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Foreword

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This special issue is a tribute to our colleague and friend Joseph A. Wolf who passed away on August 14, 2023.

(Photo courtesy of the Mathematisches Forschungsinstitut Oberwolfach)

Joe was born on October 18, 1936, in Chicago. He did both his undergraduate and graduate studies at the University of Chicago, where he defended his PhD thesis *On the manifolds covered by a given compact, connected Riemannian homogeneous manifold* under the supervision of Shiing-Shen Chern in 1959. After postdoctoral positions in Paris, Bonn and at the Institute of Advanced Study in Princeton, he was appointed at the University of California, Berkeley, first as Assistant Professor in 1962, then as Associate Professor in 1964, and finally as Professor in 1966. He held this position until taking early retirement in 1994.

During his career, Joe published more than 190 research articles with over 50 different coauthors. Out of these, more than 70 were published after his retirement. His most cited work is the book *Spaces of constant curvature* from 1967, which has become a classic and is still an excellent timely reference. It is a valuable rich resource for self-study by graduate students and senior researchers interested in the connections between differential geometry and Lie theory. The interplay between geometry and group theory is one of the recurring themes in Joe's work. His research contributions ranged from homogeneous spaces and complex manifolds over both finite- and infinite-dimensional Lie groups to representation theory and harmonic analysis.

Joe also was a very dedicated teacher who considered it one of his most important duties to pass on his knowledge to the next generation. He never grew tired of answering questions and did so with extraordinary patience. He supervised 23 PhD students. In the 1990s, his students affectionately referred to their group as the "Wolfpack".

This special volume is a collection of invited research papers by some of Joe's coauthors and friends. We would like to express our sincere gratitude to everyone who contributed an article. In addition to the mathematical contributions, some authors have also written personal reminiscences of Joe, which we include after this foreword.

In the first stages of this project, Alan Huckleberry was also significantly involved. Sadly, Alan passed away in September 2025, before the special issue could be completed.

Aarhus, São Paulo, Erlangen, and Bremen, January 2026

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Personal reminiscences of Joe by the authors

Huibin Chen, Zhiqi Chen, and Fuhai Zhu

Our acquaintance with Joe began in the summer of 2009, when he gave a mini-course at the "International Conference on Representation Theory and Harmonic Analysis" at the Chern Institute of Mathematics, Nankai University, China. It was there that Fuhai and Zhiqi first met him.

Over the years, we were fortunate to continue our academic interactions with him. Zhiqi visited the University of California, Berkeley, in 2010–2011 and again in 2016–2017, and Fuhai visited in 2015–2016. During these visits, we benefited greatly from Professor Wolf's guidance and suggestions on our research in geometry and Lie groups.

Later, Huibin visited UC Berkeley from 2017 to 2018 as a joint Ph.D. student under Professor Wolf's supervision. He learned much from Joe's rigorous approach to mathematics as well as his kindness toward students.

We are deeply grateful for his support and encouragement over the years.

Claudio Gorodski

I first met Joe as a PhD student in Berkeley during the Spring semester of 1990, when I attended his authoritative course on Lie groups. His classes attracted many people, and the room was always packed with students. I enjoyed his way of thinking and explaining — always to the point — as well as the subject itself so much that I enrolled in his second course on Lie groups in the Fall and in his course on symmetric spaces in 1991. Since then, I have always favoured incorporating these subjects into my research in Differential Geometry.

Joe served on the committee for both my Qualifying Exam and my PhD Thesis.

Later, in 1996, I was a postdoc in Berkeley under Joe's supervision. He introduced me to another postdoc there at the time, Pierre Bieliavsky. This was a great connection because Pierre helped Elisha Falbel and me with our work in sub-Riemannian geometry, and the three of us published a joint paper in which we completed our classification work. On a personal note, Joe and Lois were incredibly hospitable, and I remember with fondness the night they invited me out for dinner.

After returning to São Paulo, I would occasionally reach out to Joe with questions about Lie groups or symmetric spaces via email. He was always ready with answers.

In later years, it seems Joe returned to working in Differential Geometry, so we would meet every now and then at various conferences. As early as 2005, we were both in Budapest for a meeting. On one occasion, he introduced me to Paulette Libermann, Élie Cartan's last student. Talking to her was a rare privilege, and Joe knew well how much I would appreciate it.

In 2018, I had the honor of editing a special volume of the São Paulo Journal of Mathematical Sciences dedicated to Joe, featuring papers by his close collaborators and friends. This is certainly the journal volume I most cherish having worked on.

