Ragnar-Olaf Buchweitz

1952-2017

In Memoriam

Gert-Martin Greuel

University of Kaiserslautern

Münster, March 2019

Ragnar in Oberwolfach, 2006

Stages of his life

- Ragnar was born on March 18, 1952, in Neuruppin, Germany.
- He studied since 1969 at the University of Hannover
  Diplom 1972: *Clifford-Moduln in der K-Theorie*
  PhD 1976: *Über Deformationen monomialer Kurvensingularitäten und Weierstrasspunkte auf Riemannschen Flächen*
  (Adv. K. Kopfermann, H. Tietz)
- Thèse d'état in 1981 at the University Paris VII.
  Contributions à la théorie des singularités
  (Member of Jury: M. Demazure, J.L. Verdier)
- Habilitation and Venia Legendi in 1982, in Hannover.

Stages of his life

- 1981 - 83 Assistant Professor at Brandeis University, USA.
- 1983 - 84 Professeur assoc. at Université Paris-Sud, France.
- 1984 - 87 Heisenberg-scholar of the "Deutsche Forschungs-gemeinschaft" (DFG), Germany.
- He became professor at the University of Toronto in 1987, where he stayed and worked for 30 years.
  - He served as acting chair of the Department of Mathematics.
  - He was the founding chair of the Department of Computer and Mathematical Sciences at the UT Scarborough campus.
  - There he served as Dean from 2004 to 2009.

He received many grants and awards, in particular the Humboldt Research Award 2010 (Germany).

His mathematical culture

- Ragnar had an impressive knowledge in commutative algebra, algebraic geometry, singularity theory, and representation theory.
- He was a gifted problem solver but even more he was interested in the global picture and the general principals behind any problem.
- He was a great teacher and mentor and he provided guidance and help to anyone who asked him.
- Communication was very important to him and he collaborated with a large number of mathematicians in different fields.

Collaborators

9 Avramov, Luchezar L.
7 Flenner, Hubert
4 Leuschke, Graham J.
3 Greuel, Gert-Martin
3 Iyengar, Srikanth B.
3 Liu, Shiping
3 Van den Bergh, Michel
2 Green, Edward Lee
2 Krause, Henning
2 Miller, Claudia M.
2 Solberg, Oyvind
1 Aroca, José Manuel
1 Auslander, Maurice
1 Chen, Qun
1 Conca, Aldo
1 Ebeling, Wolfgang
1 Eisenbud, David
1 El Haouari, Mohammed
1 Faber, Eleonore
1 Giusti, Marc
1 Graf von Bothmer, H.-C.
1 Herzog, Jürgen
1 Hille, Lutz
1 Hori, Kentaro
1 Ingalls, Colin
1 Lenzing, Helmut
1 Lowen, Wendy
1 Madsen, Dag Oskar
1 Merle, Michel
1 Millson, John J.
1 Mond, David
1 Pike, Brian
1 Roberts, Collin D.
1 Sally, Judith D.
1 Schreyer, Frank-Olaf
1 Schwede, Stefan
1 Sega, Liana M.
1 Snashall, Nicole
1 van Straten, Duco

Pictures of Ragnar's collaborators

G.-M. Greuel, P. Slodowy and R.-O. Buchweitz

La Rabida Conference 1981, Alcázar Sevilla

Author profile in zbMATH

Buchweitz, Ragnar-Olaf

Edit Profile

Author ID: buchweitz.ragnar-olaf
Published as: Buchweitz, R.; Buchweitz, R. O.; Buchweitz, R.-O.; Buchweitz, Ragnar-Olaf
Homepage: http://www.utsc.utoronto.ca/cms/ragnar-olaf-buchweitz
External Links: MGP · Math-Net.Ru · ResearchGate · GND

Compute Distance To: Paul Erdős

Documents Indexed: 50 Publications since 1976, including 3 Books

Co-Authors all

- 5 single-authored
- 9 Avramov, Luchezar L.
- 7 Flenner, Hubert
- 4 Leuschke, Graham J.
- 3 Greuel, Gert-Martin
- 3 Iyengar, Srikanth B.

