



M N Saha and the Physics Nobel Prize – Celebrating M N Saha’s 125th Birth Anniversary

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Meghnad Saha alias M N Saha (1893-1956) is known for the development of the Saha-ionisation equation, which made it possible to calculate the ionization energy for elements under known pressure and temperature; and with that to explain the structure of stars [1-4]. Saha communicated with great physicists like Albert Einstein [5,6] and astrophysicist Harry Hemley Plaskett [7,8]. To make his ideas public he founded the renowned journal “Science and Culture” in 1935, which is the mouth piece of the Indian Science News Association. Saha established a school of physics, which produced many influential scientists like D S Kothari, B D Nag Chowdhury, P K Kichlu, N K Sur and R C Majumdar. There are a number of books and articles, which explore various aspects of his life [9-16]. Saha was the third Indian physicist (after J C Bose (1920) and C V Raman (1924)) to be elected as the Fellow of the Royal Society of London in 1927 [17]. Until 1956, that is Saha’s death only three Indian physicists were nominated for the Physics Nobel Prize. Saha was one of them. The other two were C V Raman and H J Bhabha [18]. In the present article, which is based on my previous work, a short review about his nomination as well as the cause of his unsuccessful nomination is given [19].



Photo 1. M N Saha

(Courtesy: Saha Institute of Nuclear Physics, Calcutta.)

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M N Saha's Nomination for the Nobel Prize by Indian Physicists

In the history of the Physics Nobel Prizes, the first time, in 1929, two Indians, that is, D M Bose and S K Mitra from the University of Calcutta were asked by the Nobel Committee (henceforth NC) to send proposals. In a joint letter they nominated M N Saha. They emphasized Saha's "two fundamental contributions to the subject of Astrophysics viz. the theory of Thermal Ionisation of Elements, and the theory of Selective Radiation Pressure" (D M Bose and S K Mitra to N C, Jan 25, 1930).



Photo 2. Debendra Mohan Bose and S K Mitra (Courtesy: University of Calcutta).

The importance of the theories and their applications for astrophysics and atomic physics was explained by the nominators as follows:

"... Saha's theory provides for physical explanation of the data on stellar spectra accumulated for over half a century by the labour done by Sir Norman Lockyer in England, and of Prof (E C) Pickering and Miss (A J) Canon in the Harvard College Observatory, U S A. The theory has stimulated further work all over the world amongst physicists and astrophysicists. Further extension of theory has been made by H N Russel, A Fowler, E A Milne, and W Woltjer. Prof Saha also has improved the theory in a further series of papers published in the "*Philosophical Magazine*", and has secured experimental verification of the theory." (D M Bose and S K Mitra to NC, Jan 25, 1930).

As we shall see below, the Nobel Committee had asked its expert to evaluate Saha's work.

Saha was again nominated by S K Mitra "for his great work on 'Thermal Ionisation of Gases, and its application to Physics of the Sun, the Stars, and to the problems of the Terrestrial Atmosphere, and to Thermionics'" (S K Mitra to NC, Nov 18, 1938). Mitra wrote that the leading astrophysicists like H N Russell and A S Eddington have recognized the applications of Saha's theory. About the application of Saha's work in the field of thermionics and thermal conductivity of flames,

"Dr I Langmuir, and his co-workers, and several others (...) found that Saha's theory of thermal ionisation of elements can explain the anomalies in the emission of electrons from incandescent metallic filaments in the presence of vapours of alkalis and other elements" (S K Mitra to NC, Nov 18, 1938).

Mitra, an expert on the earth's upper atmosphere, stated:

“... , the most fundamental problem, viz., formation of electronic layers (E and F) can be explained only with the aid of Saha’s theory. ... Recently Saha himself has worked out a brilliant synthesis of the two theories and has further explained successfully the formation of the different layers” (S K Mitra to NC, Nov. 18, 1938).

