Professor Sir Tejinder Virdee, dear Jim, Vatsala, Natisha, Jasmeer, colleagues and friends, ladies and gentlemen,

Slide 1[1]

NA14; 1979 - 1985

We were both young post-docs when we first met, Jim and I, back in 1979. We both had just completed our theses (Fig.1), remarkably on similar subjects, soft strong interactions, using similar techniques, a bubble chamber.

Slide 2

Your supervisor was Peter Dornan and your experiment, Jim, had been performed at SLAC, mine at CERN. I have never asked you why you went all the way to the United Sates, to a place with an *electron* accelerator to do an experiment in a *hadron* beam. It puzzles me to this day! Moreover, as the title of your thesis says, you used a triggered bubble chamber. I had always learned that a bubble chamber cannot be triggered and I decided that I did not want to discuss the matter. Too confusing!

[1]Slides are appended to this writeup

862

SIGMA HYPERON PRODUCTION
IN A TRIGGERED BUBBLE CHAMBER

by

Tejinder Singh Virdee

A thesis submitted for the degree
of Doctor of Philosophy of the
University of London

Department of Physics
Imperial College
London SW7

February 1979

MULTICHANNEL ANALYSIS OF HIGH STATISTICS DATA
ON THE REACTION $K^-p \to \overline{K}^0\pi^-p$ AT 4.2 GeV/c

PROEFSCHRIFT

TER VERKRIJGING VAN DE GRAAD VAN DOCTOR IN DE
WISKUNDE EN NATUURWETENSCHAPPEN
AAN DE KATHOLIEKE UNIVERSITEIT TE NIJMEGEN, OP GEZAG VAN
DE RECTOR MAGNIFICUS, PROF. DR. P. G. A. B. WIJDEVELD,
VOLGENS BESLUIT VAN HET COLLEGE VAN DECANEN
IN HET OPENBAAR TE VERDEDIGEN
OP VRIJDAG 2 FEBRUARI 1979
DES NAMIDDAGS TE 2 UUR PRECIES

door

JOSEPH JOHANNUS ENGELEN
geboren te Maasniel

Druk: Krips Repro, Meppel

Figure 1: Left: Sigma Hyperon Production in a Triggered Bubble Chamber, by T.S. Virdee. Right: Multichannel Analysis of High Statistics Data on the Reaction $K^-p \to \overline{K}^0\pi^-p$ at 4.2 GeV/c., by J.J. Engelen; both theses were presented in February 1979.

Slide 3

We both realized that the future of high energy physics was not in bubble chamber experiments and that is why we turned to new techniques. Independently we had decided that NA14, hard scattering of real photons, offered an excellent opportunity for learning new techniques and for doing great physics. The experiment was not on the floor yet and even the floor was not there yet: the building housing the North Area High Intensity Facility was still under construction. We joined the experiment at an early stage. Spokesperson and CERN group leader Daniel Treille not only was an excellent physicist from whom we learned a lot, he also gave us the responsibilities and freedom to participate prominently in NA14.

Slide 4

NA14 (Fig.2) became a modern large acceptance open magnetic spectrometer featuring large acceptance electromagnetic calorimetry. Jim made many contributions to the hardware, software, operation and data analysis of the experiment. In particular I want to mention here the Čerenkov counter, designed by Jim and built under his supervision. It was a huge piece of equipment with large and delicate mirrors. When it was to be hoisted into the spectrometer it was busy in the experimental hall, ECN3, and Jim was nervous. All of a sudden there was a loud clinking of glass and Jim froze... It turned out a technician was playing a joke on him, on us, producing the sound of breaking glass whilst the Čerenkov detector was moved around.

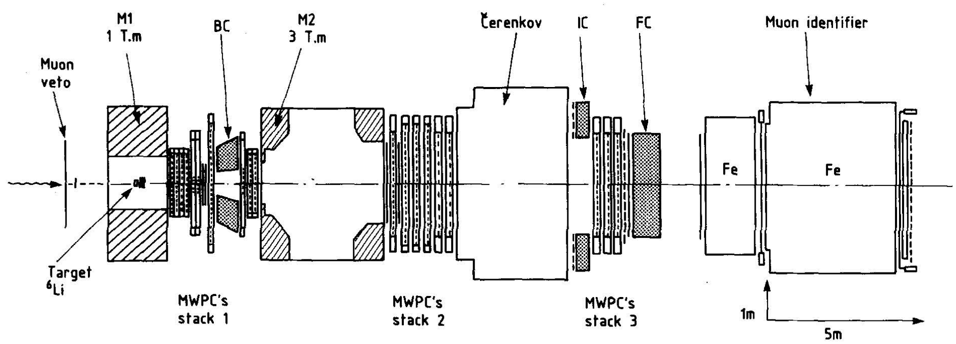


Figure 2: NA14 spectrometer

The experimental hall, in fact an underground cavern because of the high intensity beams, was located at the Prévessin site of CERN, our offices at the Meyrin site. So we needed to commute frequently between Prévessin and Meyrin. In practice this meant that one needed a car. Indeed we had a car at our disposal from the CERN pool, a Renault 'quatre L' (Fig.3).

