

**A89-24401 Perturbations and streaming motions on large scales (in universe).** A. G. DOROSHEVICH and A. A. KLYPIN, *Royal Astronomical Society, Monthly Notices* (ISSN 0035-8711), Vol. 235, Dec. 15, 1988, pp. 865-874. 23 Refs.

The problem of the interpretation of large-scale streaming motions on the 50-100 Mpc scale is discussed. A method of conditional correlations is developed which makes it possible to find the mean value and dispersion of large-scale velocities for a fixed motion of an observer. The scale and the amplitude of possible perturbations are compared with constraints obtained by the Relict experiment. Perturbations ( $\Delta\rho/\rho$ ) of about 0.1-0.3 on the 50-100 Mpc scale seem to be needed to overcome the contradictions between modern cosmological models and huge bulk motion on large scales. The perturbations with the same amplitude but on the 200-300 Mpc scale are excluded by ( $\Delta T/T$ ) constraints.

**A89-13278 Isotopic cosmogony (Izotopnaia kosmogoniia).** LEVKONSTANTINOVICH LEVSKII, *Priroda* (ISSN 0032-874X), Aug. 1988, pp. 11-19. 8 Refs.

Several models for the origin of the solar system are reviewed, including the condensation model, the hypothesis concerning a neighboring supernova, and the model of colliding gas-dust clouds. An effort is made to give a consistent explanation of the available experimental data concerning the chemical and isotopic composition of planets, planetary satellites, and meteorites.

**A88-39922 Is the formation of the universe 'from nothing' possible? (Vozmozhno li obrazovanie vselennoi 'iz nichego'?).** IAKOV-BORISOVICH ZEL'DOVICH, *Priroda* (ISSN 0032-874X), April 1988, pp. 17-27. 21 Refs.

An effort is made to clarify whether the formation of the universe 'from nothing' contradicts the general laws of nature. It is suggested that the observed baryon asymmetry of the universe appears at an early stage of the universe expansion due to a difference in the properties of particles and antiparticles, and the absence in nature of a precise conservation law for the number of baryons and leptons. Also considered are the hypothesis of the pulsating universe, the closed universe model, and the hypothesis of the quantum birth of the universe. A.D. Sakharov offers some comments on Zel'dovich's paper.

**A88-38853 Cosmological models with decaying neutrinos (Kosmologicheskie modeli s nestabil'nymi neutrino).** A. G. DOROSHEVICH, A. A. KLYPIN, and M. I. U. KHELOPOV, *Astronomicheskii Zhurnal* (ISSN 0004-6299), Vol. 65, Mar.-Apr. 1988, pp. 248-262. 50 Refs.

Cosmological models with decaying neutrinos are analyzed. Estimates of relic background radiation fluctuations, correlation function, galactic peculiar velocities and the masses and decay times of neutrinos are given. The set of observational data is properly explained by the models with a two-component neutrino of mass 60-70 eV or four-component neutrino of mass 30-35 eV. The age of the universe for these models is  $(10-11) \times 10^{10}$  to the 9th yr and the neutrino decay time is 10 to the 9th yr. Models with a positive cosmological constant have essential difficulties with the explanation of the slope of the correlation function of galaxies.

**A88-37551 'Hot' model for the formation of galaxies—The sizes of galaxies and the origin of the stellar component ('Goriachaia' model) formirovaniia galaktik—Razmery galaktik i proiskhozhdenie zvezdnoi komponenty).** A. A. SUCHKOV, *Astronomicheskii Zhurnal* (ISSN 0004-6299), Vol. 65, Jan.-Feb. 1988, pp. 1-11. 35 Refs.

A mechanism by which a protogalaxy transforms into a stellar system is proposed in the framework of the hot model of galaxy formation. The mechanism gives a quantitative relation between the mass and size of the galaxy which agrees well with the observational relation; it also specifies two characteristic mass values which coincide with masses of stars and globular clusters. It is shown that a hot protogalaxy ( $T = 10$  to the 7th K) contracting under the gravity of a massive dark halo attains a critical size and fragments into separate clouds via thermal instability.

**A89-23729 Coalescence of self-gravitating gaseous masses—A numerical model (Koalestsentsiia samogravirulushchikh gazovykh mass—Chislennaia model').** D. I. BARAUSOV, A. I. U. SHAKOV, and A. D. CHERNIN, *Astronomicheskii Zhurnal* (ISSN 0004-6299), Vol. 65, Nov.-Dec. 1988, pp. 1155-1163. 15 Refs.

