

CURRICULUM VITAE

(Extended CV)

Heinrich J. Völk

BORN

December 12, 1936, in Donauwörth, Germany

FAMILY STATUS

Married, one child

EDUCATION

- Ludwigs-Maximilians-Universität München (LMU), Freie Universität Berlin 1955- 1961
- Diploma in Physics, LMU 1961
- Dr. rer. nat. (PhD) in Physics, LMU 1965
- Habilitation (Dr. rer. nat. habil.) at Technische Universität München (TUM) 1974

University and MPG fellowships and assistantships:

- Verwalter einer wiss. Assistentenstelle, Inst. für Angewandte Geophysik, LMU 1958-1959
- Promotionsstipendium, Institut für Plasmaphysik (IPP), Garching + Teaching Assistant, Theor.Physics, LMU 1962-1965

PROFESSIONAL ACTIVITIES

- Research Associate, IPP 1964-1965
- Research Associate, Dept. of Aeronautics and Astronautics, MIT 1965-1966
- Assistant Professor, Dept. of Aeronautics and Astronautics, MIT 1966-1967
- Senior Research Associate, Max Planck Institute for Extraterrestrial Physics 1967-1974
- Scientific Member and Director at Max Planck Institute for Nuclear Physics, Heidelberg 1975-2004
- Honorarprofessor, University of Heidelberg 1976-2004
- Distinguished Visiting Professor, Dept. of Physics and Enrico Fermi Institute, The University of Chicago 1982
- Scientific Member Emeritus, Max Planck Institute for Nuclear Physics 2005-
- Honorary Professor Emeritus, University of Heidelberg 2005-

SABBATHICAL LEAVES

- The University of Chicago Sept.1973-
Sept. 1974

PUBLICATIONS

(Metrics summary for all authored articles c.f. NASA-ADS Database, date: 19.12.2016)

- Total number of papers: 587
- Number of refereed papers: 381
- Total citations: 23,855; h-index: 85

MAIN SCIENTIFIC RESULTS

- Calculation of spatially 1-dim. equilibrium solutions for Vlasov plasmas and investigation of their stability, with constants of the motion employed as Lyapunov functions. For spatially uniform solutions which are also 1-dim. in momentum space, indeed necessary and sufficient stability criteria result. Interestingly for higher dimensions, already in momentum space, the available constants of the motion turn out not to be sufficiently dense to permit the application of the Lyapunov method at the kinetic level, apart from exceptional cases.
- Macroscopic quasi-linear theory of the Firehose instability. Application to hydromagnetic simulations as dissipation mechanism in collisionless parallel relaxation shocks.
- Investigation of plasma instabilities in the Solar Wind in an effort to understand the collisionless dissipation in the flow.
- Physical interpretation of the striations observed in Ionospheric ion cloud experiments as polarization instability.
- Nonlinear Landau damping proposed as main dissipation mechanism for Alfvén waves in cosmic high- β plasmas.
- Nonlinear perturbation theory of cosmic-ray propagation in random magnetic fields. Applied to the elimination of singularities in the quasi-linear transport coefficients.
- Calculation of the spatial variation of the cosmic-ray transport coefficients in the Interplanetary Medium. Quantitative proposal for a mechanism of cosmic-ray modulation by the Solar Wind.
- Penetration of cosmic rays into molecular clouds: Arguments for an essentially free penetration and a correspondingly unimpeded γ -ray production.
- Theory of induced velocities and coagulations rates of grains in a turbulent gas. Calculation of grain growth in the interstellar medium and in protostellar systems. Transport theory for dust and vapour, and the resulting chemical fractionation in the early protosolar cloud
- Nonlinear theory of diffusive shock acceleration of charged particles in hydromagnetic approximation: Shock structure, self-generated Alfvén waves, wave dissipation, possibility of a high acceleration efficiency.
- “Onion shell” test particle model for cosmic-ray acceleration in expanding supernova remnants: overall momentum spectrum shown to approximate a power law
- Participation in composition measurements of comet Halley dust particles with the Heidelberg dust experiment on the GIOTTO spacecraft.
- Comparative study of cosmic-ray transport by diffusion vs. advection in our Galaxy and the starburst galaxy M 82. Estimate of the high-energy γ -ray emission from M 82.
- Calorimeter theory for the correlation between the radio and far-infrared continuum emissions for star forming galaxies. Applications to the star formation history of galaxies and to the magnetic field generation rate in starburst galaxies.
- Simplified nonlinear, time-dependent models for particle acceleration in supernova remnants. Average acceleration efficiency estimated as ~ 10 percent.

