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Abstracts of recently accepted papers

Lines of Circumstellar C_2, CN, and CH^+ in the optical spectra of post-AGB stars

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Recent optical spectra of post-AGB stars show the presence of C_2, CN, and CH^+ originating in the circumstellar shell. We present here new, higher resolution spectra which provide constraints on the physical parameters and information on the line profiles. An empirical curve of growth for the C_2 Phillips and CN Red system lines in the spectrum of HD 56126 yields $b = 0.50^{+0.59}_{-0.23}$ km s^{-1}. CH^+ (0,0) emission lines in the spectrum of the Red Rectangle have been resolved with a FWHM $\approx 8.5\pm$ 0.8 km s^{-1}. The circumstellar CN lines of IRAS 08005–2356 are resolved into two separate components with a velocity separation of $\Delta v = 5.7 \pm 2.0$ km s^{-1}. The line profiles of CN of HD 235858 have not been resolved.

To appear in IAU 177 "The Carbon Star Phenomenon", Turkey 1996, Ed. Bob Wing
For preprints, contact ebakker@viking.as.utexas.edu, *or via the WWW at* http://viking.as.utexas.edu:8080/articles.html

Hydrodynamic models of Planetary Nebulae

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This article tries to give a short review of the hydrodynamic modelling of Planetary Nebulae to date. I start by discussing the types of observations the modelling aims to reproduce and then discuss the results of different types of models. First the 'simplified' models in which evolutionary changes in the stellar properties are neglected, then the 'evolutionary' models in which these effects are taken into account. The 'simplified' models can reproduce single shell nebulae with the right kinematic properties. The 'evolutionary' models can reproduce multiple shells and some of the kinematic and morphological differences between various ions. I also briefly discuss some of the difficulties which have not been addressed and/or solved by the numerical modelling, such as the point-symmetric nebulae, some of the collimated phenomena, and clumpiness.

Invited review to appear in Astrophysics & Space Science (proceedings of the RS meeting on PNe, eds. J.E. Dyson & F.D. Kahn)

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or http://www.astro.su.se/preprints.html
or ftp://ftp.astro.su.se/pub/garrelt/gm_liverpool.ps.gz

Silicate Feature Variation in LPV Stars I. Initial Observations

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We report new mid-infrared spectra of five bright, long period variable stars, and related objects, obtained at the Wyoming Infrared Observatory with Denver University's medium resolution CAESR instrument. The data, when combined with LRS spectra from IRAS, show variation of the silicate feature with phase of the LPV. We perform a calculation for impingement time of the shock on the circumstellar dust shell to demonstrate that this variation could be due to a shock-shell interaction.

Accepted by Astrophysical Journal

Preprints can be obtained by contacting mce@phoenix.phys.du.edu

New theoretical yields of intermediate mass stars

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We present theoretical yields of H, ^{4}He, ^{12}C, ^{13}C, ^{14}N, and ^{16}O for stars with initial masses between 0.8 and 8 $M_\odot$ and initial metallicities Z = 0.001, 0.004, 0.008, 0.02, and 0.04. We use the evolutionary tracks of the Geneva group up to the early asymptotic giant branch (AGB) in combination with a synthetic thermal-pulsing AGB evolution model to follow in detail the chemical evolution and mass loss up to the end of the AGB including the first, second, and third dredge-up phases. Most of the relations used are metallicity dependent to make a realistic comparison with stars of different initial abundances. The effect of Hot Bottom Burning (HBB) is included in an approximate way.

The free parameters in our calculations are the mass loss scaling parameter η_{AGB} for stars on the AGB (using a Reimers law), the minimum core mass for dredge-up M_c^{min}, and the third dredge-up efficiency λ. As derived from previous extensive modeling, $\eta_{AGB} = 4$, $M_c^{min} = 0.58\ M_\odot$, and $\lambda = 0.75$ including HBB are in best agreement with observations of AGB stars both in the Galactic disk and the Magellanic Clouds.

