THE OHIO STATE UNIVERSITY

Women in STEM Roadshow

Director: Dr. Sultana N. Nahar, The Ohio State Universty, USA

Assalamu alaikum, Nameskar, Good Morning!

Dear our participants - the future Scientists, Respected Teachers, Alumni, our Cheif Guest, Chair VC of JMI, US officials, OSU representatives, and local and international experts, Volunteers

WELCOME TO THE WOMEN IN STEM ROADSHOW!

- Women in STEM Roadshow (WSR) is a project of US Mission India under US Department of State

Objectives: Support and encourage young female students across India in choosing careers in STEM (science, technology, engineering, mathematics) fields

- With this objective, the workshop has been designed to demonstrate the importance of STEM and provide relevant scopes and tools
- The project has 9 workshops, each of 2 days, and a year long monitoring and evaluation of STEM activities of the participants
- The scheduled workshops are: 2 in Delhi, 2 in Hyderabad, 2 in Kolkata, 1 in Patna, 1 in Kurnool, 1 in Aligarh

WSR WORKSHOP 1: Delhi, Feb 5 - 6, 2018

Support: US Department of State

WORKSHOP STRUCTURE

- The workshop has 3 main sessions
- I: Objectives, overview, why STEM
- II: Strategy for teaching and learning skills, train for the careers
- III: EductionUSA that provides information of US universities and how to apply for higher studies
- 2 Pre-sessions, Certificate ceremony
- Participants of the Delhi workshop has students in the STEM from a number of universities and colleges, a few high school students, 2-3 teachers, one US alumnus
- The participants include 12 students from Kashmir
- We are giving i) stipends to students as needed, ii) Mentor Fellowships to two participating teachers in STEM
- The participating alumni are committed to spend two hours in high schools to encourage and answer questions in STEM to female students
- Our local experts and their teams have done considerable amount of field work in recruiting the participants

MONITORING and EVALUATION

- STEM related activities will be encouraged and recorded and evaluated by the Indo-US APJ Abdul Kalam STEM Education and Research Center of Aligarh Muslim University and Ohio State University in Aligarh
- Participants will remain connected through a network of emails, facebook, twitter
- Updates will be maintained at WSR website: http://www.astronomy.ohio-state.edu/∼nahar/ womenstemroadshow.html (go.osu.edu.womenstemroadshow)
- WSR has been in newspapers in Aligarh, Hyderabad, Patna

WORKSHOP TEAM MEMBERS

International Expert: Dr. Nasreen Haque (Ph.D. Physics, USA), CEO, Intalage, Inc, USA, STEM education involving teachers and students in the USA

International Expert: Dr. Karen Irving (Ph.D. Science education, USA), Teaching and Learning, OSU, developed STEM program for postgraduate Indian Graduate students under the Indo-US Knowledge Initiative award

- Consultant: Dr. Anil Pradhan (Physics, England), Astronomy, OSU, Director: Indo-US APJ Abdul Kalam STEM Education and Research Center of OSU-AMU
- Our local expert: Dr. Noor-e-Zhahra (Ph.D. engineering), recipient of national teaching award
- Chief Guest Dr. Najma Heptullah - a role model of achievements for females - career expanded from Ph.D. in Zoology to philanthropy to leadership

- Why STEM fields

- Part of life, For advances in humanity, for survivability

- Why females

- half of the population - half of the intellectual power to make advances

- Should we waste our intellectual power

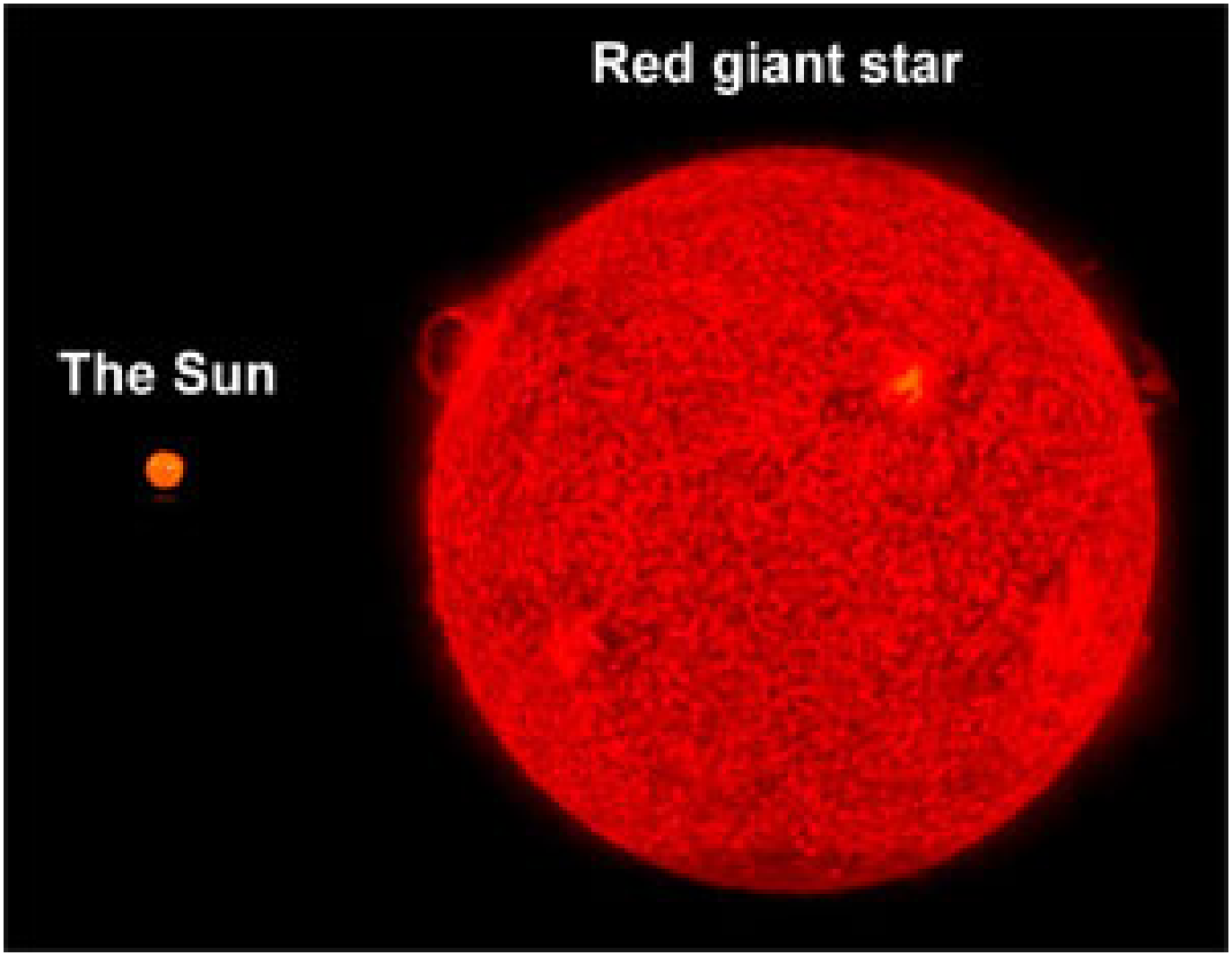
- NO!

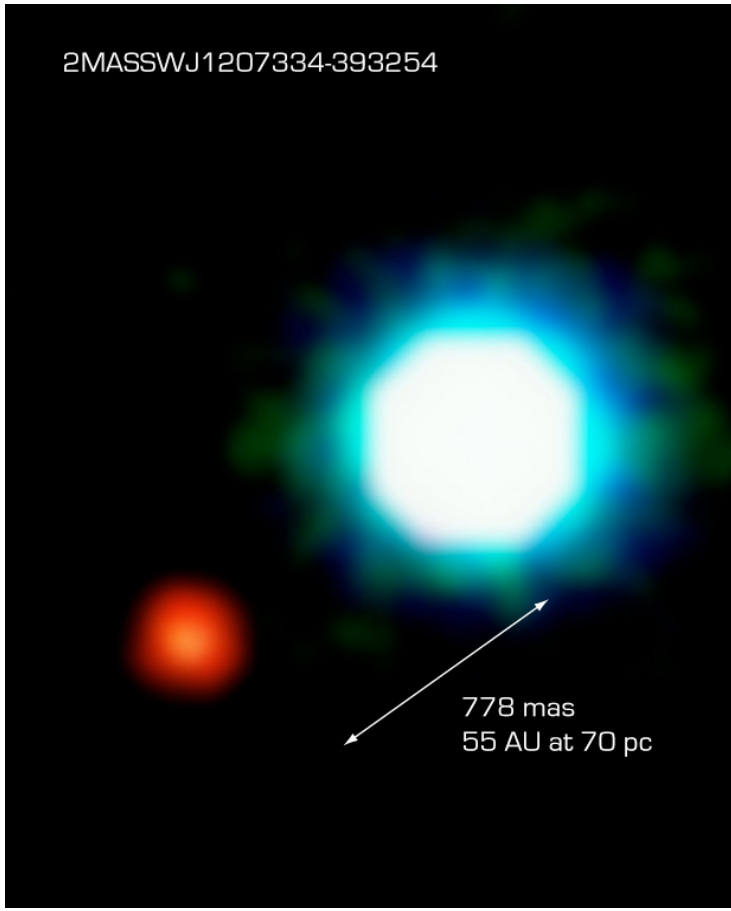
Dinosaurs ruling the earth: 65M years ago

Asteroid impact depleted them

LIFETIME OF OUR SUN

- Sun's fate after 6-7 billion years - Red Giant which will engulf all planets. We need to suvive.
- Searching habitable exoplanets - 11B planets in our galaxy.





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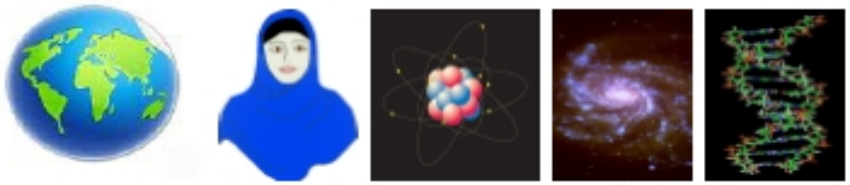


INTERNATIONAL SOCIETY OF MUSLIM WOMEN IN SCIENCE (ISMWS)

ISMWS CHARTER

Founder: Dr. Sultana N. Nahar
The Ohio State University, Columbus, Ohio, USA
April 19, 2010

- **AIM:** - encourage Muslim women in science profession, form a network for various support
- **Objective:** Stay in Science (basic or applied)
- **Motto:** Out of 24 hours a day, we keep some hours for our intellectual nourishment
- **Members:** Over 250 from 28 countries

Web: http://www.astronomy.ohio-state.edu/ ~nahar/ismws.html
For membership (free) - Email: nahar.1@osu.edu

Notes from ISMWS Charter:

- **Each of us, male and female, have biologically the same brain and the same capability to understand the amazing mysteries of nature, finding out the laws that govern them and implement them for our benefits and advancement. Even if we use our brain continuously, we would probably use only 10-15% of it**

- **No religion restricts a person from learning, gaining knowledge. Knowledge is a necessity. Islam encourages knowledge for both man and woman.**

- **All living forms, the world we live in, the universe around us have been created not to ignore them, but to know them for our purposes**

- **The more we know the universe, the nature, the human functions, living beings, the more beauty we see, the more power and control we achieve to solve problems, the more we admire Allah and His creations**

THE LONGEST RUNNING UNIVERSITY

Universit Al Quaraouiyine founded in 859 in Fez, Morocco is the oldest existing, continually operating and the first degree-awarding educational institution in the world (UNESCO and Guinness World Records[5][6])

- It was founded by Fatima al-Fihri

A WOMAN: A MOTHER AND A MENTOR

- An scientist mother can play the most crucial role in building a nation - she teaches and mentors her children - More educated mothers - more educated nation
- It is also said that decisions made in participation with women have been the most effecitve
- Two creidts for success, one creidit for effort
- Challenge - hit the boundary of your talent

KASHMIR UNIVERSITY WINNERS

- Best teachers and students winners - impressive

SCIENCE IS BEAUTIFUL

X-RAYS FROM A BLACK HOLE - CENTAURUS A GALAXY

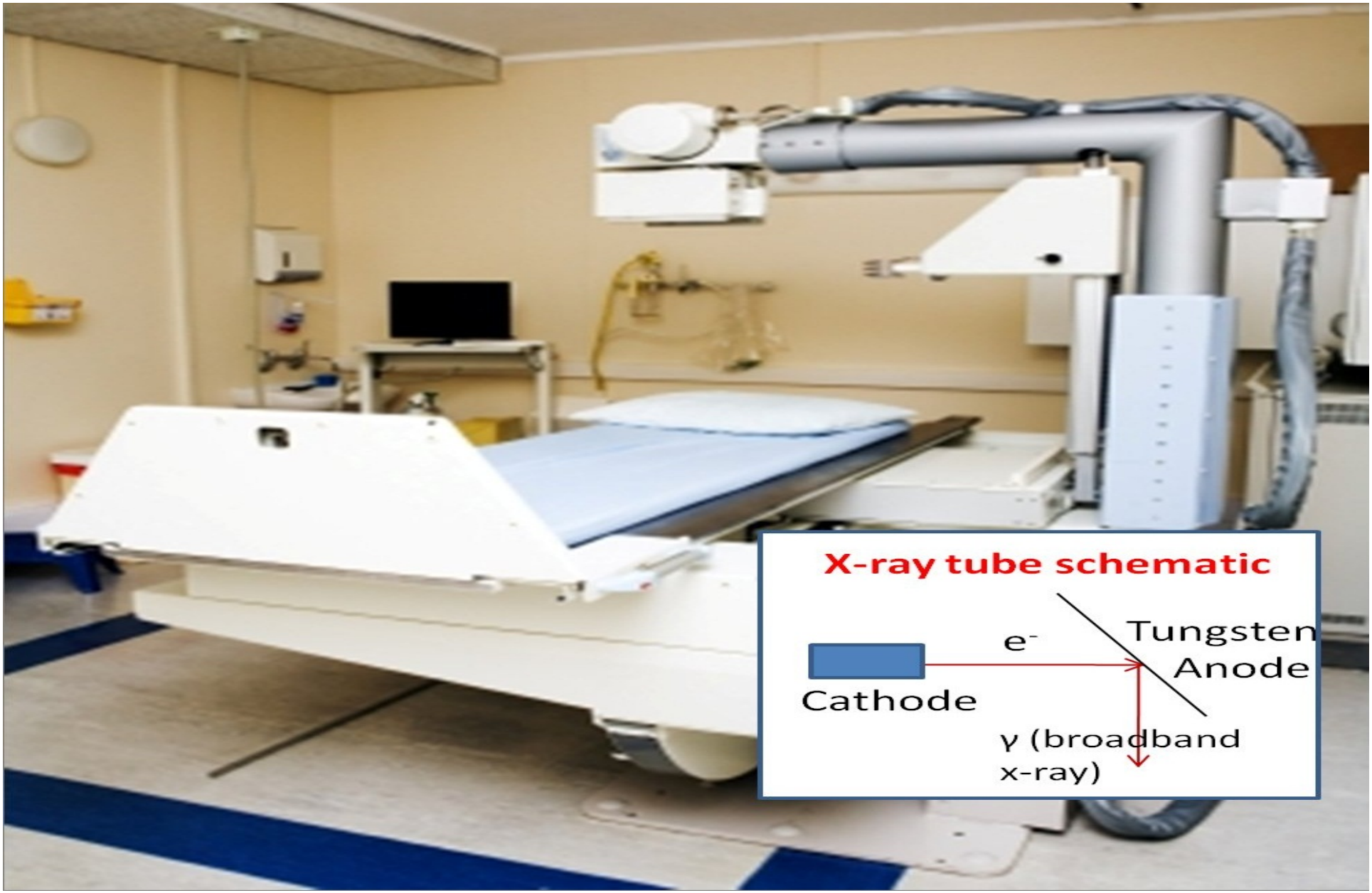
(Chandra)

- Photometric image: red - low, green - intermediate, blue - high energy X-rays. Dark green & blue bands - dust lanes that absorb X-rays
- Blasting from the black hole a jet of a billion solar masses extending

X-RAYS IN MEDICAL FACILITIES

- Medicine: radiography, CTscans, imaging, Linear Accelerators (LINAC) for radiation therapy

Study of X-rays has led to new treatment



ISMWS

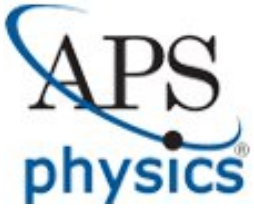
- Being a scientist is very much rewarding. It gives the freedom to think and experience the adventure of finding solutions to challenges. Research gives the joy of getting something new and something useful, and publishing the results in scientific journals means contributing to advancement. When I deliver a scientific presentation, I don't think about me as a woman, I think about my research that is engaging to other scientists.

- Family is very important for us. Taking care of a human being is far more difficult job than anything else, because each human mind thinks independently and hence can always oppose to what you think. Taking care of a family can be most challenging and also be the most rewarding. However, each of us need to nurture and utilize our intellectual power. We need support and time to detach. Detachment is needed for any thoughtful work.

• We must adopt to ignore hostile and non-supportive comments, and put downs by fellow students, friends, and others. As my father said that it is important to "Remain focused to your goal, and do not get distracted by the minor problems. They become insignificant with achievement."

• Make a practice: "I will keep at least two hours every day for my science regardless what part of the day"
- Average: 8 hours of sleep and rest, 8 hours for various chores, use 2 hours of science out of this 8 hours.

• Get part of any useful society, organization. You may find many benefits from it



Invite to APS membership:

AMERICAN PHYSICAL SOCIETY

Memebership (free for 4 - 6 years) info:

Contact: Sultana Nahar

Email: nahar.1@osu.edu

Website for details:

http://www.astronomy.ohio-state.edu/ ∼nahar/fip.html

After becoming member (will recieve ID from APS),

- Get your web account using your account

- become a member of your division & of APS unit - FIP: Forum of International Physics

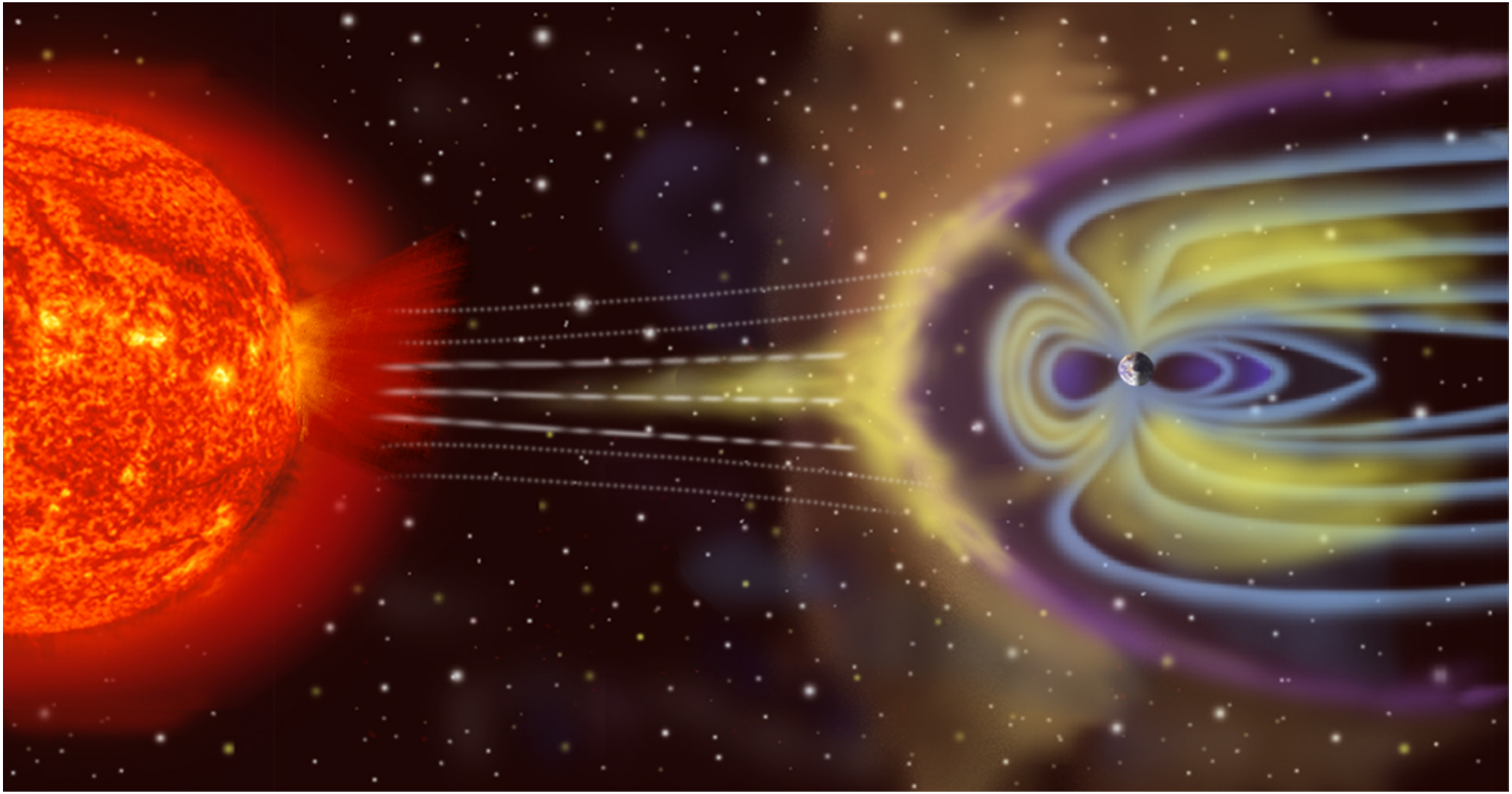
- Post your resume

- Sign up for job alerts and apply online

- Submit abstracts for APS conferences

- Check many other activities and benefits, such as, free isses of Physics today, newsletters, calendar, research alters, application notices for various recognition

THE PROTECTED EARTH



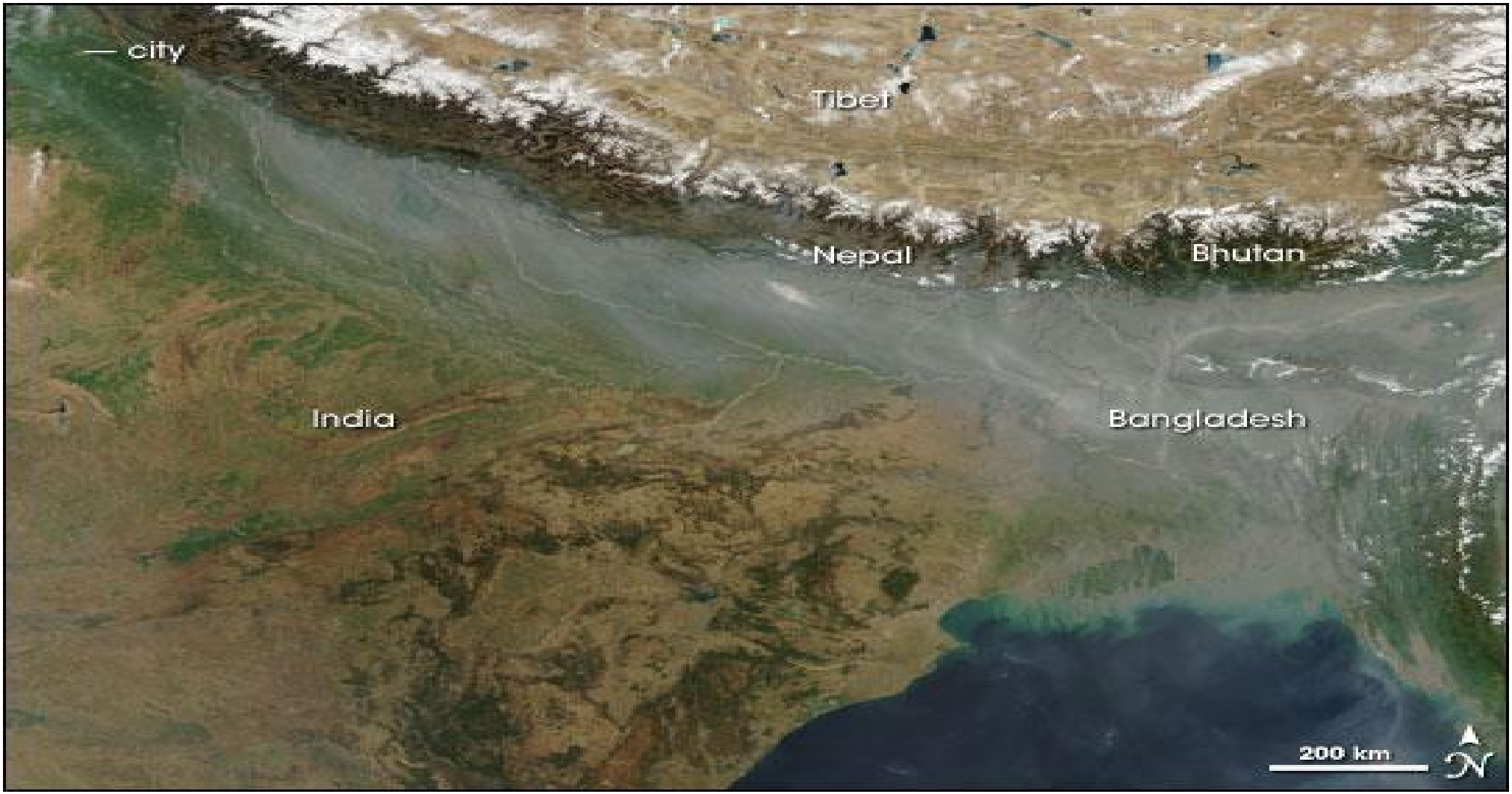
- Solar radiation establishes the Thermal Structure of the earth and its atmosphere. The total amount of radiation energy entering the earth system is balanced exactly by the amount being radiated into space until last few years upsetting the balance

EFFECTS OF GLOBAL WARMING

i) Glaciers melting has doubled, ii) Sea level rising 0.8mm/year – rise > 20 cm by 2100 (IPCC), iii) Brown cloud and thick haze - in humid condition & in winter Monsoon with no rainfall to wash the pollution

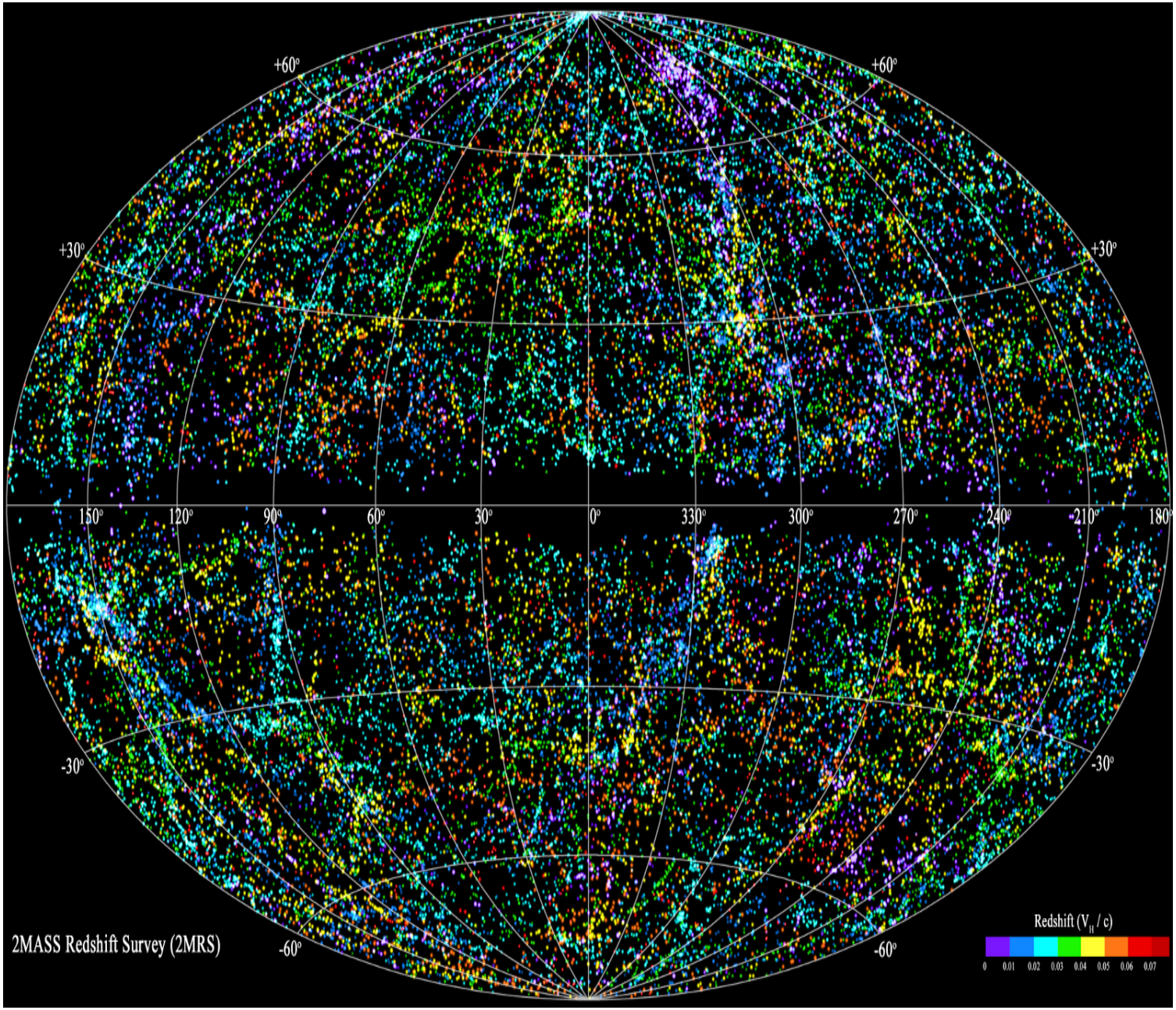
EFFECTS OF GLOBAL WARMING

iii) Brown cloud and thick haze - in humid condition & in winter Monsoon with no rainfall to wash the pollution