I think his attitude toward colleagues could be well described by two words: warmth and respect. I truly enjoyed talking to him about mathematics and his way of reasoning. He is already deeply missed.

Karl-Hermann Neeb

My contribution to this volume deals with a subject matter that was also dear to Joe Wolf, to whom this this volume is dedicated. Open orbits of subgroups in flag manifolds appear in many places of his work, see for instance [8]. Here we deal with the specific case of causal flag manifolds. Joe's work had a substantial influence on my own. First of all, his beautiful book on spaces of constant curvature [7], which I studied as a student, the importance of his work on flag domains in the theory of Lie semigroups and compression semigroups [4], his work on direct limit Lie groups [5] and their representations [6, 9] and, finally, his work on cycle spaces [1], which relates closely with crown domains of Riemannian symmetric spaces and their importance in constructing nets of local algebras in AQFT (cf. [2, 3]).

The closest contacts I had with Joe were during extended visits of Alan Huckleberry's complex analysis group in Bochum in the 1990s, where we often had dinner together. I frequently asked him for references for "well-known" results. Then he would typically need only a few minutes of digging in his computer account to come up with a very precise reference to one of his own papers from 20 or more years ago. It was amazing to see how efficient he organized his database. In 2004 we organized an Oberwolfach meeting on complex analysis and representation theory, together with Alan Huckleberry.

I only have the fondest memories of Joe as mathematician, a colleague and a friend. With him we lost a mathematician with a very broad view of mathematics, firmly grounded in Analysis, Geometry and Algebra.

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[4] Joachim Hilgert and Karl-Hermann Neeb, *Lie Semigroups and Their Applications*, Lecture Notes in Mathematics, vol. 1552, Springer, 1993.

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[7] Joseph A. Wolf, *Spaces of Constant Curvature*, McGraw-Hill, 1967.

[8] ———, *The action of a real semisimple group on a complex flag manifold. I: Orbit structure and holomorphic arc components*, Bull. Am. Math. Soc. **75** (1969), 1121–1237.

[9] ———, *Principal series representations of direct limit groups*, Compos. Math. **141** (2005), no. 6, 1504–1530.

Ivan Penkov

I first met Joe at one of the conferences in Bulgaria in the early 1980ies. At that time, some leading Bulgarian physicists and mathematicians had realized that Bulgaria can be used as a meeting ground for prominent scientists from the West and from the Soviet Union. In this way, local scientists got the opportunity to meet with world leaders in Mathematics and Physics, who would otherwise most likely never visit Bulgaria. For us, a small group of junior Bulgarian mathematicians, this was a chance of a lifetime.

My close connection with Joe began in January 1990 when I started as a Visiting Assistant Professor at Berkeley (I owe the invitation to apply for this position to Mariusz Wodzicki, the inventor of the Wodzicki non-commutative residue). Joe was a senior member of the mathematics department at Berkeley, whose research field was closest to mine, and he created a welcoming atmosphere for me at Berkeley. Moreover, Joe showed genuine interest in my mathematics and made me feel a partner. By the end of my stay in Berkeley, in December 1990, we had formed a bound which turned to last a lifetime. At that point, my family and I were moving to UC Davis and I proposed to Joe to run a joint intercampus seminar, in order not to lose the momentum of mathematical interactions (not yet collaboration) we had developed. Quite surprisingly for me, Joe supported the idea enthusiastically. His reaction was: it has been attempted several times to start joint seminars in the general areas of Representation Theory and Geometry between different UC campuses, but this has led to nowhere. Maybe now should be the time to get this idea going!

In the fall of 1991, I accepted a tenure-track position at UC Riverside. The intercampus seminar quickly became quite representative. By then it was strongly supported also by Robert Blattner at UCLA and Geoffrey Mason at UC Santa Gruz. Over the next 15 years or so, the seminar hosted over 250 talks by leading mathematicians and by many junior faculty and graduate students. It was a laboratory for the development of at least 30-40 graduate students from practically all UC campuses. Joe, together with Geoff, was always the most loyal supporter and co-organizer of the seminar.

A few words about Joe's personality and our collaborations. As I have made clear already, Joe was a truly kind person who showed genuine interest in the mathematics and personalities of the mathematicians who surrounded him. Also, he was a very practical man. Joe once told me that when he and Lois moved to Berkeley around 1960, he did himself the entire job of electric wiring at the house. Joe had a unique combination of practicality and excitement for new things. I once drove him to my house in Lake Arrowhead (in the mountains of Southern California) in my usual almost racing manner and, contrary to my intuition, Joe was truly thrilled.