Slide 5

But Jim had only just passed his driving test, shortly before coming to CERN. He needed someone to help him to get some driving experience. Jim got 'refresher' driving lessons in the 'quatre L' from various members of the NA14 group.

The CERN Prévessin site was very well suited for that, it had

Figure 3: Renault 4L

several roads where hardly anyone came. Jim was a natural and very soon he was ready to buy a car of his own. Not just a car, a fast sports car.

Slide 6

A Mazda (Fig.4) with rotary engine! He took me and my little son who was with me for a demonstration ride, again at the Prévessin site of CERN to demonstrate its accelerating power and maneuverability. I was slightly sick after the demonstration, with sweat in my hands, but my son was impressed and remembers the ride till this day!

Although the NA14 spectrometer had a few weak points that gave us a lot of trouble, in particular several unreliable proportional wirechambers, the physics programme was successful, the results were unique and at the forefront of perturbative QCD. We performed pioneering measurements of QED Compton scattering - directly probing

Figure 4: Mazda RX7

the fourth power of the quark charge with real photons, QCD Compton scattering and photon-gluon fusion. I very much enjoyed reading the papers again in preparation of this talk. The first paper (Figures 5 and 6) we published was written by Jim.

Slide 7

He presented the text page by page in a group meeting and got somewhat irritated by the frequent interruptions of those who had not contributed to the analysis. It lasted forever and I had to go home to help my wife bring our three small children to bed. Jim was not amused, he told me I could not leave such a crucial meeting. I did anyway but was so intimidated that I returned to CERN in the evening to participate again in the meeting that was still going on!

Slide 8

This must have been in the fall of 1984.

It was around the time that Jim told me and a few other close colleagues that he was going to be a father too. And in order for Vatsala to be able to reach Jim when the moment was there, he managed to get a pager from CERN. Normally reserved for persons who where crucial to the operation of the laboratory such as accelerator technicians. I remember Jim coming to my office, looking puzzled, surprised when he said: it beeped! So I said: then you should call Vatsala. Jim hesitated a moment and said: 'no, it must be a mistake. It is still more than a month.'

Slide 9

UA1, R&D, CMS

Although the NA14 collaboration decided to upgrade the detector for a study of charm production both of us decided to move on to new projects at the energy frontier. This was around 1985. I went to Nikhef in Amsterdam to become involved in design and construction

Volume 152B, number 5,6 PHYSICS LETTERS 14 March 1985

MEASUREMENT OF DEEP INELASTIC COMPTON SCATTERING OF HIGH ENERGY PHOTONS

NA 14 Collaboration

P. ASTBURY [c], E. AUGÉ [d], R. BARATE [b], P. BAREYRE [g], P. BENKHEIRI [e], D. BLOCH [i], P. BONAMY [g], P. BORGEAUD [g], B. BOUQUET [d], J.M. BROM [i], J.M. BRUNET [f], H. BURMEISTER [b], M. BURTCHELL [c], S. COSTA RAMOS [e], F. COUCHOT [d], B. D'ALMAGNE [d], M. DAVID [g], A. DE BELLEFON [f], A. DE LESQUENS [g], P. DELLO RUSSO [i,1], A. DUANE [c], J.P. ENGEL [i], J. ENGELEN [b], A. FERRER [d], T.A. FILIPPAS [a], E. FOKITIS [a], P. FRENKIEL [f], E.N. GAZIS [a], J. GIOMATARIS [a], M. GORSKI [k], P. GREGORY [c], W. GURYN [d,2], J.L. GUYONNET [i], T. HOFMOKL [j], A. JACHOLKOWSKA [j], E.C. KATSOUFIS [a], J. KENT [f], P. KYBERD [c,3], B. LEFIEVRE [f], R. LEGENDRE [g], Y. LEMOIGNE [g], K. MAESHIMA [b], T. MARSHALL [g,4], J.G. McEWEN [h], J. MORRIS [c,5], P. MOUZOURAKIS [d,6], R. NAMJOSHI [c,7], B. NANDI [c,8], Ph. NOON [c], S. ORENSTEIN [f,9], T. PAPADOPOULOU [a], J.B.M. PATTISON [b], P. PETROFF [d], D. POUTOT [f], P.G. RANCOITA [g,10], F. RICHARD [d], P. ROUDEAU [d], A. ROUGE [e], M. SCHAEFFER [i], Ch. SEEZ [c], H. SHOOSHTARI [h], I. SIOTIS [c], J. SIX [d], Ch. TRAKKAS [a], D. TREILLE [b], G. TRISTRAM [f], L.V. VAN ROSSUM [g], G. VILLET [g], T.S. VIRDEE [c], A. VOLTE [f], D.M. WEBSDALE [c], J. WEST [c,11] M. WINTER [b,12], W. WOJCIK [b,13], G. WORMSER [d], J.P. WUTHRICK [e] and Y. ZOLNIEROWSKI [g]