PART OF THE TRAVELLING UNIVERSE: PHYSICS

Most Complete 3D Map
(Created by 2MASS maping over 3 decades)



- The 2-Micron All-Sky Survey includes 43,000 galaxies within 380 million Ly

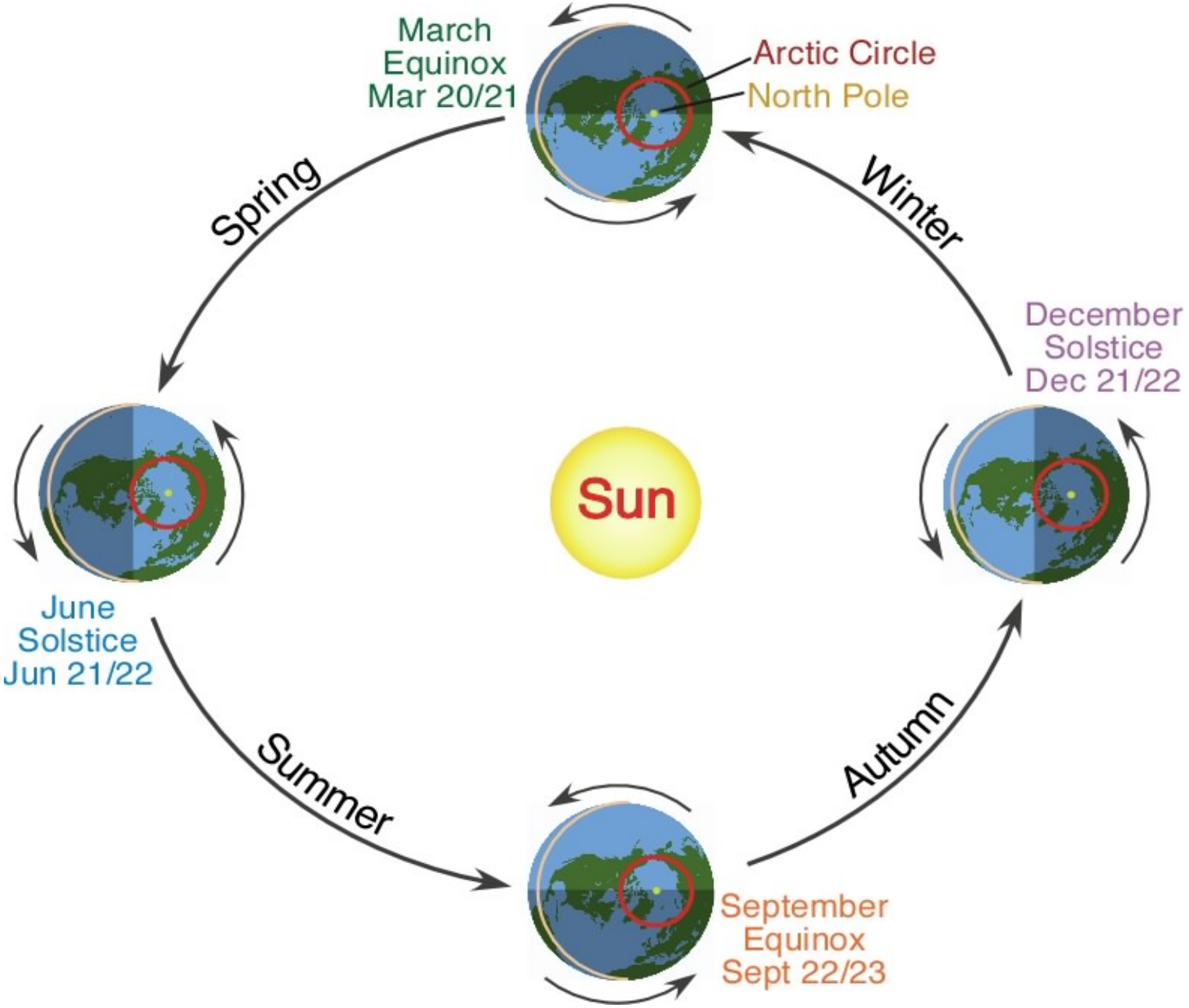
Our galaxy: MILKY WAY

- Has 200-400 billion stars. How do we study them?

- Analyzing the light coming from them.

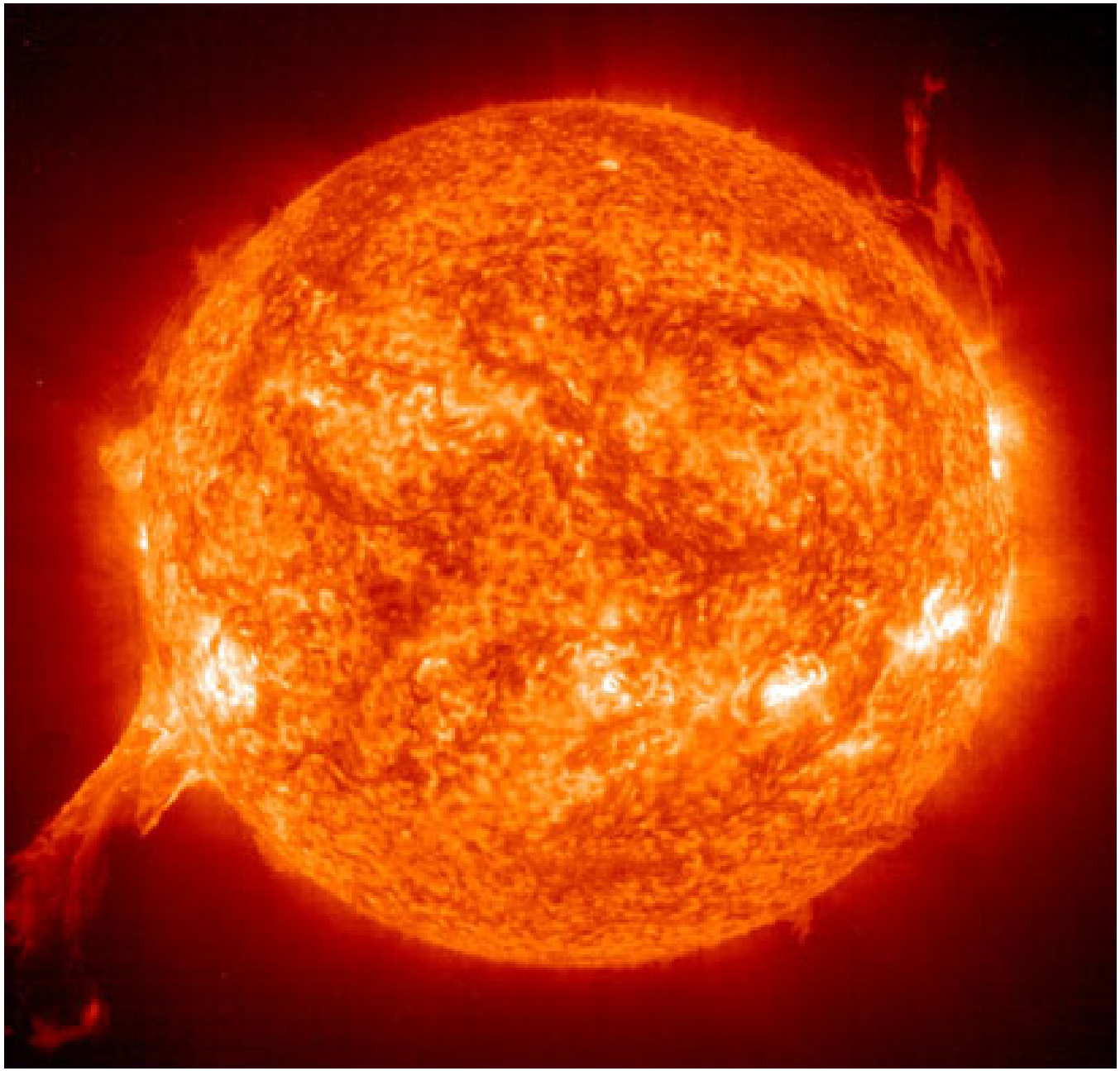
Light or radiation is emitted by excited or "HOT" atoms, molecules in them

The SUN, Our STAR



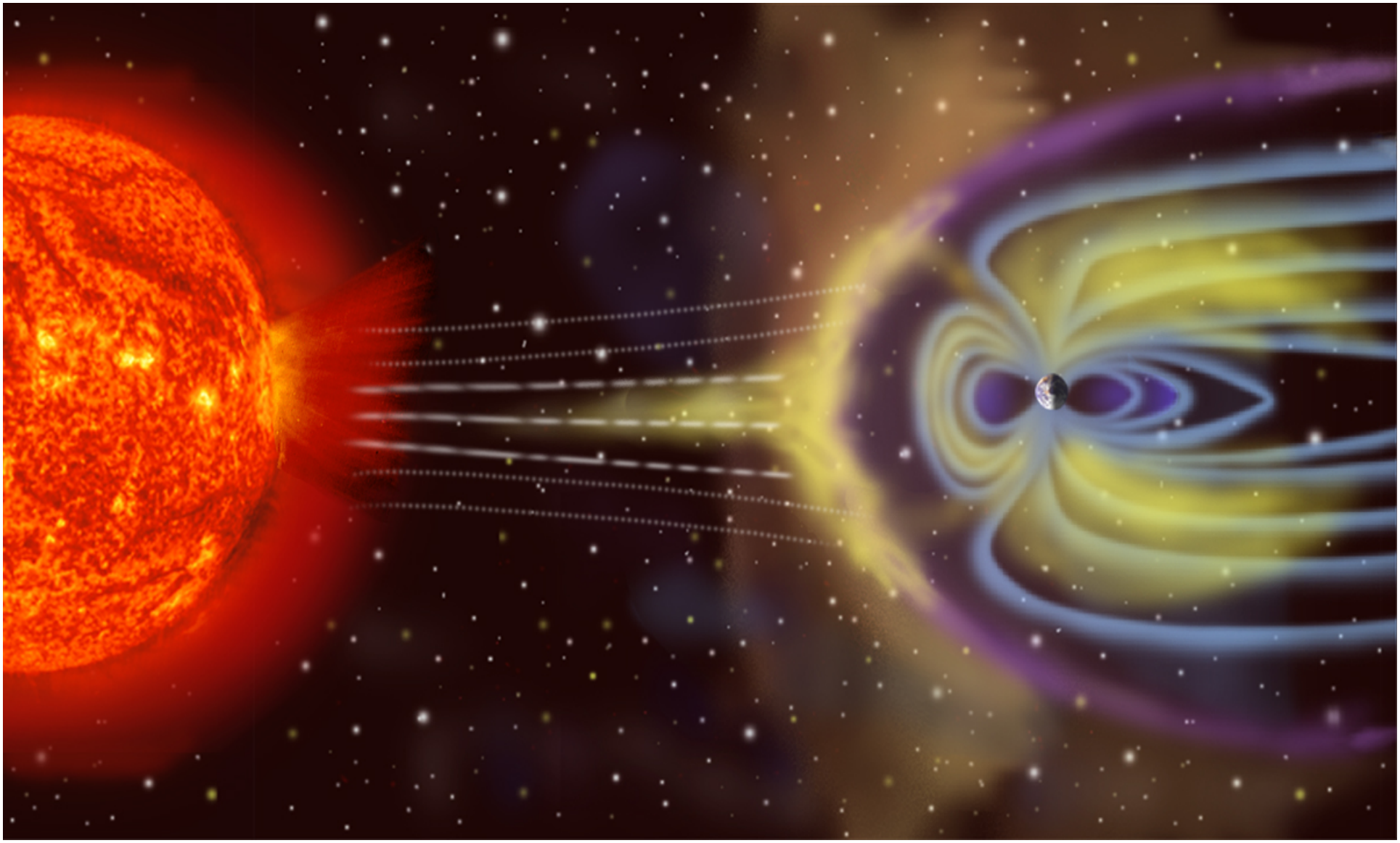
- Sun is the source of energy for our Earth, its planet
  - It is the standard for studying other stars

Our SUN - The "unQuiet" Star



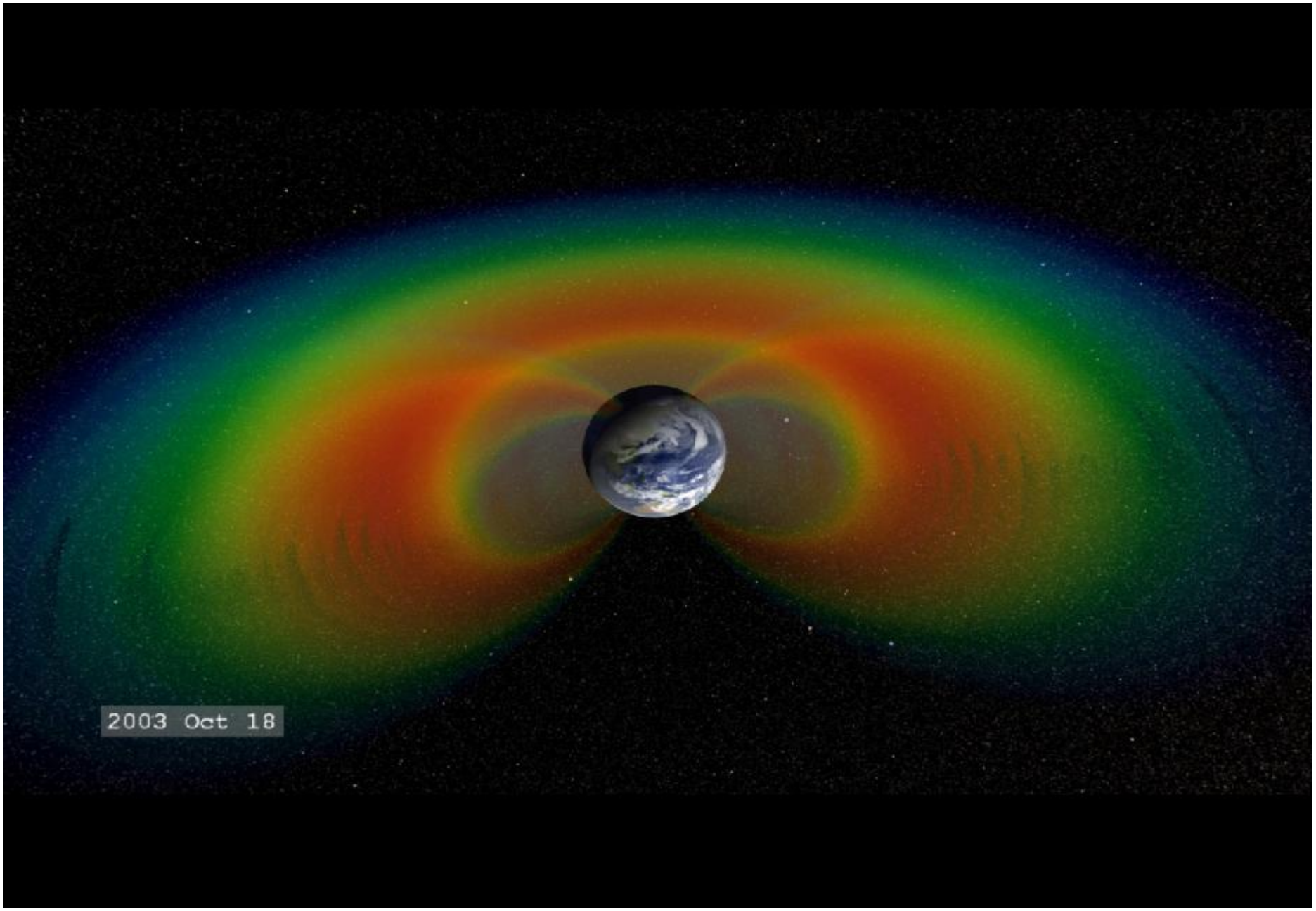
- Sun has a 11 years cycle of minimum to maximum ACTIVITY, when its magnetic field flips between North and South
- Activity: Eruptions with explosions ejecting large amount of particles & radiation in to space which can affect the earth

SOLAR EJECTIONS: RADIATION & PARTICLES



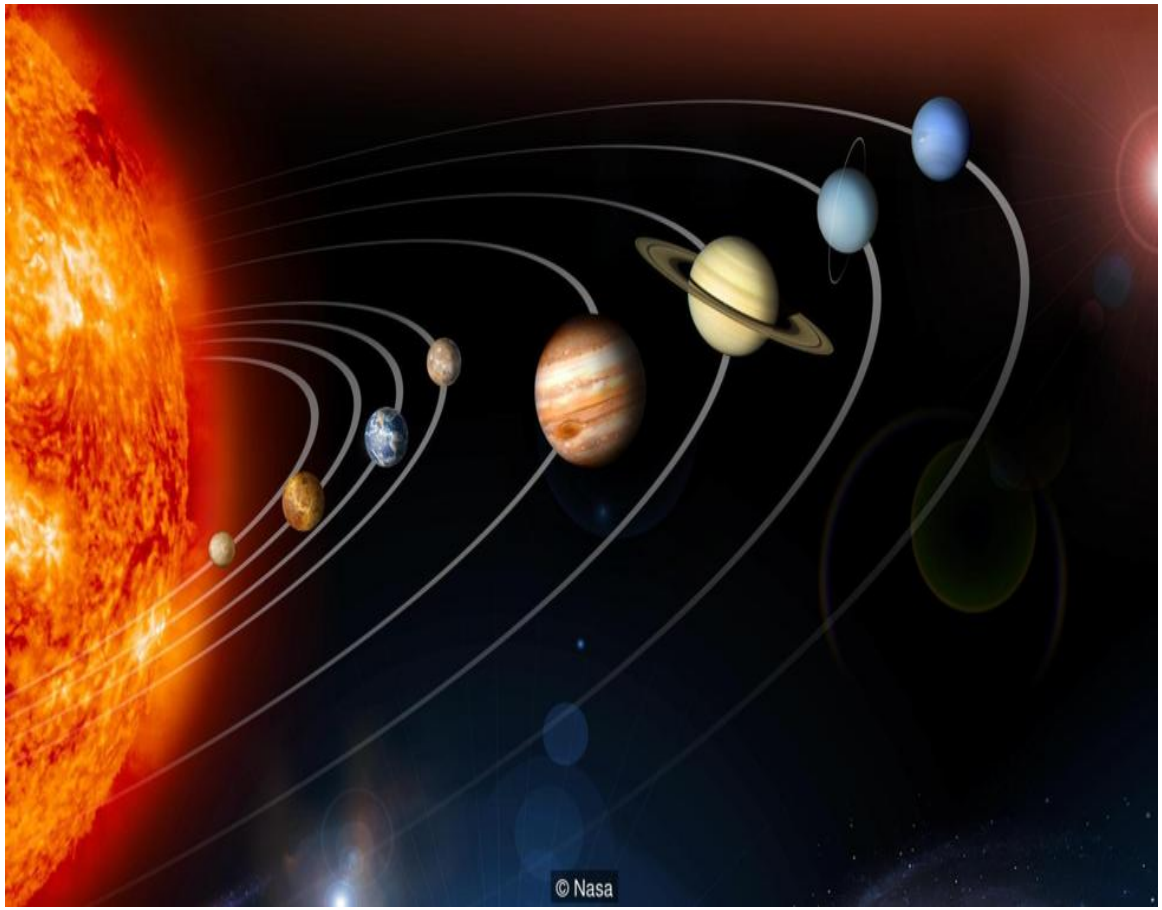
- Solar storms ejects bursts of electrons, protons, & heavy ions accelerated by massive explosions inside
- Our Earth's atmosphere and magnetic field protects us from these massive bursts of particles and radiation by reflections, absorption, and captures

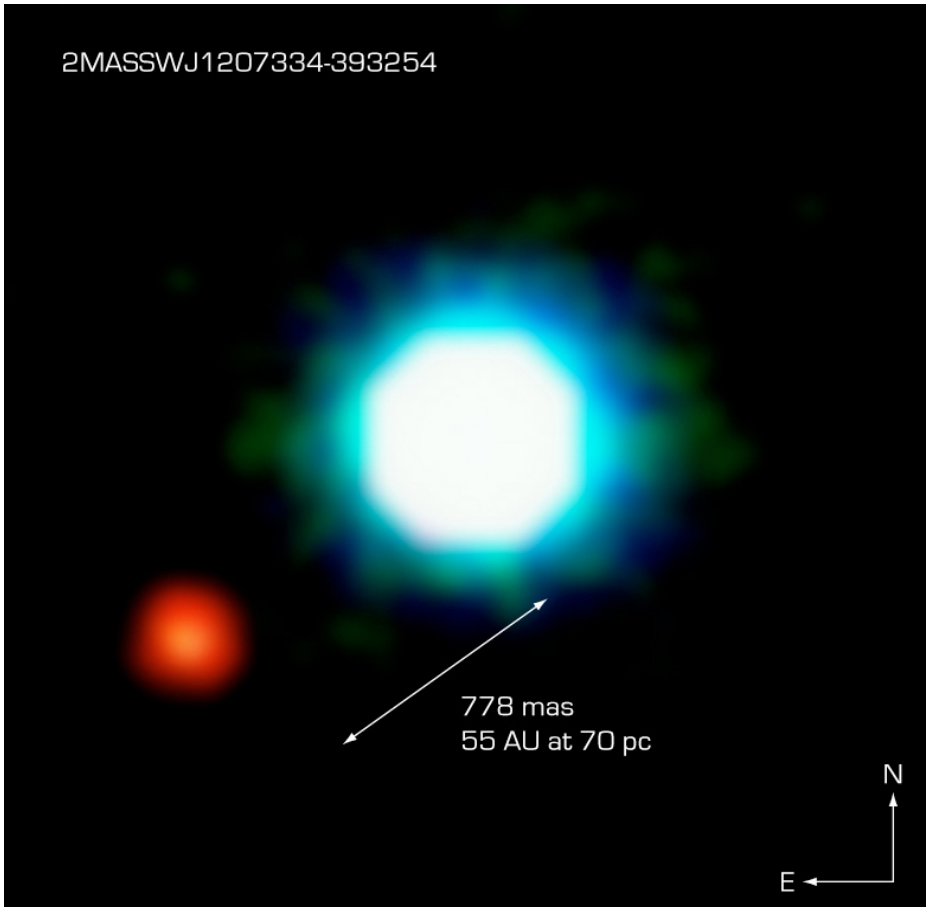
VAN ALLEN BELT AURURA: HALLOWEEN SOLAR STORM



- Electrons of energie 2-6 Mev captured in the earth's magnetic field during 2003 solar storm.

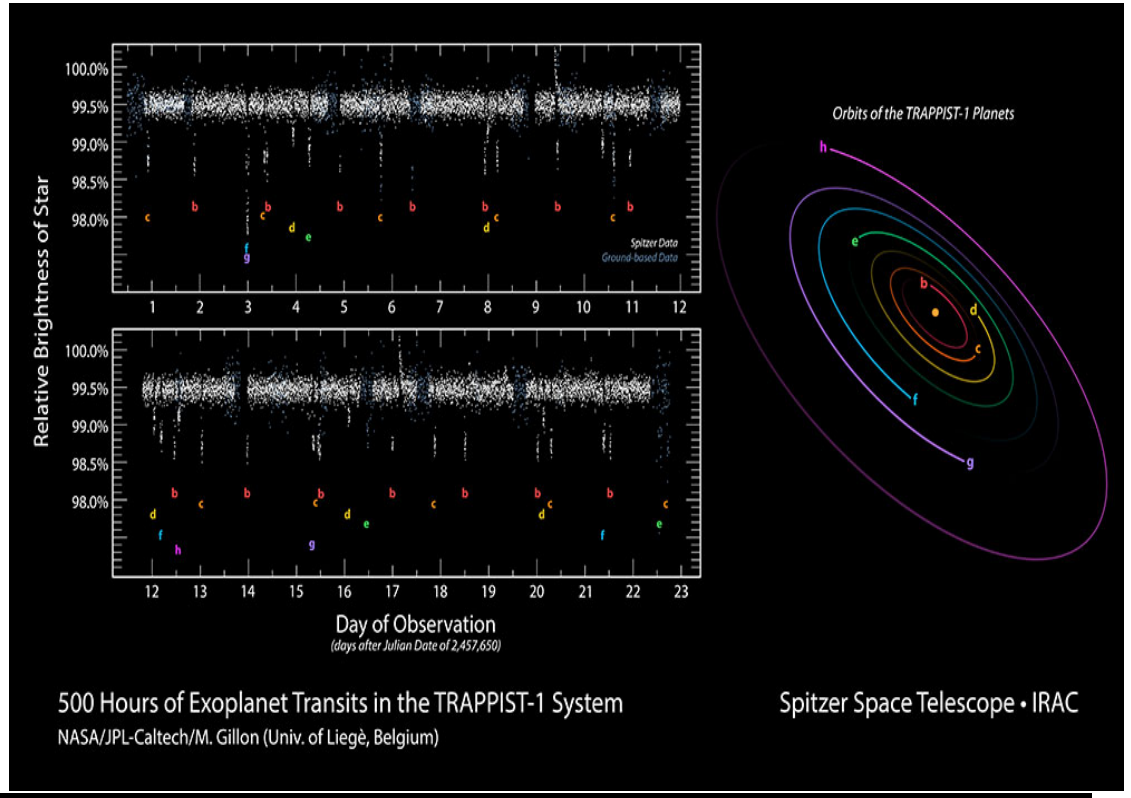
STARS WITH PLANETS AND EXOPLANETS





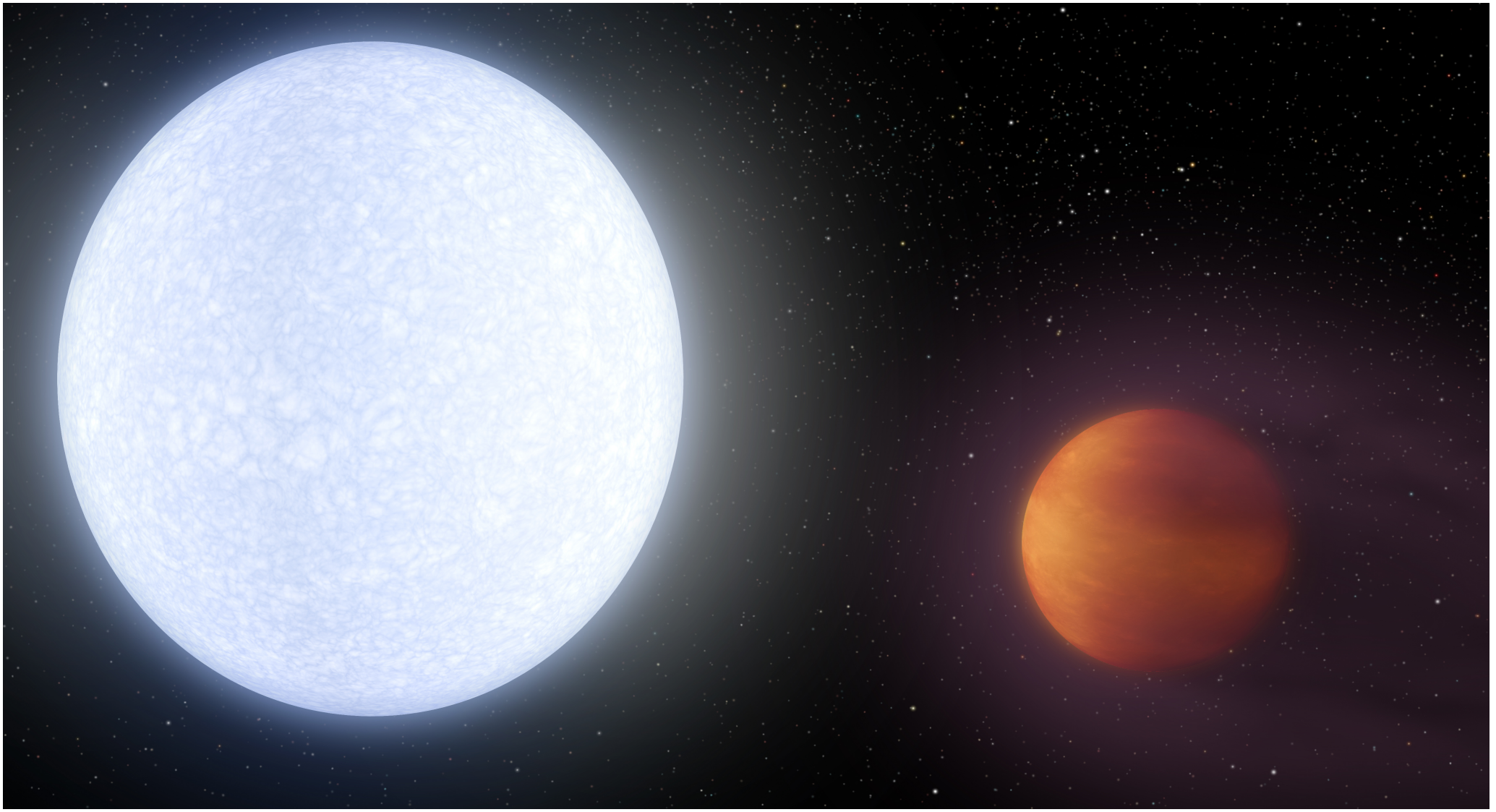
- **L: Solar planets:** Planets around our sun
- **R: Exoplanets:** Planets around a star except the sun. The first direct picture of an exoplanet, 2M1207b-ESO2004, by HARPS spectrograph of ESO telescope in Chile
- 3671 expolanets detected during 1988 - Oct 2017, over 2000 by Kepler (space, NASA) & over a hundred by HARPS (Chile, ESO), others by HST, Spitzer etc