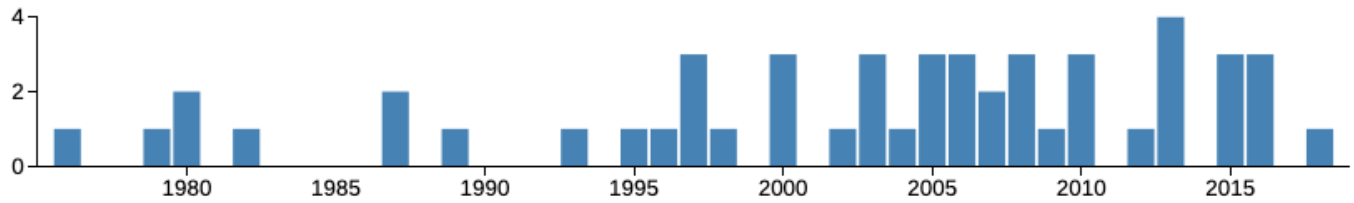
Journals all

- 5 Inventiones Mathematicae
- 4 Advances in Mathematics
- 3 Compositio Mathematica
- 3 Journal of Algebra
- 3 Oberwolfach Reports

Fields all

- 27 Algebraic geometry (14-XX)
- 22 Commutative algebra (13-XX)
- 20 Associative rings and algebras (16-XX)
- 12 Category theory, homological algebra (18-XX)
- 12 Several complex variables and analytic spaces (32-XX)

Publications by Year



Mathematical achievements 1976 – 1990

- **Buchweitz, R.-O.:** Über Deformationen monomialer Kurvensingularitäten und Weierstrasspunkte auf Riemannschen Flächen. TU Hannover (Diss.) (1976).
- **Buchweitz, R.-O.; Greuel, G.-M.**: Le nombre de Milnor, équisingularite et déformations de singularites des courbes reduites. C. R. Acad. Sci. (1979).
- **Buchweitz, R.-O.:** On deformations of monomial curves. Semin. sur les singularites des surfaces, Cent. Math. Ec. Polytech., 1976-77, LN Math. (1980).
- **Buchweitz, R.-O.; Greuel, G.-M.:** The Milnor number and deformations of complex curve singularities. Invent. Math. 58 (1980).
- **Aroca, J. M.; Buchweitz, R.-O.; Giusti, M.; Merle, M. (ed.):** Algebraic geometry. Proc. of the Int. Conf. La Rabida, Springer-Verlag (1982).
- **Buchweitz, R.-O.; Greuel, G.-M.; Schreyer, F.-O.:** Cohen-Macaulay modules on hypersurface singularities. II. Invent. Math. 88, 165-182 (1987).
- **Buchweitz, R.-O.; Eisenbud, D.; Herzog, J.:** Cohen-Macaulay modules on quadrics. Appendix by R.-O. Buchweitz. Singularities, Representation of Algebras, and Vector Bundles, Proc. Symp., Lambrecht 1985, LNM (1987).
- **Buchweitz, R.-O.:** Maximal Cohen-Macaulay modules and Tate-cohomology over Gorenstein rings, 155 page unpublished manuscript (1987).
- **Auslander, M.; Buchweitz, R.-O.:** The homological theory of maximal Cohen-Macaulay approximations. Mém. Soc. Math. (1989).

Contents of some highly cited papers

- **Buchweitz, R.-O.; Greuel, G.-M.:** The Milnor number and deformations of complex curve singularities. Invent. Math. 58 (1980).

  - Definition of μ for arbitrary red. curve singularity

$$\mu(C,0) = \dim_{\mathbb{C}} \omega_{C,0}/d\mathcal{O}_{C,0}$$

  In a flat family $X \to \mathbb{C}$:
  - (i) $\mu(X_0) - \mu(X_t) = \dim_{\mathbb{C}} H^1(X_t)$
  - (ii) $\mu(X_t)$ constant $\Leftrightarrow$ the family is topologically trivial.