- Estimates for the γ -ray visibility of supernova remnants: A test of cosmic ray origin.
- Theory of supra-thermal ion injection at shocks into the diffusive acceleration process.
- Interpretation of the observed high positron:electron ratio in the Galactic cosmic rays as an indicator for the existence of nearby electron-positron sources like Pulsars.
- Theory of cosmic-ray driven Galactic Winds from disk galaxies like the Milky Way. Effect of the general galactic magnetic field on the mass and angular momentum loss. Kinetic treatment of energetic-particle transport in the Wind and self-consistent determination of the cosmic-ray diffusion coefficient in the Galaxy. Explanation of the small radial gradient of the diffuse γ -ray emission in the Galactic Disk as a consequence of the increase of the wind velocity towards the Galactic Center.
- Evaluation of the nonthermal energy content and of the γ -ray emission of starburst galaxies and clusters of galaxies. Cosmic-ray confinement time in the Intracluster Gas shown to exceed the age of the Universe, leading to the concept of “cosmological cosmic rays” in clusters. Model for the generation of the extended intra-cluster magnetic fields by galactic mass loss in the form of magnetized winds due to early starbursts in the constituent galaxies.
- Participation in the build-up and organization of the HEGRA (High Energy Gamma Ray Astronomy) stereoscopic system of imaging atmospheric Cherenkov telescopes. Interpretation of HEGRA observations during the entire experiment life time.
- Participation in the science definition of the ISOPHOT experiment on ISO (Infrared Space Observatory). Interpretation of observational results regarding the Virgo cluster of galaxies: decomposition of the radio/far-infrared correlation into a warm and a cold component, measurement of the 158 μm [CII] line emission and modelling of its relation to the star formation properties, discovery of a diffuse emission component of cold dust. Dust emission studies in nearby galaxies and discussion of a trivial local vs. the global radio/far-infrared correlation in M 33.
- First determination of the energy spectrum of the Galactic cosmic-ray proton component with the imaging atmospheric Cherenkov technique.
- Participation in the evaluation of the physics requirements for a large stereoscopic system of Cherenkov telescopes (subsequently called the H.E.S.S. experiment [High Energy Stereoscopic System]); strong emphasis on a large field of view of 5 degrees, like HEGRA. One of the authors of the “Letter of Intent” for H.E.S.S., coining the expression “Nonthermal Universe”. Science organization of the H.E.S.S. Collaboration.
- Quantitative proposal for cosmic-ray re-acceleration by spiral shocks in the Galactic Wind, from the “knee” to the “ankle” in the observed energy spectrum.
- Partner in the application and extension of a nonlinear, time-dependent kinetic model of shock acceleration of nuclei and electrons in spherical symmetry to the synchrotron and γ -ray production in supernova remnants. Application of this theory to the observations of several objects. Semi-empirical evaluation of the magnetic field amplification. Interpretation of the observed synchrotron X-ray filaments in terms of the synchrotron loss length of the accelerated electrons. Introduction of the concept of anisotropic injection of particles into the acceleration at the outer blast wave. Prediction of the hadronic γ -ray emission from theory, making use of the observed electron synchrotron spectrum. Evaluation of the contribution of non-detected supernova remnant sources to the diffuse Galactic gamma-ray emission. Evaluation of the cosmic-ray secondary-to-primary ratio through re-acceleration on supernova remnants in the Galactic disk. Theory of synchrotron emission from supernova remnants and of the so-called Σ -D relation in terms of the time evolution of typical objects.
- Author of observing proposals for H.E.S.S. and contributing author of H.E.S.S. papers, especially regarding observations of supernova remnants, star forming galaxies and galaxy clusters. Confirmation of the prediction of dominant particle transport in starburst

galaxies by advection in a starburst wind, as derived from the radio continuum morphology. On the other hand, the predicted significant hadronic γ -ray emission from galaxy clusters, due to galaxy mergers and starbursts in the cosmological past, could not be confirmed despite considerable efforts.