A numerical two-dimensional gas-dynamic model of a noncentral supersonic collision of self-gravitating gaseous masses with a primordial chemical composition is used to find coalescence criteria. Allowance is made for volume radiant cooling. The formation of a gaseous protogalaxy with a significant amount of angular momentum is possible during coalescence.

**A89-13117 Changes in the photometric and colorimetric characteristics of eruptive stars at the stage of circumstellar dust envelope formation—Pu Vul during the deep minimum of 1980 (Izmenenie fotometricheskikh i kolorimetricheskikh kharakteristik eruptivnykh zvezd na stadii formirovaniia okolozezdnykh pylevykh obolochek. PU Vul vo vremia glubokogo minimuma 1980 goda).** I. U. S. EFIMOV, *Astronomicheskii Zhurnal* (ISSN 0004-6299), Vol. 65, July-Aug. 1988, pp. 807-815. 10 Refs.

It is shown that the model of the circumstellar dust envelope with the size of particles changing in time explains several observed characteristics of the photometric and colorimetric behavior of PU Vul at the stage of circumstellar dust envelope formation. These characteristics include the time-dependent light minima in various spectral bands, the reddening of the star during the decline of light and the bluing in the area of minimal brightness, the rapid light and color variations at the light minimum, and certain characteristics of the color-magnitude diagram. From the comparison of the calculated curves and the observed data, it is concluded that the deep minimum of 1980 was caused by the formation, near the hot component of the system, of a circumstellar envelope of silicate particles, which grew from molecular size to the size of interstellar particles with a mean growth rate of 0.001 micron/day.

**A88-43803 Cosmological redshift in the stationary Seeliger-Einstein universe (Kosmologicheskoe krasnoe smeshchenie v statsionarnoi vselennoi Seeligera-Einsteina).** P. N. KROPOTKIN, *Akademii Nauk SSSR, Doklady* (ISSN 0002-3264), Vol. 298, No. 4, 1988, pp. 827-829. 15 Refs.

It is argued that the Seeliger-Einstein stationary cosmological model should not yet be ruled out. The need for a more complete investigation and comparison of mechanisms proposed for the explanation of photon aging is emphasized.

**A88-41077 The cosmology of the super-early universe and the 'fundamental length' (O kosmologii sverkhrannei vselennoi i 'fundamental'noi dlina).** V. L. GINZBURG, V. F. MUKHANOV, and V. P. FROLOV, *Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki* (ISSN 0044-4510), Vol. 94, April 1988, pp. 1-5. 13 Refs.

The cosmology of the super-early universe and its consequences are based on a far-reaching assumption pertaining to the validity of the theory down to Planckian scales, and in particular, to a length of 10 to the -33 cm. It is maintained that the existence of a 'fundamental length' which is greater than this Planckian length can radically change the situation. The study is pertinent to the inflationary hypothesis.

**A88-26019 How the universe exploded (Kak vzorvalas' vselennai).** IGOR' DMITRIYEVICH NOVIKOV, *Priroda* (ISSN 0032-874X), Jan. 1988, pp. 82-91.

Current problems in cosmology are discussed, and it is suggested that the inflation of the universe is the key that may solve the riddle concerning the fundamental properties of the universe. Particular emphasis is placed on Linde's (1986) theory, according to which quantum fluctuations existing at very large densities (close to the Planck density of 10 to the 94th g/cm) play the dominant role. In Linde's conception, the universe has neither beginning nor end.

## Japanese Aerospace Literature This month: *Theoretical Cosmology*

**A90-40093 Soft inflation (in cosmology).** ANDREW L. BERKIN, KEI-ICHI MAEDA, and JUN-ICHI YOKOYAMA, *Physical Review Letters* (ISSN 0031-9007), Vol. 65, July 9, 1990, pp. 141-144. Previously announced in STAR as N90-22506. 21 Refs. (NAGW-1340).

The cosmology resulting from two coupled scalar fields was studied, one which is either a new inflation or chaotic type inflation, and the other which has an exponentially decaying potential. Such a potential may appear in the conformally transformed frame of generalized Einstein theories like the Jordan-Brans-Dicke theory. The constraints necessary for successful inflation are examined. Conventional GUT models such as SU(5) were found to be compatible with new inflation, while restrictions on the self-coupling constant are significantly loosened for chaotic inflation.