STARS WITH MULTIPLE EXOPLANETS



- Big news of discovering solar type planetary system by TRAPPIST (telescope in Chile)
- L: Seven planets of TRAPPIST I, R; Intensity variation and the orbits
- Some belong to binary and to triple star systems

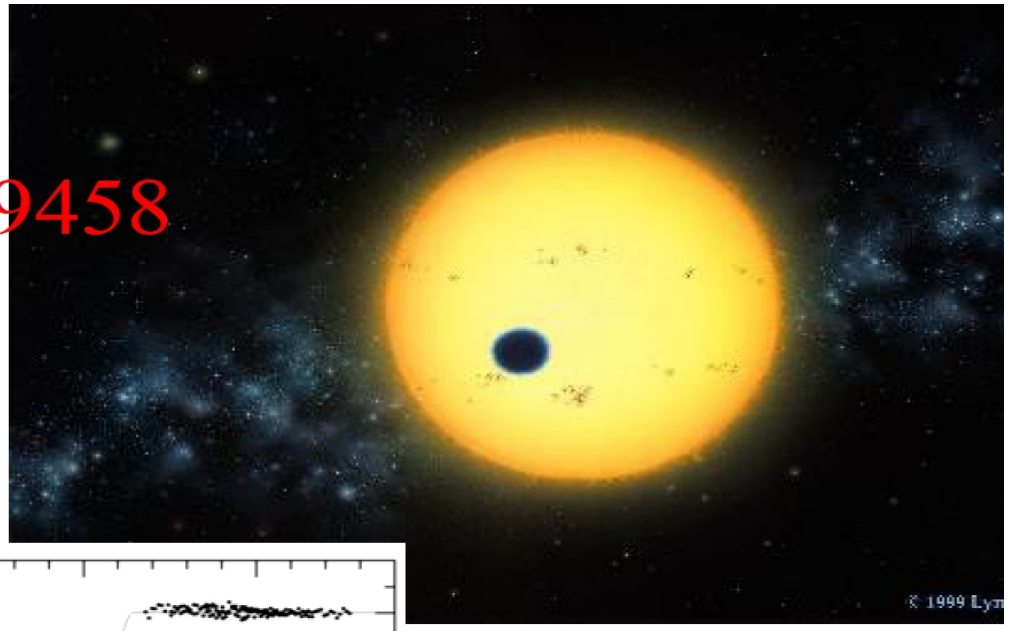
HOT JUPITER PLANETs

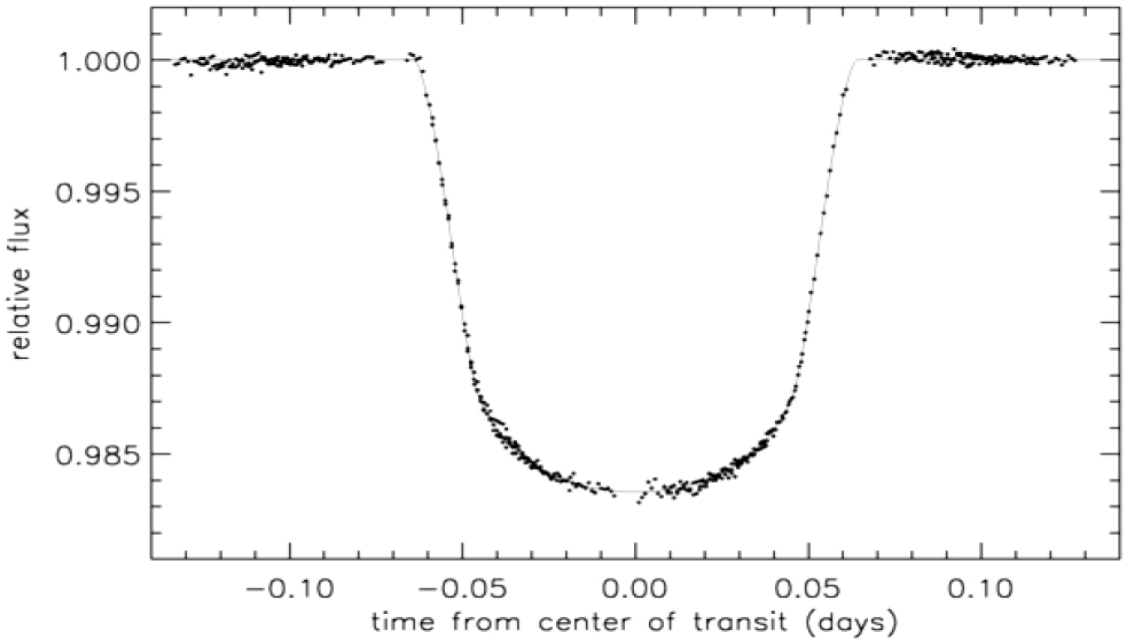


- Class of planets being discovered - size like Jupiter but close to their stars - Hot Jupiters
- OSU lead team discovered a planet hot like a star - about 4000 K, very close to its star, and circling it in a few days
- May fall into its own star and vaporize

DETECTION SPECTROSCOPY OF EXOPLANETS: TRANSIT METHOD

planetary transit
in the star HD 209458

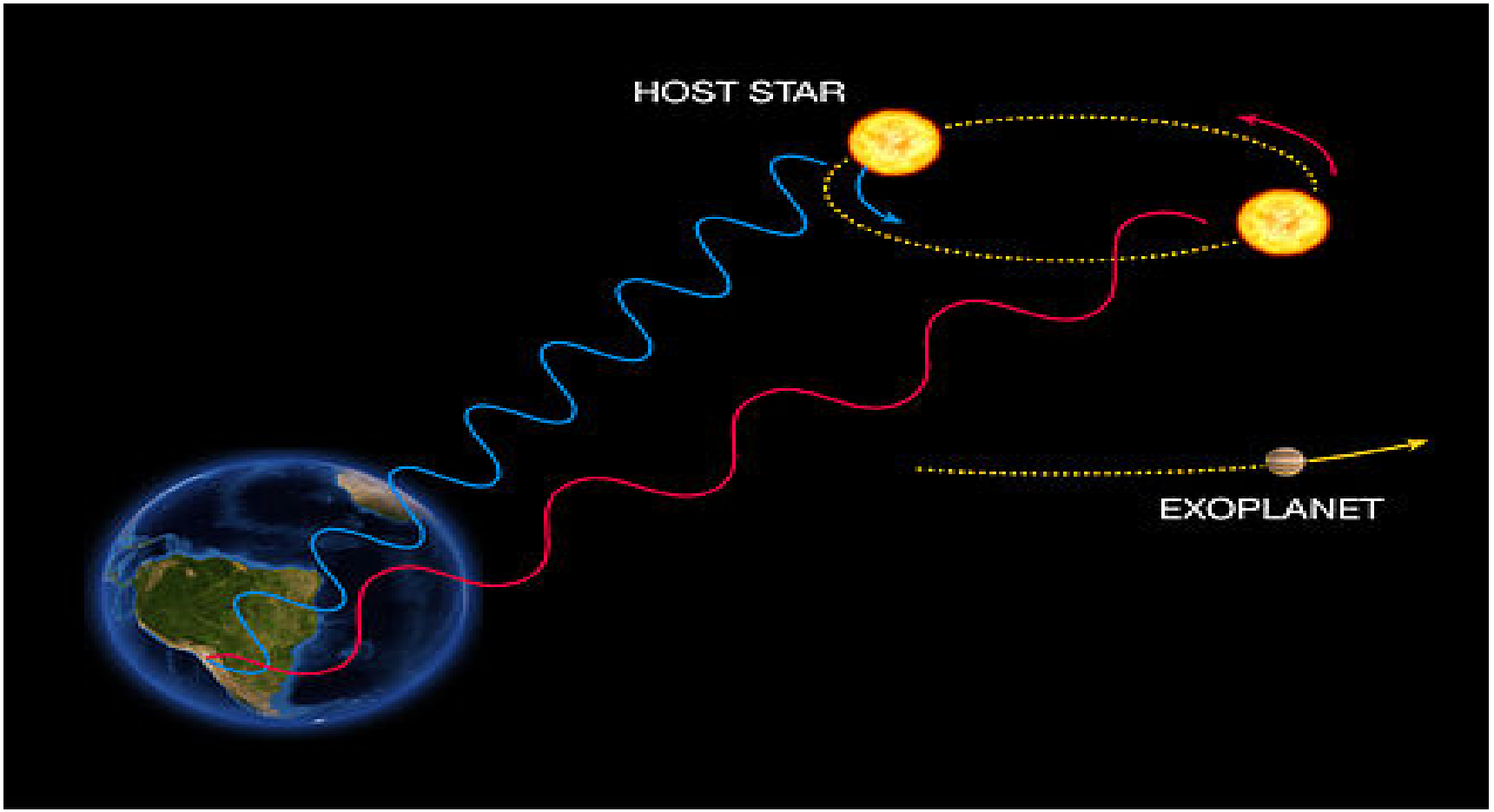




• L: Transit method: Most common, via photometry as intensity varies up to of a few percent

- Ex: Simply identifying "Proxima b", was a considerable challenge

DETECTION SPECTROSCOPY OF EXOPLANETS: RADIAL-VELOCITY METHOD

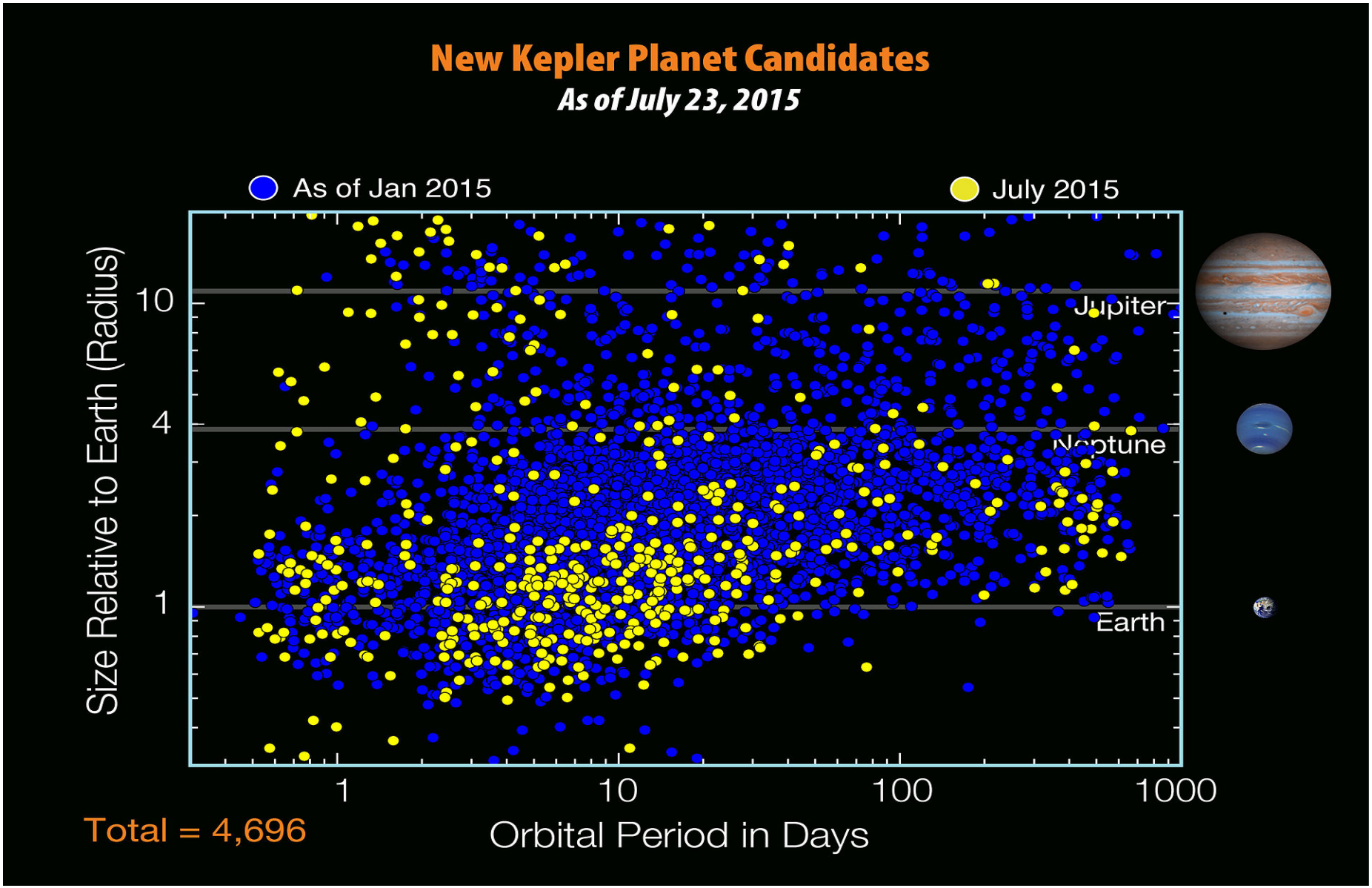


The Radial Velocity Method

ESO Press Photo 22e/07 (25 April 2007)

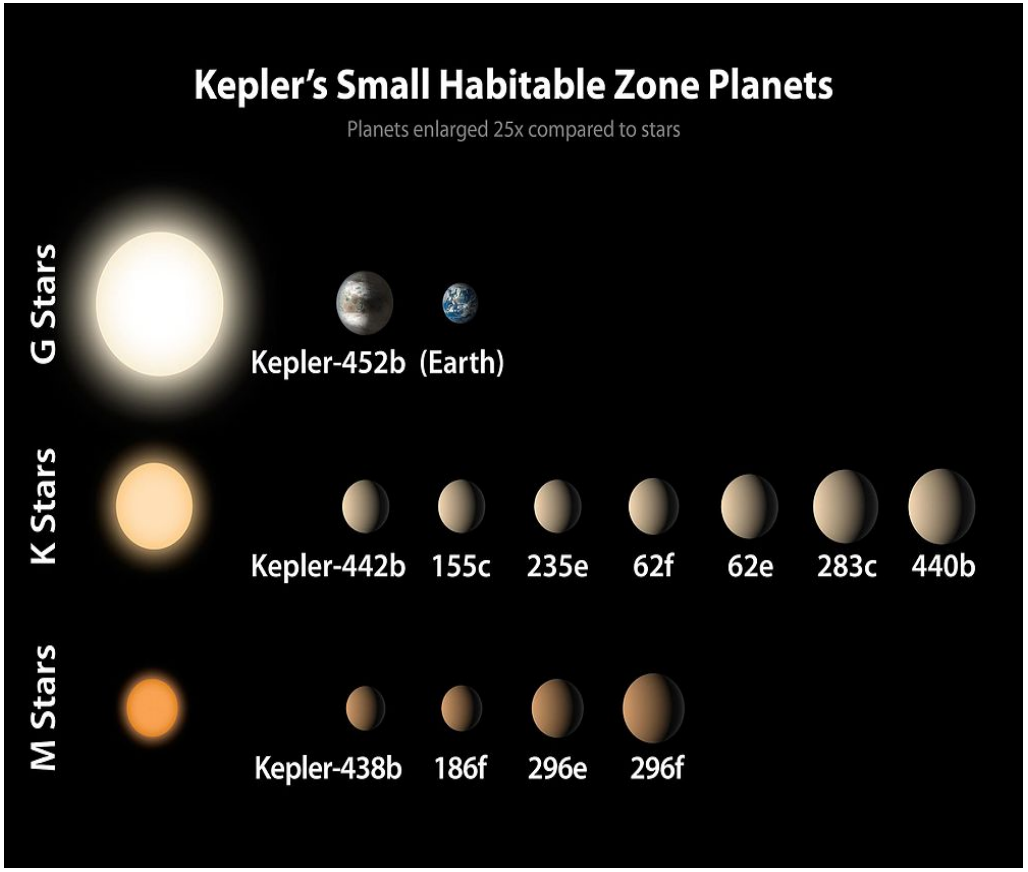
- **R: Radial-velocity method:** Use of Doppler spectroscopy of periodic red- and blueshifts in radial velocity due to gravitational force of the exoplanet on the host star
- **Direct image:** By, e.g., 200-in mirror Hale telescopes
- **Gravitational microlensing**

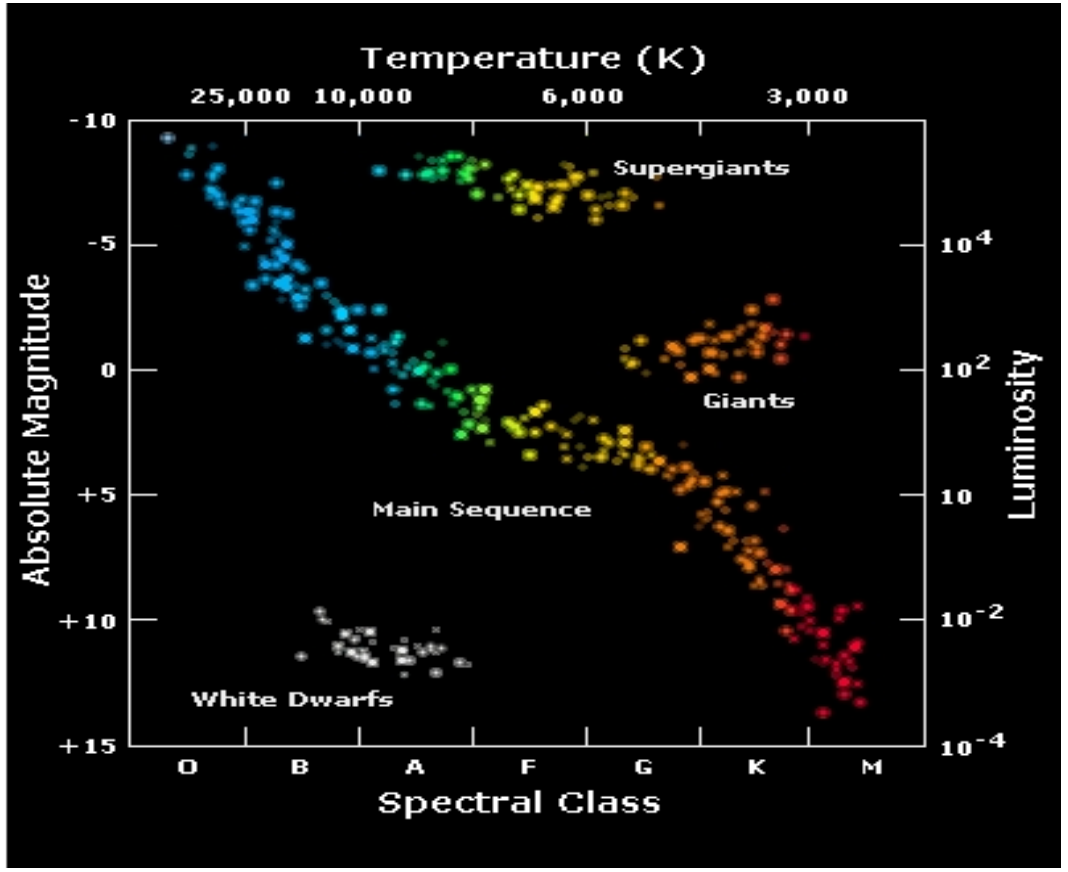
KEPLER'S CANDIDATES: EXOPLANETARY HOST STARS



- Kepler detected 4696 host cadidates in 2015
- Size varying < Earth to > Jupitar
- Considering 200 billion stars and number of red dwarfs in the Milky Way, there could be 40 billion planets

HR DIAGRAM FOR EXOPLANETARY HOST STARS



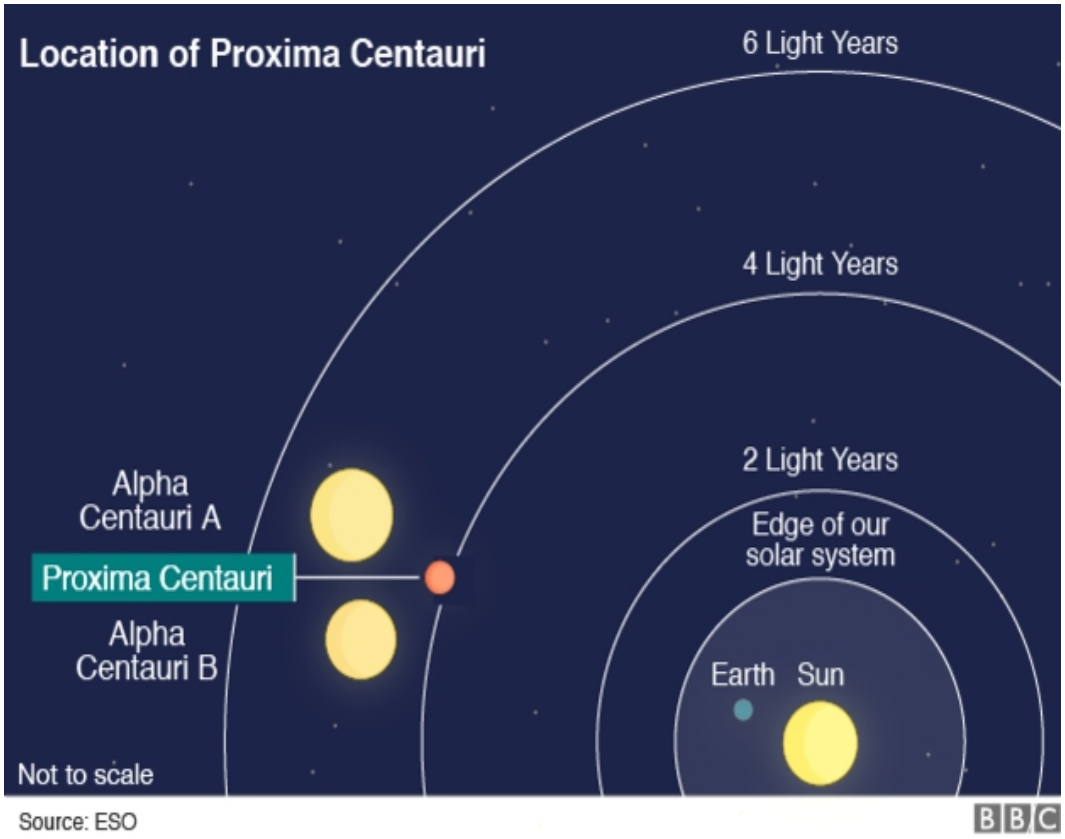


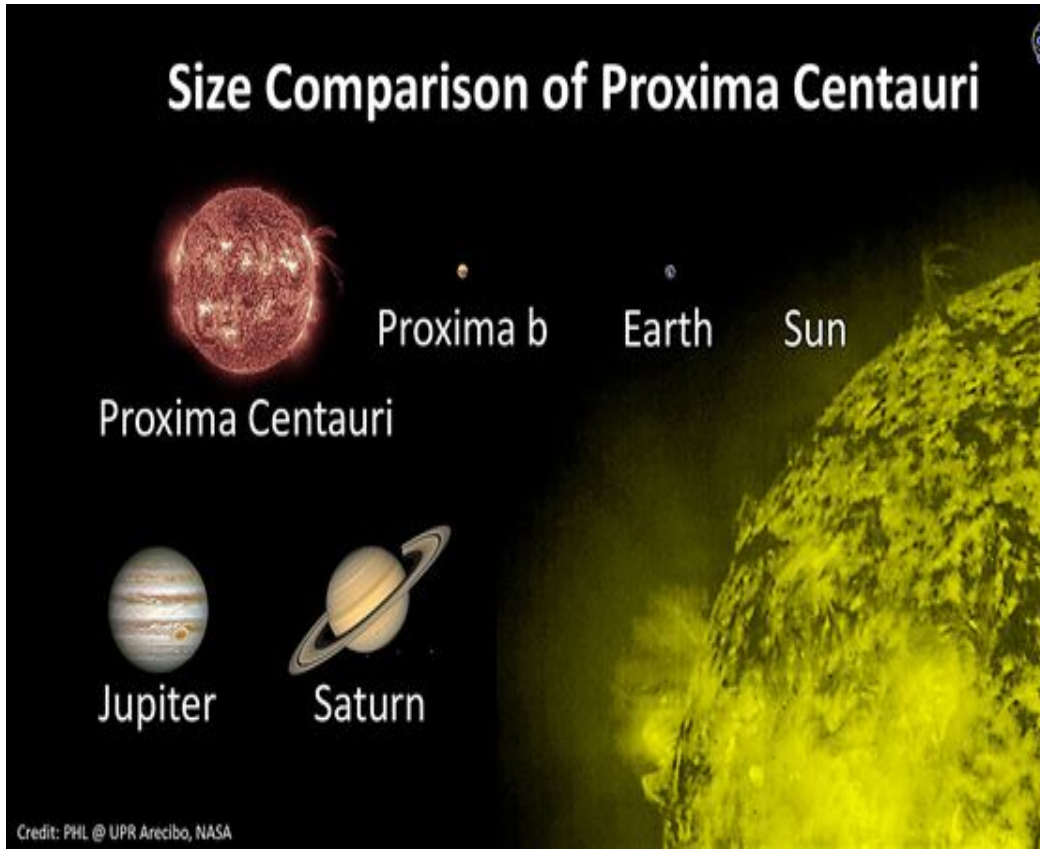
- L: All habitable planets are largely G, K, & F, M stars
- R: Mainly cool stars yellow to red in the HR diagram
- Transit Method: The measurement of variation in stellar flux is extremely slight, and interpretation of observation requires precise knowledge of stellar atmospheres and of emitted spectrum.

- In particular, the predicted near-UV flux is important since Earth-like life forms are highly sensitive to it.