- Prediction of the chemical evolution of our Galaxy to be influenced by a significant removal of the heavy element fraction by the Galactic Wind. Rejection of the prevailing view of chemical evolution under the sole influence of mass infall, which is based on the stellar initial mass function as observed for the solar neighbourhood that contains only a low fraction of massive stars.
- Disproof of a pure inverse Compton γ -ray emission from Galactic type Ia supernovae.
- Prediction of a marginally detectable gamma-ray emission from the very young SN 1987A in the Large Magellanic Cloud.

SPACE EXPERIMENTS, GROUND-BASED GAMMA-RAY EXPERIMENTS

- Co-Principal Investigator Electron Beam Experiment on GEOS of ESA
- Co-Investigator ISOPHOT on ISO of ESA
- Co-Spokesperson HEGRA experiment on La Palma
- Chairman Collaboration Board of H.E.S.S. experiment in Namibia

SOME OTHER ACTIVITIES RELATED TO SCIENTIFIC RESEARCH

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| • Member of the Planetary (Solar) System Working Group of ESA | 1973-1975 |
| • Member of the Editorial Board "Space Science Reviews" | 1983-1989 |
| • Member of the Science Program Committee of ESA | 1986-1987 |
| • Member of the Space Science Advisory Committee of ESA | 1987-1988 |
| • Chairperson of the Survey Committee and Editor of the "Denkschrift Astronomie" of the Deutsche Forschungsgemeinschaft | 1986-1987 |
| • Chairperson of the European Space Science Committee, ESF (Strassburg) | 1987-1994 |
| • Chairperson of the Presidential Committee "Astronomie", Max Planck Society (MPG), Munich | 1991-1992 |
| • Member of the Editorial Board "Journal of Physics" | 1996-1999 |
| • Coordinator of the Laboratoire Européen Associé (LEA) for Gamma-Ray Astronomy at High Energies, between MPG (Munich) and CNRS (Paris) | 2001-2005 |
| • Member of the ApPEC (Astroparticle Physics European Coordination) Steering Committee on behalf of German ministry BMBF | 2002-2004 |
| • Representative of MPG to ASEPS (Asia Europe Physics Summit) | 2009-2011 |

H.J. Völk has been a member of the Kuratorium of the MPI für Radioastronomie (Bonn). He has been a member of the Fachbeirat of the MPI für Extraterrestrische Physik (Garching), MPI für Aeronomie (Lindau), of the Visiting Committee of the Service d'Astrophysique (Saclay), DSM (Saclay), Potchefstroom University (RSA). He has been a member of numerous advisory committees of the BMBF, and of the Program Committee of the DLR (Porz).

H.J. Völk is a member of the Deutsche Physikalische Gesellschaft, a member of the Astronomische Gesellschaft, and a Fellow of the Institute of Physics. He is a Senior Fellow of the Helmholtz-Alliance for Astroparticle Physics.

He is a member of Academia Europaea.

AWARDS

- Victor Hess Memorial Lecture, 2001
- 2006 Descartes Prize for scientific collaborative research of the EU for the H.E.S.S. Collaboration, 2007
- 2010 Rossi Prize of the American Astronomical Society (together with Felix Aharonian, Werner Hofmann, and the H.E.S.S. Collaboration), 2011
- 2013 TIFR-IUPAP Homi Bhabha Medal and Prize, 2013
- 2020 Honorary Doctor of the Siberian Branch of the Russian Academy of Sciences