Friendship Creates Intercontinental Cooperation in Aerosol Research

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At the Asian Aerosol Conference 2022 a Commemorative Session took place to honor Prof. Dr. Dave Pui for fifty years of successful aerosol research, working together with students and post docs, mainly from Asia and aerosol scientist from all over the world and honor him for his friendship activities within the aerosol community.

I know Dave 50 years. We collaborated for more than 40 years, supported by students, post docs, other colleagues and our families based on a deep, still going on friendship.

We Met the First Time in Minneapolis in 1972

1970, I got my PhD at the University RWTH Aachen in Germany. The topic was the determination of gas concentration distributions in a premixed open flame using flame spectroscopy. Then I started my postdoc time at the University of California in La Jolla, investigating combustion processes in a shock tube using flame spectroscopy. My second year I spent in Minneapolis, starting with working further on my PhD-topic in Prof. Pfender’s Lab.

Fifty years ago, 1972, Dave Pui was student at the University of Minnesota in the Particle Lab of Prof. Ken Whitby and Prof. Ben Liu.

In the first year at the University of California, La Jolla, I heard a lot about the increasing smog (aerosol) problem in the air, mainly caused by the particles from combustion processes (traffic). In the Particle Lab in Minneapolis everybody including Dave were already involved in this topic. I got the idea to use flame spectroscopy for the detection of soot (aerosol) in flames, which became later on the topic of my habilitation. In the Particle Lab I performed a study with Prof. Ken Whitby on “Measurement of Aerosols Produced by a Propane Air Flame in a Controlled Clean Environment”. We found out that clean gas combustion processes still produce small particles exhausted into the environment.

This was the first time that I met Dave in the lab. We did not work together. Our collaboration started later in the eighties of the last century.

After I went back to Germany I wrote my habilitation on “Particles in Flames”. I got the offer of a professorship with the topic “Aerosol Measurement Technology” at the newly founded Technical Highschool in Duisburg, Germany, which is now the University of Duisburg - Essen. 1989 colleagues and I founded the Institute for Energy- and Environmental Technologies (IUTA) in Duisburg, an institute for applied research attached to the university. One mayor topic in the institute was and still is aerosol research.

Today we are celebrating fifty years of Dave Pui’s work with pioneers, students, post docs, scholars, friends to create collaboration and friendship in aerosol science and technology. But even more important is another 50th anniversary. It is the Golden Wedding of Therese and Dave.

My wife Rita and I congratulate Therese and Dave and wish them all the best for the future. Thank you Dave and Therese for inviting us to the wedding although we did not know each other very well at that time. But it looks like you wanted already create a personal link between our families. You are already carrying our boy Marcus (blond boy), with whom you nowadays want to work together. I will come back to this later on.

This demonstrates that besides collaboration in aerosol research you are interested in friendship with colleagues all over the world. The combination of collaboration and friendship is the necessary basis of any research community.
Almost 40 Years of Research Collaboration

In his presentation in the beginning of the commemorative session Dave presented already most of our joint activities. I will just point out some highlights from my point of view, especially things which effected my work in Germany very much.

Several joint projects in the beginning dealt with aerosol process analysis, like charging or sampling and transport of aerosols. They had impact on our first large project in Duisburg (Special Research Program – SFB 209, 1983–1998) “Matter and Energy Transport in Aerosols”, financed by the German National Science Foundation for the first time at the new type of Technical Highschool in Germany.
In the nineties Dave and I belonged to the first researchers, who started to combine aerosol research with nanotechnology.

Our activities in nanotechnology were recognized in Germany by the Max-Planck- and the Humboldt-Associations. In 1993 they offered us the Max Planck Research Award. This was and is still today the highest award in engineering science in Germany. The Humboldt Association also financed further on several sabbatical leaves of Dave and me.

Another follow up was a second Special Research Program (SFB 445, 2000, 12 years) “Nanoparticles from Gases” financed again by the German National Science Foundation.

The last big joint project starting 2003 was to get ideas to avoid particle contamination on the mask in the tools of the Extreme UV- Lithography (EUVL). Intel approached me just before I had to retire (In Germany there exists a law forcing retirement at the age of 65 (Age Discrimination)), whether I am willing to lead such a project. Dave and I had worked together already for long time on the topic “Clean Technologies”. He was willing to perform this project (5 years). I convinced my student Christof Asbach, who just finished his PhD to join the group in Minneapolis. We worked on this topic together for a couple of years and published 16 papers.

Another area of joint activities was the development of aerosol measurement instruments, which Dave already listed in his presentation.

The first joint project in the nineteen eighties was the development and testing of the DMPS, a size distribution of particles measuring device, based on the combination of the Differential Mobility Analyzer (DMA) and a condensation nuclei counter of TSI. It was a very important instrument in aerosol research for several years. Then it performance was improved. The SMPS based on the same principle was developed.

Still nowadays ultrafine particles are of great interest. Dave`s students Da-Ren Chen and my student Detlev Hummes modified the DMA into the Nano-DMA, to be able to separate ultrafine particles. Important is that we both were linked to the company TSI. In the literature you will find many articles about our investigations, improvements and developments of aerosol instruments.