We compare the abundances predicted during the final stages of the AGB with those observed in planetary nebulae in the Galactic disk and show that the model with the aforementioned parameters is in good agreement with the observations. The metallicity dependent yields of intermediate mass stars presented in this paper are well suited for use in galactic chemical evolution models.

Accepted by A&AS, Sept. '96

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Spectrum of Planetary Nebula NGC 6884

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The bright, compact, moderately high excitation planetary nebula, NGC 6884 (Perek-Kohoutek 82 +07°1) has a rich spectrum promising good diagnostics and offering a good target for the Hamilton Echelle Spectrograph at Lick Observatory. We combine International Ultraviolet Explorer (*IUE*), near UV, visual, and IR Data to obtain $N(\mathrm{ion})/N(\mathrm{H}^+)$ for more than 30 species from H to [Fe VI]. These diagnostics suggest a rather large density range, and an electron temperature near 10,000 K. The relative structural simplicity of this planetary

nebula makes it worthwhile to attempt a plausible photoionization model and deduce atomic abundances, T($\star$), and other properties implied for the central star. It is believed substantially improved chemical compositions are found.

Accepted by ApJS

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Circumstellar C_2, CN, and CH^+ in the optical spectra of post-AGB stars

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We present optical high-resolution spectra of a sample of sixteen post-AGB stars and IRC +10216. Of the post-AGB stars, ten show C_2 Phillips and Swan and CN Red System absorption, one CH^+ emission, one CH^+ absorption, and four without any molecules. We find typically $T_{rot} \sim 43-399, 155-202$, and $18-50$ K, $\log N \sim 14.90-15.57, 14.35$, and $15.03-16.47$ cm^{-2} for C_2, CH^+, and CN respectively, and $0.6 \leq N(\mathrm{CN})/N(\mathrm{C_2}) \leq 11.2$. We did not detect isotopic lines, which places a lower limit on the isotope ratio of $^{12}C/^{13}C$ ¿ 20. The presence of C_2 and CN absorption is correlated with cold dust ($T_{dust} \leq 300$ K) and the presence of CH^+ with hot dust ($T_{dust} \geq 300$ K). All objects with the unidentified 21 μm emission feature exhibit C_2 and CN absorption, but not all objects with C_2 and CN detections exhibit a 21 μm feature. The derived expansion velocity, ranging from 5 to 44 km s^{-1}, is the same as that derived from CO millimeter line emission. This unambiguously proves that these lines are of circumstellar origin and are formed in the AGB ejecta (circumstellar shell expelled during the preceding AGB phase). Furthermore there seems to be a relation between the C_2 molecular column density and the expansion velocity, which is attributed to the fact that a higher carbon abundance of the dust leads to a more efficient acceleration of the AGB wind. Using simple assumptions for the location of the molecular lines and molecular abundances, mass-loss rates have been derived from the molecular absorption lines and are comparable to those obtained from CO emission lines and the infrared excess.

Accepted by A&A main journal

For preprints, contact ebakker@astro.as.utexas.edu, *or access* http://viking.as.utexas.edu:8080/articles.html

Circumstellar molecular envelopes of AGB and post–AGB objects

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This review presents the physical and chemical structure of circumstellar envelopes (CSEs) around stars on, and beyond, the asymptotic giant branch (AGB). It focusses on information that is relevant to the interpretation of the molecular line emission from these envelopes. The mass loss rate estimate from CO radio line emission is briefly discussed. It continues with an overview of the morphology and kinematics of AGB and post–AGB CSEs, based on the observational evidence obtained from molecular line emission. Also the small–scale structure of the circumstellar medium is discussed. Finally, a possible scenario for the puzzling, drastic change (at least

apparently) from largely spherical AGB–CSEs to the prominent equatorial density enhancements that dominate in CSEs around late post–AGB objects, e.g., planetary nebulae (PNe), is put forward.