- **Buchweitz, R.-O.; Greuel, G.-M.; Schreyer, F.-O.:** Cohen-Macaulay modules on hypersurface singularities. II. Invent. Math. 88, 165-182 (1987).

  - The hypersurface singularity $k\langle x_1, ..., x_n\rangle/\langle f\rangle$ is of finite CM-representation type
    $\Rightarrow f$ is a simple (ADE) singularity ($\Leftarrow$ is due to Knörrer).

Contents of some highly cited papers

- **Buchweitz, R.-O.:** Maximal Cohen-Macaulay modules and Tate-cohomology over Gorenstein rings, 155 page unpublished manuscript (1987).
  - MCM (i.e. maximal CM) modules carry a natural triangulated structure which implies that there is a naturally defined cohomology-theory attached to these modules - the Tate-cohomology.
  - Contains already MCM-approximations and many results from the next paper.
- **Auslander, M.; Buchweitz, R.-O.:** The homological theory of maximal Cohen-Macaulay approximations. Mém. Soc. Math. (1989).
  - Any f. g. module N over a commutative Noetherian local ring with dualizing module admits a CM approximation:
  - i.e. $\exists\,!$ a surjection $M \twoheadrightarrow N$, $M =$ MCM, s. t. any other surjection from a MCM factors over M.
  - The theory (and its dual) is developed in abelian categories with a suitable subcategory of "maximal Cohen-Macaulay objects".

Pictures of Ragnar's collaborators

F.-O. Schreyer, D. Eisenbud, S. Gusein-Zade, G.-M. Greuel, M. Stillman, ?, Lé, D. T., C.T.C. Wall, R.-O. Buchweitz

Oberwolfach 1992

Mathematical achievements 1990 – 2000

- **Avramov, L. L; Buchweitz, R.-O.:** Lower bounds of Betti numbers. Compos. Math. 86 (1993).
- **Buchweitz, R.-O.; El Haouari, M.:** Cohomologie de Hochschild et espaces projectifs tronqués. Manuscr. Math. 86 (1995).
- **Buchweitz, R.-O.; Flenner, H.:** Unfoldings of holomorphic maps as deformations. Proc. Complex analysis and geometry, Trento. L. N. P. A. Math (1996).
- **Buchweitz, R.-O.; Millson, J.:** CR-geometry and deformations of isolated singularities. Mem. Am. Math. Soc. 597 (1997).
- **Avramov, L.; Buchweitz, R.-O.; Sally, J.:** Laurent coefficients and Ext of finite graded modules. Math. Ann. 307 (1997).
- **Buchweitz, R.-O; Chen, Qun:** Hilbert-Kunz functions of cubic curves and surfaces. J. Algebra 197 (1997).
- **Buchweitz, R.-O.:** Finite representation type and periodic Hochschild (co-)homology. Proc. Seattle 1997. Contemp. Math. 229 (1998).
- **Buchweitz, R.-O.; Flenner, H.:** The Atiyah-Chern character yields the semiregularity map as well as the infinitesimal Abel-Jacobi map. CRM Proc. LN (2000).
- **Avramov, L.; Buchweitz, R.-O.:** Homological algebra modulo a regular sequence with special attention to codimension two. J. Algebra 230, (2000).
- **Avramov, L.; Buchweitz, R.-O.:** Support varieties and cohomology over complete intersections. Invent. Math. (2000).