Mitra’s nomination for the Physics Nobel Prize was ignored by the Nobel Committee. The Prize for that year went to E O Lawrence, U S A, “for the invention and development of the cyclotron and for results obtained with it, especially with regard to artificial radioactive elements.”[20]

The last time, that is, in 1954 S K Mitra again received an invitation from the Nobel Committee. In a long letter, on November 15, 1954, he nominated Saha for the Physics Nobel Prize for the year 1955. Mitra first criticised the attitude of the Nobel Committee for ignoring Astrophysicists in the last 55 years. He argued:

“‘Astrophysics’ is not merely physics applied to understand physical conditions on the sun and the stars, and in interstellar space. It has, on the other hand, very often suggested problems which have greatly enriched Physics, It is high time that Astrophysics is selected as one of the subjects for an award in Physics, and I can think of no living astrophysicist who deserves this award more than Prof M N Saha” (S K Mitra to NC, Nov 15, 1954).

S K Mitra had quoted from A S Eddington’s article from the “Encyclopedia Britannica”, in which Saha’s equation was listed as one of the twelve great discoveries (S K Mitra to NC, Nov. 15, 1954).

Saha himself sought support from Niels Bohr, Denmark. In a letter he informed Bohr that he met many American astronomers and physicists, who were of the opinion that I did not get proper recognition for my work on Astrophysics:

“Prof A H Compton has been kind enough to discuss the matter with me, and subsequently wrote to me that he is going to send up my name for the award of the Nobel Prize, and he has secured the assent of Dr I Langmuir. Probably he will also get more support from the Britishers and others. ... I shall be glad if you can see your way in supporting Prof Compton’s proposal. I shall be glad to give any further information, if you are kind enough to take up the matter” (M N Saha to N Bohr, Sept 30, 1936).

From the record of the Nobel Foundation we came to know that neither N Bohr nor I Langmuir nominated Saha, but Compton did it twice.

A H Compton as Saha’s Nominator

In 1937, Saha was nominated by the American physicist and Nobel Laureate A H Compton for the Nobel Prize. He proposed to award the Chemistry or Physics Nobel Prize for Saha’s paper from the year 1920, in which he:

“showed from thermodynamical reasoning how the state of gaseous ionization should depend upon temperature and pressure. Immediate application was made to the spectrum of the sun and stars with striking success. By the use of his formulas, it has been possible reliably to calculate the degree of dissociation of gaseous molecules at laboratory temperature, and thus to perform successfully such physical and chemical experiments as those involving the use of atomic hydrogen. It is fair to say that the validity of his theory has now established, and that it has become a tool of permanent value in the study of high temperature phenomena” (A H Compton to NC, Jan 11, 1937).

Second time, on Feb 8, 1939, A H Compton sent a proposal to the Nobel Committee and nominated Ernest O Lawrence, M N Saha and Otto Stern. His nomination letter, in part reads:

“Second on my list I should place Professor M N Saha of the University of Calcutta, whom I recommended for the Prize two years ago because of his study of the ionization of stellar atmospheres. Not only has this work been fundamental to much of the recent developments in astrophysics, but it has also

formed the basis of recent physical studies of the thermodynamics of high temperature ionization” (A H Compton to NC, Feb 8, 1939).

Compton’s letter reached the Nobel Committee too late (on Feb 25, 1939) to be considered; because according to the rules the deadline of nomination was 31 January [21]. However, Saha was nominated from India, in the same year (detail above).

Opinion and Decision of the Nobel Committee

The report of the Nobel Committee showed that for the year 1930, 39 competent persons were asked to make proposals. Out of them 37 scientists sent proposals; in which 21 valid recommendations were made for a full or shared Prize. Out of these 21 nominations, C V Raman and M N Saha were two Indian candidates ([Report of the Nobel Committee, 1930](#)).

According to the rules and regulations, after receiving the proposals, the Nobel Committee make list of the proposed candidates; and ask its experts to write reports on the work of “potential” candidates. In case the candidate was nominated in the previous years also, the report is supplemented. In 1930 the NC wrote reports on the work of R W Wood, M N Saha and C V Raman [21].