- However, current model spectra of cool stars do not accurately reproduce observed fluxes even for the Sun. The problem lies in the attenuation of transmitted flux due to the opacity of the stellar plasma

OUR INTEREST: HABITABLE EXOPLANETS





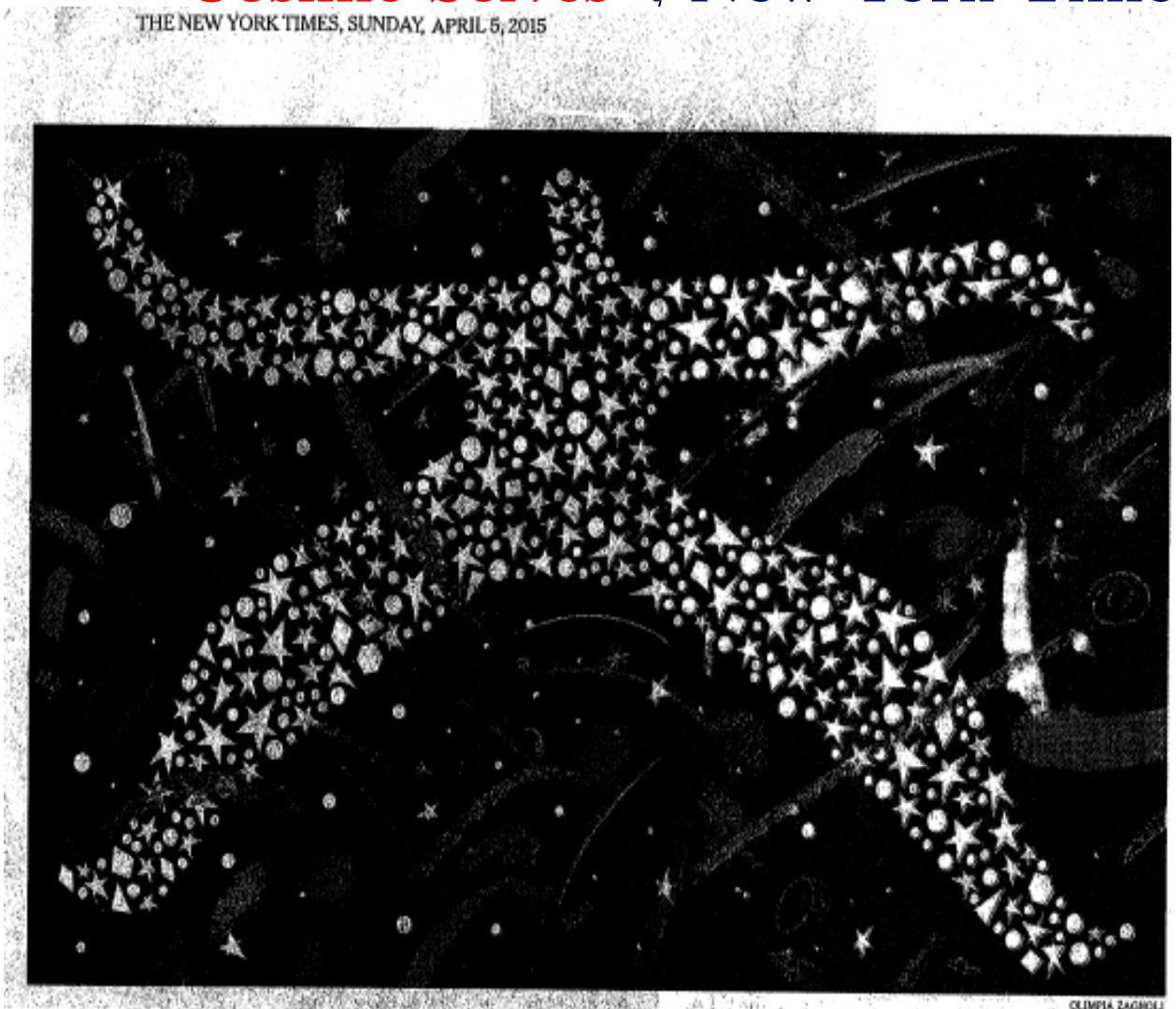
- Habitable planets where liquid water may exist
- Proxima b, exoplanet to our closest star Alpha Centauri (4 ly away: Earth-like in size, hard & rocky surface, possibility of liquid water & temperature similar to us

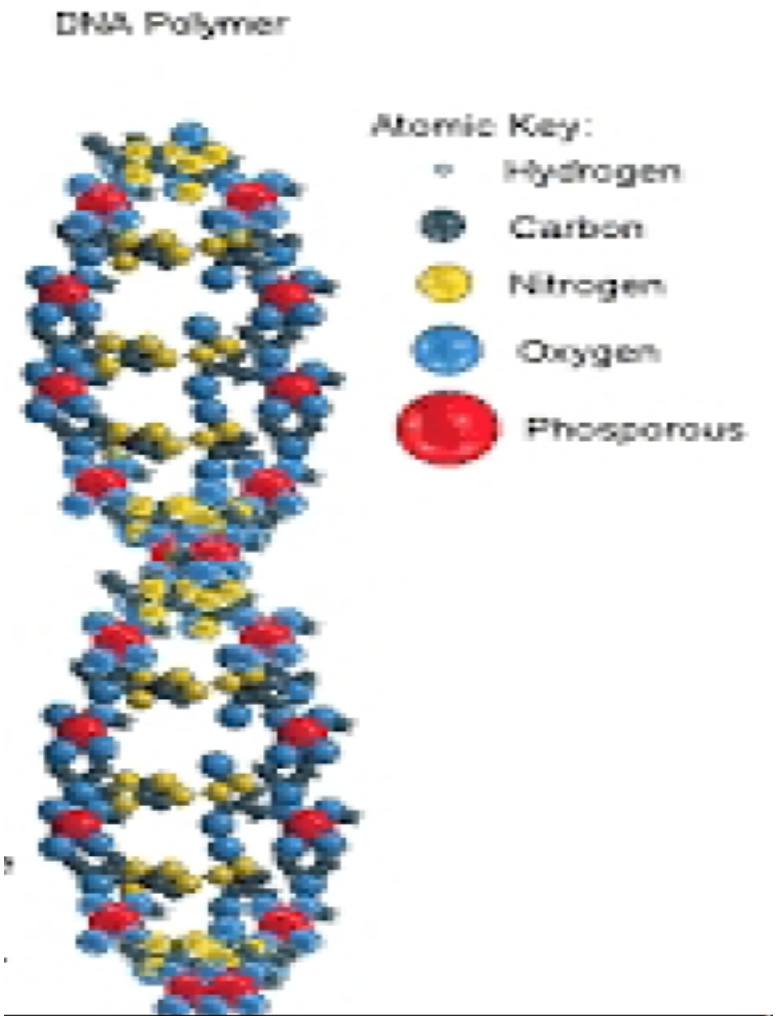
- But a spacecraft using current technology will take 18 thousands of years to reach it → New idea for 20 years

- 1 in 5 sun-like stars have an earth-sized planet in the habitable zone → potentially 11 billion exist in the Milky Way galaxy

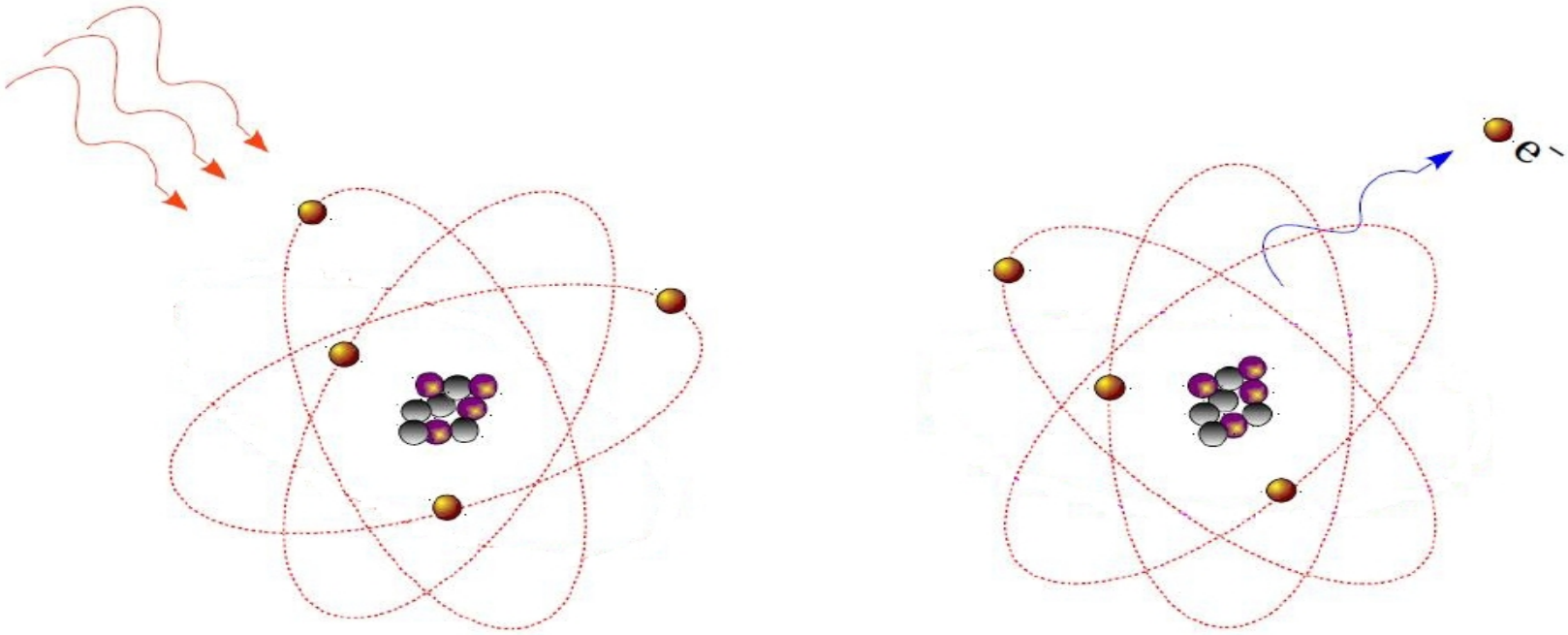
BIO-SIGNATURE: P DETECTION IN SPACE

- P is a highly reactive element. It is used extensively in fertilizers, detergents, pesticides, plasticizers, etc
- It is also a basic element of evolution.
- Phosphorus, a constituent of DNA, cells, teeth, bone, has been searched in cosmos for a long time (Cartoon: "Our Cosmic Selves", New York Times, 2015, DNA Polymer)





PHOTOIONIZATION (PI):



i) Direct Photoionization (background):

$$\mathbf{X^{+Z} + h\nu \rightleftharpoons X^{+Z+1} + \epsilon}$$

ii) Resonant Photoionization: an intermediate state before ionization → "Autoionizing state" → RESONANCE

$$\mathbf{X^{+Z} + h\nu \rightleftharpoons (X^{+Z})^{**} \rightleftharpoons X^{+Z+1} + \epsilon}$$

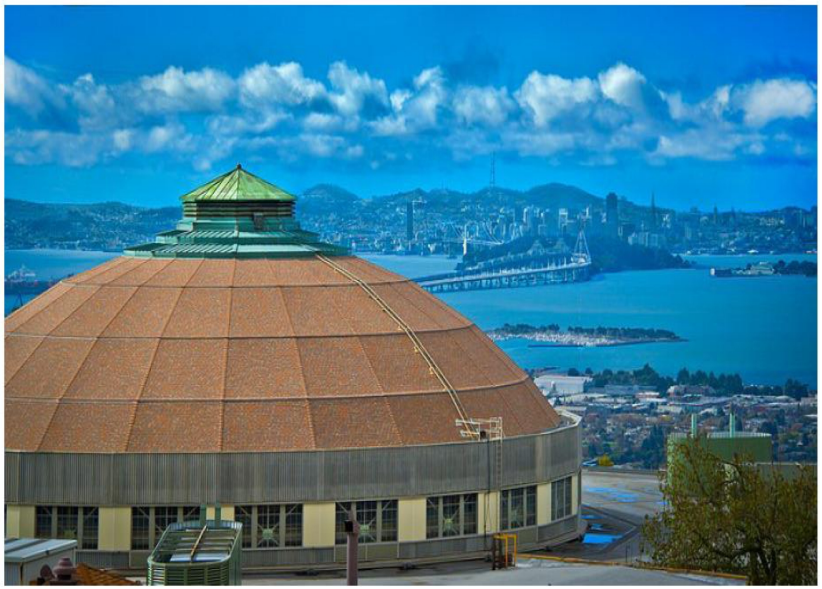
- κ_ν depends on photoionization cross section $\sigma_{\mathbf{PI}}$

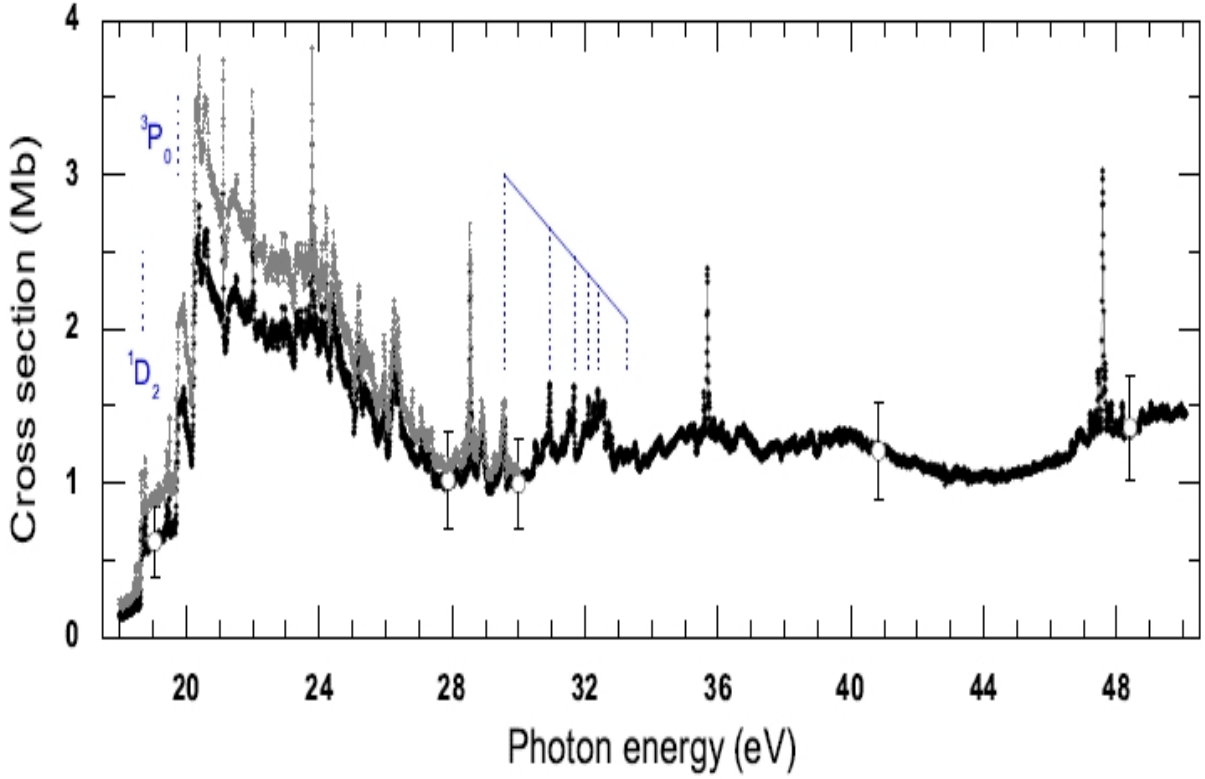
$$\kappa_\nu = \mathbf{N_i}\sigma_{\mathbf{PI}}(\nu)$$

PHOTOIONIZATION OF P II: Experiment (ALS, Berkeley)

(Guillermo et al. 2015

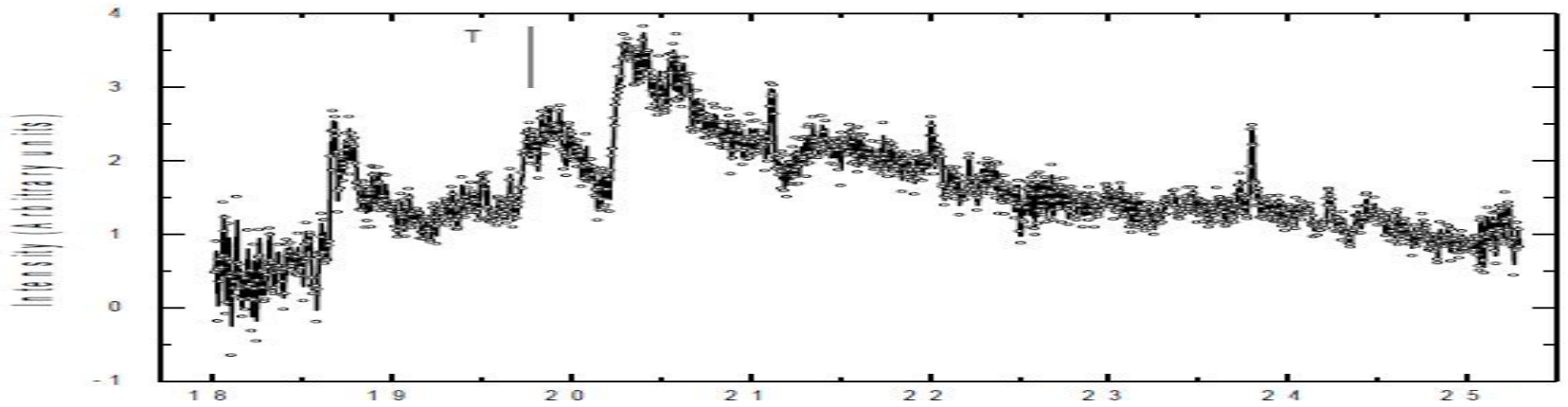
The ALS at Lawrence Berkeley National Laboratory



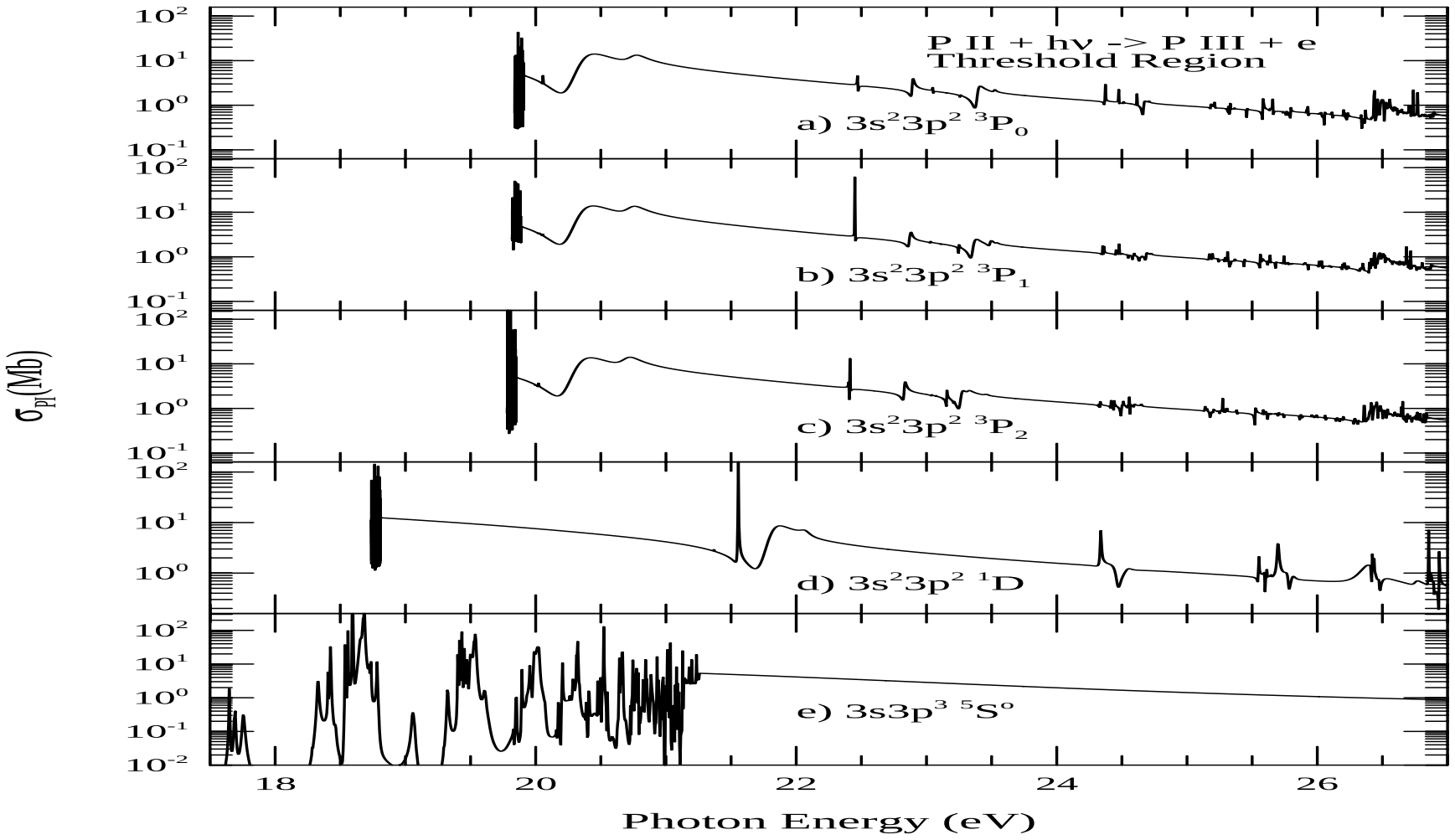


- Synchrotron based Advanced Light Source (ALS) produces high resolution photoionization spectra
- Figure shows combined features of states in target beam
- Needs theoretical spectral analysis for identification of features and abundance of states

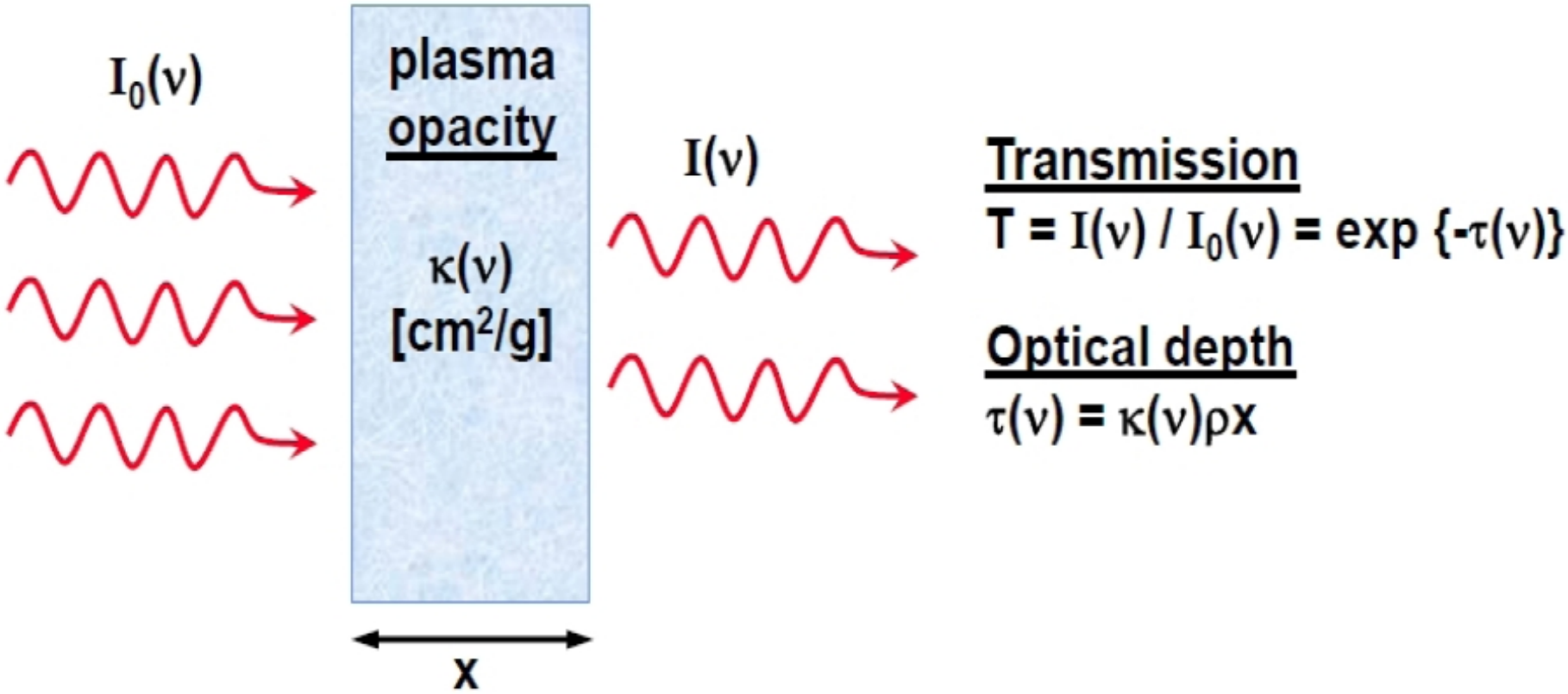
MEASURED PHOTOIONIZATION CROSS SECTIONS OF P II: BENCHMARK WITH R-MATRIX METHOD (Nahar et al 2016)



Photoionization Cross sections of P II at Thresholds



PLASMA OPACITY



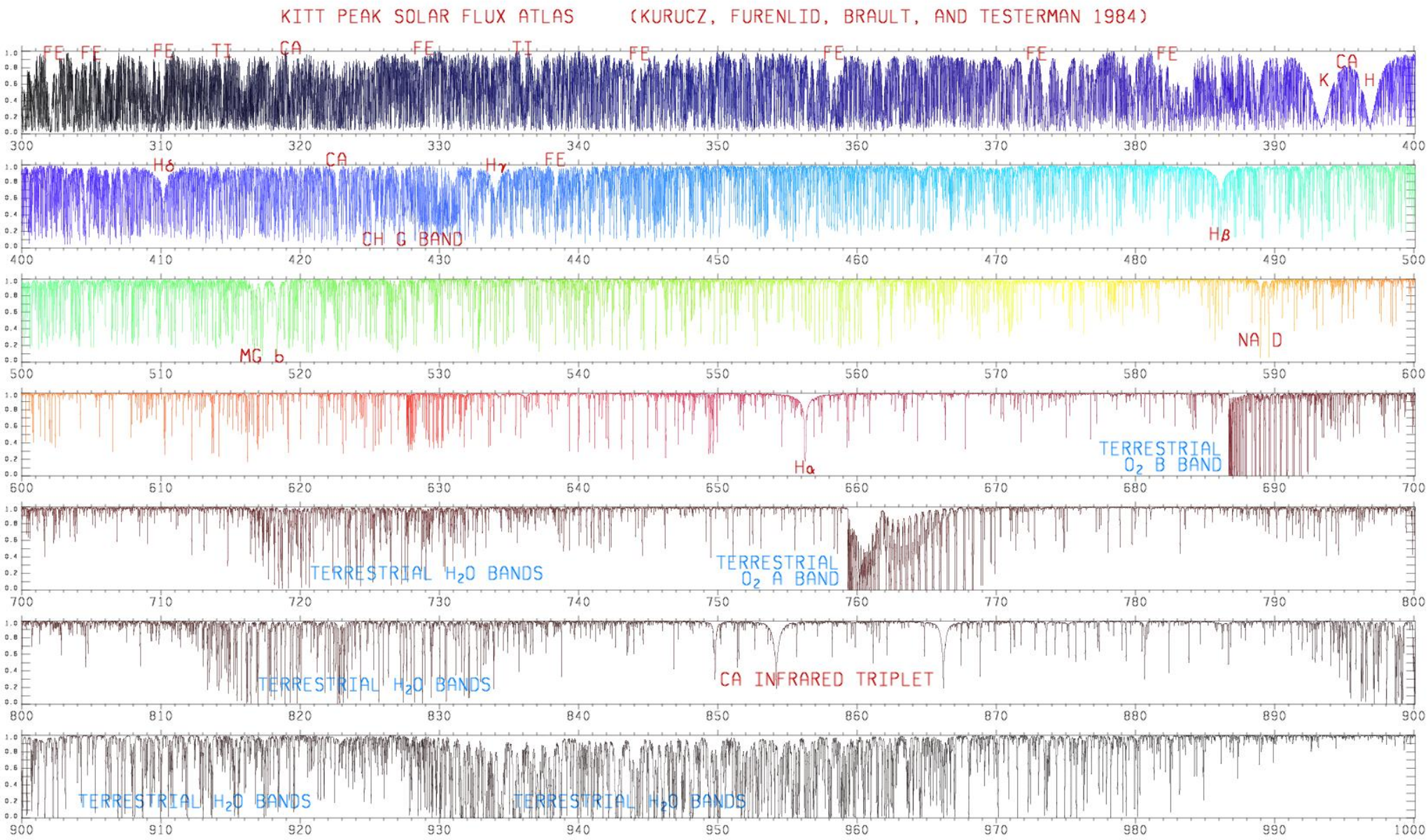
- Opacity is a fundamental quantity of radiation absorption by the constituet elements during transmission in plasmas.
- Microscopically monochromatic opacity $\kappa(\nu)$ depends on two radiative processes: 1. Photoexcitation -

$$\kappa_\nu(\mathbf{i} \rightarrow \mathbf{j}) = \frac{\pi \mathbf{e^2}}{\mathbf{mc}} \mathbf{N_i f_{ij}} \phi_\nu$$

