Laudatio for Carlo Rubbia and Samuel Ting

Magnifizenz,
meine Damen und Herren,
ladies and gentlemen,
dear Carlo Rubbia, dear Samuel Ting,

the **50th anniversary of CERN** - of which we just got a beautiful account - is certainly the **proper occasion** to honour two great personalities in particle physics like you.
We also believe that **Aachen is the right place** to do so and that we owe this honour to both of you **simultaneously**, because to us – contrary to **superficial evidence** as for instance on my first picture – there are **striking similarities** between you, at least as far as your relations to us in Aachen are concerned:

- you have both **worked with many of us for decades**,
- you have both been **heads of large collaborations** in which we participated,
- you have both **worked at CERN** together with groups from Aachen,
- you have both made **milestone contributions** to elementary particle physics,
- you have both won the **Nobel Prize** for this,
- you have both **been in Aachen** and given magnificent talks –

but this is the first time we managed to get **both of you busy** people here at the **same time ---**
and I can assure you that this is a **great pleasure** to all of us.

The third person on this picture is **George Charpak**, the inventor of multiwire proportional chambers. The picture was taken in **1992 at CERN** when he had just won his Nobel Prize.

But let us go back in time a bit and start with the **early vita** of our Laureates. Carlo Rubbia was born…

When **Modern Elementary Particle Physics** began in the late **60's and early 70's** both our Laureates were already **highly respected experimentalists**, Carlo Rubbia at CERN studying neutral kaons, CP-violation, and pp-scattering and Sam Ting at DESY in Hamburg putting QED to its full right again. Talking again about similarities: both held **professorships** in the States while they had their experiments in Europe: Sam Ting at MIT and Carlo Rubbia at Harvard.

Groups from **Aachen** around **Helmut Faissner and Albrecht Boehm** were then already working together with Carlo Rubbia. The picture shows Carlo together with Eddi Hermens from Aachen at CERN in 1968, one of the earliest pictures of our collaboration with our Laureates I could find.

At that time it was clear to many, that something **dramatic** was going to **happen** in physics. **Quarks and leptons,** constituents of matter, (now we know 6 kinds each, nicely symmetric in 3 families) had been postulated and discovered. **Theories of electroweak and strong interaction** had been formulated and the predicted neutral currents had been found. But the **picture,** as we know it today, was still very **incomplete and fuzzy.** All the **red parts** in our present scheme were still **missing** and the full picture was not in sight at all. As we will see, our **Laureates had their big share** in filling the missing parts and shaping our present understanding of elementary particles.
Into the time of **intense searches** in the early 70's the news broke of what people later dubbed the **October Revolution** of Elementary Particle Physics and like the real October revolution it happened in November.

In **November 1974 Sam Ting** and his team, then at Brookhaven, **discovered the J particle**. The paper with the **unpretentious title** 'Experimental observation of a heavy particle J' announced the discovery of a **heavy object** carrying a **new** so far unknown (but predicted by Maiani et al.) **quality of matter**, called 'charm'. For this discovery Sam Ting, here during a lecture at CERN in 1974, was awarded the **Nobel prize** together with **Burt Richter** from SLAC. The **new picture** of particle physics now began to show the **intriguing symmetry** of quark and lepton families. But there was still a long way to go.

The charm discovery spurred a **worldwide race** with a harvest of new results. It became clear that the **best choice** for success were **high energy colliders** although some important results still came from normal accelerators. Colliders are much more efficient to **deliver high reaction energies** as shown on this little cartoon. They will play an **essential role** in what follows and in the further work of our Laureates.

In 1976 **Carlo Rubbia** came up with his **revolutionary idea** of a **proton-antiproton** collider at CERN. Interestingly, Carlo first presented this concept in Aachen at the **Neutrino conference** in 1976. It was met with some **reservation**. This apparently didn't bother Carlo at all, as you see him here during the conference reception cheery with **Abdus Salam**, who would receive the Nobel prize in 1979 for his work on the electroweak theory. In fact, Carlo's idea turned out to be the **brilliant concept**, that paved the way to his discovery of the Heavy Bosons, the predicted carriers of weak interaction pedicted in this theory. We will come back to this in a moment.