**A89-28905 Detectability of early thermal radiation from a neutron star in SN 1987A.** KEN-ICHI NOMOTO, SACHIKO TSURUTA, Supernova 1987A in the Large Magellanic Cloud; Proceedings of the Fourth George Mason Astrophysics Workshop, Fairfax, VA, Oct. 12-14, 1987 (A89-28851 11-90). Cambridge and New York, Cambridge University Press, 1988, pp. 421-423. 15 Refs. (MOESC-16404216; NSF AST-86-02087).

Cooling of a young neutron star right after its birth is examined. Theoretical calculations show that within less than a month after the explosion, the surface temperature falls significantly below the detection limit of Ginga due to the plasmon neutrino emission near the surface. However, it will remain high enough to be detected easily by Rosat, AXAF, and other future X-ray satellites within the next 100 years.

**A90-42901 Gravothermal oscillations in N-body systems.** J. MAKINO, *Dynamics of dense stellar systems; Proceedings of the Workshop, Toronto, Canada, May 27, 28, 1988* (A90-42876 19-90). Cambridge, England and New York, Cambridge University Press, 1989, pp. 201-206. 15 Refs.

A direct N-body simulation of a 3000-body equal-mass system to study the postcollapse evolution of globular clusters was performed. After the initial collapse, an expansion of large amplitude was observed. During this expansion the temperature profile showed a temperature inversion similar to those observed in gas models and Fokker-Planck calculations, which suggests a gravothermal origin for the expansion. Thereafter, however, only oscillatory behavior of small amplitude was observed. It may be interpreted as follows: few binaries still remained in the core, giving too high an energy generation rate for the gravothermal oscillation. In a realistic system with much larger N the effect of binaries in the core is relatively weak, so that the gravothermal oscillations may continue.

**A90-36512 Runaway planetary growth with collision rate in the solar gravitational field.** KEIJI OHTSUKI and SHIGERU IIDA, *Icarus* (ISSN 0019-1035), Vol. 85, June 1990, pp. 499-511. 19 Refs.

The present examination of the effects of collision rates among solar gravitational field planetesimals on runaway planetary growth qualitatively explains the orbital calculations of Iida and Nakazawa (1989) in view of a two-body approximation which neglects the sun. The competitive growth of several protoplanets is numerically simulated with a simple model. The results obtained show that the collision rate in the solar gravitational field enhances the possibility of runaway growth in a certain low-velocity region, in contrast to the two-body approximation.

**A90-35301 Cosmological observations in an inhomogeneous universe—Distance-redshift relation.** KAZUYA WATANABE, and KENJI TOMITA, *Astrophysical Journal, Part 1* (ISSN 0004-637X), Vol. 355, May 20, 1990, pp. 1-12. 26 Refs.

The distance-redshift relation (DRR) in an inhomogeneous universe is studied. On the basis of relativistic optical equations, numerical calculations are performed to get a realistic DRR. It is shown that the DRR is coincident with that in the standard Friedmann-Robertson-Walker (FRW) model on average if galaxies or clusters of galaxies are assumed to be completely transparent. It is also shown that the effect of the shear along the light path is small if the scale of inhomogeneities is larger than galactic scale, and that these numerical results are consistent with the analytical investigation of Futamase and Sasaki (1989).

**A90-24977 A gravitational thermodynamic approach to probe the primordial spectrum of cosmological density fluctuations.** YASUSHI SUTO, MAKOTO ITOH, and SHOHO INAGAKI, *Astrophysical Journal, Part 1* (ISSN 0004-637X), Vol. 350, Feb. 20, 1990, pp. 492-501. Research supported by the Itoh Science Foundation and Inamori Foundation. 29 Refs.

Gravitational thermodynamic theory predicts the probability distribution function  $f(N)$  for finding N galaxies in a sampling volume V. The theoretical function  $f(N)$ , which contains a single parameter b, is compared with the results of the N-body simulations emerging from various density perturbation spectra in a flat universe. It is shown, however, that the Nbody results match the predicted function  $f(N)$  quite well only when the parameter b is regarded as scale-dependent, i.e.,  $b = b(R)$ , where R is a linear size of a sampling volume V. In fact,  $b(R)$ , obtained by fitting the actual distribution to  $f(N)$ , turns out to be a useful measure to quantify the present clustering in the universe. This measure is very sensitive to linear structure on large scales.