2. Photoionization -

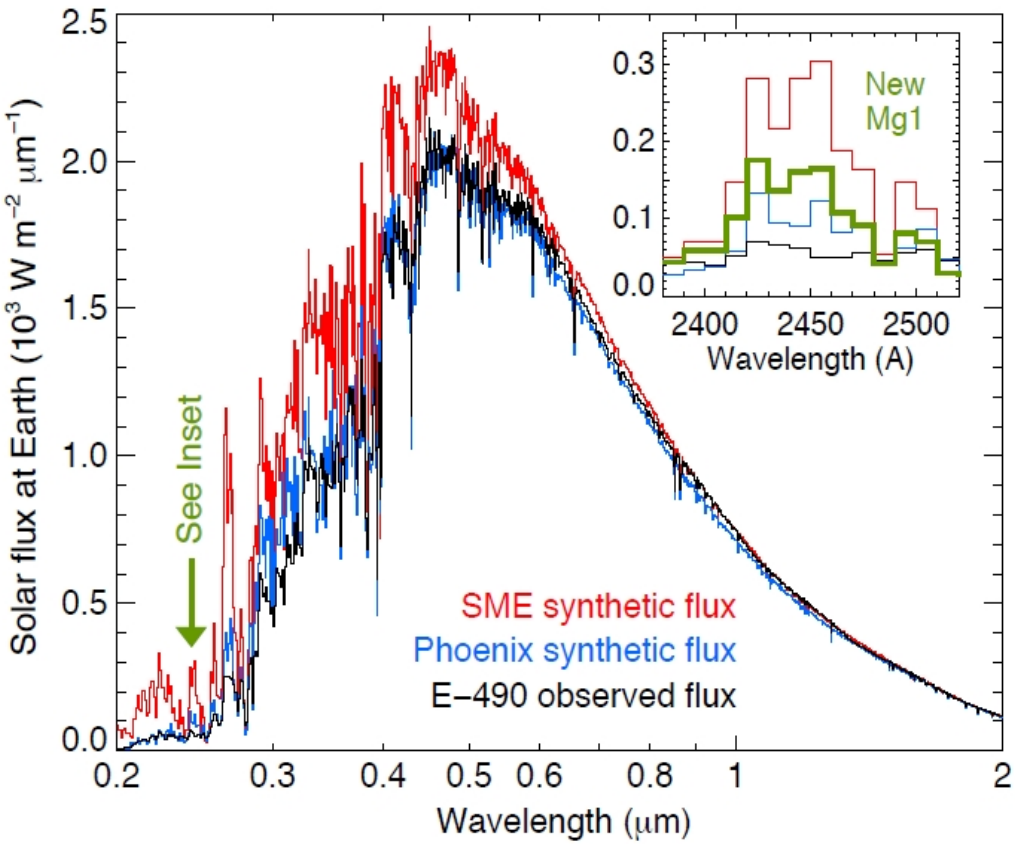
$$\kappa_\nu = \mathbf{N_i} \sigma_{\mathbf{PI}}(\nu)$$

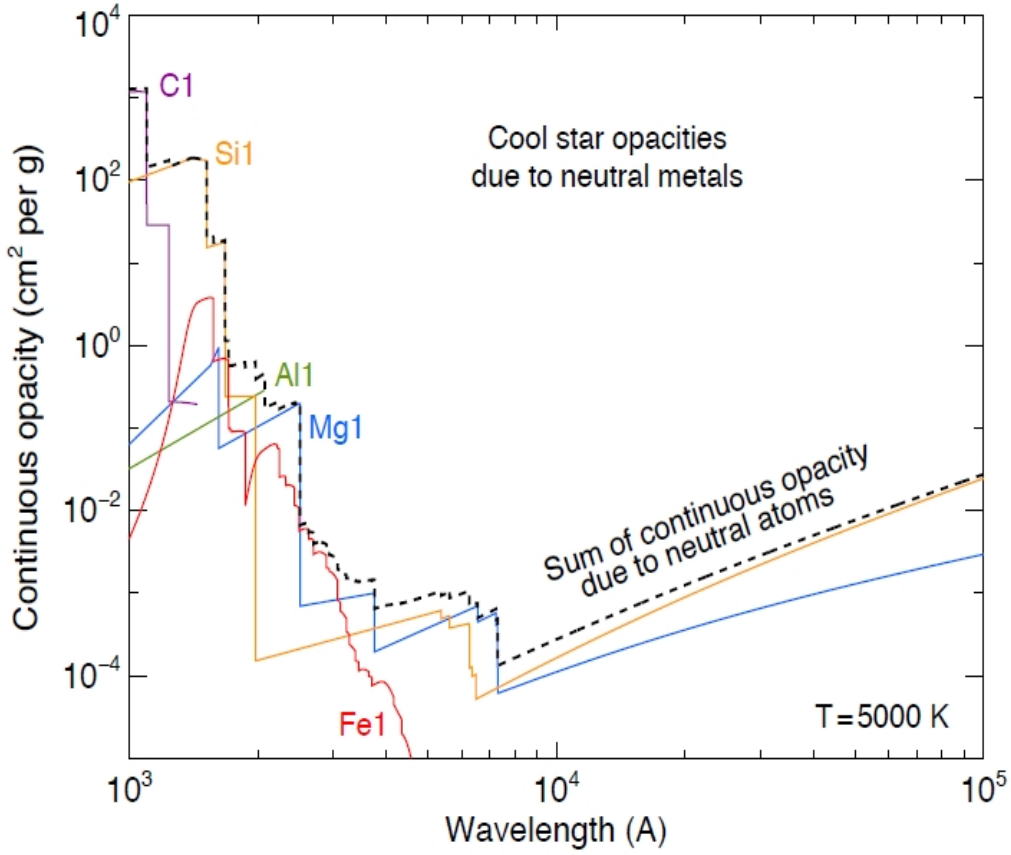
SOLAR SPECTRUM AS SEEN FROM THE EARTH



- Solar spectrum by Kurucz. The short wavelength region is mainly from Fe I, Fe II with large absorption or high opacity. - Less opacity in the yellow region, peak in the black body distribution function - reaonson for the yellow sun.

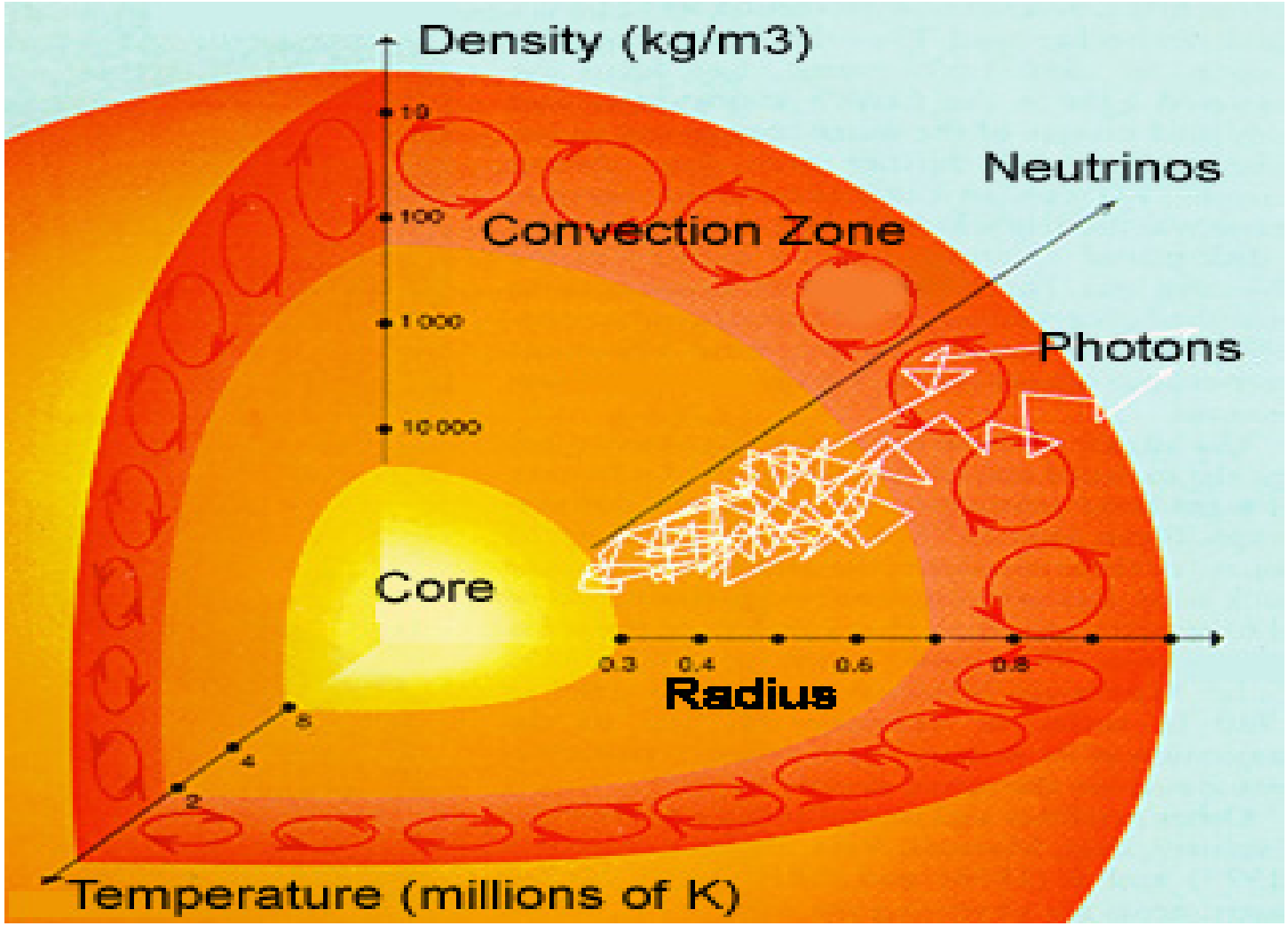
DISCREPANCY IN UV OPACITY (Valenti et al 2015)





- L: Synthetic flux spectra of the Sun - Models (Red, Blue) fail to account for the underlying observed (Black) continuum opacity over a large wavelength region, near-UV to optical in the 0.2-0.5 micron range
- R: The bound-free & free-free opacity in the UV for neutral C, Si, Al, Mg and Fe in the atomospheres of cool stars, that needs to be considered in the models

SOLAR OPACITY AND ELEMENTAL ABUNDANCES

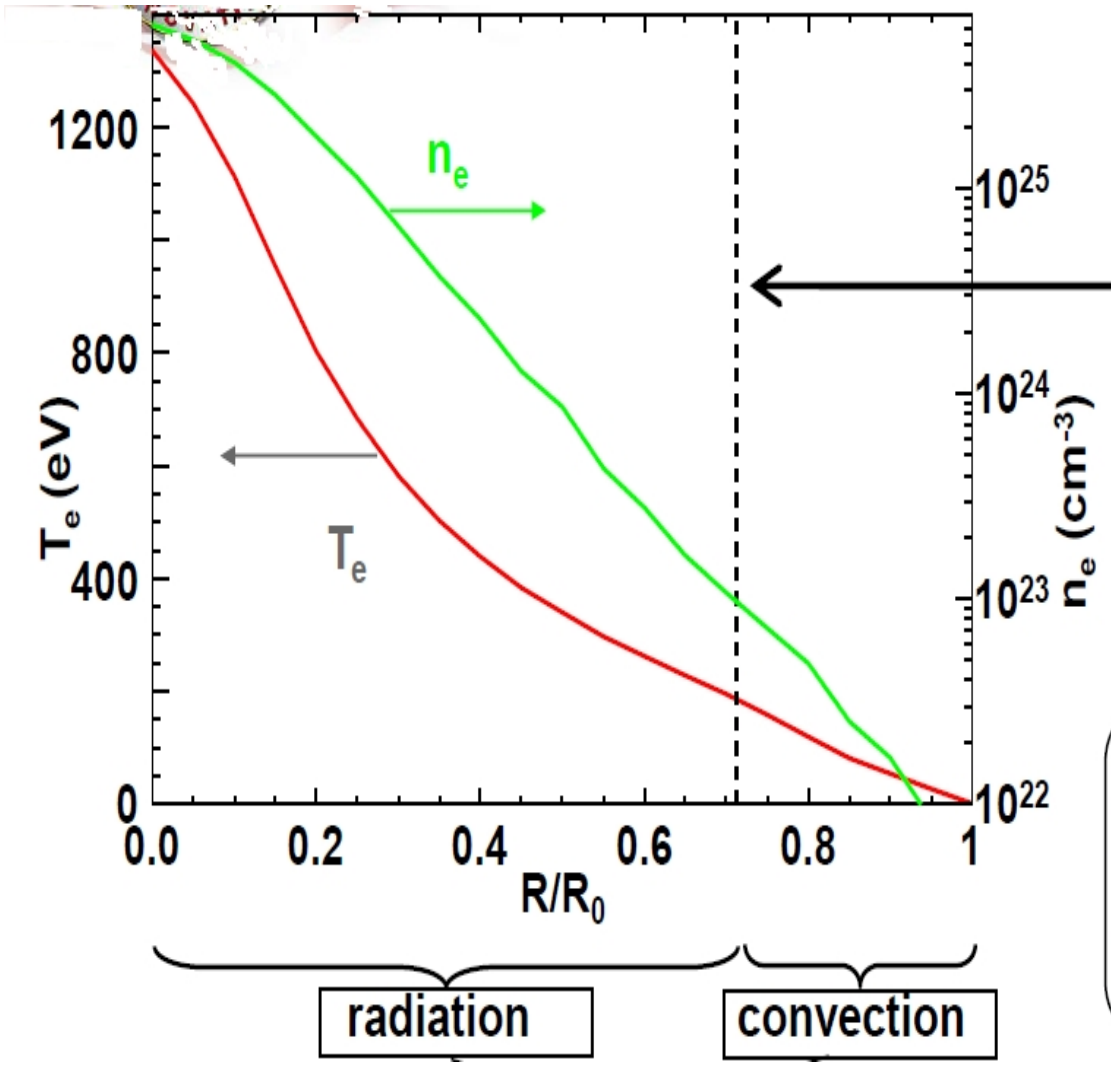


- Opacity, a fundamental quantity for plasmas, determines radiation absorption and transport in plasmas
- Solar opacity: Study amount of radiation traveling out
- Microscopically opacity (κ) depends on

i) photo-excitation (bound-bound transition)

ii) photoionization (bound-free transition)

DISCREPANCY IN SOLAR RADIATIVE AND CONVECTION ZONES BOUNDARY (R_{CZ})



- measured boundary $R_{CZ} = 0.713 \pm 0.001$
- Predicted $R_{CZ} = 0.726$
- Thirteen σ difference

Bahcall et al, ApJ (2004)
Basu & Antia Physics Reports 2008

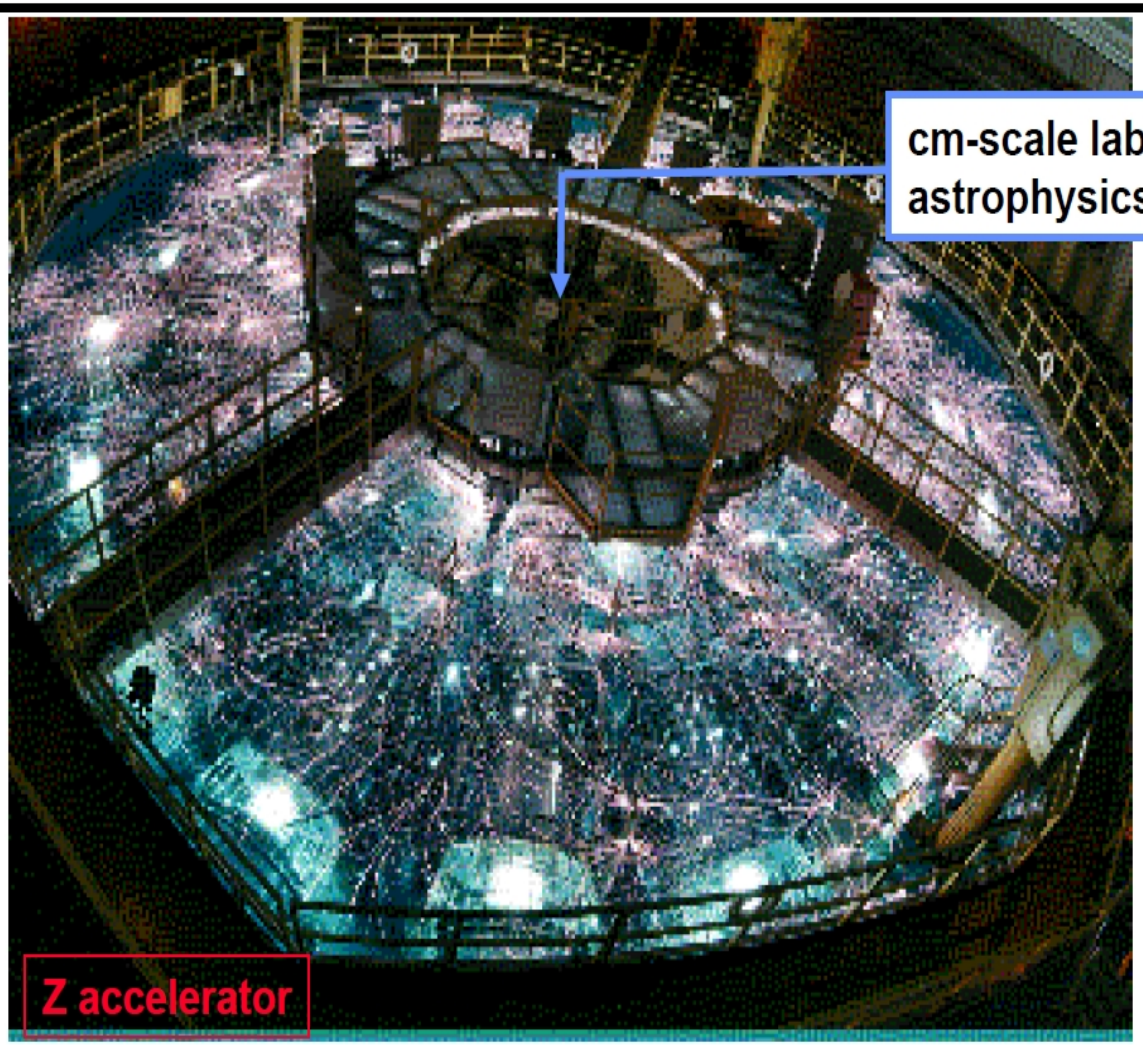
Asplund et al Ann Rev AA (2009)
Christensen-Dalsgaard et al A&A (2009)

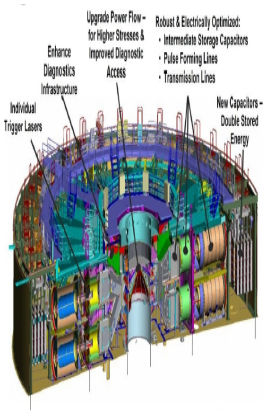
- Calculated, using current atomic data, $R_{CZ} = 0.726$ - large (over 5600 mi difference) → changes solar structure
- Recent 3D model finds C, N & O, up to 40-50% lower
- Less elements, but increase in 10-15% opacity to resolve the discrepancy → MISSING PHYSICS

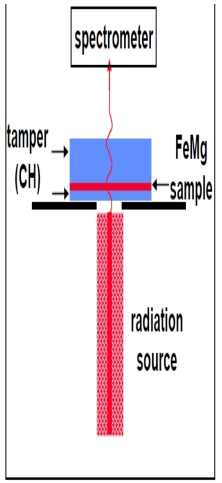
Z PINCH SET-UP, SANDIA NATL LAB

- Created plasma at T=190 eV $\sim$ 2 MK, $\rho = 2.8 \times 10^{22}/\mathrm{cm}^3$ at same condition as inside the Sun

The 20million Amp current provided by the Z accelerator enables this research







New Z

The refurbished Z delivers 24 million Amps to the load

50% increase in electrical energy for present day experiments

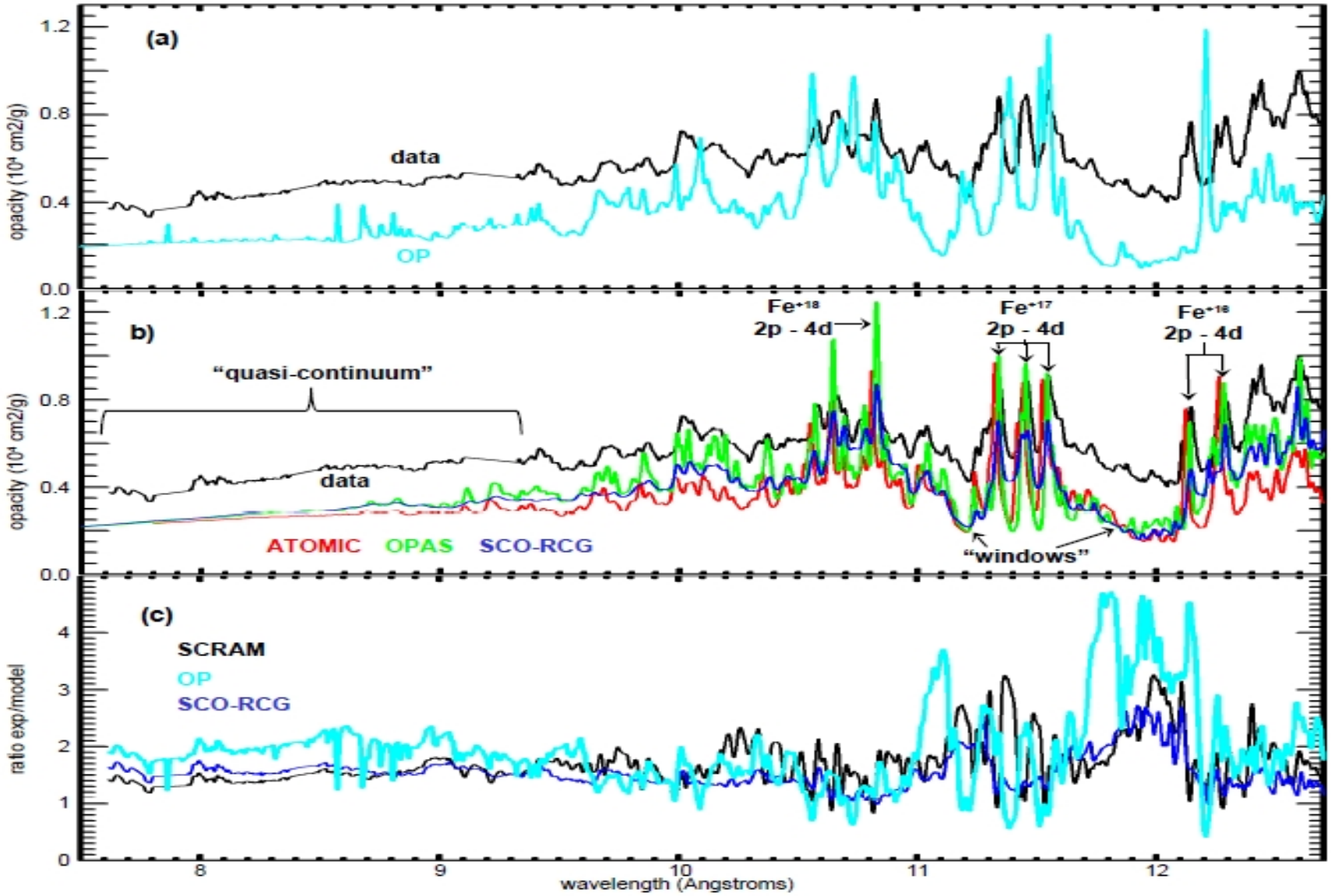
New sample design

Increasing the rear tamper thickness delays expansion onset

This leads to higher density and higher temperature

COMPARISON OF IRON OPACITY: Experiment & Theory

(Bailey et al, Nature Lett 2015)



- Present models use photoionization data - no resonances, except those in TOPbase database

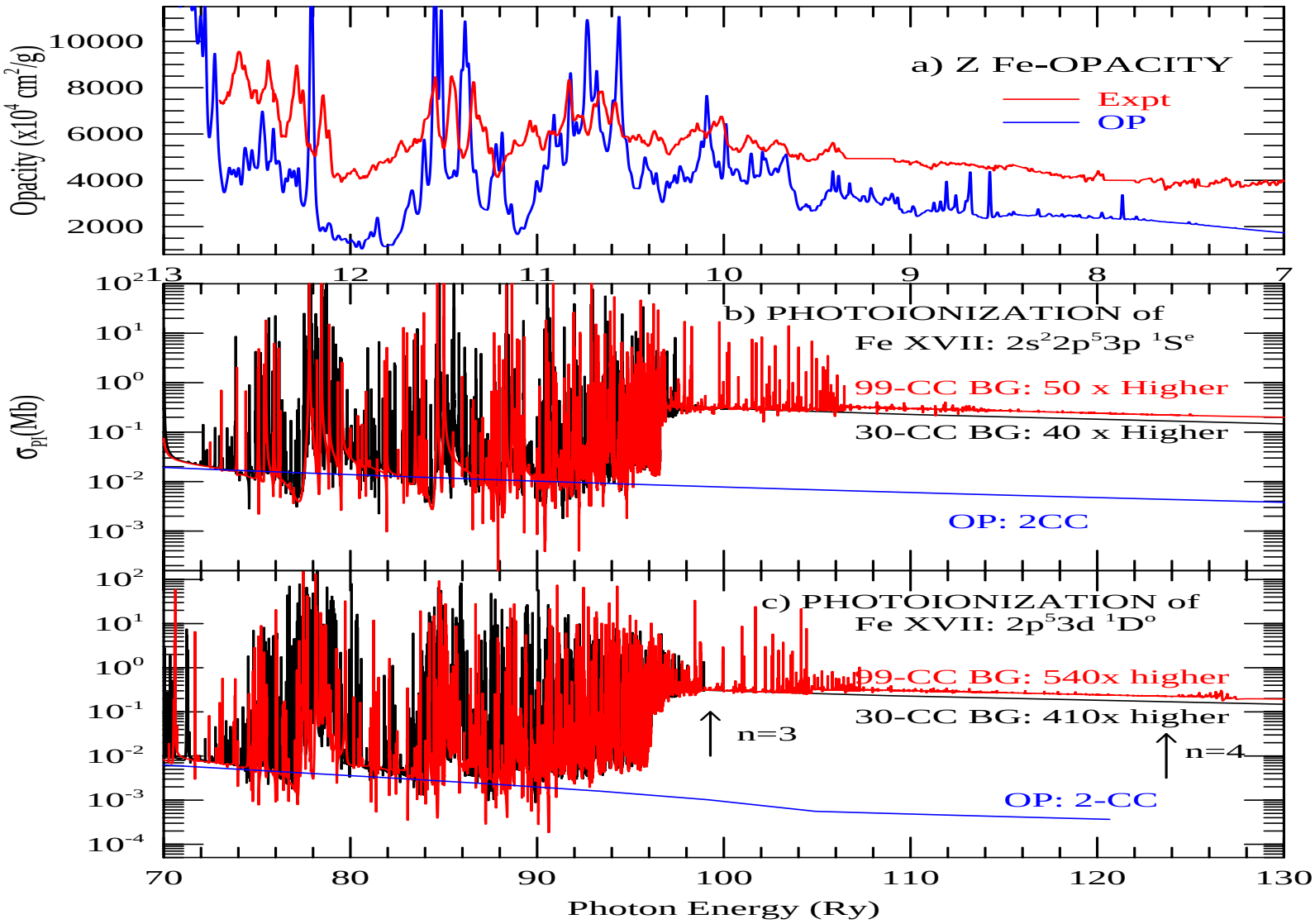
Problems (theory): i) Deep windows, ii) lower background

COMPARISON: RESONANT EFFECT ON Fe XVII PHOTOIONIZATION (Red - New, Blue - OP, Black - 2011):

TOP: a) Measured Fe opacity (Bailey et al 2015)

LOWER TWO: Photoionization cross sections of Fe XVII (Nahar & Pradhan, Phys.Rev.Lett 2016)