According to the translated summary of the report of the Nobel Committee:

“Saha has started with some definite, already for long time well known facts about the appearance of the spectral lines of different characteristics at different heights within the chromosphere of the sun. ... shortly before Saha’s first publication, Eggert had applied Nernst formula for the isobar reaction on the problem of the gas equilibrium inside a star and had shown that many suppositions about the inner constitution of the stars can be found. ... Saha applied Eggert’s method on the problem of the state of the gases on the outer surface of the stars. With the help of the formula which Saha obtained in this way, the ionization degree of an element under any pressure and temperature can be calculated, under the condition that the ionization potential of the element is known”. (Report of the Nobel Committee, 1930. Original report is in Swedish).

The Nobel Committee was of the opinion that:

“The value of the ionisation potential for different elements has been determined by J Franck and G Hertz, J C McLennan and others.... In 1921 Saha has published a paper, in which he gave a summary of the fundamentals of the theory. Also, he named further applications of these fundamentals for the solar spectrum and the different classes of stellar spectrum. In his next paper, Saha gave more information about the applications of the theory on the spectrum of celestial bodies” (Report of the Nobel Committee, 1930).

In the report the committee concluded:

“Saha’s work is proved to be very important for modern astrophysics, but this can hardly be seen as a new physical discovery, more as an application to known physical accumulated astrophysical data. With all recognition for the value of Saha’s achievements, the Committee find itself not in the position to recommend him for the reception of the Nobel Prize for physics.”

With that the NC opined that Saha did not deserve the prize. The Committee gave decision in Raman’s favour; who received the Physics Nobel Prize in 1930 [22].

In 1937, the NC did not change its previous decision regarding Saha’s achievements. In a short paragraph in its report the NC wrote that already in 1930 Saha was nominated for his work on the application of thermodynamics in astrophysics. At that time a report on his work was given by Vilhelm Carlheim Gyllensköld. He found that Saha’s contributions, although having great importance for astrophysics, but they cannot be seen as a new physical discovery. They support the known physical laws.

In order to understand the decision of the NC, one needs to understand the development of physics in Sweden. For instance, the author R M Friedman stated that in the 1920s, the famous Swedish scientist and

Nobel Laureate, S Arrhenius, who was influential Member of Royal Swedish Academy of Sciences, “proposed that astrophysics no longer should be considered part of physics. ... Thus, he concluded, astrophysics is astronomy, and therefore not part of physics [22]. Also, the theoretical physicist, C W Oseen’s “goal of promoting theoretical physics and of improving the international stature of Swedish physics had led him to attempt restricting the definition of physics within the Academy and for the prize [23].

In 1957, renowned astrophysicist S Chandrasekhar was nominated by his uncle CV Raman [24]. At that time he did not get the Nobel Prize. In 1983, S Chandrasekhar and W A Fowler shared, the Nobel Prize for “for his theoretical studies of the physical processes of importance to the structure and evolution of the stars” and “for his theoretical and experimental studies of the nuclear reactions of importance in the formation of the chemical elements in the universe”, respectively [25]. The first Nobel Prize for astrophysics was awarded to H A Bethe in 1967 “for his contributions to the theory of nuclear reactions, especially his discoveries concerning the energy production in stars [26].

Conclusions

M N Saha was nominated for Nobel Prize many times between 1930 and 1956. Except the American A H Compton, rest of the times his nominators were from Calcutta. In 1930 he was “short-listed” and the expert of the Nobel Committee wrote report on his work. According to the opinion of the Nobel Committee Saha did not make a discovery. However, the historical researches show that some of the members of the Nobel Committee refused to consider astrophysics as a part of main stream physics. Thus, not only Saha, but also other astrophysicists were ignored until the middle of 1960s.