**A90-21639 Effects of metal abundances on the evolutionary period changes of classical Cepheids.** MASAYA SAITOU, *Astrophysics and Space Science* (ISSN 0004-640X), vol. 162, No. 1, Dec. 1989, pp. 47-56. 37 Refs.

Theoretical values of the evolutionary period changes of classical Cepheids are calculated as functions of not only periods but also chemical abundances. It is found that the theoretical values of period changes marginally depend on metal abundances. Comparison with observed period changes of galactic Cepheids shows reasonable agreement. Small-amplitude Cepheids are discussed combined with their evolutionary states.

**A90-21053 The Mach number of the cosmic flow—A critical test for current theories.** JEREMIAH P. OSTRIKER and YUSUSHI SUTO, *Astrophysical Journal, Part 1* (ISSN 0004-637X), Vol. 348, Jan. 10, 1990, pp. 378-382. 27 Refs. (NAGW-765).

A new cosmological, self-contained test using the ratio of mean velocity and the velocity dispersion in the mean flow frame of a group of test objects is presented. To allow comparison with linear theory, the velocity field must first be smoothed on a suitable scale. In the context of linear perturbation theory, the Mach number  $M(R)$  which measures the ratio of power on scales larger than to scales smaller than the patch size R, is independent of the perturbation amplitude and also of bias. An apparent inconsistency is found for standard values of power-law index  $n = 1$  and cosmological density parameter  $\Omega = 1$ , when comparing values of  $M(R)$  predicted by popular models with tentative available observations. Nonstandard models based on adiabatic perturbations with either negative n or small  $\Omega$  value also fail, due to creation of unacceptably large microwave background fluctuations.

**A90-24497 Helium flashes and hydrogen mixing in low-mass population III stars.** MASAYUKI Y. FUJIMOTO, ICKO IBEN, JR. and DAVID HOLLOWELL, *Astrophysical Journal, Part 1* (ISSN 0004-637X), Vol. 349, Feb. 1, 1990, pp. 580-592. 61 Refs. (NSF AST-84-13371; NSF AST-88-07773).

A one solar mass, zero-metal star is evolved through the peak of the major core helium flash and compared with models for which the metal abundance is  $Z = 0.0001$  and  $0.02$ . Before central hydrogen is exhausted, and long before the major core helium flash occurs, the  $Z = 0$  model experiences a heliumburning thermal runaway at the center. As this model evolves along the giant branch, recurrent helium-burning thermal runaways are initiated at the base of the hydrogen-burning shell. The thermal structure of the electron-degenerate core of the  $Z = 0$  red giant is completely different from that of the higher Z red giants. As a result of this structure, the major flash begins at a location much farther from the center than in the higher Z cases. Most significantly, during the flash in the  $Z = 0$  model, the outer edge of the convective shell formed in the helium zone extends into layer containing hydrogen, which does not occur in the  $Z = 0.0001$  or  $Z = 0.02$  cases.

**A90-21359 Cosmological evolution of active galactic nuclei and X-ray background radiation.** KATSURO MORISAWA and FUMIO TAHAKARA, *Astronomical Society of Japan, Publications* (ISSN 0004-6264), Vol. 41, No. 4, 1989, pp. 873-896. 29 Refs. (MOESC-61540175).

The possible cosmological evolution of the spectrum and luminosity function of active galactic nuclei (AGNs) is investigated in order to explain the cosmic X-ray background (XRB). It is found that either the pure luminosity evolution model with a break luminosity of around  $10$  to the  $42.1$ - $42.5$  ergs/sec or the translation evolution model with a break luminosity around  $10$  to the  $42.5$  ergs/sec can reproduce the observed log N-log S relation of AGNs and the intensity of the soft XRB. On the other hand, it is shown that the pure density evolution model is not acceptable. The fluctuation of the XRB calculated using the pure luminosity evolution and translation evolution models agrees with the observations. The predicted average red shift, luminosity, and energy index in flux-limited samples are also consistent with the observations. In order to reproduce the spectrum of the XRB, the energy index must be  $0.0$ - $0.2$  at the highest red shift, and the spectra of AGNs must be cut off at  $70$ - $130$  keV.