[a] *National Technical University, Athens, Greece*
[b] *CERN, Geneva, Switzerland*
[c] *Imperial College, London UK*
[d] *Linear Accelerator Laboratory (LAL), Orsay, France*
[e] *Ecole Polytechnique LPNHE, Palaiseau, France*
[f] *Collège de France, Paris, France*
[g] *DPHPE, Saclay, France*
[h] *University of Southampton, Southampton, UK*
[i] *CRN et Université Louis Pasteur, Strasbourg, France*
[j] *Institute of Experimental Physics, University of Warsaw, Warsaw, Poland*
[k] *Institute for Nuclear Studies, Warsaw, Poland*

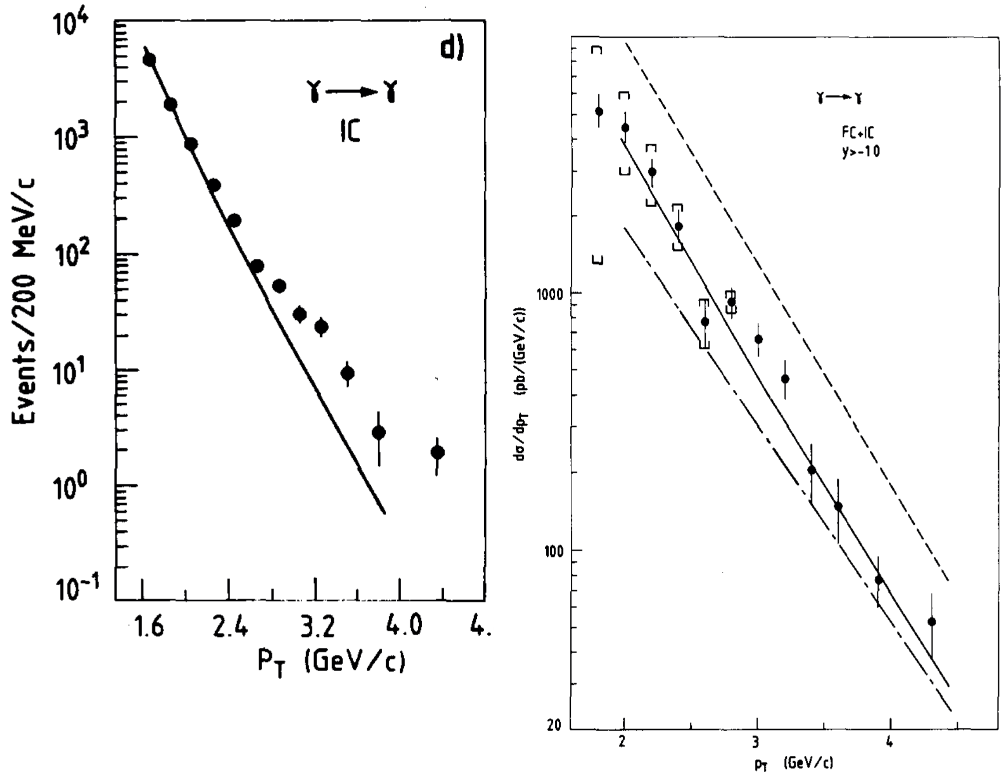
Received 5 January 1985

We present the first results on inclusive photo-production of prompt photons at high transverse momenta. The data were taken in an open spectrometer at CERN using a high intensity photon beam with energy between 50 and 150 GeV. After subtracting the yield of photons from indirect sources, a clear excess is observed for transverse momenta above 2.5 GeV/*c*. Deep inelastic Compton scattering with appropriate QCD corrections account for this excess. The data disfavour the gauge integer charge quark models so far proposed.

