Professor K. P. Sinha, a theoretical physicist, had an extensive range of interests in science and beyond. He passed away at the age of 93 peacefully in his residence in Bengaluru on 23 January 2023. He continued to be an active researcher in theoretical physics, except for the last few years when a declining memory handicapped him. His evolution as a theoretical physicist, eventually becoming a Senior Professor of Theoretical Physics at the Indian Institute of Science (IISc), Bengaluru, in 1970, is unusual.

Sinha was born on 5 July 1929 in Akhtiyarpur, Bihar, and completed his M.Sc. in Chemistry in 1950 from Allahabad University. He worked under the guidance of George Ingel Finch, Director of the National Chemical Laboratory (NCL), Pune, on electron diffraction studies and secured a Ph.D. in experimental solid-state physics in 1956. He studied systems such as iron oxides and manganese ferrites. Moving to the UK, Sinha did post-doctoral work, during 1957–59, at the HH Wills Laboratory in the group of Maurice Henry Pryce. Sinha started his work in theoretical physics at Bristol while analysing his own experimental work for his Ph.D. at NCL. He earned a second Ph.D., now in theoretical physics, from the University of Bristol.

It is interesting to recall the styles of research of Sinha’s mentors: G. I. Finch, in addition to being a versatile physical chemist, was a leading mountaineer in the world. He was the first to prove the great value of supplementary oxygen for climbing at extreme altitudes. M. H. L. Pryce got his Ph.D. under the supervision of Max Born and Ralph Fowler; he also worked with Pauli and von Neumann. His interests ranged from the theory of photons, the general theory of relativity, atoms in intense magnetic fields, magnetism in solids and nuclear fission. One can see the effect of these in Sinha’s daring jumps across fields in physics and sometimes beyond.

Using electron diffraction, Sinha studied in detail, during his Ph.D., octahedral and tetrahedral distortions in manganese ferrite and iron oxide. He synthesized his samples, in collaboration with his colleague A. P. B. Sinha at NCL. A. P. B. Sinha, a distinguished solid-state chemist, passed away in 2021 at age 94. Interestingly, K. P. Sinha’s first research paper was in 1954, on the ‘Theory of photographic processes’, in collaboration with his colleague A. B. Biswas—it tried to go beyond the well-known theory of Gurney and Mott.

Sinha’s long career in solid state theory started with his work on the ‘Jahn–Teller’ effect and ‘cooperative Jahn–Teller effect’ in transition metal oxides with M. H. L. Pryce at Bristol and with Japanese physicist Yukito Tanabe. In 1958, while at Bristol, he wrote a single-author article in Nature. This was on the importance of understanding structural transitions in spinel oxides—it is a forerunner to modern theory and the phenomenon of the cooperative Jahn–Teller effect.

On returning from Bristol to NCL in 1959, he became a group leader of the Solid State and Molecular Physics unit. During Sinha’s time at NCL, he met young Naren-dra Kumar, a dynamic electrical engineer who was an NMR Machine Maintenance Engineer. Kumar quickly finished a Ph.D. with Sinha and started working on a variety of problems in theoretical physics, including some in the general theory of relativity and cosmology, even during his Ph.D. period. Kumar went on to become a distinguished physicist, President of the Indian Academy of Sciences, working at IISc from 1970. Kumar retired as Director of the Raman Research Institute and passed away in 2017.

While at NCL, Sinha worked on interesting issues raised by new experiments in metallic and superconducting systems. In 1964, with D. N. Ganguly, he showed how interband hybridization gets modified by pressure, resulting in an increase in superconducting $T_c$. With Ganguly and U. N. Upadhyaya, Sinha studied a surprising experimental observation of enhancement of superconducting $T_c$ when magnetic atoms were added to metals like titanium when local moments were not yet formed. It is fascinating that in modern parlance, Ganguly–Upadhyaya–Sinha theory could be interpreted as the emergence of Cooper pair singlet coupling (super exchange), via the virtual transition of two electrons into the empty impurity d-orbitals—somewhat analogous to super exchange physics used in RVB theory of superconductivity. In another interesting paper with Upadhyaya, again inspired by some experimental anomaly, Sinha discussed the possibility of resistance minimum (which is usually attributed to the Kondo effect), even in the absence of local moment formation and magnetic Kondo scattering.