To give a feeling for the amount of collaboration between the two of us, I checked the publication list of my division and determined 85 publications, which include Dave Pui`s name.

The joint activities took place in the University in my division as well in IUTA. After my retirement I worked mainly in IUTA as Scientific Director until 2018. Then I started my final retirement.

Prof. Dr. Christof Asbach, my former student and now president of the Gesellschaft für Aerosolforschung (GAef), the first aerosol association in the world celebrating also the 50th anniversary this year, also started to work in IUTA after he came back from Minneapolis. He is now leading a division in the institute. Dave and Christof worked together the last couple of years on topics like concentration measurements of aggregated or agglomerated nanoparticles and filtration of aerosols.

Formation of the Worldwide Aerosol Community Since 1972

Dave and I made the experience that international collaboration can create a lot of advantages in our research activities. For enhancing the international collaboration needed especially in an interdisciplinary field like aerosol research a community has to be formed as basis. Therefor we both helped to create an aerosol community consisting out of associations and assemblies. A mayor task of them is to increase the chances for cooperation by performing conferences and other binding activities. The foundation of the Gesellschaft für Aerosolforschung (GAef) followed many foundations of national associations all over the world. The associations were combined to form regional assemblies (AAAR, EAA, AARA). The assemblies were combined in the International Aerosol Research Assembly (IARA). In the beginning the mayor interest in the foundation of IARA was to get a basis for the International Aerosol Conference (IAC) every four years. We thought that IARA is also the best baseline for worldwide co-operations. Therefor we introduced via IARA the Fissan-Pui-TSI Award for co-operations between colleagues from two continents. TSI endowed $75,000 to set up the award to be conferred at the International Aerosol Conference.

When a new topic comes up, international conferences are needed to arrange new collaborations. To combine aerosol-technology and nano-technology we prepared a series of three conferences, supported by the European Science Foundation (ESF) and the National Science Foundation in
Amerika (NSF). The topics were:
1999, Tacoma – “Nanoparticles: Technologies and Applications”
2000, Dublin – “Nanoparticles: Applications in Materials Science and Environmental Science and Engineering”

Another series of international symposia, in which we were involved, organized by colleagues in Asia, were:
2003, Taipei – “Nanoparticles: Technology and Sustainable Development”

Friendship Supports Collaboration

Another important factor supporting collaboration is friendship. We combined our families. We visited each other on family events like birthdays and weddings. We exchanged our children. We made many sightseeing tours together, for instance to Australia, Japan, Spain, Switzerland and the last one to Eastern Germany before the Corona Crisis.

Couple of years ago Dave came up with the idea to create a Celebrating Friendship Club, which is described in Fig. 6. Unfortunately, because of corona, we were not able to meet again after the Berlin-Meeting in 2019.

He also came up in 2004 with a bucket list, which he called the “Contract of Friendship Forever” (Fig. 7). It is not easy to read, therefore I tell you the content. It is the list of things we should do before we are kicking the bucket (die). At the end he proposes family friendship, links between all family members. At that time he did not know what kind of duty to fulfill this he is talking about, when you look at the large number of his grand children (Fig. 8).

In Fig. 8 my family and Dave’s family are shown.
In my family the man at the left side is Marcus, the little boy whom you saw in the wedding picture. Everybody can see that Dave’s family is much bigger than mine and therefore his duty is much bigger than mine.

In the last couple of years Dave was very much involved in developing Air Cleaning Towers (Fig. 9). Our son Marcus is architect in Berlin. They do have an office also in China and are involved in the setup of the new university “West Lake University” in Shenzhen, where Dave is teaching. Marcus and Dave started to talk about cooperation in setting up such a tower in the West Lake University.

Fig. 3. Our visit of Dave’s parents and sister in Hongkong many years ago.
At my 80th birthday Dave visited us. We made a tour through Switzerland organized by Jing Wang. When we had to switch the train, Dave felt that he has to explain the tower concept to the public. He started to demonstrate the function of the tower with both arms on the platform of the station. The passing by passengers were excited. No wonder that he has me convinced to collaborate and keep friendship with him 40 years long.

Dear Dave

! We, Rita and I, wish you all the best for the future and may our friendship live forever !

Fig. 4. Trip through Napa Valley of Dave and me tasting wines.

Fig. 5. Sizzy (Dave’s daughter and my godfather child) and Kyle’s wedding in Puerto Rico.
Celebrating Friendship Club

• Members: Dave Pui, Yasuo Kousaka, Michel Pourprix, Heinz Fissan
• Activities: Research cooperation, publications, conference contributions, children exchange, joint trips, meetings every two years in different places in the world

2006 Kyoto, Japan: 2019 Berlin, Germany:

Fig. 6 Celebrating Friendship Club.

The Contract of Friendship for Ever

Fig. 7. The contract of friendship forever.
The Goal of Family Friendship and our Duties

- My Duty

Goal: Friendship between all of them

Dave`s Duty

Dave`s Largest and Latest Research Object and his Teaching Capabilities

First generation SALSCS, Xi’an

Fig. 8. The goal of family friendship and our duties.

Fig. 9. Dave’s largest and latest research object and his teaching capabilities.