**A90-16227 Neutron star evolution with internal heating.** NORIAKI SHIBAZAKI and FREDERICK K. LAMB, *Astrophysical Journal, Part 1* (ISSN 0004-637X), Vol. 346, Nov. 15, 1989, pp. 808-822. Research supported by the John Simon Guggenheim Memorial Foundation. 77 Refs. (NAGW-1583; NGR-05-020-668; NSF PHY-86-00377; NSF PHY-86-03273).

The thermal evolution predicted by current models of the superfluid-crust interaction is noted to differ substantially from the thermal evolution predicted by models without internal heating as well as previous models of heating. Heating rates approaching the maximum predicted by current models enhance the photon luminosity of the star in the neutrino cooling era, and dramatically alter the thermal evolution in the photon cooling era. Standard cooling models are consistent with current pulsar temperature estimates and upper limits, except those for the Vela pulsar, which are lower than predicted.

**A90-15141 On the detachment of an isolated closed universe by Hawking evaporation.** SHIN TAKAGI, *Classical and Quantum Gravity* (ISSN 0264-9381), Vol. 6, Nov. 1, 1989, pp. 1641-1654. 42 Refs.

A monotonically expanding bubble of false vacuum separated by a thin domain wall from an infinite region of true vacuum is studied. It is argued on the basis of a two-dimensional model that the detachment of the bubble will always occur due to quantum evaporation. The model also predicts that the bubble emits a burst of negative-energy radiation in the earliest stage of its evolution if its initial radius is much smaller than a certain characteristic value.

**A90-14834 The stability and evolution of two-component isothermal clusters.** PAULUS WIYANTO, *Astrophysics and Space Science* (ISSN 0004-640X), Vol. 159, No. 2, Sept. 1989, pp. 219-238. Research supported by the Japan Society for the Promotion of Science. 8 Refs.

The stability and two-component isothermal clusters surrounded by a rigid nonconducting spherical wall is examined by linear normal analyses and nonlinear simulations. The examinations are done for four types of models, classified by the differences concerning gravo-thermal stability and Spitzer's condition. Our results show that perturbations in gravo-thermally stable systems disappears with time and the systems tend to isothermal ones with equipartition, as is expected. On the other hand, in the gravo-thermally unstable systems, the presence of small amount of massive component which has higher central density accelerates the gravo-thermal collapse by heat flowing from the massive component to the less massive component and being transported outward efficiently. This effect of the interaction between two components on gravo-thermal collapse is shown clearly in the forms of the respective eigenfunctions.

**A89-53547 On the probability of inflation in a higher-dimensional cosmological model.** YASUO EZAWA, *Classical and Quantum Gravity* (ISSN 0264-9381), Vol. 6, Sept. 1989, pp. 1267-1271. 12 Refs.

The probability of sufficient inflation in a higherdimensional cosmological model is estimated. The probability is expected to be very small. Some properties of the model are pointed out that may give a finite probability unambiguously.

**A89-51414 Theoretical framework on the formation of the large scale structure in the universe.** SATORU IKEUCHI, *Large scale structure and motions in the universe; Proceedings of the International Meeting, Trieste, Italy, Apr. 6-9, 1988* (A89-51401 22-90). Dordrecht, Kluwer Academic Publishers, 1989, pp. 169-178. 30 Refs.

It is argued that galaxy-formation theory is now confusing. In order to resolve this situation, the theoretical framework on the formation of large-scale structure in the universe is reviewed, paying special attention to the first-ranked observational facts. Then the conditions which the theory must satisfy with minimum parameters are summarized in relation to additional observational facts. Finally, a possible framework for galaxy-formation theory which seems to be consistent with the large-scale structure is presented.

**A89-51053 Interchange processes of the interstellar medium—Mass circulation between the Galactic disk and halo.** FAN LI and SATORU IKEUCHI, *Astronomical Society of Japan, Publications* (ISSN 0004-6264), Vol. 41, No. 2, 1989, pp. 221-240. 25 Refs.

Interchange processes among the three phases of the interstellar medium (cold clouds, warm ionized gas, and hot tenuous gas), including mass circulation between the Galactic disk and halo regulated by supernova remnants and superbubbles, are studied. The time variation of each component of the interstellar medium is calculated and a steady state is obtained for the connected Galactic disk-halo system. It is found that the mass circulation rate is about 1.6 solar masses/yr between the disk and halo for usual parameters. The high supernova rate case is studied as a trial model corresponding to young galaxies or starburst galaxies. In this case, the halo works as a reservoir of mass, and the time variation of the interstellar medium shows a periodicity. This behavior indicates recurrent bursts of star formation.