Contents of some highly cited papers

- **Buchweitz, R.-O; Chen, Qun:** Hilbert-Kunz functions of cubic curves and surfaces. J. Algebra 197 (1997).
  $S = k[x_0, x_2, x_3]/\langle f \rangle$, k a field of char p. The Hilbert-Kunz function

  $$HK_S(q) = dim_k S/\langle x_0^q, x_1^q, x_3^q \rangle, \ q = p^n,$$

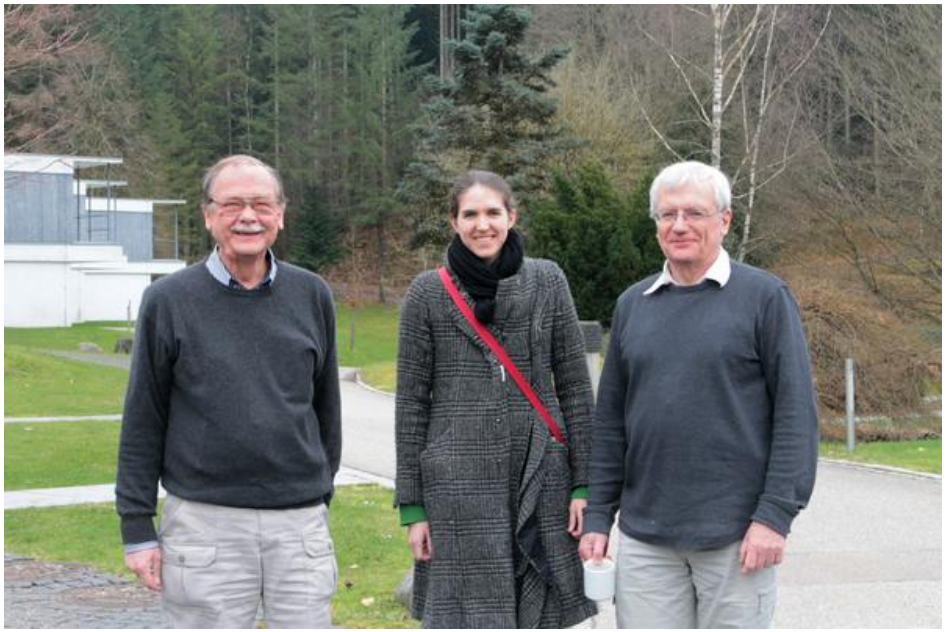
  is determined for the hom. coordinate ring S of all of plane cubics.

- **Avramov, L.; Buchweitz, R.-O.:** Support varieties and cohomology over complete intersections. Invent. Math. (2000).
  - R a local complete intersection ring, M, N f.g. R-modules.The support variety $V(M, N)$ measures the size of $Ext_R^*(M, N)$.
  - Equivalent:
  (1) $Ext_R^i(M, N) = 0$ for $i \gg 0$. (2) $Ext_R^i(N, M) = 0$ for $i \gg 0$.
  (3) $Tor_R^i(M, N) = 0$ for $i \gg 0$. (4) $V(M, N) = \{0\}$.

Pictures of Ragnar's collaborators

left: R.-O. Buchweitz, H. Flenner
(RiP, Oberwolfach 2005)

R.-O. Buchweitz, W. Lowen, L. Avramov
(RiP, Oberwolfach 2016)



Mathematical achievements 2000 – 2006

- **Buchweitz, R.-O.; Liu, S.** Artin algebras with loops but no outer derivations. Algebr. Represent. Theory 5, (2002).
- **Buchweitz, R.-O.; Liu, S.** Dimension of the mesh algebra of a finite Auslander-Reiten quiver. Commun. Algebra 31 (2003).
- **Buchweitz, R.-O.; Flenner, H.:** A semiregularity map for modules and applications to deformations. Compos. Math. 137 (2003).
- **Buchweitz, R.-O.:** Morita contexts, idempotents, and Hochschild cohomology – with applications to invariant rings. Proc. Grenoble. Cont. Math. 331 (2003).
- **Buchweitz, R.-O.; Liu, S.:** Hochschild cohomology and representation-finite algebras. Proc. Lond. Math. Soc. (2004).
- **Buchweitz, Ragnar-Olaf ; Lenzing, Helmut (ed.):** Representations of algebras and related topics. Proceedings ICRA X, Toronto 2002.
- **Avramov, L.; Buchweitz, R.-O.; Şega, L. M.:** Extensions of a dualizing complex by its ring: Comm. versions of a conjecture of Tachikawa. J. P. A. A. (2005).
- **Buchweitz, R.-O.; Green, E.; Madsen, D.; Solberg, Ø.:** Finite Hochschild cohomology without finite global dimension. Math. Res. Lett. 12 (2005).
- **Buchweitz, R.-O.; Flenner, H.:** Power series rings and projectivity. Manuscr. Math. 119 (2006).
- **Buchweitz, R.-O.; Mond, D.:**Linear free divisors and quiver representations (GMG60). CUP, London Mathematical Society Lecture Note Series 324 (2006).

