Research based course on **Atomic Astrophysics and Spectroscopy with computational workshops on the R-matrix codes** (online) under the Indo-US APJ Abdul Kalam STEM Education and Research Center of Ohio State University (OSU)-Aligarh Muslim University (AMU), by Prof. Sultana N. Nahar (Email: nahar.1@osu.edu) jointly with Prof. Anil K. Pradhan, Dept of Astronomy, OSU, USA

- Lectures & Workshops: 4 weeks, Saturdays & Sundays, 3 hours/session, Jun 18 - Jul 11, 2022
- Venue: zoom platform. Time: 11 am - 2 pm, US Eastern time
- Computational Facility (online): Ohio Supercomputer Center (OSC), USA

Course certificates (completion/participation w/o exam) will be provided, participation is free

- Textbook: "Atomic Astrophysics and Spectroscopy" -By A.K. Pradhan and S.N. Nahar (Cambridge University Press, 2011)
- Contacts: Prof. Tauheed Ahmad, Director, Indo-US STEM Education and Research Center, AMU, India Email: ahmadtauheed@rediffmail.com, Mobile: 91-8279632366, 9837404077

SYLLABUS

Week 1 (Jun 18 - 19, 2022): *Plasma, Atomic Structure, Computational Workshop*

i) Light and Matter, Plasma Sources, Particle and Photon Distributions
ii) Atomic Structure: Hydrogenic & Non-Hydrogenic Spectra
iii) Hartree-Fock, Dirac, Breit-Pauli Approximations
iv) Computational Workshop: SUPERSTRUCTURE

Week 2 (Jun 25-26): *Radiative & Collision processes, Computational Workshop*

i) Atomic Process in Plasmas - Radiative Transitions, Electron-Impact Excitation,
ii) Photoionization, Electron-Ion Recombination
iii) Computational Workshop: SUPERSTRUCTURE
iv) Close-Coupling Approximation and R-matrix Method
v) Computational Workshop: R-matrix

Week 3 (Jul 2 - 3, 2022): *Computational Workshop, Opacity, Exam, Certificate*

i) Computational Workshop: R-matrix
ii) Review, Exam, Evaluation

Week 4 (Jul 10 - 11, 2022): *Radiative processes for plasma opacity*

Prof. Anil Pradhan's lectures

i) Radiative Processes (photoionization and oscillator strengths) and Plasma modelling

ii) Plasma opacity

• Prof. Pradhan may recruit participants for opacity computations

GLOBAL PARTICIPATION

NOTE: More focus will be on Photoionization and Oscillator Strengths
Computational workshops on the R-matrix codes will be on these two processes for
the first time. They require more steps and time than electron-impact excitation
- Past computational workshops on the R-matrix codes included electron-impact
excitation

• To enroll, email the following information

Full official name:
Designation (Prof, Dr., Researcher, Student with current status of education):
Name of the affiliated University or Institution:
City and country names:
Email:

• zoom for the sessions:
https://osu.zoom.us/my/snnahar?pwd=TkJvNnptTzRQSEZ4c3RWNzBDV2pSZz09
Personal meeting id: 665 664 7991, pw: 330775

• Please create your account at Ohio Supercomputer Center (OSC) following the
instructions in the next pages. Note: OSC has given a new access code.

Get your account at Ohio Supercomputer Center (OSC)

For the computational workshops, you will need an account at OSC. Please follow the steps below:

On the internet, go to

- my.osc.edu
- click on "MyOSC - Ohio Supercomputer Center"
- Click on "Sign up"

It will open up a window where there will be two sections:

On the top section, you will enter your information (Red asterisk boxes)

If you do not have institutional email address, put down the email address that you have. I will confirm it with OSC.

In the lower section below the blue bar stating "Optional information" on the right, use the following information:

- Project code: PAS1866
- Access Number: 005639
- Click in the box "I'm not a robot"

• To login to your account, you will go to the same page of "my.osc.edu". Please remember to use Project code and the Access

• To log in to you account from a "terminal window". Follow as:

- Type: ssh YourID@owens.osc.edu (ssh app could already be in your computer)
- or: ssh -o serveraliveinterval=60 YourID@owens.osc.edu

The option "-o serveraliveinterval=60" lets you stay logged in for a longer time.

Please note that after typing each command, you will hit the <return> key

OSC Representative' comments:

• For any issue, contact OSC at: oschelp@osc.edu

Can also communicate to Heidi Hamblin at: hhamblin@osc.edu

Log in to you OSC account for running jobs

For the computational workshops, you will need a terminal window where you can write commands for viewing and editing files, submitting and running programs. You can use any of the following terminals:

- i) The terminal window that exists in your computer
- ii) Download from the internet "Putty" which creates a terminal window to log in to a remote host
- iii) use the terminal window that OSC provides from "onDemand" log in page. For the OSC terminal, please follow the steps below:

• On the internet, go to: https://ondemand.osc.edu

• Click on "OSC OnDemand - Ohio Supercomputer Center"

- OSC log in page will open up.

• Type in your user name and password and click on the bar stating "Log in with your OSC account"

- You will be led to your account page

• From the top blue bar, click on the "Clusters" and drag your cursor to "Owens shell access".

- This will take you to the terminal window to work (black background)

• Work on your programs: copying, running, check the input output files etc.

• When done with your work, go to the previous page by clicking on the "Dashboard OSC" box at the top bar of your browser

• On the right of the top bar on you account page, you will find "log out" to click and get out.