Our collaboration peaked around the year 2000. Soon after, we published our three-way paper with Ivan Dimitrov (entitled "A Bott–Borel–Weil theory of direct limits of algebraic groups") in the American Journal of Mathematics. After 2004, Joe visited me several times in Germany, always eager to share his expertise and to work on new projects.

He is already being missed by a large community of researchers, whose lives and careers he has helped shape.

Nolan Wallach

My thesis advisor, Jun-Ichi Hano, and I attended an annual meeting of the AMS at the University of Chicago in the early 1960's. At that time the center of the mathematical universe was the University of Chicago. I met two of their luminaries during that visit: Joseph Wolf and Elias Stein. One of the most striking things, to me, about them was just how young they looked, since they were already well-established mathematicians and full professors at Chicago. I found out later that Joe was less than 5 years older than I was.

My next encounter, in 1965, with Joe was indirect and by then he was a professor of mathematics at Berkley the new center of the mathematical universe and was spending that academic year at The Institute for Advanced Study. At that time, I was putting the finishing touches on my thesis. Jun-Ichi invited his friend, Shingo Murakami, who was visiting IAS for the year, to give a colloquium lecture at Washington University. His title was substantially the same as the title of my thesis. As it turned out, there was a significant overlap between his work and mine. After his lecture we had a long conversation about our work and I gave him a mimeographed copy of my draft (typed by my wife, Barbara). Murakami did his work while at the Institute and had the help of Armand Borel and Joe. When he returned to the IAS, Murakami told them about my work. Borel sent a copy of his recent paper with Tits on the structure of groups over local fields to me and Joe sent an invitation to do my Postdoc at Berkeley. This gave me the chance to interact with great mathematicians such as Chern, Kobayashi, Satake, Hochschild, ... I accepted by return mail. Berkeley was a place bubbling with intellectual and political excitement. Many of the mathematical luminaries of the last quarter of the twentieth century were also doing their Postdocs at Berkeley (Sullivan, Lawson, Cheeger, Casselman, ...). Also, the quality of the students both undergraduate and graduate (Howe, Schmid, ...) was amazing. During my time at Berkeley Joe, Kobayashi and Hochschild were especially kind to me. I wrote a short draft of a paper on the Borel–Weil Theorem and put it in Hochschild's mailbox. The next day I found a handwritten addendum in which he observed that my work was characteristic free. Joe was intrigued with that and decided that we should be able to use the ideas to write a characteristic free version of the Bott–Borel–Weil–Kostant theorem. Joe's plan was that we would meet once a week in the afternoon at his house to work on the problem. The first time I arrived, at about 1:00 on a Wednesday, Joe was in a robe having breakfast. In those days he would work at night until 4 or 5 AM and then sleep to about 1 PM. To make a long story short, we were unsuccessful, but I learned a lot of mathematics, as did Joe. Joe's eccentric behavior did not just involve his sleeping and working habits. The car he drove was a Checker. That is, a large car with a small engine originally built to be a taxicab in New York City. This car was totally out of place in the hills of Berkeley. In fact, in some weather he had to drive the car in reverse to get up the hill in front of his house. When I was preparing to leave Berkeley and I had to sell my Camaro with a big V-8 engine, he made the "modest proposal": Nobody looks at the engine why don't we do an engine swap?

When my three years at Berkeley were coming to an end, I received a tenure track offer from Rutgers University. Rutgers, under the chairmanship of Wolfson, had received a Center of Excellence Grant from the NSF that was used to make

offers to both junior and senior mathematicians. Joe received an offer of a named chair and decided to spend the year at Rutgers to help him to make the decision. Thus, Joe was my colleague during my first year at Rutgers. During that year, I was invited to participate in a weeklong meeting at The University of Maryland. Joe, generously, offered to teach my classes during my time away from Rutgers. One of the courses was "calculus for ag majors". To put it mildly, Joe's sense of humor did not go over well with those students. Joe had other offers while he was deciding about Rutgers and his final decision was to turn the offers down. He spent the rest of his career at Berkeley.

I spent the Winter Quarter of 1980 at the University of California, San Diego, as did Roger Howe to work with Thomas Enright. Joe used the reciprocity between Berkeley and UCSD to spend most of the quarter working with us. It was then that I found out about Joe's superhuman ability to eat hot Mexican peppers. That was the last time that I would have the privilege to work with Joe. In the end we wrote only 3 papers. But without his kindness and influence, I feel that my mathematical career would not have blossomed so far beyond what I had hoped for when I arrived at Washington University in 1962.