Invited paper at the Royal Astronomical Society meeting on Planetary Nebulae, Liverpool, United Kingdom, April 11, 1996, it will appear in Astrophysics and Space Science

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or via anonymous ftp on ftp://hp5.astro.su.se/pub/preprints/liverpool.ps.gz

The neutral envelopes around AGB and post-AGB objects: Their structure and evolution

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This review discusses the large–scale geometry and kinematics of envelopes around evolved stars, as inferred from radio line observations of circumstellar molecules, as a function of the evolutionary stage of the central object. In particular, the drastic change in morphology from largely spherical envelopes around asymptotic giant branch stars to distinctly non–spherical neutral envelopes around planetary nebulae is addressed. In addition, the small–scale structure of the envelopes, i.e., whether the circumstellar medium is smooth or clumpy, is discussed. Finally, a scenario for the morphological evolution, based on the assumption of a highly clumped medium, is presented.

Invited paper at IAU Symposium 177, "The Carbon Star Phenomenon", Antalya, Turkey, May 27-31, 1996

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The neutral envelopes around AGB and post-AGB objects: Circumstellar Molecules

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The circumstellar gas/dust envelopes of stars on and beyond the asymptotic giant branch, harbor an impressive number of different molecular species and their isotopic variants. Some of these molecules are of photospheric origin, but the majority have been produced through various chemical processes in the envelope. This chemistry depends primarily on the chemical composition of the gas (i.e., C/O<1 or >1), but the conditions also change as the central star evolves. In this review we present circumstellar molecular abundance and isotope ratio estimates, and discuss how they can be used in the study of the late evolution of stars, which in extreme cases may become heavily obscured.

Invited paper at IAU Symposium 178, "Molecules in Astrophysics: Probes & Processes", Leiden, The Netherlands, July 1-5, 1996

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SiO Maser Sources toward the Sgr B2 Molecular Cloud

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We have detected six new SiO maser sources towards the Sgr B2 molecular cloud. One is identified with an OH 1612 MHz maser source which was previously found by the VLA, and another associated with an IRAS source. The other four sources are not associated with any known OH/IR or IRAS sources. The spatial density and the kinematic property for these sources are found to be similar to those of the OH/IR sources near the Galactic center. This fact suggests that they are mostly stellar SiO maser sources in front of (or behind) the Sgr B2 molecular cloud. A possibility of association with young stellar objects, however, cannot completely be ruled out for the one SiO source (17450-2808) which is associated with an IRAS source exhibiting infrared colors of young objects.

Ap. J. March 20, 1997 issue in press
Preprints can be obtained by contacting deguchi@nro.nao.ac.jp

Mainline OH Observations of the Arecibo set of OH/IR Stars

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The Arecibo 1612 MHz survey of a complete sample of color selected IRAS sources with 25 μm fluxes S(25) > 2 Jy detected 393 OH/IR stars. A complementary 1667 & 1665 MHz OH survey of these objects is presented here. Main line masers have been detected in 238: 18 exhibit only 1665 MHz emission, 220 exhibit 1667 MHz masers, while 119 exhibit both. The main lines were not detected in 155.

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Chemical abundances for a planetary nebulae sample located outside the solar circle

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The Galactic disk shows a radial gradient of chemical abundances, with larger values in the inner region and a decreasing towards the edge. In order to check the behavior of this gradient at galactocentric distances larger than that of the Sun, we derived chemical abundances for a sample of planetary nebulae located outside the solar circle. Our results show a decreasing of the galactocentric gradient for distances larger than 9 kpc, and different behaviors for type-I and type-II nebulae. For type-I, our results are totally compatible with a constant value, within the dispersion of the data. On the other hand, for type-II a residual gradient can still be viewed.