Contents of some highly cited papers

- **Buchweitz, R.-O.; Flenner, H.:** A semiregularity map for modules and applications to deformations. Compos. Math. 137 (2003).

  - Construction of a general semiregularity map for algebraic cycles on arbitrary complex spaces (generalizing work of Bloch, Illusie)

  - Far reaching consequences for deformation of modules, the Hilbert scheme and the variational Hodge conjecture.

- **Buchweitz, R.-O.; Green, E.; Madsen, D.; Solberg, Ø.:** Finite Hochschild cohomology without finite global dimension. Math. Res. Lett. 12 (2005).

  - The Hochschild cohomology $HH^n(\Gamma)$, Γ a finite dim. algebra over a field, may vanish for all $n \gg 0$ if the global dimension of Γ infinite. A negative answer to a question of Happel.

- **Buchweitz, R.-O.; Mond, D.:**Linear free divisors and quiver representations (GMG60). CUP, London Mathematical Society Lecture Note Series 324 (2006).

  - Determine semi-invariants for linear free divisors for the positive roots of a Dynkin quiver, inverting a result of H. Derksen and J. Weyman and giving a lot of interesting examples.

Pictures of Ragnar's collaborators

J. Wahl, B. Teissier, R.-O. Buchweitz

(GMG 60, Stelzenberg 2004)

C.T.C. Wahl, J.Steenbrink,

R.-O. Buchweitz, J. Wahl,

U. + G.-M. Greuel, W. Ebeling,

H. Hamm, G. Pfister

Mathematical achievements 2006 – 2010

- **Buchweitz, R.-O.; Krause, H. Schwede, S. (ed.):** Mini-workshop: Thick subcategories – classifications and applications, Oberwolfach (2006).
- **Buchweitz, R.-O.; Leuschke, G.** Factoring the adjoint and maximal Cohen-Macaulay modules over the generic determinant. Am. J. Math. (2007).
- **Avramov, L.; Buchweitz, R.-O.; Iyengar, S.** Class rank of differential modules. Invent. Math. 169 (2007).
- **Buchweitz, R.-O.; Flenner, H.:** Global Hochschild (co-)homology of singular spaces. Adv. Math. 217 (2008).
- **Buchweitz, R.-O.; Flenner, H.:** The global decomp. th. for Hochschild (co-) homol. of singular spaces via the Atiyah-Chern character. Adv. Math. (2008).
- **Buchweitz, R.-O.; Green, E.; Snashall, N.; Solberg, Ø.:**Multiplicative structures for Koszul algebras. Q. J. Math. 59 (2008).
- **Buchweitz, R.-O.; Ebeling, W.; Graf von Bothmer, H.-C.:** Low-dimensional singularities with free divisors as discriminants. J. Algebr. Geom. 18 (2009).
- **Avramov, L.; Buchweitz, R.-O.; Iyengar, S.; Miller, C.:**Homology of perfect complexes. Adv. Math. 223 (2010); Corrigendum, Adv. Math. 225 (2010)
- **Buchweitz, R.-O.; Leuschke, G.; Van den Bergh, M.:** Non-commutative desingularization of determinantal varieties. I. Invent. Math. 182, (2010).

Contents of some highly cited papers

- **Buchweitz, R.-O.; Green, E.; Snashall, N.; Solberg, Ø.:**Multiplicative structures for Koszul algebras. Q. J. Math. 59 (2008).

  - $\Lambda = kQ/I$ a Koszul algebra over a field k, Q a finite quiver. The authors describe the multiplicative structure of the Hochschild cohomology ring $HH^*(\Lambda)$.