Achieved: i) Resonant convergence, ii) κ_R increment by 35%



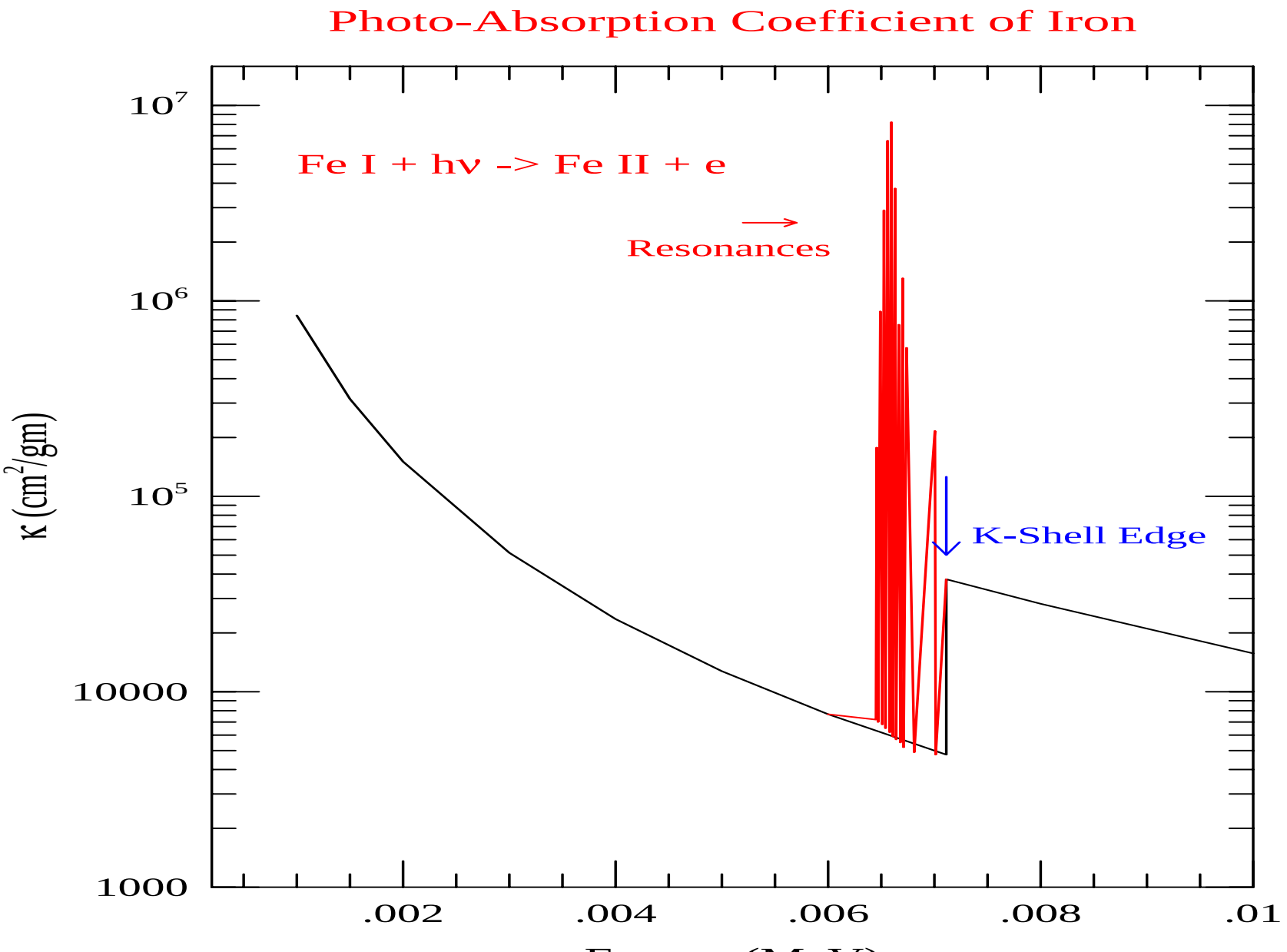
The OPACITY Project & The IRON Project

AIM: Accurate Study of Atoms & Ions, Applications to Astronomy

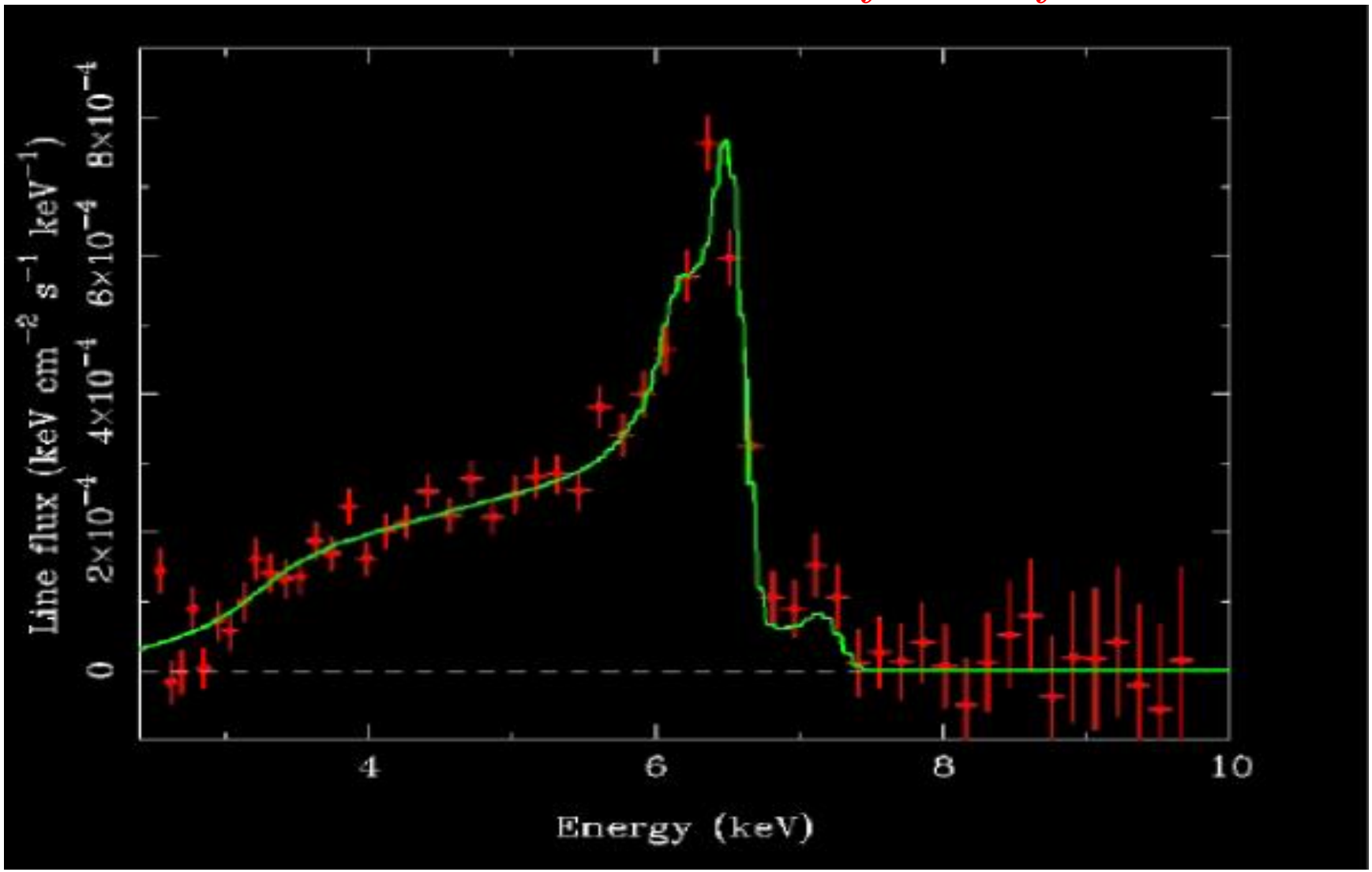
- International Collaborations: France, Germany, U.K., U.S., Venezuela, Canada, Belgium
- Earlier opacities were incorrect by factors of 2 to 5 $\rightarrow$ inaccurate stellar models $\rightarrow$ initiation of the Opacity Project in 1981
- THE OPACITY PROJECT - OP (1981 - 2006):
- Studied radiative atomic processes for (E, f, $\sigma_{\rm PI}$)
- Elements: H to Fe
- Calculated opacities of astrophysical plasmas
- THE IRON PROJECT - IP (1993 -): collisional & radiative processes of Fe & Fe peak elements
- RMAX: Under IP, study X-ray atomic astrophysics
- Atomic & Opacity Databases (from OP & IP)
- TOPbase (OP) at CDS:
http://vizier.u-strasbg.fr/topbase/topbase.html
- TIPbase (IP) at CDS:
http://cdsweb.u-strasbg.fr/tipbase/home.html
- OPserver for opacities at the OSC: http://opacities.osc.edu/
- Latest data at NORAD-Atomic-Data at OSU:
http://norad.astronomy.ohio-state.edu

K-α RESONANCES IN Fe PHOTOIONIZATION

(Pradhan, Nahar, Montenegro et al 2009)



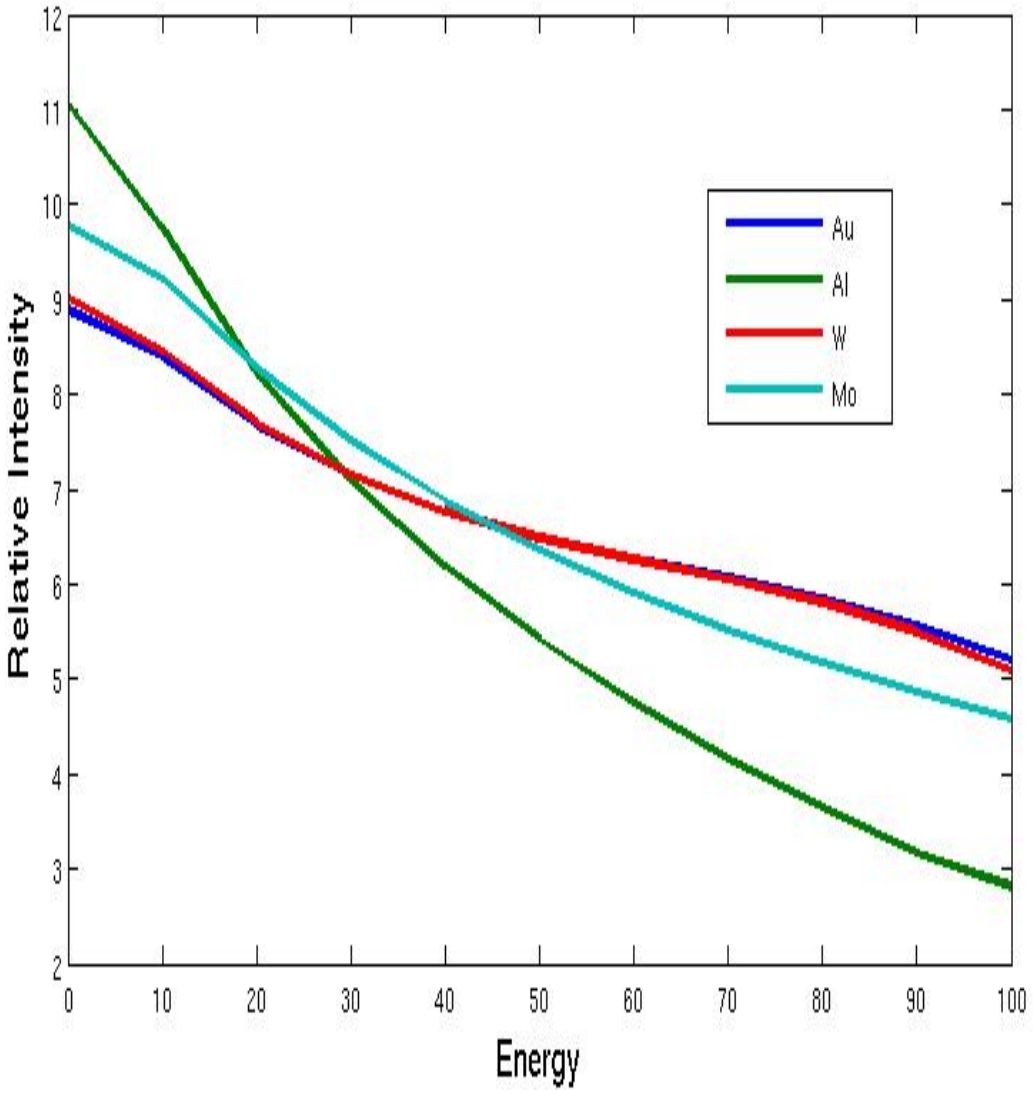
SIGNATURE OF A BLACK HOLE: SeyfertI Gy MCG-6-30-15 6

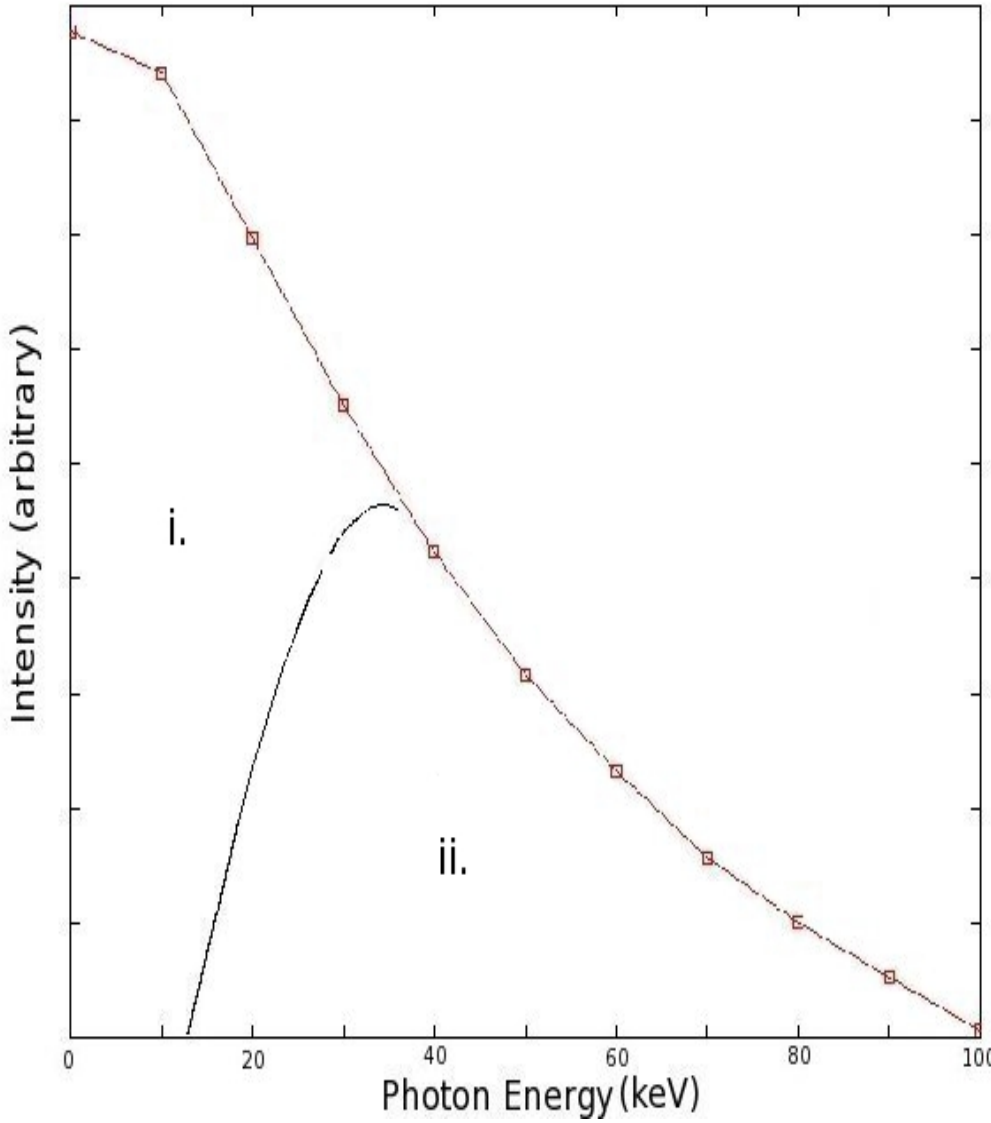


• The energy range for 1s-2p transitions in Fe = 6.4 - 7 keV. However, the large extension of the lines toward low energy, 3 - 7 keV, indicate that the escaped photons have lost energies in the gravitational force of the black hole. (Illustrated in AAS, Pradhan and Nahar 2011)

BREMSSTRAHLUNG OF A X-RAY MACHINE

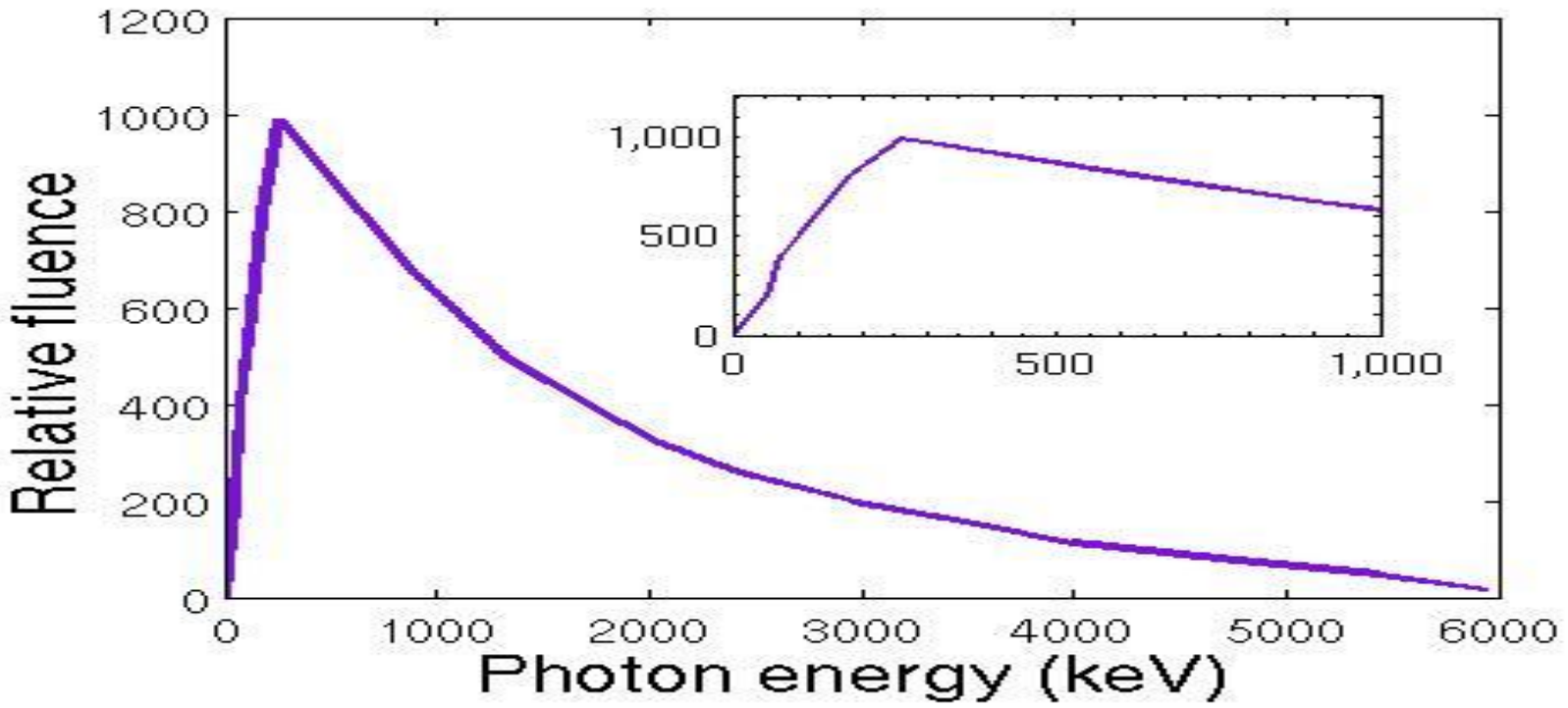
- **Left:** Shape of X-ray Bremsstrahlung (keV): Al (green), Mo (turquoise), Au (blue), and W(red)
- **Right:** W Bremsstrahlung: i. Without & ii. With Al filter
- A filter reduces low energy radiation





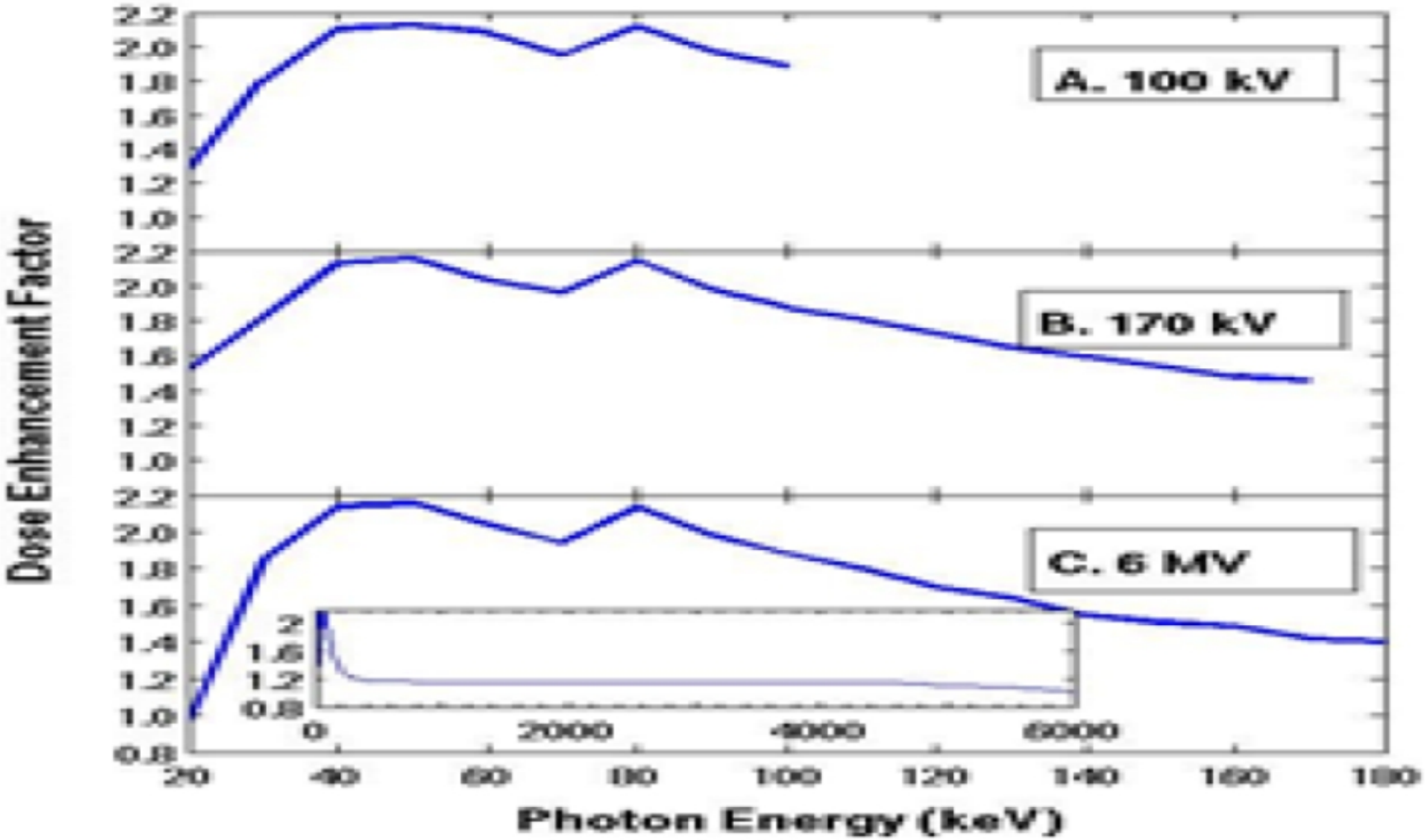
FILTERED X-RAY BREMSSTRAHLUNG OF A LINAC

- **LINAC: 6-16 MeV, Peaks at ∼300 keV after filtration**



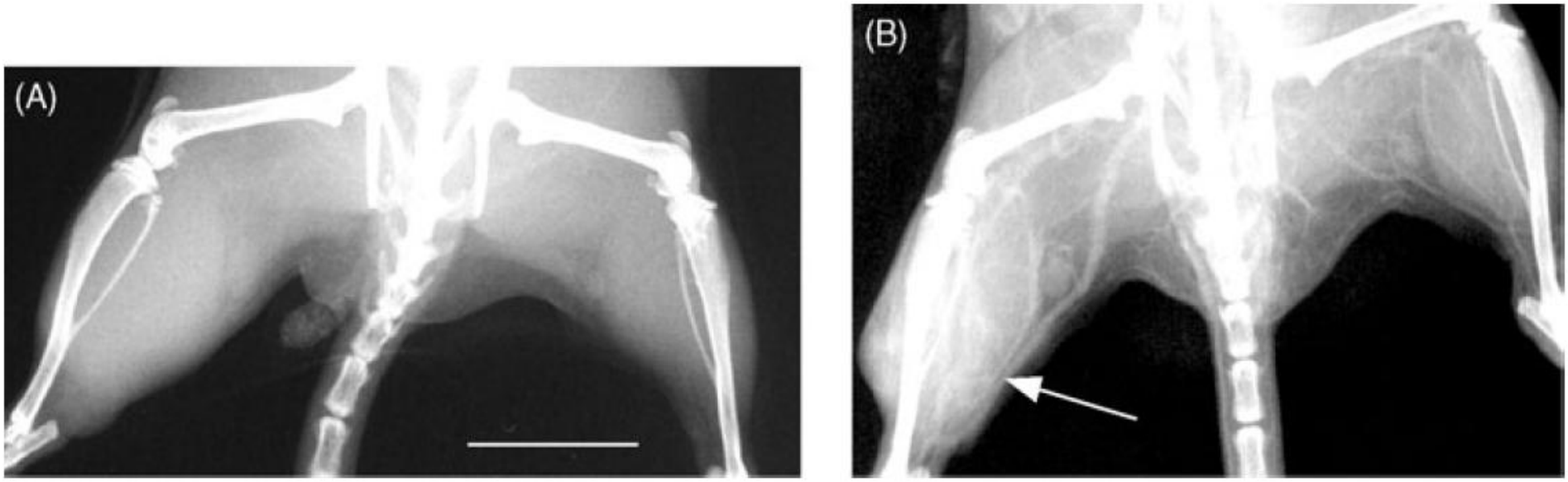
LOW VERSUS HIGH ENERGY X-RAY ABSORPTION & DOSE DEPOSITION OF Pt (Lim et al. 2012)

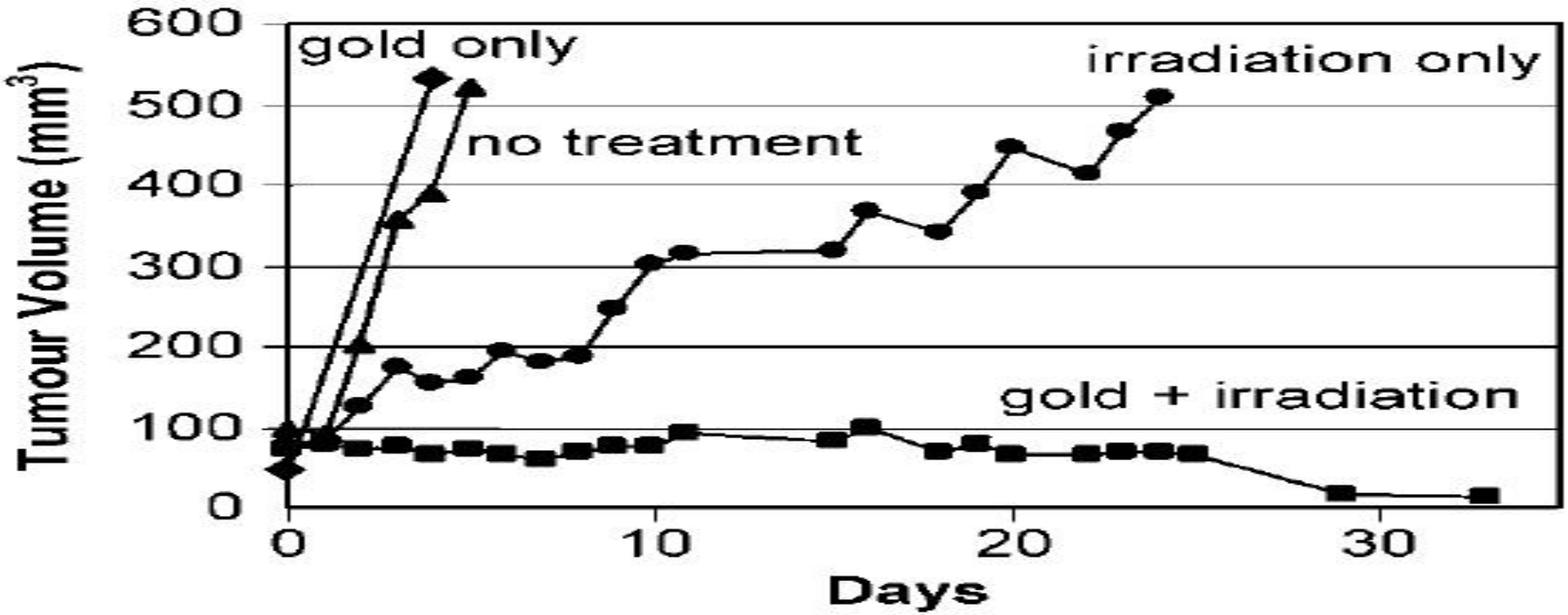
- Fig: Monte Carlo Simulation of x-ray dose deposition in tissues with Pt ∼ same for 100 & 170 keV, & 6 MEV
- DEF: 1st peak (∼40 keV)- L-shell ionization, 2nd peak (∼ 80 keV - K-shell ionization.