As type-I planetaries are originated from younger, more massive progenitors ($M > 2.5\ M_{\odot}$), and type-II from older progenitors, these results are probably related to the chemical evolution of the galactic disk, and should be examined in view of the results from chemical evolution models. As radial gas flows and infall rates with radial dependence can combine to produce abundance gradients, time variation of these parameters could produce such differences.

To appear in *Advances in Stellar Evolution*, ed. R. Rood, Cambridge University Press

Preprints can be obtained by contacting costa@obs-nice.fr

Absolute magnitudes and kinematics of Barium stars

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The absolute magnitude of barium stars has been obtained from kinematical data using a new algorithm based on the maximum-likelihood principle. The method allows to separate a sample into groups characterized by different mean absolute magnitudes, kinematics and z-scale heights. It also takes into account, simultaneously, the censorship in the sample and the errors on the observables. The method has been applied to a sample of 318 barium stars. Four groups have been detected. Three of them show a kinematical behaviour corresponding to disk population stars. The fourth group contains stars with halo kinematics.

The luminosities of the disk population groups spread a large range. The intrinsically brightest one ($M_v = -1^m.5$, $\sigma_M = 0^m.5$) seems to be an inhomogeneous group containing barium binaries as well as AGB single stars. The most numerous group (about 150 stars) has a mean absolute magnitude corresponding to stars in the red giant branch ($M_v = 0^m.9$, $\sigma_M = 0^m.8$). The third group contains barium dwarfs, the obtained mean absolute magnitude is characteristic of stars on the main sequence or on the subgiant branch ($M_v = 3^m.3$, $\sigma_M = 0^m.5$). The obtained mean luminosities as well as the kinematical results are compatible with an evolutionary link between barium dwarfs and classical barium giants. The highly luminous group is not linked with these last two groups. More high-resolution spectroscopic data will be necessary in order to better discriminate between barium and non-barium stars.

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Radio photospheres of Long Period Variable Stars

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We report the detection of cm-wavelength emission from a sample of nearby long period (Mira and semi-regular) variables using the VLA. Six of the eight stars in the sample were detected. We find the continuum emission in the radio band to have a spectral index near 2.0, as expected for optically thick black-body emission. The flux densities are a factor of ≈ 2 above the level expected from the optical photospheres of the stars. We monitored three stars over a period of nearly two years and find flux density variations of less than $\pm 15\%$. We partially resolved the stellar disk of W Hya and find an average diameter of $0.''080 \pm 0.''015$ and a brightness temperature of 1500 ± 570 K.

Our observations suggest that long period variables have a "radio photosphere" near $2R_*$, where R_* is the stellar radius (defined by line-free regions of the optical spectrum). For the physical conditions expected in the radio photosphere, free electrons, obtained predominantly from the ionization of potassium and sodium, provide the dominant opacity through free-free interactions with neutral H and H_2 . A simple model with a single set of physical parameters can approximate all of our cm-wavelength data, as well as providing plausible sizes and brightness temperatures at far-IR wavelengths. At cm-wavelengths, unity optical depth is achieved at a radius of about 4.8×10^{13} cm, where the density and temperature are $\approx 1.5 \times 10^{12}$ cm^{-3} and ≈ 1630 K, respectively.

The lack of variability of the cm-wavelength flux density for stars like *o* Ceti, R Leo, and W Hya limits variations of the temperature and/or radius of the radio photosphere to less than ± 150 K and $\pm 4 \times 10^{12}$ cm. Also, any periodic shocks or disturbances near $2R_*$ probably propagate outward at less than ≈ 5 km s^{-1} and/or are mostly damped. The radio photosphere lies just outside of a "molecular photosphere," seen optically in strong absorption lines of metallic oxides, and just inside of the SiO maser shell and the dust formation zone. Indeed,

the inner boundary of the SiO maser emission region may be determined by continuum opacity in the radio photosphere. Our study suggests that the density and temperature in the SiO shell are $\approx 5 \times 10^{10}$ cm^{-3} and $\approx$ 1300 K, respectively. Extrapolating our model outwards to $\geq 10^{14}$ cm radius, where significant dust is detected at 10 μm wavelength and H_2O masers are found, gives densities $\leq 3 \times 10^9$ cm^{-3} and temperatures $\leq$ 1100 K.