Meanwhile **Sam Ting** had moved to DESY to set up his **MarkJ** experiment at the new **PETRA** electron-positron

collider, at that time the **highest energy machine** of its kind worldwide. Several groups from Aachen had joined Sam Ting's MarkJ or other collaborations to prepare the experimental program. On the picture you see Sam Ting during MarkJ construction at DESY together with Albrecht Boehm from Aachen. Success came soon after turn-on of the machine when in **1978** first **evidence for gluons**, the carriers of the **strong** interaction, was seen and in 1979 their existence was finally established.

Sam Ting and his colleagues from Aachen as well as other groups from Aachen had their **big share** in this success. As an example you see here the gluon evidence at the MarkJ detector taken from the **Diploma thesis of Gregor Herten.** Whereas in most events 2 quarks are produced in socalled jets, some events show a 3^{rd} jet, evidence of the gluon.
The gluon discovery was one of the **greatest successes** of the DESY laboratory in Hamburg, after they had been in the **unrewarding role of being only second** in the race for beauty quarks and tau leptons.

Our picture has already filled up quite a bit, but there is still the **large area of weak interaction** missing. This was the aim of Carlo Rubbia's collider I mentioned before. He had finally convinced people of his idea and in **1978 Simon van der Meer** could prove that **'cooling'** antiprotons, the decisive step towards the proton-antiproton collider, was working. Starting in 1980 Carlo Rubbia set up the **UA1 collaboration** with major contributions from Aachen to build a detector for the hunt for **Heavy Bosons**, carriers of the weak interaction. Aachen had built the big **muon chambers** which covered the **huge detector** from outside. They had left clearly visible traces of Aachen logos on the outside, which made the whole detector look like an **Aachen enterprise,** although they had only built the outer shell of it.

Incredibly only three years after construction started, first collisions were seen and in **1983 the Heavy Bosons** were discovered. The famous paper 'Experimental Observation of isolated large transverse electrons with associated missing energy at sqrt s**2=540 GeV' wasthe proof. The picture shows one of the discovery events with the electron on one side and no balancing energy on the other. In **1984 Carlo Rubbia** was awarded the **Nobel prize** together with **Simon van der Meer.**
The contributions from Aachen are best illustrated by the 1985 **award of the German Physical Society** which went to **Traudl Hansl-Kozanecka, Ernst Radermacher and Karsten Eggert** from Aachen and **Hans Hoffmann** from CERN. On the photo we see them together with **Joachim Treusch**, then president of the German Physical Society.

Our picture is **nearly complete**, but the 6^{th} quark is still missing and one could ask, whether this was the **full story**. To answer this, CERN had opted for the new large electron positron collider **LEP**. Herwig **Schopper**, until then Director of DESY, was appointed **Director-General** to steer CERN through the difficult times of shaping the experimental program and constructing the **LEP collider and its experiments**.
Like many researchers at PETRA **Sam Ting** moved his activity to the new machine to build the gigantic new L3 detector. This time he could convince all **HEP institutes** in Aachen to join him in this enterprise. Here you see him quite **content and happy** during a visit to Aachen. **LEP was a great success.** It showed that the standard model as we have it today is valid after all scrutiny and most important: is **complete in the sense that there are only three families** containing light neutrinos.

Even the **top quark**, indirectly seen at LEP, was finally discovered at Fermilab in USA and you may wonder, why we are not content. The problem are the **masses**, some of which are given here, which vary widely and whose origin is not at all understood. To attack this problem, Carlo **Rubbia,** who succeeded Herwig Schopper as Director-General of CERN in **1994**, had always pushed for a **large hadron collider** LHC to be built in the LEP tunnel at CERN. One of the important meetings to prepare the program attracted more than 500 people and took place in Aachen in 1990. On this picture you see Carlo Rubbia happily presenting his ideas. As the chairman I had to **try and stop him eventually in his enthusiasm**. It was largely due to his drive and persistence that a decision was taken in **1994 to go ahead with the LHC** project, which is the huge **major project of European high energy physics**. We in Aachen are again participating in one of the large detectors which you see here being assembled at CERN.

Presently our **Laureates have moved to new projects**, about which they will report themselves today. Some groups in Aachen have again joined in one of them, the **AMS antimatter search**.

Dear Carlo, dear Sam,
Let me express again our **gratitude** to you and let me add: since you have both been so **intimately linked to our work** and because you have both been to a **large extent at the root of our success ---**
we could **convince our rectorate to grant**, to my knowledge for the first time in Aachen, the honorary doctorate to **two persons at the same time.**
Let me give the floor now to our **Rector,**
Magnifizenz Burkhart Rauhut