CANCER TREATMENT WITH X-RAYS

• Irradiation with radiosensitizing agents (nanoparticles) is more effective than pure irradiation. • Fig: Cancer treatment of mice with gold nanopaoticles & X-rays (Hainfeld et al 2004)

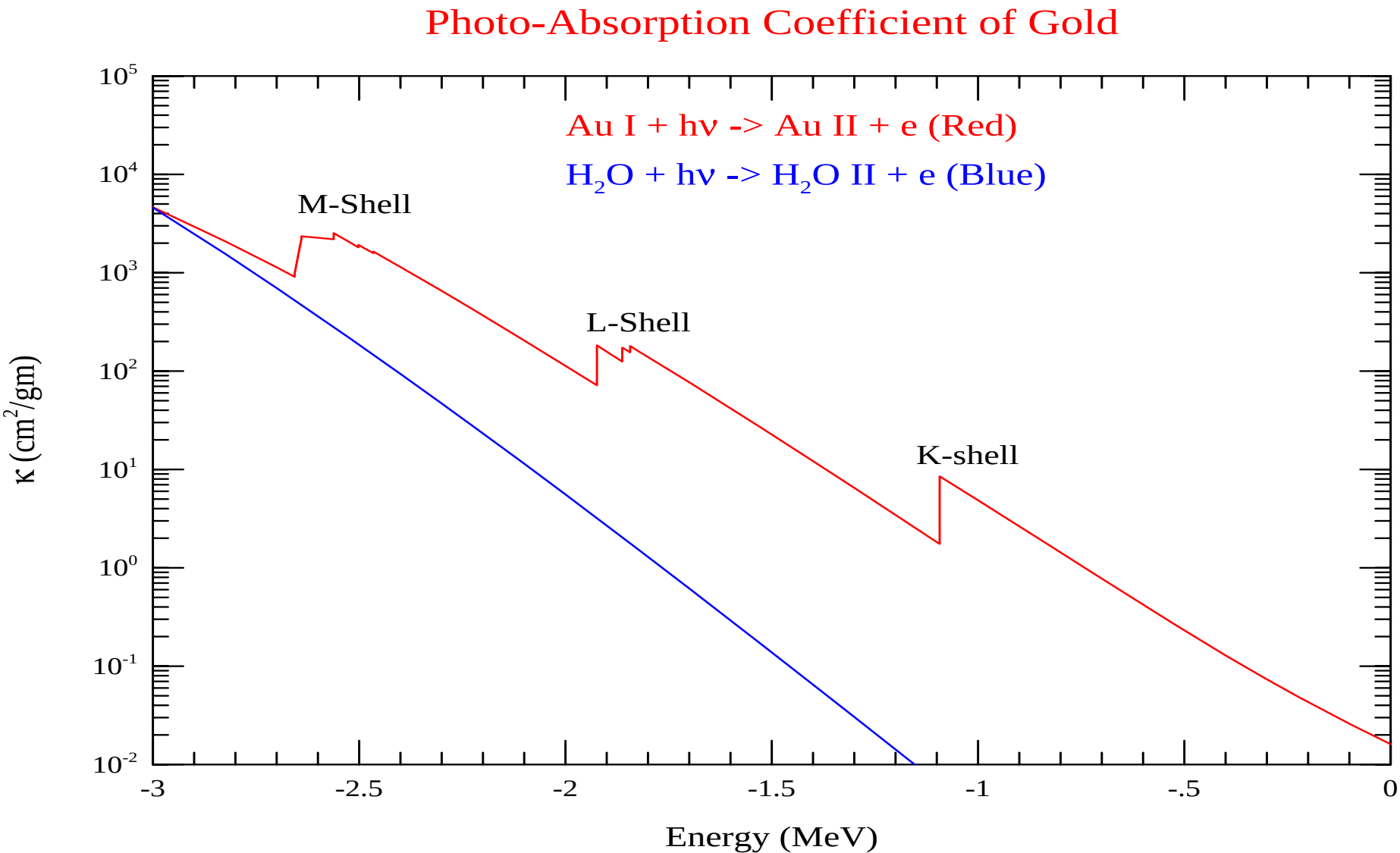




PHOTOIONIZATION: Au & H2O (without RESONANCES)

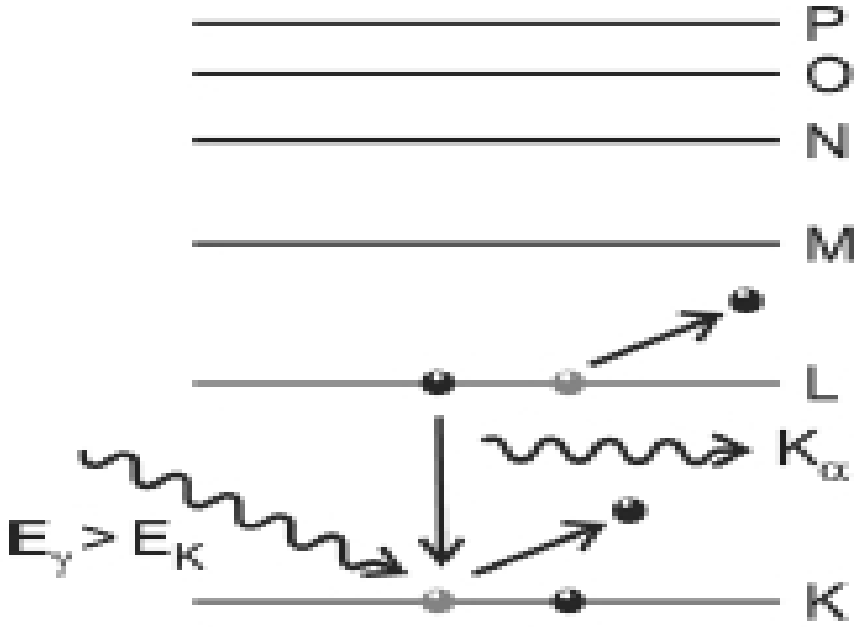
$$\mathrm{X(ion)} + h\nu \rightarrow X^{+} + \mathrm{e}$$

- **Enhancements at K, L, M sub-shells**
- **Au K-shell ionization edge $\sim$ 81 keV**
- **K-edge (O) = 0.53 keV $\rightarrow$ no rise**



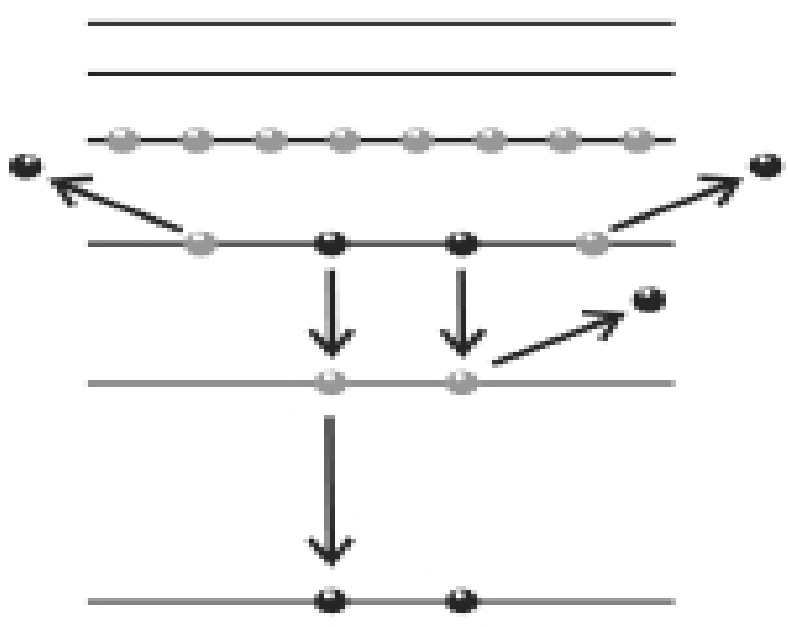
INNER-SHELL PHOTOIONIZATION & AUGER PROCESS

- **Auger Process: Inner shell ionization can lead to electron and photon emissions - Fig.(i)**
- **Ionization by X-ray photons $E_X > E_K$**
- **Koster-Kronig cascade - Fig.(ii)**
- **Single ionization $\rightarrow$ ejection of 20 or more electrons in an ion with occupied O and P shells**



Ionization & Auger Process

(i)



Electron Vacancies

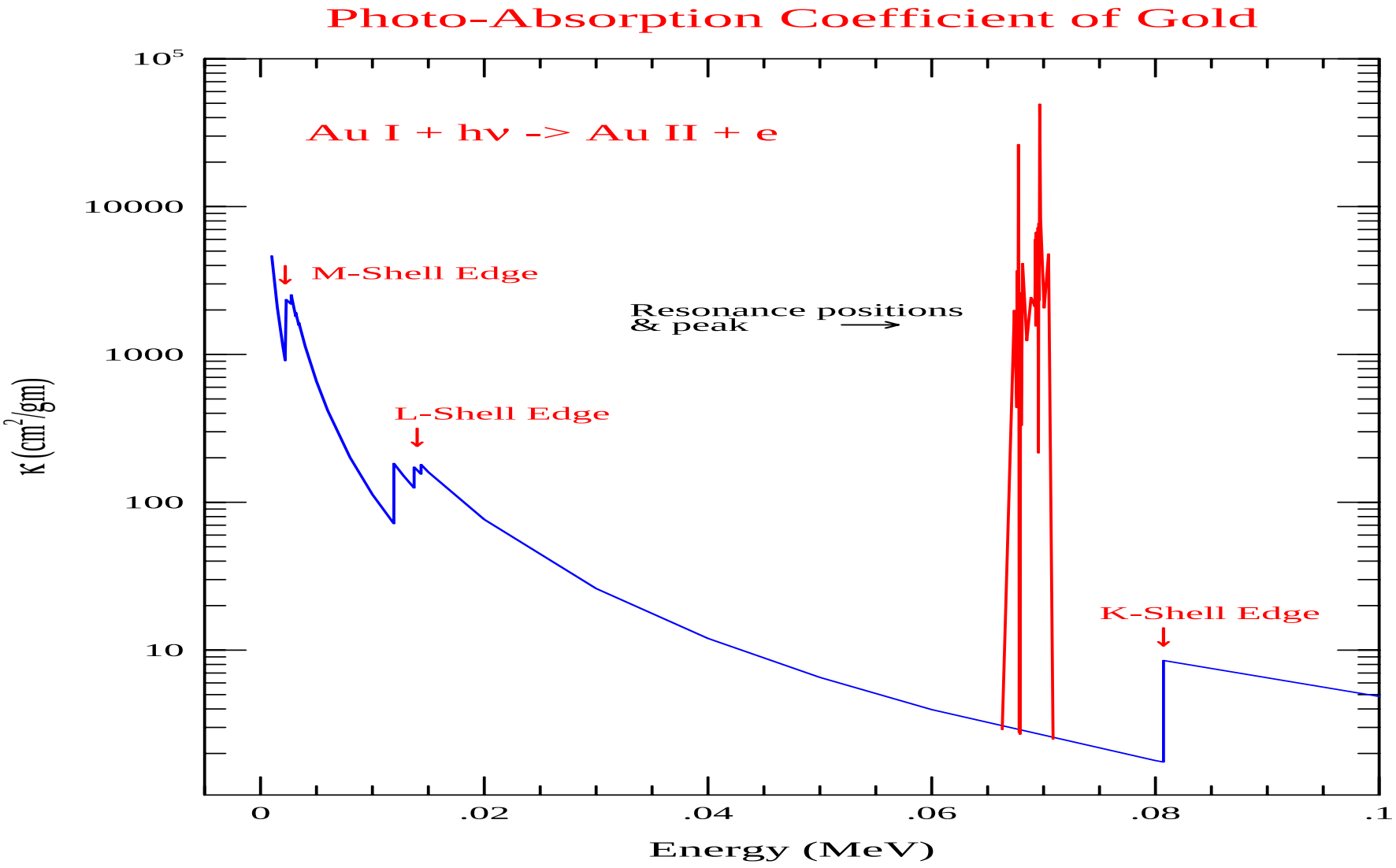
(ii)

PHOTO-ABSORPTION COEFFICIENT $\kappa(\mathrm{cm}^2/\mathrm{g})$:

(Montenegro, Nahar, Pradhan et al 2009)

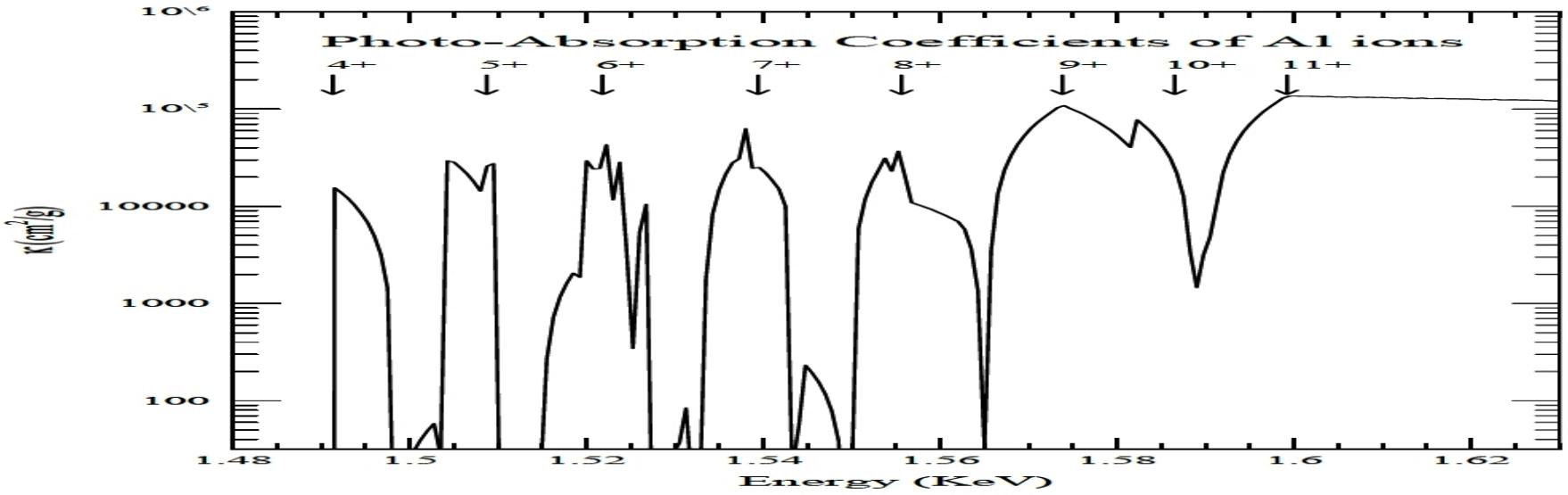
$\mathbf{Au} + h\nu \rightarrow \mathbf{Au}^+ + \mathbf{e}$

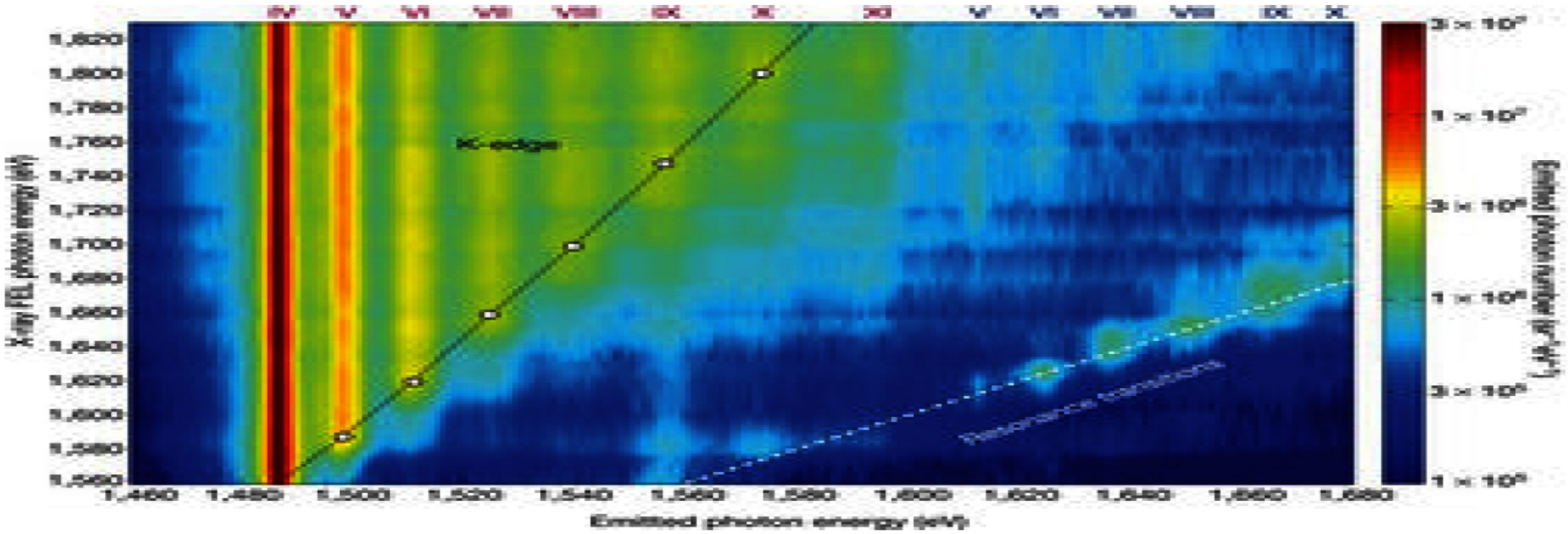
- **Existence of K-α resonances (red), due to $\mathrm{K} \rightarrow \mathrm{L}$ excitations, in $\mathrm{E_{res}}$ = 66 - 72 keV, below $\mathrm{E_K}$ $\rightarrow$ give more electrons**



RESONANT K_α EMISSION BELOW K-EDGE FROM VARIOUS IONIZATION STATES OF Al

- Bottom: Berkeley Experiment detected K_α photons at 1.46-1.68 keV below K-edge (Vinko et al, Nature Lett 2012)
- TOP: Predicted K_α resonances (Nahar & Pradhan 2015)

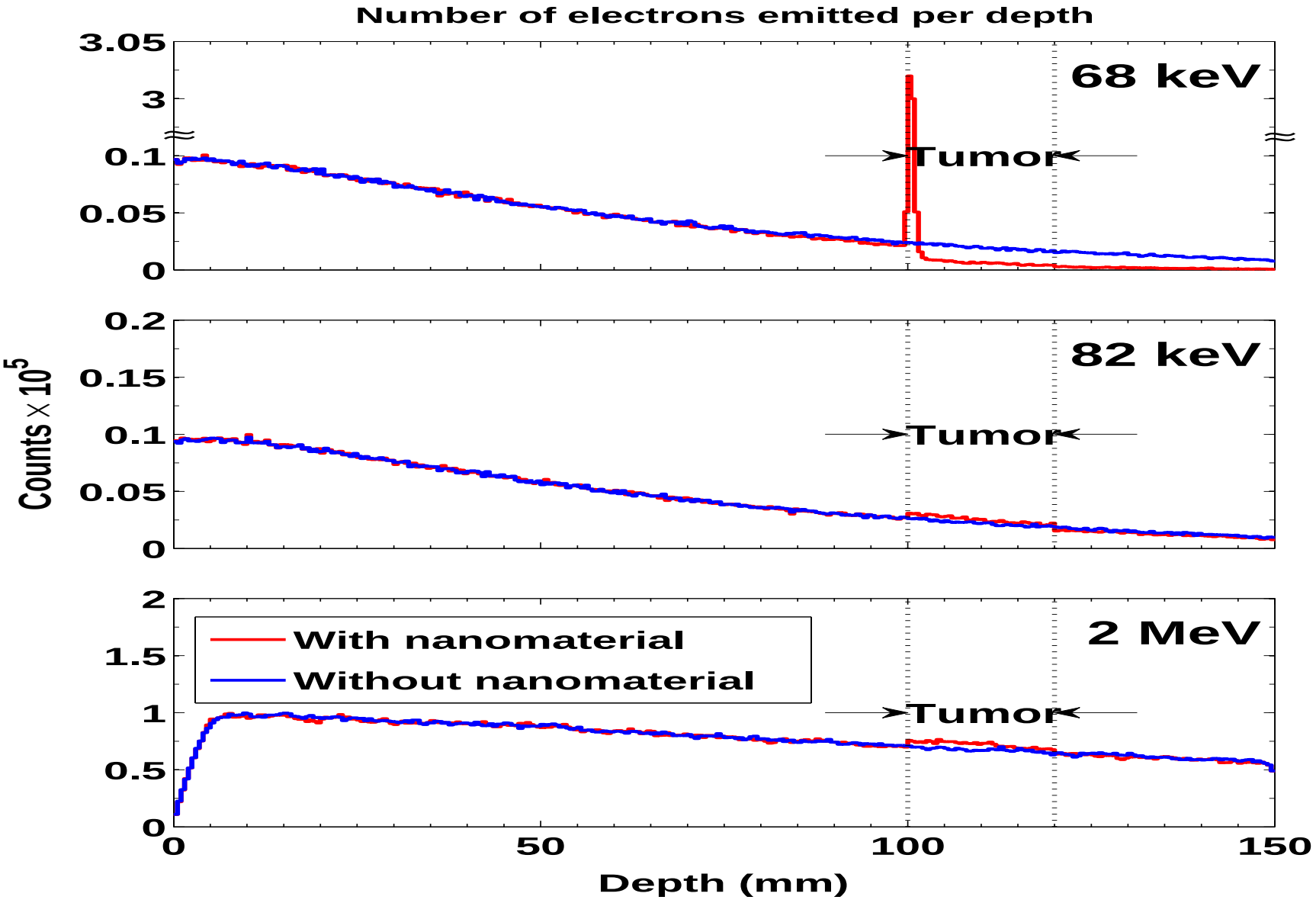




ELECTRON PRODUCTIONS AT 68 & 82 keV, & 2 MeV

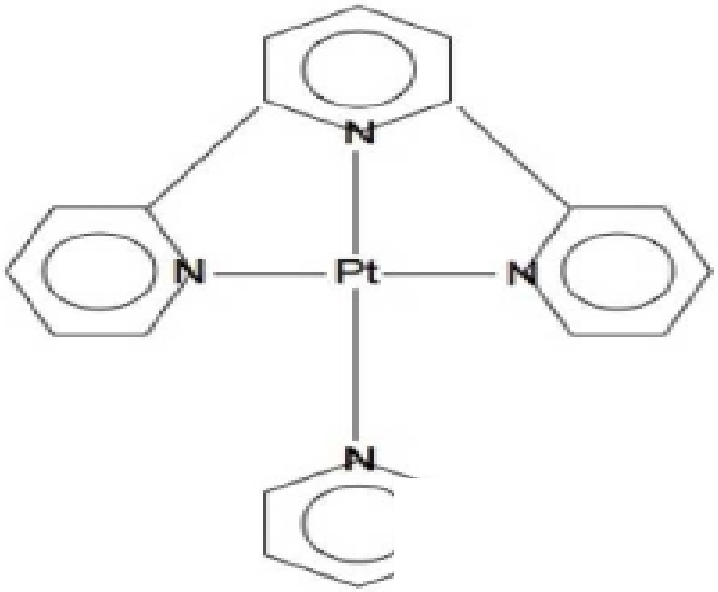
(Montenegro, Nahar, Pradhan et al. 2009)

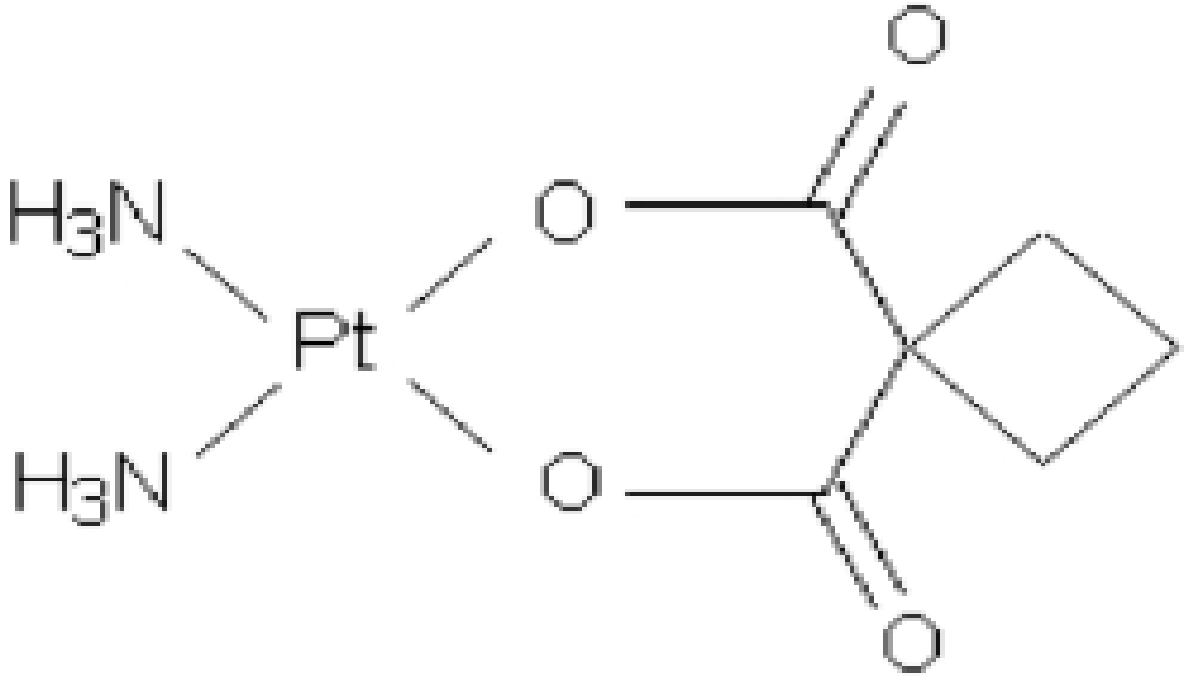
Figure: Number of Auger electrons produced with depth following X-ray absorptions: Red - tumor dopped with gold nanoparticles at 5 mg/ml in region 10-15 cm, Blue - only water



Pt-COMPOUNDS IN RNPT EXPERIMENTS: 1) TERPYRIDINE, 2) CARBOPLATIN (Lim et al 2014)

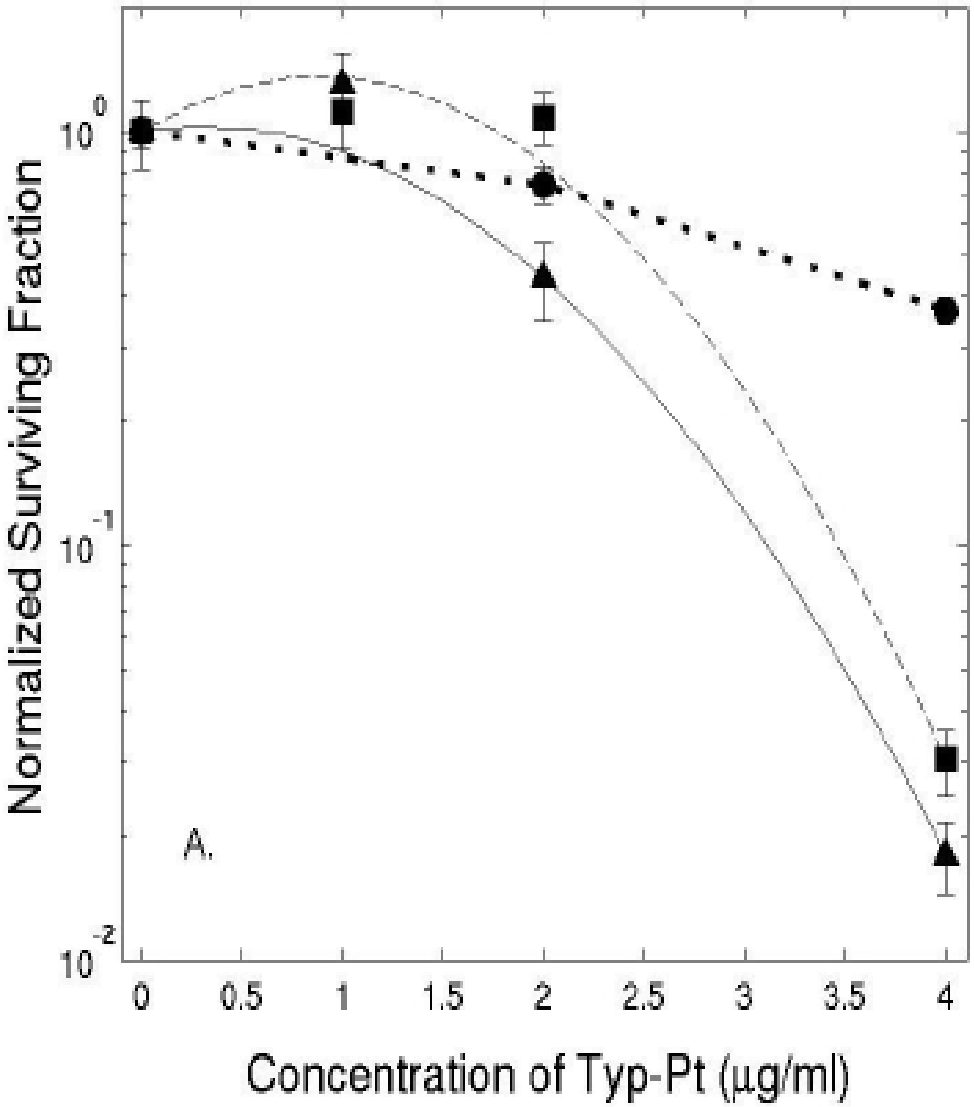
- Structure of Pyridine terpyridine Pt(II) nitrate (Typ-Pt), a drug found to be less cytotoxic
- Structure of (carboplatin commonly used chemotherapeutic drug