Based on the sample of stars we observed, it appears that the flux density at radio frequencies from long period variables can be modeled with a simple formula. Given the excellent agreement between measured and modeled flux densities, it is possible that distances can be estimated from a flux density measurement with a precision of about 10%. Since the radio frequency emission from long period variables has a well defined spectrum, is very compact, and is relatively constant in time, we suggest these stars can be used to determine the absolute flux density scale for mm- and submm-wavelength interferometers.

Accepted by The Astrophysical Journal, Feb 1997

Preprints can be obtained by contacting reid@cfa.harvard.edu

Carbon Stars and Nucleosynthesis in Galaxies

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The role of carbon stars in the build-up of chemical elements in galaxies is discussed on the basis of stellar evolution calculations and estimated stellar yields, abundance analyses of AGB stars, galactic-evolution models and abundance trends among solar-type disk stars. We conclude that the AGB stars in general, and carbon stars in particular, probably are main contributors of *s*-elements, that their contributions of flourine and carbon are quite significant, and that possibly their contributions of lithium, ^{13}C and ^{22}Ne are of some importance. Also contributions of N, Na and Al are discussed. The major uncertainties that characterize almost any statement concerning these issues are underlined.

Invited Review, IAU Symposium 177, 'the Carbon Star Phenomenon'

Preprints can be obtained by contacting ryde@astro.uu.se
or via anonnymous ftp on ftp://ftp.astro.uu.se/pub/articles/atmos/P107/carbon_stars.ps

The rich spectrum of circumstellar PAHs

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We present observations taken with the Short Wavelength Spectrometer (SWS) on board the Infrared Space Observatory (ISO) of three evolved C-rich stars, the post-AGB star HR 4049 and two planetary nebulae, IRAS21282+5050 and NGC 7027. The spectra are dominated by the well-known infrared emission bands, attributed to Polycyclic Aromatic Hydrocarbons (PAHs). The SWS spectra for the first time allow a complete overview of the richness of the PAH spectrum with high spectral resolution and high S/N. We present an inventory of the spectral features in the 2.4–17 μm wavelength window.

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or via WWW on http://www.astro.uva.nl/isostar/preprints.html

The shape and strength of circumstellar PAH emission bands

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We discuss the shape and strength of the emission bands observed in Short Wavelength Spectrometer (SWS) spectra of three carbon-rich evolved stars (Beintema et al. 1996a). The emission bands, due to stretching and bending modes of C-C and C-H bonds in Polycyclic Aromatic Hydrocarbons (PAHs), show large difference in strength and shape, depending on the excitation temperature and size distribution. We find that HR 4049 shows remarkable structure in the major bands (3.3, 6.2, '7.7', 8.6 and 11.3 μm) and probably has small, ionized, hydrogen-rich and highly excited PAHs. In contrast, the Planetary Nebulae IRAS21282+5050 and NGC 7027 show a larger abundance of neutral PAHs and plateau emission near 7-8 and 11-12 μm, probably due to larger molecules. The population of PAHs in HR 4049 probably has a different evolutionary history than those in the planetary nebulae.

Accepted by Astronomy & Astrophysics (Letters)

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Mineralogy of Oxygen-rich dust shells

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Spectra taken with the Short Wavelength Spectrometer on board of the Infrared Space Observatory of dust shells around evolved oxygen-rich stars reveal the presence of several emission features at wavelengths between 20 and 45 μm. These features have a range of widths and strengths, but are all narrow compared to the well-known amorphous silicate bands at 9.7 and 18 μm. The emission peaks are tentatively identified with crystalline forms of silicates such as pyroxenes and olivine. The emission features tend to be more prominent for objects with cooler dust shells (T $<$ 300 K). This may be due to an intrinsic change in optical properties of the dust as it cools, or it may be due to an increase in the fraction of crystalline silicates compared to amorphous forms as the mass loss rate increases. The implications for the physics of dust formation in the outflows of cool giants are briefly discussed.