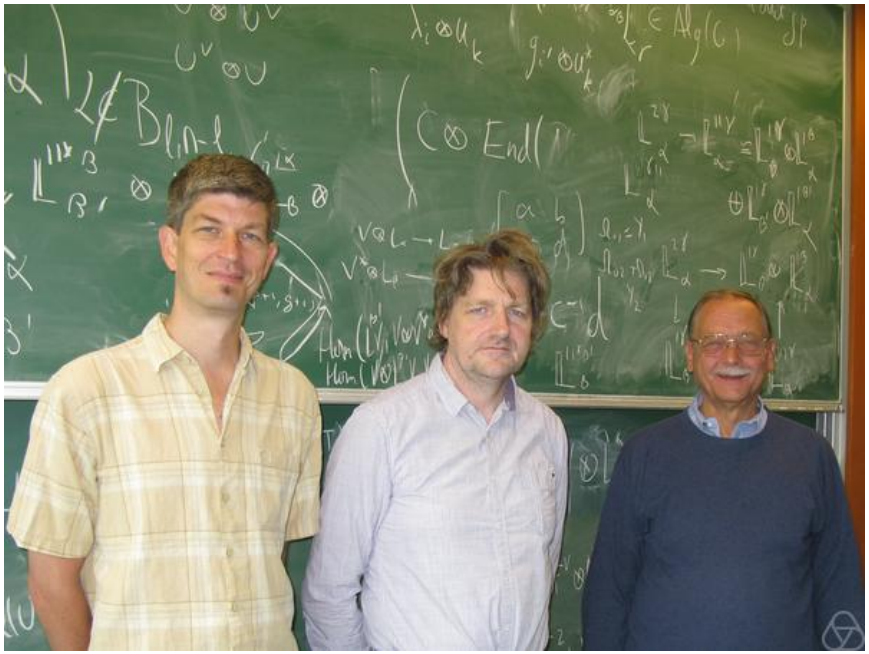
- **Avramov, L.; Buchweitz, R.-O.; Iyengar, S.; Miller, C.:**Homology of perfect complexes. Adv. Math. 223 (2010); Corrigendum, Adv. Math. 225 (2010)

  - Let $(R, \mathfrak{m}, k)$ be a local ring. The authors provide uniform lower bounds on the Loewy lengths

$$\ell\ell_R M := inf\{i \geq 0 \,|\, \mathfrak{m}^i M = 0\}$$

  of modules M of finite projective dimension in terms of invariants depending only on R.

Pictures of Ragnar's collaborators



G. Leuschke, M. V.d. Bergh,

R.-O. Buchweitz, Oberwolfach 2012

R.-O. Buchweitz, S. Schwede, H. Krause

Oberwolfach 2006

Mathematical achievements 2012 – 2016

- **Buchweitz, R.-O.; van Straten, D.:** An index theorem for modules on a hypersurface singularity. Mosc. Math. J. 12 (2012).
- **Buchweitz, R.-O.; Conca, A.:** New free divisors from old. (English) Zbl 1280.32016 J. Commut. Algebra 5 (2013).
- **Buchweitz, R.-O.; Hille, L.:** Hochschild (co-)homology of schemes with tilting object. Trans. Am. Math. Soc. 365 (2013).
- **Buchweitz, R.-O.:** The fundamental group of a morphism in a triangulated category. In: Algebras, quivers and representations. Abel Symposia 8 (2013).
- **Buchweitz, R.-O.; Hori, K.; Krause, H. (ed.):** Matrix factorizations in algebra, geometry, and physics. Oberwolfach Rep. 10 (2013).
- **Buchweitz, R.-O.; Flenner, H.:** Strong global dimension of commutative rings and schemes. J. Algebra 422 (2015).
- **Buchweitz, R.-O.; Roberts, C.:** The multiplicative structure on Hochschild cohomology of a complete intersection. J. Pure Appl. Algebra 219 (2015).
- **Buchweitz, R.-O.; Leuschke, G.; Van den Bergh, M.:** On the derived category of Grassmannians in arbitrary characteristic. Compos. Math. 151 (2015).
- **Buchweitz, R.-O.; Pike, B.:** Lifting free divisors. Proc. Lond. Math. Soc.112 (2016).