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Managing Editor's Remark

Meghnad Saha (M N Saha) was born on October 6, 1893 in a village Sheoratali, near Dacca which is now in Pakistan and expired on 16 Feb 1956. He was well known for his development of the Saha ionization equation, which is used to describe chemical and physical conditions in stars. He was nominated many times for the Nobel Prize in Physics/Chemistry, but unfortunately Nobel Committee did not consider and he was not succeeded in getting the Nobel Prize. The importance of his research lies in the fact that it opened up the new vistas in the field of Astrophysics. Saha was not only an outstanding scientist but above all a great human being too.

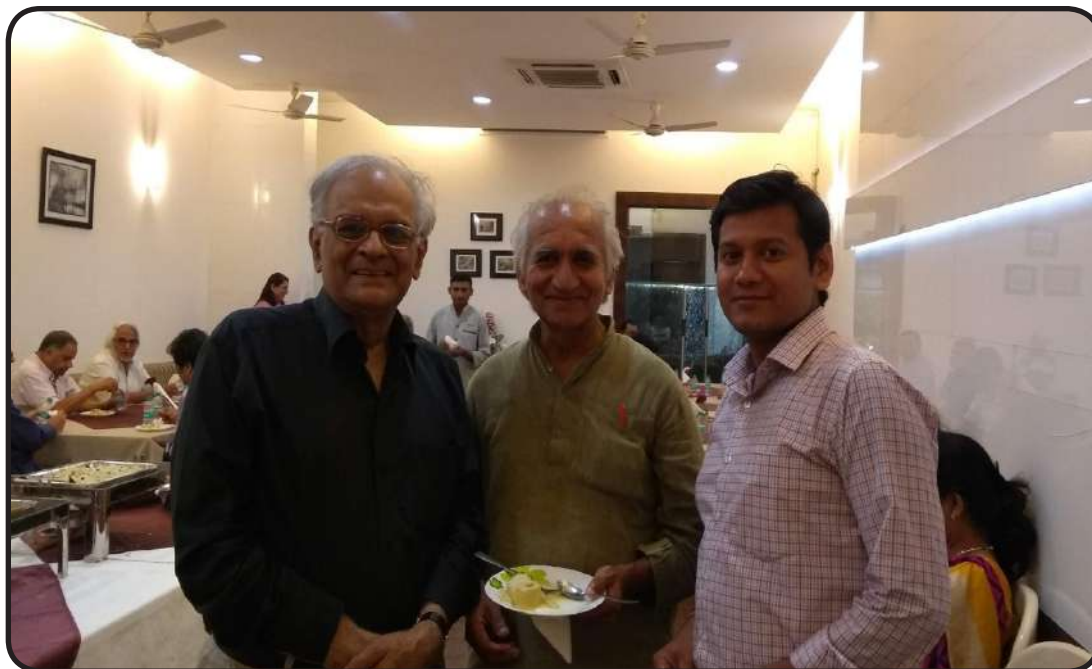


The National Academy of Sciences India, celebrated 125th birth anniversary of Prof Meghnad Saha during Oct 6-7, 2018, in Allahabad, under the chairmanship of Prof Ajoy Ghatak (ajoykghatak@gmail.com), A very large number of students and teachers from Inter Colleges actively participated in this two days celebrations. Many young students interacted directly with Senior Scientists.

The NASI executive Secretary Dr Niraj Kumar, welcomed the Guests and participants.

Manoj Kumar
Managing Editor, Asian J Phys.

Oct 7, 2018



On the occasion of celebration of M N Saha's 125th Birth Anniversary by NASI at Allahabad on Oct 7, 2018.
(left) Prof Ajoy Ghatak, Prof Vinod Rastogi (middle) and Manoj Kumar (right)



On the occasion of celebration of M N Saha's 125th Birth Anniversary by NASI at Allahabad on Oct 7, 2018.
Prof Vinod Rastogi (fourth from left) and Dr Niraj Kumar (fifth from left)