Accepted by Axtronomy & Astrophysics (Letters)

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Two-fluid models for stationary dust driven winds
II. The grain size distribution in consideration of drift

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A multi-component method for the description of the evolution of the grain size distribution in consideration of a size dependent grain drift and growth rate is applied in order to model dust driven winds around cool C-stars.

Grain drift introduces several modifications concerning dust growth: On the one hand the residence time in the region of efficient growth is reduced, on the other hand the growth efficiency is higher due to an increased collisional rate. For carbon grains the surface density of radical sites is increased, but on the other hand there is a reduction of the sticking efficiency of the growth species for drift velocities larger than $\sim$ 5 km s^{-1}. Furthermore, nonthermal sputtering may become relevant for high drift velocities.

It is found that the consideration of drift results in a considerable distortion of the size distribution as compared to the case of zero drift velocity. Generally, there are less, but larger grains if drift is included.

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In Memoriam

Professor Victor Ambartsumian is dead[1]

Eminent Armenian scientist, astronomer Professor Victor Ambartsumian, Honorary President of the Armenian National Academy of Science, died on the 12^{th} of August, 1996. He was an honorary, or foreign, member of the academies of sciences of more than 25 countries and a Doctor of many well-known Universities. The scientific community of the world recognized his activites by electing him president of the IAU (1961-1964) and president of the International Council of Scientific Unions (1970-1974). His book *Theoretical Astrophysics* (1958, Pergamon Press) became a bible for a generation of astronomers.

V. Ambartsumian was born in 1908. He wrote his first papers on "The New Sixteen-Year Period for Sunspots", "Description of Nebulae in Connection with the Hypothesis on the Origin of the Universe" when he was only an 11–year–old schoolboy. His talent was recognised very soon and his father sent him to Leningrad where he obtained his higher education. V. Ambartsumian's first collaborators and friends then were A. Kozyrev, D. Ivanenko and M. Bronstein. During the short period 1928-1930 (he was still a student) Ambartsumian published 22 papers in Astron. Nachrichten, Z.f.Phys, MNRAS and other journals. He had broad research interests. His work "The Quantization of Space" was reported at the International Conference in Odessa where Sommerfeld, Pauli, Jordan, Dirac and many others were present. After the meeting Pauli told Ambartsumian,"Colleague Ambartsumyan, at the moment the position of quantum electrodynamics appears hopeless. However, in a conversation with Mr Tamm I said that just a few ideas are needed like those of the English mathematician Ursell and yours to make the study of quantum mechanics possible again." In another paper published in 1930 (when neutrons had not yet been discovered) V. Ambartsumian and D. Ivanenko argued against the presence of electrons in the atomic nuclei. Soon Ambartsumian became a lecturer at Leningrad State University and when after 1934, he was made a professor at 26 years old!, he organised and headed the Chair of Astrophysics at the Leningrad State University. His first PhD student was V.V. Sobolev (known from the Sobolev Approximation). It is commonly accepted that V. Ambartsumian is a father of the Soviet school of Theoretical Astrophysics. The most important steps in his scientific career can be given as:

1. Early papers published in the 30s and devoted to radiative transfer and stellar dynamics. After many years Edward Arthur Milne would write in *Observatory* that he had never imagined that the theory of radiation transfer, on which he, too, had been working, could have attained the level of development and beauty which it had achieved in the hands of Ambartsumyan.