Mathematical achievements 2016 – 2018

- **Avramov, L.; Buchweitz, R.-O.; Lowen, W. (ed.):** Hochschild cohomology in algebra, geometry, and topology. Oberwolfach Rep. 13 (2016).
- **Buchweitz, R.-O.; Leuschke, G.; Van den Bergh, M.:** Non-commutative desingularization of determinantal varieties. II: Arbitrary minors. INRS (2016).
- **Buchweitz, R.-O.; Faber, E.; Ingalls, C.:** Noncommutative resolutions of discriminants. Proc. ICRA 2016. Contemporary Mathematics 705 (2018).

  - In this last paper the authors give an introduction to the McKay correspondence and its connection to quotients of $\mathbb{C}^n$ by finite reflection groups. This yields a natural construction of non-commutative resolutions of the discriminants of these reflection groups.

Pictures of Ragnar's collaborators

C. Ingalls, E. Faber, R.-O. Buchweitz

Oberwolfach 2015

L. Hille, R.-O. Buchweitz

Oberwolfach 2012

Citation profile in zbMATH

Citations contained in zbMATH — all cited Publications

38 Publications have been cited 630 times in 533 Documents

	Cited by ▼	Year
The homological theory of maximal Cohen-Macaulay approximations. Zbl 0697.13005 Auslander, Maurice; Buchweitz, Ragnar-Olaf	109	1989
Cohen-Macaulay modules on hypersurface singularities. II. Zbl 0617.14034 Buchweitz, R.-O.; Greuel, G.-M.; Schreyer, F.-O.	96	1987
Support varieties and cohomology over complete intersections. Zbl 0999.13008 Avramov, Luchezar L.; Buchweitz, Ragnar-Olaf	59	2000
The Milnor number and deformations of complex curve singularities. Zbl 0458.32014 Buchweitz, Ragnar-Olaf; Greuel, Gert-Martin	52	1980
Finite Hochschild cohomology without finite global dimension. Zbl 1138.16003 Buchweitz, Ragnar-Olaf; Green, Edward L.; Madsen, Dag; Solberg, Øyvind	24	2005

all cited Publications

Cited by 503 Authors — all

- 23 Takahashi, Ryo
- 12 Bergh, Petter Andreas
- 12 Buchweitz, Ragnar-Olaf
- 11 Celikbas, Olgur
- 11 Iyama, Osamu