1 Elettronica Progetti, Bari, Italy.
2 Present address: Brookhaven National Laboratory, Upton, NY, USA.
3 Present address: Queen Mary College, London, UK.
4 On leave from Indiana University, Bloomington, IN, USA.
5 Present address: Logica Ltd, UK.
6 Present address: European Parliament, Brussels, Belgium.
7 Present address: Rutgers University, New Brunswick, NJ, USA.
8 Present address: Institute of Electrical Engineers, Harlow, UK.
9 On leave from City College, New York, NY, USA.
10 On leave from INFN-Milano, Milan, Italy.
11 Present address: IBM Laboratories, Eastleigh, UK.
12 Present address: CRN, Strasbourg, France.
13 Present address: CCPN, Paris, France.

419

Figure 5: QED Compton paper



γ q --> γ q

Figure 6: QED Compton gamma transverse momentum spectra

of what became the ZEUS experiment at HERA, the electron/positron - proton collider planned at DESY. You, Jim, joined the UA1 experiment. This experiment had already celebrated its successes of W and Z discovery. The reason you joined it - we never discussed it explicitly, but I am sure you were, very early on, convinced that the next step after UA1, the LHC, was the way to go for making new discoveries and in particular for finding the Higgs-boson. If there was a Higgs-boson.

This may sound obvious today, but it was far from obvious then. In particular it was not at all clear that it would be possible to construct a detector that could operate at the LHC. It was clear that R&D had to start early and that meant that the pioneers of LHC detector design and R&D and 'collaboration building' would have to skip LEP.

For the accelerator the crucial innovation was: industrial production of superconducting bending magnets. Experts were rather confident about the technical feasibility, although the R&D effort would be large - and turned out to be more expensive than anticipated. This led to a cost overrun that led to a crisis in CERN Council and put the LHC project at peril. Even if this cost overrun was well justified, because CERN had to take prototype production in its own hands to show industry how to do it and finally managed to get affordable offers from industry for large scale production.

For the detectors the situation was more complex. Large luminosity was required to optimize the rate of Higgs production and to offset the relatively low energy of the LHC. Relatively low as compaired to the initial competitor, the SSC in the US. This large luminosity would lead to a large radiation load on the detectors and would lead to a very high rate of particles traversing the detectors. Significant innovations would be required to make these detectors feasible.

Only a handful of experimentalists had the vision, the courage and the perseverance to dedicate their time and energy to these 'impossible' projects very early on, more than 15 years before these detecors would take data. Jim Virdee was one of these physicists.

I became involved with the LHC project in a different way, rather from the sideline. Around 1995 I was invited to become a member of the LHC Committee. One of the collegial peer review committees that, in my opinion are very important for the functioning of CERN. It had been 10 years since we had left NA14 and although we had met occasionally from then on we met again more frequently. Also privately. You and Vatsala had moved from an apartment in Geneva and lived, with your children Natisha and Jasmeer in Bellevue, close to the lake.

A few years earlier, in 1992, I had attended the Evian workshop on experimentation at the LHC. Four prospective 'four pi' multi-purpose detectors were presented. There would only be room for two, also because of financial limitations. Jim participated passionately in the discussions, not hiding that he was very critical of some of the plans that were presented. As it turned out: CMS, presented by Michel Della Negra, was the only of the four proposed projects that was realized according to the original design choices; two other projects were merged to become one and a fourth project was stopped.