In 1967, while at NCL, Sinha and Kumar started thinking about the possibility of light-induced non-equilibrium high-temperature superconductivity in special situations, where the conventional mechanism of electron–electron attraction mediated by a single-phonon is replaced by photon (one-photon process) and by one-phonon and one-photon (two-boson process) mediated attraction. Their article on ‘Photon induced superconductivity’ appeared in Physical Review in 1968. R. K. Shankar pursued his Ph.D. thesis on this topic with K. P. Sinha at IISc, in mid-70s. Vinod Krishan, then a UGC Associate at IISc (a renowned Astrophysicist who later retired from the Indian Institute of Astrophysics, Bangalore), wrote an article on this problem with Sinha. Nearly half a century later, in recent times, experimental results on femtosecond laser pulse-induced room temperature transient superconductivity and electromagnetic cavity-modified superconductivity are widely discussed, using a variety of mechanisms. Though not well cited, it is clear Kumar–Sinha mechanism (1968) is at work in some situations—it is gratifying that they were far ahead of their time.

Sinha’s wide-ranging contribution, in what could be called modern theory of solid state at that time, got him a job at the prestigious Bell Laboratories in 1968. After a stint of three years, he was invited as a senior Professor at the IISc, by the then Director Satish Dhawan. It was Dhawan who also invited N. Kumar as a young Assistant Professor in late 1970 when Kumar was a Post-Doctoral Fellow at the University of British Columbia, Vancouver, working with M. H. L. Pryce (former Post-Doctoral adviser of K. P. Sinha), who had moved from Bristol to British Columbia. Sinha
and Kumar, in some sense, laid the founda-
tion for a famous and vibrant condensed
matter theory group developed and nurtured
later by T. V. Ramakrishnan at the Physics
Department of IISc.

Many of Sinha’s Ph.D. students from
NCL days worked on the interaction be-
tween important elementary excitations in
quantum magnets, namely magnon, phonon
and electron quasiparticles. It started with
work with U. N. Upadhyaya, N. Kumar, S.
S. Shah and others. Sinha continued to
work, at IISc, on the magnetic properties
of solids. ‘Plasmon–magnon interaction in
magnetic semiconductor’ by K. P. Sinha
and one of us (GB) appeared in the first
issue of Pramana in 1973. It reported,
based on theory, that this novel interaction
is weak—a somewhat negative result.
However, thanks to experimental advances in
the field of spintronics, magnonics and
plasmonics over decades, this work has
been picked up recently, after nearly 50
years. It is likely that even this weak effect
could be measured and made use of.

A remarkably big and versatile IISc is
known for its eclectic-wide ranging activi-
ties, motivated and open-minded research
students with varied interests. It provided a
bigger platform for Sinha to perform. Fur-
ther, Satish Dhawan’s efforts to expand
research activities saw him invite E. C. G.
Sudarshan, a renowned theoretical physicist
at the University of Texas, Austin, to spend
several weeks each year at IISc. K. P. Sinha,
at the University of Texas, Austin, to spend
Sudarshan, known for its eclectic-wide ranging activi-
ties, could be measured and made use of.

Every new experimental discovery in
solid-state physics could be exciton con-
densation in semiconductors or high Tc
superconductivity in cuprates, or a claim of
observation of cold fusion in some electro-
chemical reactions excited Sinha. He attem-
ted to develop theories and explanations.
In 1989, at a Cold Fusion meeting in Ban-
galore, he suggested the role of electron
pairing in that context based on his work
in superconductivity. He returned to that
theme in 1998 in an obituary he wrote for
Professor F. C. Frank. In 1999, with the
assistance of Epoch Engineering in Gai-
thersburg, Maryland, he further documented
and presented his ideas in the USA. In the
summer of 1999 at Harvard University, he
completed and published a mathematical
description of his concept in Infinite Energy
magazine. He then joined MIT as a visiting
scientist in the year 2000 to work with
Peter Hagelstein, Louis Smullin and An-
drew Meulenber of Draper Laboratories.

