaturvedi, KESPRINT & Harvard Team)

(March 27, 2020)

Rishikesh Sharma

Brown dwarfs (BDs) are loosely defined as the objects that separate giant planets from low-mass stars and their mass ranges from around 13 M_J to 78 M_J (the approximate mass range to sustain deuterium fusion). We have discovered an intermediate-mass transiting BD, TOI-503b, from NASA's Transiting Exoplanet Survey Satellite (TESS) mission. TOI-503b is the first BD discovered by TESS and PARAS, revolves around a metallic-line A-type star in 3.67718±0.0001 days circular orbit. The light curve from TESS indicates that TOI-503b transits its host star in a grazing manner, which limits the precision with which we measure the BD's radius (RBD = 1.34 ± 0.22 RJ). We obtained high resolution spectroscopic observations with the FIES, Ondřejov, PARAS, Tautenburg, and TRES spectrographs, and measured the mass of TOI-503b to be MBD = 53.7 ± 1.2 MJ. The host star has a mass of Mstar = 1.80 ± 0.06 Msun, a radius of Rstar = 1.70 ± 0.05 Rsun, an effective temperature of Teff = 7650 ± 160 K, and a relatively high metallicity of 0.61 ± 0.07 dex. We found the host star to be overabundant to iron and underabundant to some key elements such as Ca, Sc, or Mg, which revealed that the star is a metallic-line or Am star. We used stellar isochrones to derive the age of the system to be ~180 Myr, which places it in the group of youngest transiting BDs discovered yet. TOI-503b joins a growing number of known short-period, intermediate-mass BDs orbiting main- sequence stars, and is the second such BD known to transit an A-type star, after HATS-70b. With the growth in the population in this mass-period regime, it seems that the driest part in the BD desert (35–55*MJ* sin *i*) is reforesting.

This discovery is the joint venture of a team from PRL, CFA Harvard, USA and KESPRINT Consortium, Europe.

Source/Reference of the Work: https://doi.org/10.3847%2F1538-3881%2Fab7245

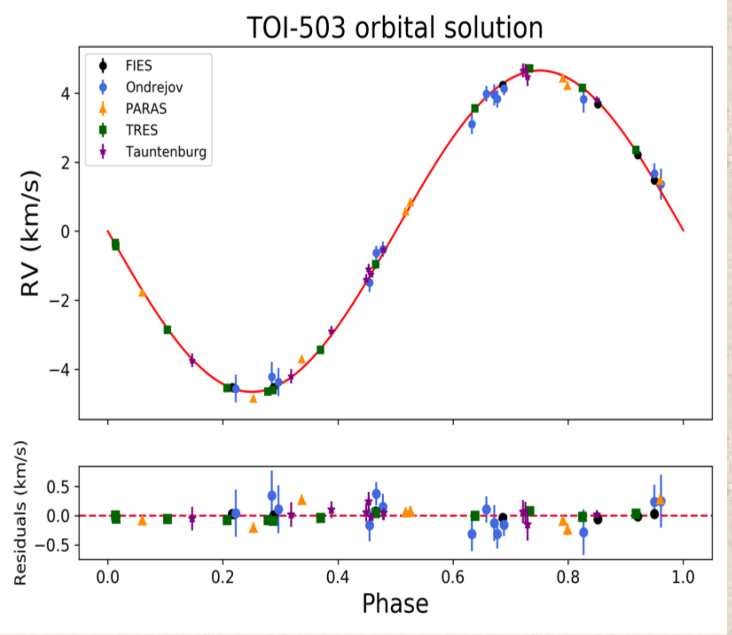


Figure 1: - *Orbital solution for TOI-503 showing the RV model in red. This orbital solution is derived by simultaneously fitting all RVs from the different contributing spectrographs and the normalized TESS light curve.*

Solar eclipse 2020 : A rare celestial event

Observations by A&A Division
(Dr. Veeresh)

On **21st June 2020** Earth witnessed an annular solar eclipse and the path of annularity passed through the northern part of India. The ring-of-fire was seen from some places in Rajasthan, Haryana and Uttarakand. In Ahmedabad, Solar eclipse lasted for nearly 3.5 hours (10:03 hrs. to 13:32 hrs.) with nearly 82% maximum obcuration of the Sun. Researchers at PRL attempted to capture this rare celestial event using pinhole camera as well as with the advance cameras. Depending on the position of the moon along the Earth-Sun line there are three types of solar eclipses - partial solar eclipse, total solar eclipse and annular solar eclipse. Unlike partial eclipse, the total and annular eclipses are rare as all three bodies earth, moon and the sun must be exactly lined up. Annular eclipse occurs when moon is at the farthest point in its orbit (apogee). At apogee the apparent size of the moon is smaller than the apparent size of the Sun and thus yielding a ring-of-fire.

Figure : Image of the Solar eclipse on 21st June 2020 at Ahmedabad. Taken by single-lense-reflex camera having exposure 1/6400 sec, ISO 200, f/16 at 400mm. Credit : Dr. Shashikiran Ganesh.