2. First numerical inversion of the Radon transform (MNRAS, 96, 172, 1935, the paper presented to MNRAS by Arthur Eddington), involved the 3D velocity distribution of stars in the Galaxy. After many years A. Cormack (Dept. of Physics, Tufts University, USA) would write in this connection: *...even in 1936 computed tomography might have been able to make significant contributions to, say, the diagnosis of tumors in the head....it seems to me quite possible that Ambartsumian's numerical methods might have made significant contributions to that part of medicine had they been applied in 1936* (Computed Tomography, some history and recent developments, Proc. of Symposia in Applied Mathematics, Vol.29, p 35, 1985).

3. First idea about the patchy structure of the interstellar absorption: 1938. S.Chandrasekhar wrote in this connection,... *Ambartsumian's marvelously elegent formulation of the fluctuations in brightness in the Milky Way* "in the limit of infinite optical depth, the probability distribution of the fluctuations in the brightness of the Milky Way is invariant with respect to the location of the observer." ... *Ambartsumian introduced for the first time the now commonly accepted notion that interstellar matter occurs in the form of clouds.*

4. The Principal of Invariance: 1943. The power of this method introduced in a theory of radiation transfer has been applied in other sciences (optics, mathematical physics, etc.) allowing people to handle easily very complex mathematical problems. The method was succesfuly developed later by S. Chandrasekhar in his monograph *Radiation Transfer.*

[1] Also known as Ambartsumyan or Ambarzumyan

5. Discovery of Stellar Associations: 1947. V. Ambartsumian originally introduced the term *Stellar Association* dividing them into two groups: OB and T associations. He showed that Stellar Associations are star forming regions.

6. It was in the early 50s when Prof. Victor Ambartsumian first raised the issue of the Activity of Nuclei of Galaxies (AGN).
   In his famous report at the Solvay Conference on Physics (Brussels, 1958) Ambartsumian said that enormous explosions take place in galactic nuclei and as a result a huge amount of mass is expelled. In addition if this is so, these galactic nuclei must contain bodies of a huge mass and unknown nature. During a break in the session Walter Baade went up to Ambartsumian and said,*Professor Ambartsumian, you have come from the Soviet Union, and I from America. Logically speaking, you should be a materialist, and I an idealist. But what you have just said is nothing other than a pure idealism! It's fantastic! You speak about some kind of "non-stellar" objects which no one has seen. So it must be something inexplicable, mysterious.* The concept of AGN was widely accepted a few years later. One of the students of V. Ambartsumian, B. Markarian (known from Markarian galaxies) completed a famous survey of galaxies with a UV excess using the 1 m–Shmidt type telescope of the Byurakan Observatory. IAU Symposia No. 29 and 121 were hosted by the Byurakan Astrophysical Observatory in 1966 and 1986, 10 and 30 years after Ambartsumian's pioneering ideas about AGN phenomenon.

V. Ambartsumian returned to Armenia from Leningrad and in 1946 founded the Byurakan Astrophysical Observatory on the slopes of Mt. Aragats (4090 m) rising from the valley of Mt. Ararat. Soon he became a President of the Armenian Academy of Science. About 20,000 scientists, most of them in the system of the Academy of Sceince, were working in 1985 in a small repuplic with less than a 3.5 million population. V. Ambartsumian was the founder of the journal Astrofizica (Astrophysics). He remained as an Editor in Chief of the journal and a Director of the Byurakan Astrophysical Observatory until the mid 80's.

It is commonly recognised that V. Ambartsumian's papers were very *original* and *revolutionary*, striking in their mathematical beauty and accuracy. Congratulating Ambartsumian on his 80^{th} birthday Chandrasekhar wrote, *... The only other astronomer of this century who compares with Academician Ambartsumian in his constancy and devotion to astronomy is Professor Jan Oort; but they would appear to be dissimilar in every other way. It will be a worthy theme for a historian of science of the twenty-first century to compare and contrast these two great men of science. He is an astronomer par excellence. There can be no more than two or three astronomers in this century who can look back on a life so worthily devoted to the progress of astronomy.* (Astrophysics, Vol 29, No.1, p 408, 1989).

All material was collected from different articles and books.

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