A unique feature of IISc is its collabora-
tion and synergy with other research insti-
tutes in Bengaluru: National Aeronautical
Laboratory (NAL), Raman Research Insti-
tute (RRI) and later, The National Centre
for Biological Sciences (NCBS), Internation-
al Centre for Theoretical Sciences (ICTS),
Jawaharlal National Centre for Advanced
Scientific Research (JNCASR). Thanks to
R. Jayaraman (a high-pressure physicist
from Bell Labs visiting NAL and IISc for
a year, on invitation by S. Ramaseshan,
then director of NAL) and young Rajaram
Nityananda (a Ph.D. student of Ramase-
shan), new discussions started with K. P.
Sinha and N. Kumar’s group at the Physics
Department of IISc. Research on Mott in-
sulators, Mott transition, valence fluctua-
tions, strongly correlated systems, etc.,
were carried out. Sinha encouraged his research
students to interact and collaborate with
visitors to CTS and IISc.

During this period, Sinha expanded his
research activities into cosmology and the
general theory of relativity. He had visitors
like Eric Lord, a mathematician and rela-
tivist from the UK who spent a few years at
IISc. The Department of Physics of IISc,
well known for being strong in experiimen-
tal physics, made new inroads into modern
theoretical condensed matter physics and
other fields. His students, R. K. Shankar,
V. M. Nandakumaran, R. Jagadish and
several others, worked on quantum matter
issues such as superconductivity and exci-
ton condensation.

C. Sivaram, a fresh Ph.D. student, was
well up in general relativity, quantum the-
ory, particle physics, etc. Sinha, as a guide,
encouraged him to go deep. The result was
a number of publications from the ‘Bangal-
lore group’, as referred to by Abdus Salam
and Yuval Ne’eman. On his request, Sivaram
gave a full-fledged course on Astrophysics.
C. Usha (Usha Raut), B. S. Satyaprakash
and other students joined the ‘Bangalore
Group’ soon, contributed and grew inde-
pendently.

An anecdote and acknowledgement from
one of us (G. Baskaran): Sinha gave his
students the freedom to work on problems of
their choice and collaborate with any-
one. IISc was a Science Paradise. Baskaran
enjoyed any science that came on his way
and completely ignored his Ph.D. thesis
work. At the end of 3rd year, Sinha asked,
‘Baskaran, are you ready to write your the-
sis?’ His answer was, ‘Professor Sinha, I
am not ready’. He repeated the question
after 6 months and after another 6 months.
The answer was the same. Apparently, after
the 3rd attempt, Sinha sadly concluded it
was unlikely that Baskaran will ever finish
his Ph.D. However, his upcoming marriage,
close to the end of his 5th year, woke him
up. GB wrote a thesis reluctantly, putting
together whatever he was working on then,
and handed over the manuscript to Sinha.
Being afraid that Baskaran might change
his mind, Sinha grabbed the opportunity
and corrected all 5 chapters of the thesis in
a ‘record’ 3 days. Usually, guides take one
to three months or even more to correct the
thesis. Because of a timely and quick action
from Sinha, Baskaran managed to submit
his Ph.D. thesis.

Besides holding the directorship of the
Institute of Fundamental Research on
Complex System of North Eastern Hill
University during 1991–94, Sinha held
several Visiting Professor positions in top

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Institutions in Europe and USA. He has guided 35 Ph.D. students and mentored 10 post-doctoral Fellows. After retirement, he continued his service at IISc in various capacities: National level Fellowships and Emeritus Professorship.

A Shanti Swarup Bhatnagar Award winner in Physics, Sinha was the Fellow of three Science Academies of India and The World Academy of Sciences. He won the Distinguished Alumni Award of University of Bombay (1974) and IISc Bangalore (1985). He is survived by his wife, two sons, two daughters, three grandchildren and two great-grandchildren.


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