**A89-49834 Simple particle-physics model for the reheating of the universe.** M. FUKUGITA, M. KAWASAKI, and T. YANAGIDA, *Physical Review Letters* (ISSN 0031-9007), Vol. 63, Aug. 7, 1989, pp. 585-588. 11 Refs.

The unstable-neutrino explanation for the reheating of the universe, which accounts for the cosmic-background-radiation distortion, requires nonelectromagnetic fast decay of neutrinos and a small branching ratio to the channel including electromagnetically interacting particles. It is shown that there exists a simple particle-physics model which satisfies the conditions required for the reheating within the known family of particles (except for a massive neutrino).

**A89-42001 New developments in theoretical modelling of SN 1987A.** KEN'ICHI NOMOTO, TOSHIKAZU SHIGEYAMA, SHIOMI KUMAGA, and MASA-AKI HASHIMOTO, *Proceedings of the Astronomical Society of Australia*, (ISSN 0066-9997), Vol. 7, No. 4, 1988, pp. 490-504. Research supported by the Institute of Space and Astronautical Sciences. 88 Refs.

Recent developments in modeling SN 1987A are summarized, including the progenitor's evolution, explosive nucleosynthesis, optical, X- and gamma-ray light curves, and  $dv/dt = 15$  sation. The distribution of heavy elements in the ejecta is inferred from the light curves. The plateau-like peak of the optical light curve is well reproduced if hydrogen is mixed into the deep core. The progenitor's blue-red-blue evolution and N abundance suggest that the progenitor's hydrogen-rich envelope had mass of 7-11 solar masses and was almost completely mixed.

**A89-20501 Performance analysis of direct N-body calculations.** JUNICHIRO MAKINO and PIET HUT, *Astrophysical Journal Supplement Series* (ISSN 0067-0049), Vol. 68, Dec. 1988, pp. 833-856. Research supported by the Alfred P. Sloan Foundation. 15 Refs. (NSF INT-86-13539).

A theoretical framework for analyzing the computational cost of gravitational N-body codes is introduced and applied to three different types of direct-summation codes, including the type of Aarseth code which has found most general use. The method of analysis, based on the probability distribution of nearest-neighbor distances, is described. The number of time steps required for a variety of different versions of the Aarseth scheme and a variety of physical models of spherical star clusters is estimated in order to measure the effects of different degrees of central concentration. Analytical estimates of computer time required are compared with actual measurements, and the validity of the scaling outside the range actually tested is discussed. A practical result for planning star cluster simulations on the next generation of supercomputers is derived. It is found that the consumption of computer time can be very centrally concentrated.

**A89-41352 The large-scale structure of the universe and the division of space.** SATOSHI YOSHIOKA, SATORU IKEUCHI, *Astrophysical Journal, Part 1* (ISSN 0004-637X), Vol. 341, June 1, 1989, pp. 16-25. 25 Refs.

Structures which result from the overlapping of shells produced by explosions or negative density perturbations are calculated using three-dimensional Voronoi tessellation and a comparison is made with the real structure. This model can reproduce the observed bubble-like structure on large scales. The two-point correlation function of mass distribution after overlapping shows a power-law form, though its power index is considerably smaller than the observed value. This suggests the importance of the gravitational clustering process, such as concentration of matter on the walls into filaments and nodes.

**A89-36556 Atmospheric diagnostics of stellar evolution: Chemical peculiarity, mass loss, and explosion; Proceedings of the 108th Colloquium of the IAU, University of Tokyo, Japan, Sept. 1-4, 1987.** KEN'ICHI NOMOTO, ED., Colloquium supported by IAU, Japan Society for the Promotion of Science, Tokyo Astronomical Observatory, et al. Berlin and New York, Springer-Verlag (Lecture Notes in Physics. Vol. 305), 1988, 483 pp. No individual items are abstracted in this volume.

The emission of stellar atmospheres and its implications for models of stellar evolution are discussed in reviews and reports of recent observational and theoretical investigations. Topics examined include chemical peculiarities in main-sequence stars, cool evolved stars, and hot evolved stars; mass loss in different stages of evolution; interacting binaries; and the chemical and dynamical structures of exploding stars. Particular attention is given to early multiple-wavelength observations of SN 1987A.