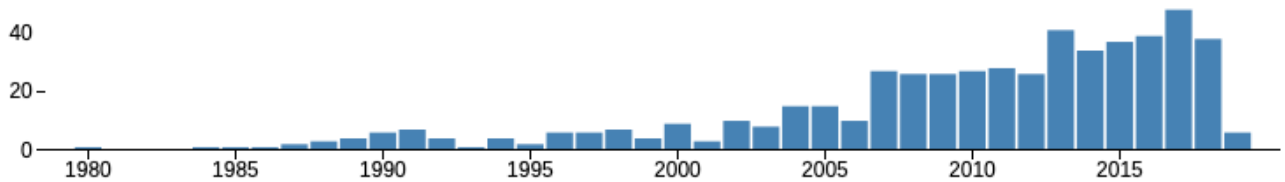
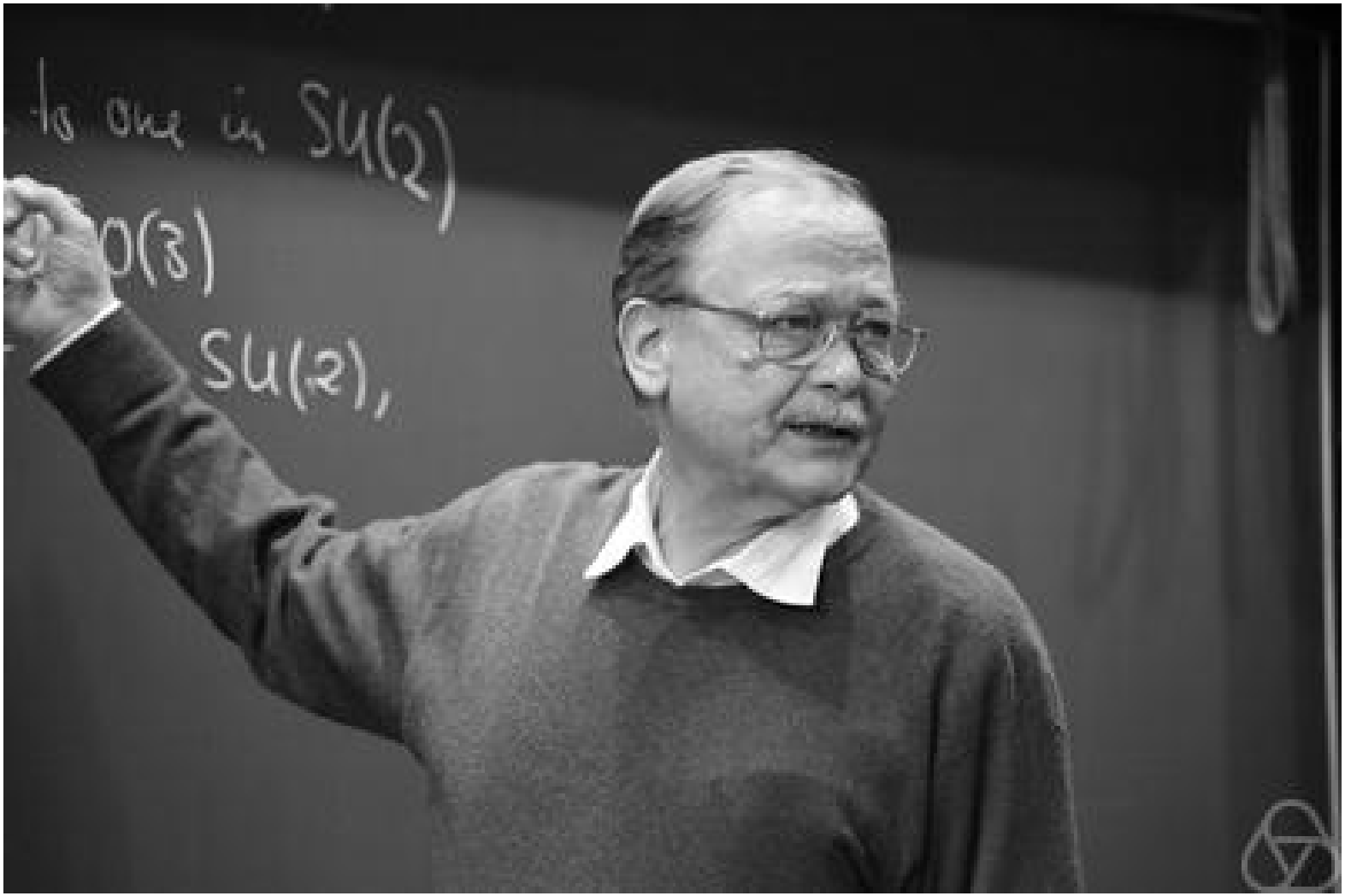
Cited in 91 Journals — all

- 96 Journal of Algebra
- 61 Journal of Pure and Applied Algebra
- 35 Advances in Mathematics
- 27 Communications in Algebra
- 23 Proceedings of the American Mathematical Society

Cited in 21 Fields — all

- 241 Commutative algebra (13-XX)
- 203 Algebraic geometry (14-XX)
- 196 Associative rings and algebras (16-XX)
- 98 Category theory, homological algebra (18-XX)
- 57 Several complex variables and analytic spaces (32-XX)

Citations by Year



As we remember Ragnar