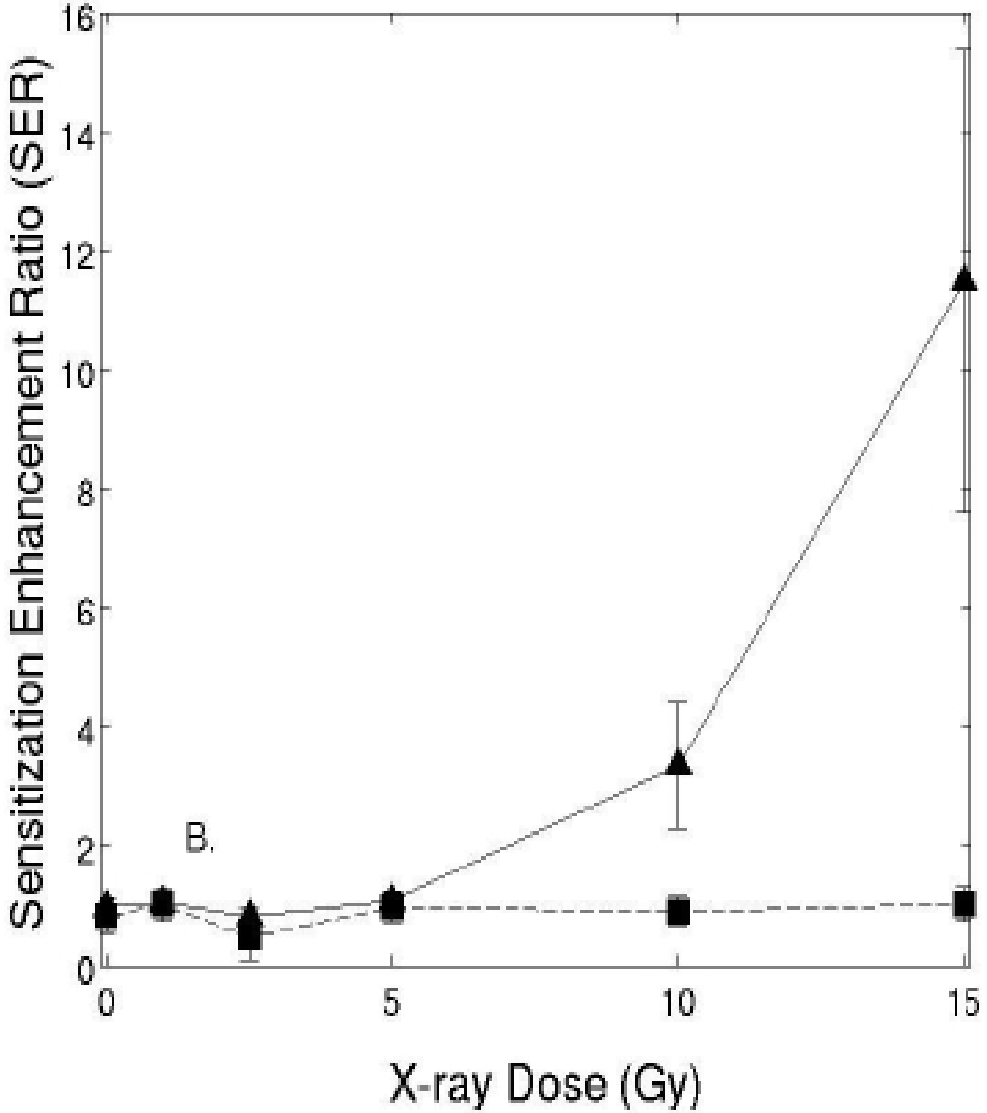




RNPT EXPERIMENT (IN VITRO) WITH TERPYRIDINE IN F98 GLIOMA BRAIN CANCER CELLS OF MICE: (Lim et al. 2014)

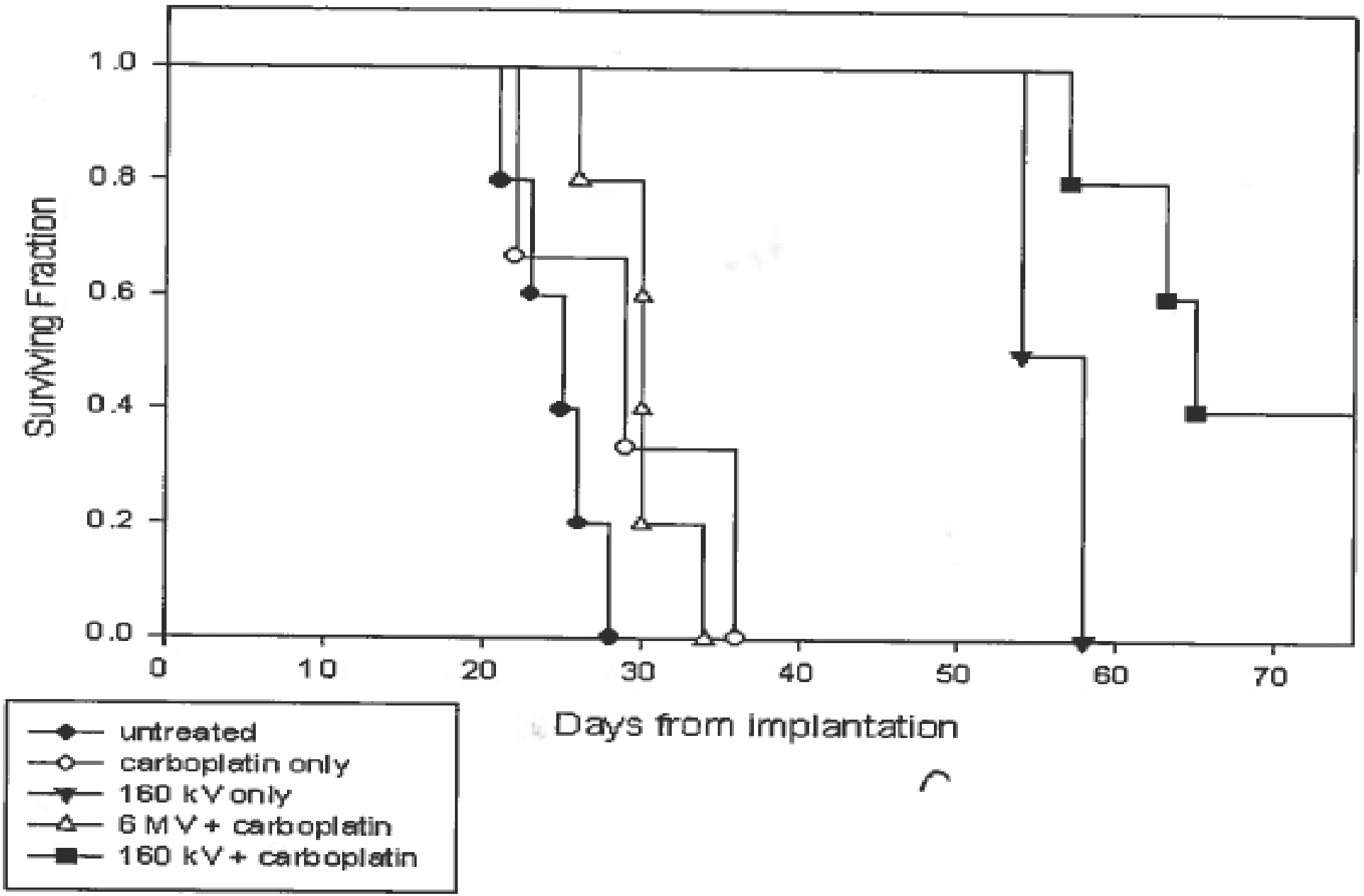
• Effect of X-ray energies, 160 keV (triangle) & 6 MeV (square), on survival of platinate dendrimers. Controlled (no x-ray, diamond)
cultured clonogenic assays of F98 Glioma cancer cells sensitized with terpyridine platinum (typ-Pt) at 1-4 $\mu g/ml$





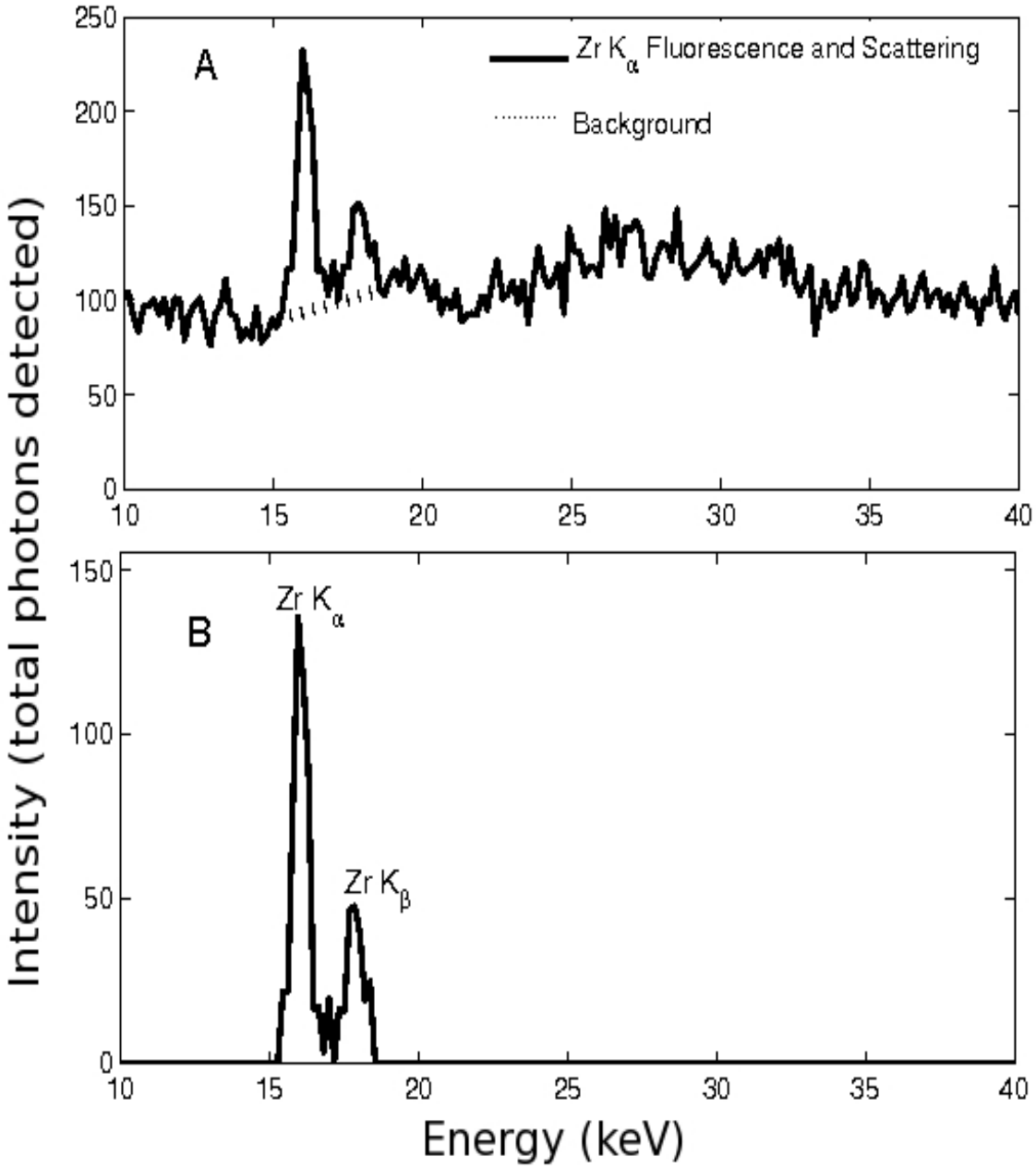
RAT EXPERIMENT WITH CARBO-PLATIN

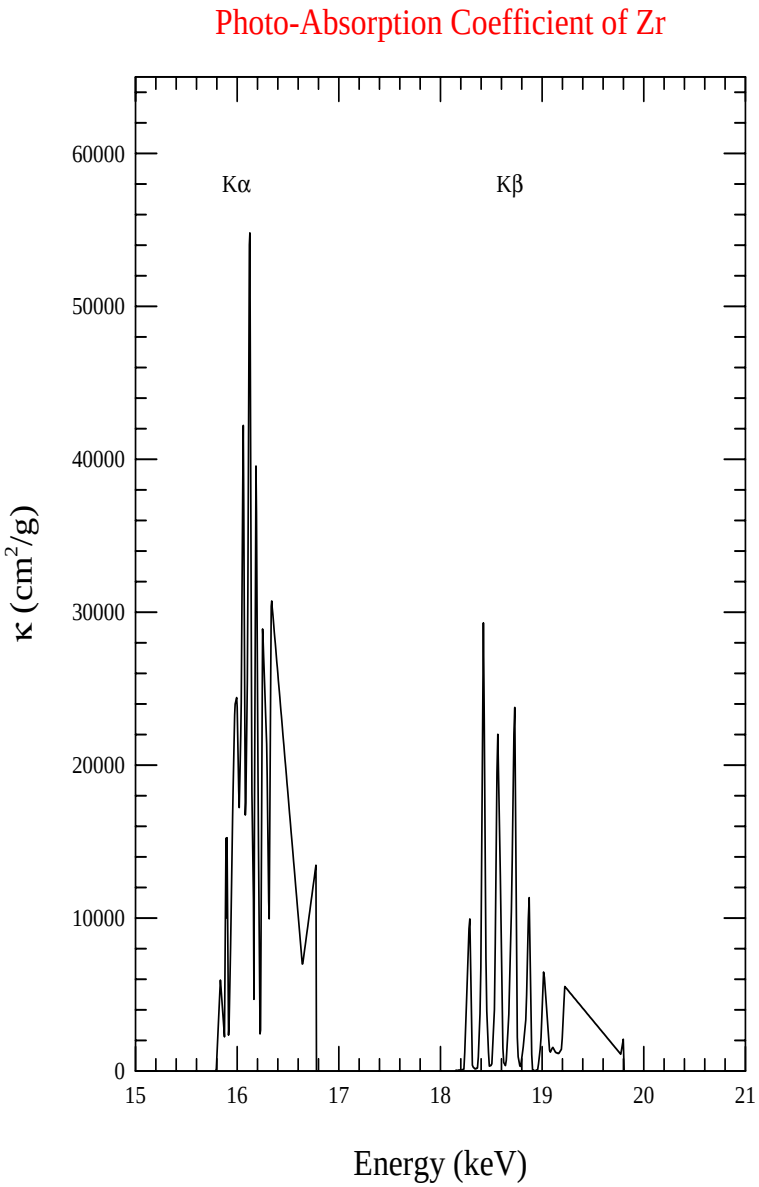
- Study showed the expexted results - rats with carbo-platin + 160 keV X-rays survived the most
- However, the observtion remains inconclusive



PRODUCTION OF MONOCHROMATIC X-RAYS FROM Zr

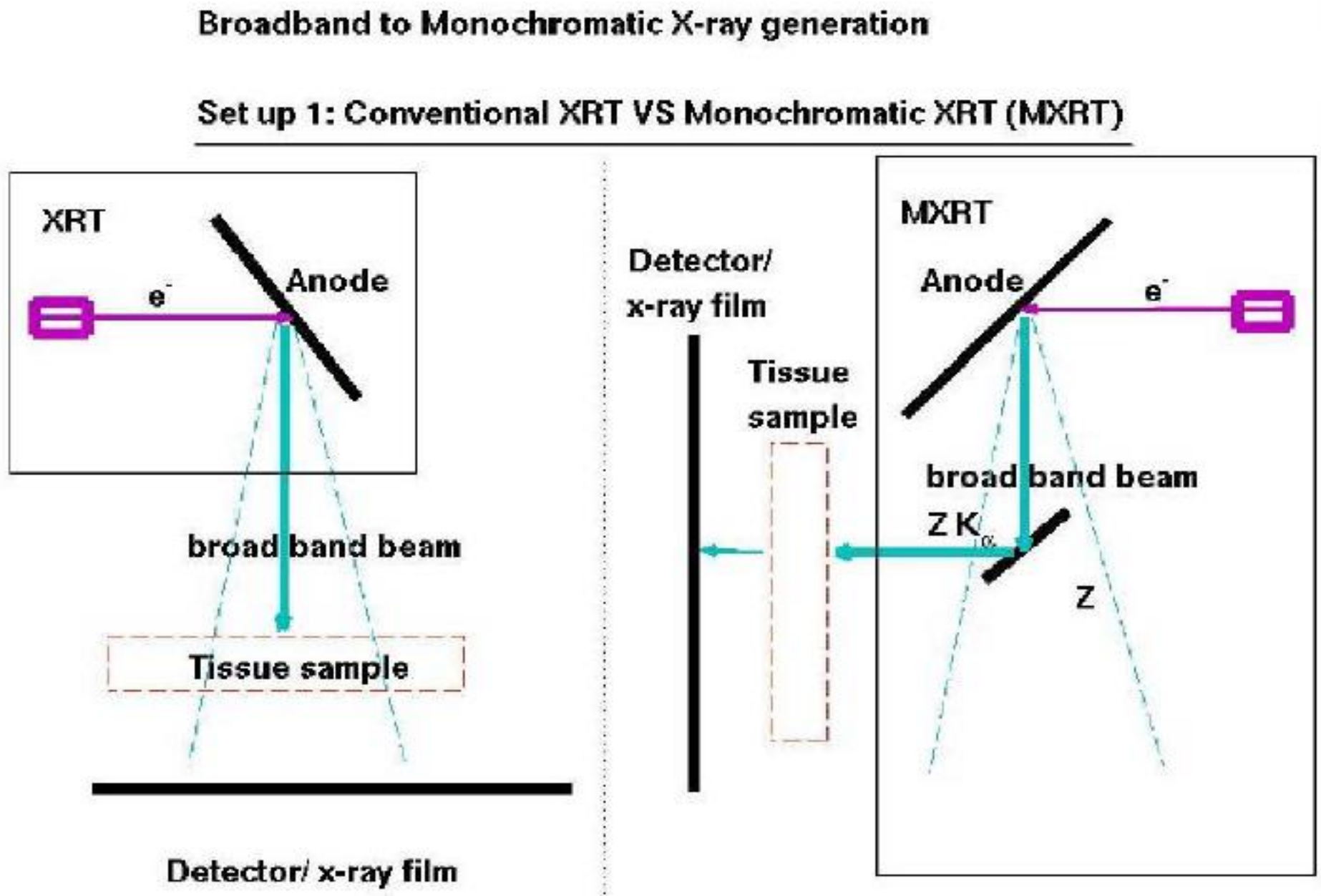
Left: Experiment shows K_α, K_β emissions (lower panel - without noise), Right: Theoretical prediction





BROADBAND TO MONOCHROMATIC (B2M) X-RAYS •

Instead of irradiating directly (left) the bremsstrahlung is directed to a plate (Zr, right) which produces K_α x-rays for the sample (Lim thesis, 2015)

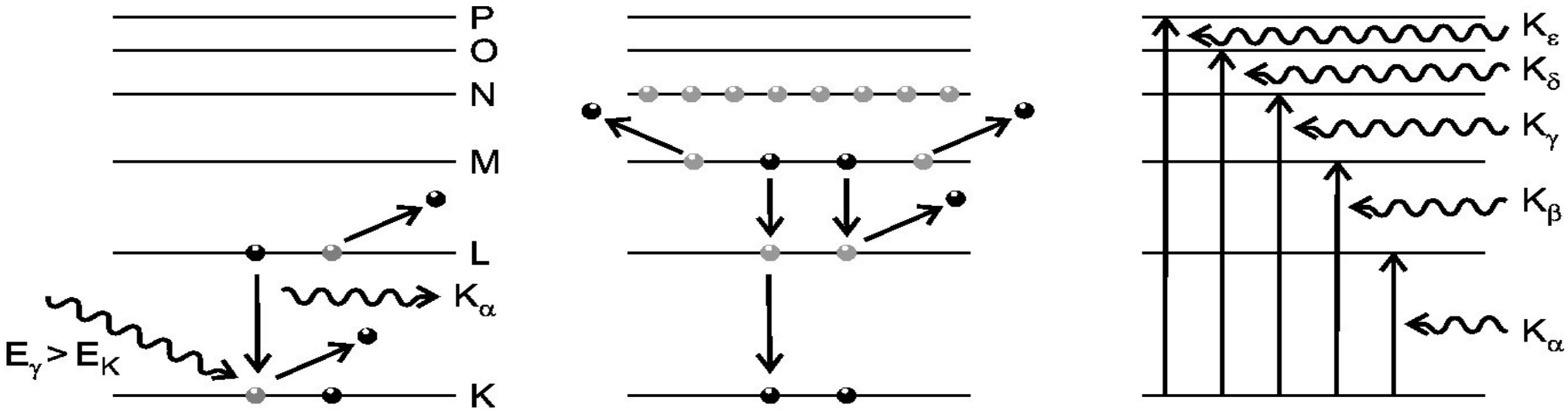


ENHANCED X-RAYS BY AN EXTERNAL SOURCE

- Using a X-ray source, resonant excitation from the K-shell into electron vacancies in higher shells may be possible
- It will compete with downward Auger decay from higher shells to fill vacancies
- The competing rates depend on the Einstein relation for A- and B-coefficient

$$\mathbf{A_{ji}}(\nu) + \mathbf{B_{ji}}(\nu)\rho_{\mathbf{ij}}(\nu) = \mathbf{B_{ij}}\rho_{\mathbf{ij}}(\nu)$$

A - Radiative Decay rate, B - photon absorption in radiation field density $\rho_{\mathbf{ij}}(\nu)$



Ionization & Auger Process

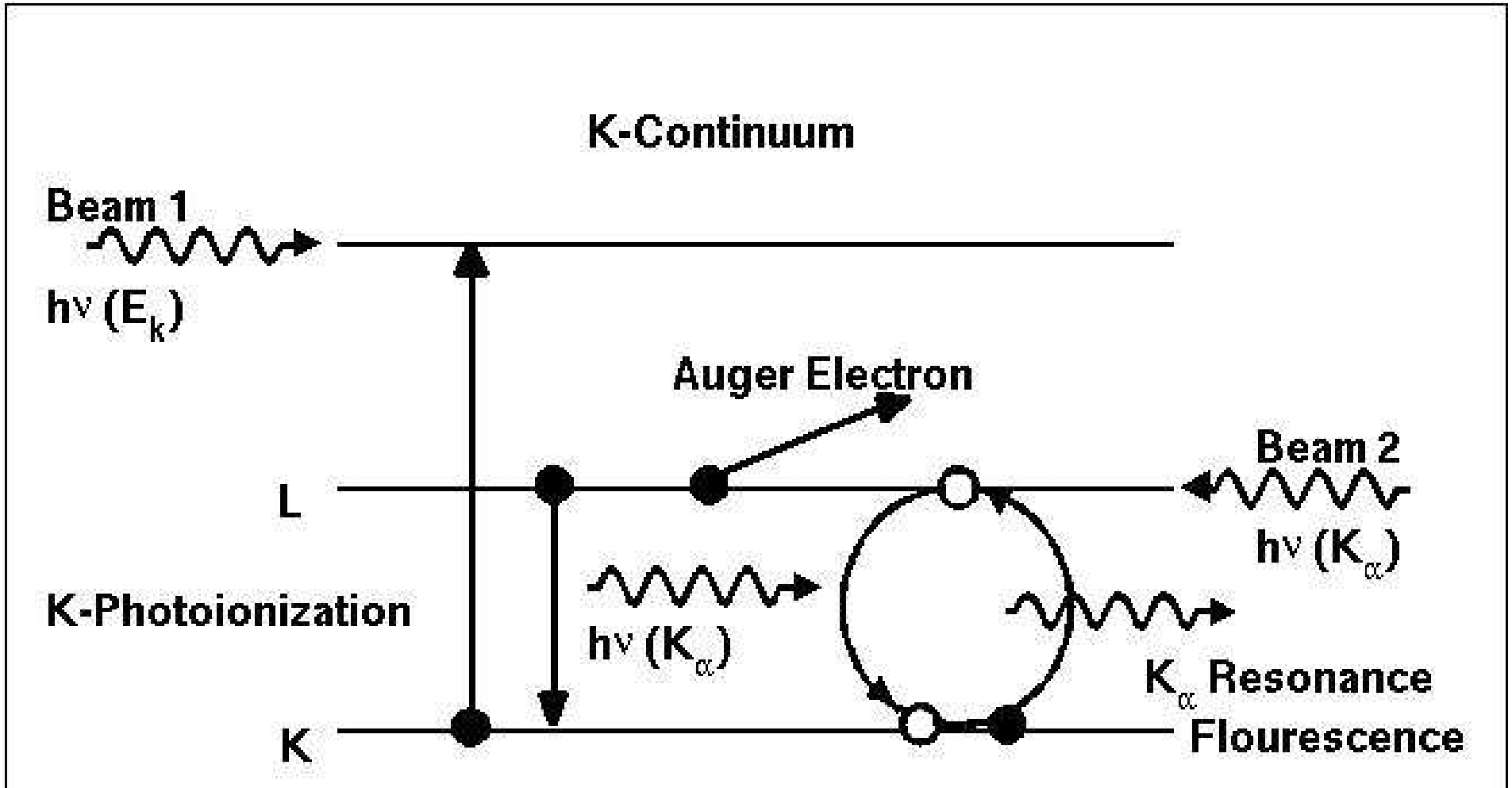
Electron Vacancies

Resonant Excitation

MONOCHROMATIC X-RAY SOURCE SET-UP

(Nahar & Pradhan 2014)

- Proposed Twin-beam Set-up
- K-shell ionization by Beam 1 (left) with energies h$\nu \geq E_k$ triggers Auger decays
- Beam 2 containing K_α photons (right) drives resonant K_α fluorescence by pumping 1s electrons to 2p orbital



• There is a saying that happiness lies in adjustment. It means that every member in the family should be supportive of each other for intellectual and mental growth, and everyday work.

• Professionally we struggle much more than men. A professional woman has two jobs, one in her profession and one in her home. At the workplace women often are not able to participate as fully as men in all the activities that require a lot of time. At home the housework and family also require signifinact amount of time. Many women have to give up their careers even after Ph.D. and trained for several years. We need to find ways to have home and profession coordinate with each other.
- A ship is not built to remain at the port.

• We should learn to ignore shyness in intellectual environment. My mother used to say "She who does not have the shame, gains the knowledge". "The successful installation of TSIS-1 on ISS is a nice beginning to the New Year! -

OUR PRACTICE

• For the sake of dignity and of your own stand, make a practice of

• Always help or support, regardless of your opinion, a person if he or she is doing something productive

• Make only positive comments about Islam and Muslims

• If you have zero comment, remain quiet. Do not initiate anything

• If you have a negative point to make, be patient and quiet

- There are plenty of people out there to make negative statements

• If you think supporting others against your own kind will do justice - know that it will not work, it may end like "digging your own grave"

• Remain united and promote each other

• Llearn to live with diversity respectfully

OUR SINCERE VOTE OF THANKS

- Logistics, Refreshments Department of Physics
- Physics Chair Prof Tauhhed Ahamd, both approvements and personal contributions
- Ex Physics Chair and Ex Dean of Science Prof Rahimullah Khan, the MAN behind the success of the event for 3 times
- ISMWS for operations & contributions
- Prof Farukh Arjmand from begining to end of this event, and as one of the sponsors
- Prof Asma Ali
- Our team: Dr, Hala, Parvez Alam, Swaleha Parveen, Taqseer Khan, Chemistry: Zeenat, Osman, Physics: Asish Jacob
- May Allah bless us all

Prof. Sultana Nahar is an atomic astrophysicist in the Astronomy Department of the Ohio State University. Her research interest is in the atomic processes in astrophysical plasmas and has developed new methodologies. She co-authors the textbook "Atomic Astrophysics and Spectroscopy" (A.K. Pradhand and S.N. Nahar, Cambridge U press 2011) and is the creator of database NORAD-Atomic-Dara. Since 1995, she has been involved in promotion of STEM education and research in developing countries by teaching research based courses with computational workshops, guidance, establishing recognition program for the best research, teachings, and academic performances in many institutions in five countries, maintaining a network of scientists from 23 countries, founded the International Society of Muslim Women in Science with members from 28 countries. With K. Irving and A.K. Pradhan, she has developed the science research based M.Ed course at OSU. She was the Associate Director (Research) for STEM Faculty training, is the Co-Director (Research) of Indo-US STEM Center for Education and Research of OSU-AMU, and is the Director of the Women in STEM Roadshow supported by Department of State.