**A89-34975 Isotropization of the cosmic background radiation due to galactic gravitational scattering.** KENJI TOMITA, *Astronomical Society of Japan, Publications* (ISSN 0004-6264), Vol. 40, No. 6, 1988, pp. 751-757. 14 Refs.

A cold dark matter dominant model with the white noise spectrum of the initial density distribution is used to study the possible role of the random multiple scattering of primordial objects with the masses of galaxies or clusters as an effective screening for the cosmic background radiation. It is shown that primordial objects with  $6 \times 10$  to the 14th/hr solar masses are in the nonlinear stage at epochs  $1+z = 6.3-1.4$  if the objects with masses 10 to the 12th/hr solar masses are in the nonlinear stage at  $1+z = 10-20$ . The smallscale anisotropy of the radiation may be smoothed out within 13-28 arcmin by this gravitational scattering with the Hubble constant equal to 100 h km/s/Mpc.

**A89-31202 Cosmic microwave anisotropies and large-scale velocity fields in isocurvature hot dark matter models.** NAOSHI SUGIYAMA, MISAO SASAKI, KENJI TOMITA, *Astrophysical Journal, Part 2—Letters* (ISSN 0004-637X), Vol. 338, March 15, 1989, pp. L45-L48. 23 Refs.

The evolution of isocurvature density perturbations in a universe dominated by hot dark matter (HDM) is studied and anisotropies in the cosmic microwave background and largescale peculiar velocity fields are evaluated. Isocurvature HDM models are more viable than adiabatic HDM models in that the former can account for relatively large velocity fields on large scales while keeping the cosmic microwave background anisotropies below the observational upper limits as compared to the latter. However, isocurvature HDM models would still have difficulties if the actual velocity fields on scales greater than 50/h Mpc were confirmed to be substantially greater than about 400 km/s.

**A89-21053 Theoretical model of SN 1987A and the presupernova evolution of massive stars.** K. NOMOTO, T. SHIGEYAMA, and M. HASHIMOTO, *High energy astrophysics: Supernovae, remnants, active galaxies, cosmology; Proceedings of the Second Workshop*, Tegernsee, Federal Republic of Germany, July 12-17, 1987 (A89-21051 07-90). Berlin and New York, Springer-Verlag, 1988, pp. 34-56. Research supported by the University of Tokyo. 48 Refs.

Results are presented from a novel set of calculations for the precollapse evolution of massive stars that is based on improved input physics, as well as from a hydrodynamical calculation of the SN explosion and the light curve. An evolutionary scenario with significant mass loss during the red supergiant phase predicts the existence of low density circumstellar matter, as well as denser matter surrounding SN 1987A. The soft component of the X-rays observed may be due to the collision of SN ejecta and the circumstellar material.

**A88-52588 Nitrogen and helium enhancement in the progenitor of supernova 1987A.** HIDEYUKI SAIO, KEN'ICHI NOMOTO, and MARIKO KATO, *Nature* (ISSN 0028-0836), Vol. 334, Aug. 11, 1988, pp. 508-510. 23 Refs.

Recent ultraviolet observations of SN 1987A indicate that the ultraviolet emissions come from circumstellar material which was processed by hydrogen burning in the interior and ejected into space when the progenitor was a red supergiant. The progenitor of SN 1987A must therefore have evolved first to a red supergiant and then back to the blue. From calculations of massive star evolution, it is shown here how the star could have undergone blue-red-blue evolution. By comparing these theoretical models with the abundance information from the ultraviolet observations, it is concluded that the hydrogenrich envelope of the progenitor was as massive as 7-11 solar masses and that almost the whole envelope was uniformly mixed, probably because of rapid rotation.

**A88-48439 Neutrino emission processes in white dwarfs and neutron stars.** NAOKI ITOH, *Advances in Space Research* (ISSN 0273-1177), Vol. 8, No. 2-3, 1988, pp. 695-698. 8 Refs.

The neutrino energy loss rates in dense stars have been calculated using the Weinberg-Salam theory. The loss rates due to pair, photo-, and plasma processes are found to be substantially lower than published results based on the Feynman-Gell-Mann theory. The reduction factor,  $\alpha$ , is found to be in the range between about 0.35 and 0.88, depending on the neutrino masses, density, and temperature. The bremsstrahlung neutrino energy loss rate is also calculated, taking into account the ionic correlation effects in the crystalline lattice state and in the liquid metal state. It is found that the ionic correlation effects reduce the bremsstrahlung neutrino energy loss typically by a factor of 2 to 20.