Figure : Images of the Sun during eclipse on 21 June 2020 made using pinhole camera

Observations from Facilities at USO

Udaipur Solar Observatory witnessed a Partial Solar Eclipse on Sunday 21st June 2020, that also coincided with the day of summer solstice. The first point of contact occurred at 10:07:37 IST and the maximum ingress was at 11:47:10 IST when the moon eclipsed 85.7% of the Sun's diameter. The last point of contact was at 13:36:59 IST. During these phases the Sun's elevation with respect to Udaipur was 56°, 78.5°, and 76.3°, respectively. The SPAR telescope on the island, with a 15-cm objective, was used to image the full-disk of the Sun with a cadence of 10 sec, while high-resolution images of the lunar limb against the solar background were taken in the G-band (430.5 nm) and Hα (656.3nm) from the 0.5 m Multi-Application Solar Telescope. Full-disk images from the guider telescope on MAST were also utilized for this astronomical event. The event was witnessed by an enthusiastic group of faculty members, technical staff, and research scholars

Movies of the partial solar eclipse from the various instruments at USO can be accessed at https://www.prl.res.in/~uso/solar_eclipse21062020.html

Fig.1 – Phases of the partial solar eclipse taken with the SPAR Telescope which show the passage of the Moon over the full disk image of the Sun.

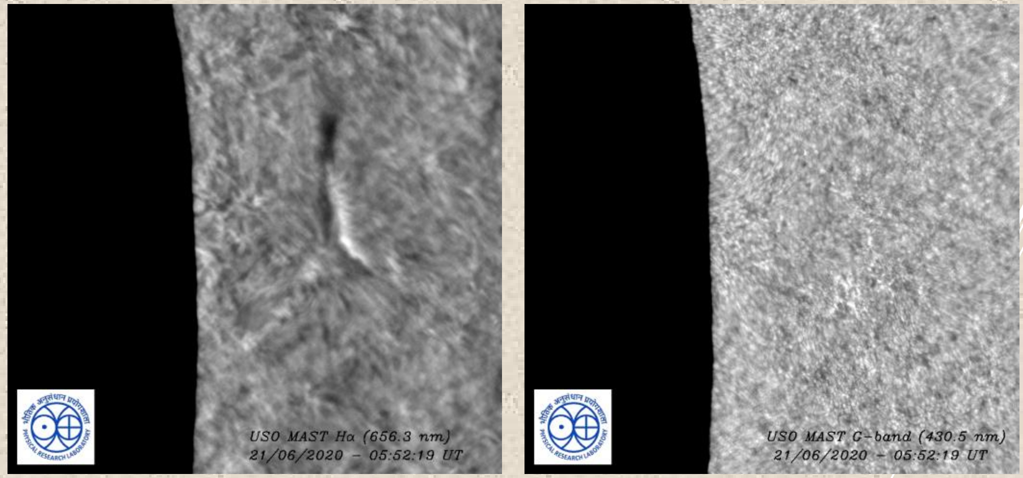


Fig.2 – High resolution images of the Sun in the photosphere (top) and chromosphere (bottom) observed by MAST during the eclipse. The irregularities on the lunar limb can be seen on the left.

Awards and Honours

- **Prabir Kumar Mitra** (SRF, USO) has won the first prize for an online talk entitled "Multiwavelength analysis and modeling of the largest solar flare in the solar cycle 24" presented at the online 'International Workshop on Space Science', jointly organized by Space Education and Research Foundation, Ahmedabad and Department of Physics, School of Science, RK University, Rajkot, during 18-21 May, 2020.

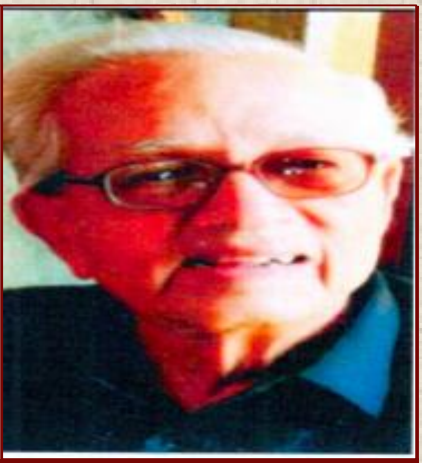
- **Goutam Samanta** (Associate Professor, AMOPH) has been featured in Optics & Photonics News.

- **Dr. R. D. Deshpande** (Scientist-SG and Chair, GSDN) has been nominated as a Member of the Scientific Programme Committee by the IUAC, New Delhi to plan and invite scientific programmes around the Geochronology facility in the country.

- **Dr. Arvind Singh** (Reader, GSDN) has been invited to be a Topical Editor for the journal Ocean Science.

- **Shri. Jigar Raval** (Scientist/Engineer-SF and Head, Computer Center) has been invited as a Member of Board or Studies for Computer Engineering and Information Technology in the Sankalchand Patel College of Engineering (SPCE), a constituent institute of Sankalchand Patel University, Visnagar, Gujarat.

Obituaries

		
Shri V. D. Patel, Sr. Technical Assistant-C, A&A Division	**Dr. Sheela L. Kusumgar, Scientist-F, Geosciences Division**	**Dr. R. V. Bhonsle, Senior Professor, A&A Division -**
01.08.1953 to 03.6.2020	**02.3.1939 to 10.06.2020**	**12.11.1928 to 14.06.2020**

PRL mourns the sad demise of its former employees and stands with the bereaved families in their time of grief. May their souls rest in peace.

PC- Anne Matilda

The Editorial Team

						
Bijaya Sahoo	Rohan Louis	Pragya Pandey	Deekshya Sarkar	Garima Arora	A.Shivam	Prashant Jangid

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