Slide 10

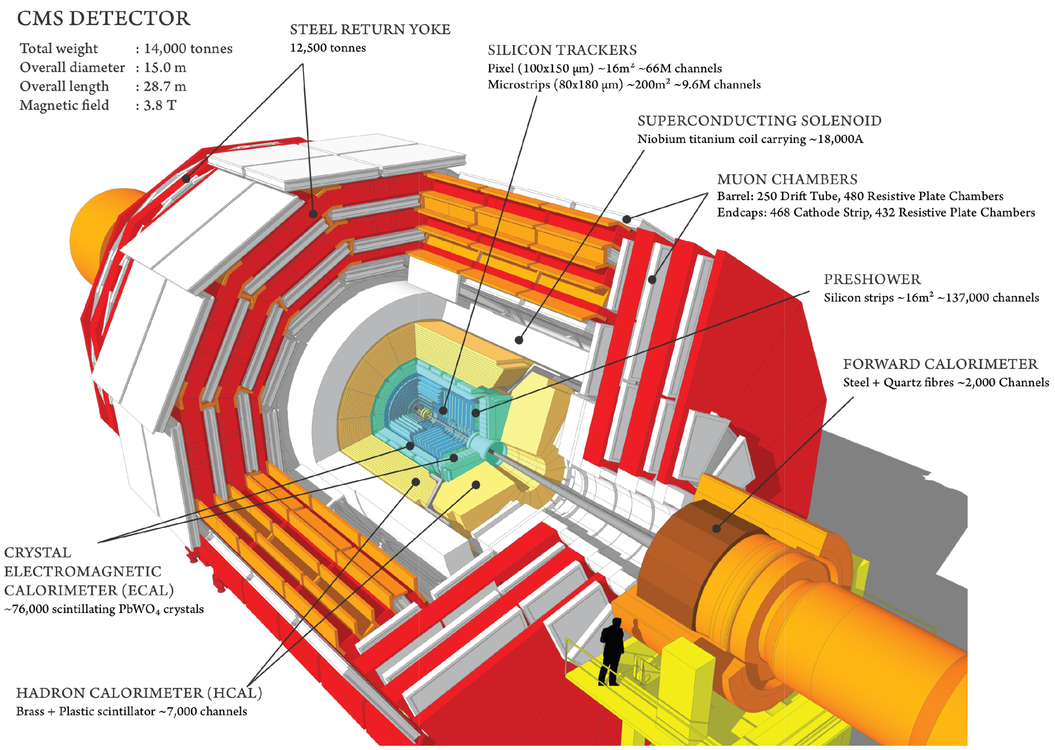


Figure 7: CMS

Apart from discussions with you Jim, I remember a presentation on revolutionary new trigger and data-acquisition schemes by Sergio Cittolin. I cannot say I understood it in full detail, but the talk brought home very clearly that trigger/DAQ at the LHC was not just a simple extrapolation from existing schemes.

The compactness of CMS does not mean that the detector was small, it means that the high resolution central tracker and the high resolution electromagnetic calorimeter as well as the largest part of the hadron calorimeter were all fit inside the solenoid magnet. This 6 meter diameter solenoid is the only magnet of CMS, providing magnetic analysis for the central tracker and, through the return flux, for the muon spectromer. A beautiful concept, but an audacious choice!

The superconducting solenoid required a next step in magnet technology. The electromagnetic calorimeter and the tracker both required innovative solutions that I will come back to.

I mentioned the workshop in Evian in 1992. Prior to that, in 1990 a very important LHC workshop took place in Aachen. In the proceedings there are several references to work by Chris Seez and Jim Virdee where the possibility to detect a Higgs boson decaying to two photons was explored. This pioneering work would bear fruit: in the CMS Higgs discovery paper of 2012, the gamma gamma decay channel is prominently represented and the first one to be discussed, with a beautiful peak in the invariant mass plot (Figures 8 and 9).

Slide 11

This required electromagnetic calorimetry with an unprecedented resolution. Lead tungstate, never used in calorimetry before if I am not mistaken, was the material of choice. Single crystals of high optical quality were required. An extensive R&D programme lead to the production of the first cubic centimeters of good quality crystals.

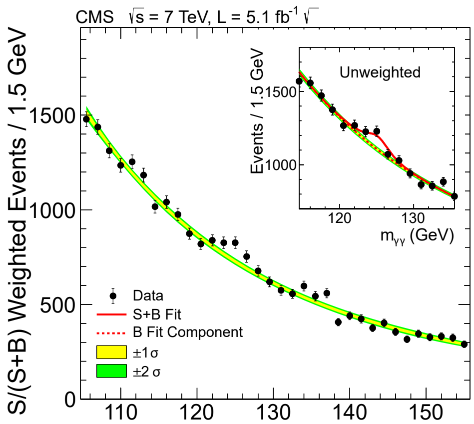


Figure 8: Digamma invariant mass in the 2012 discovery paper

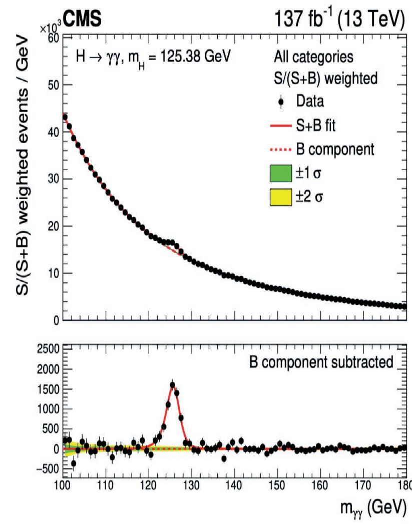
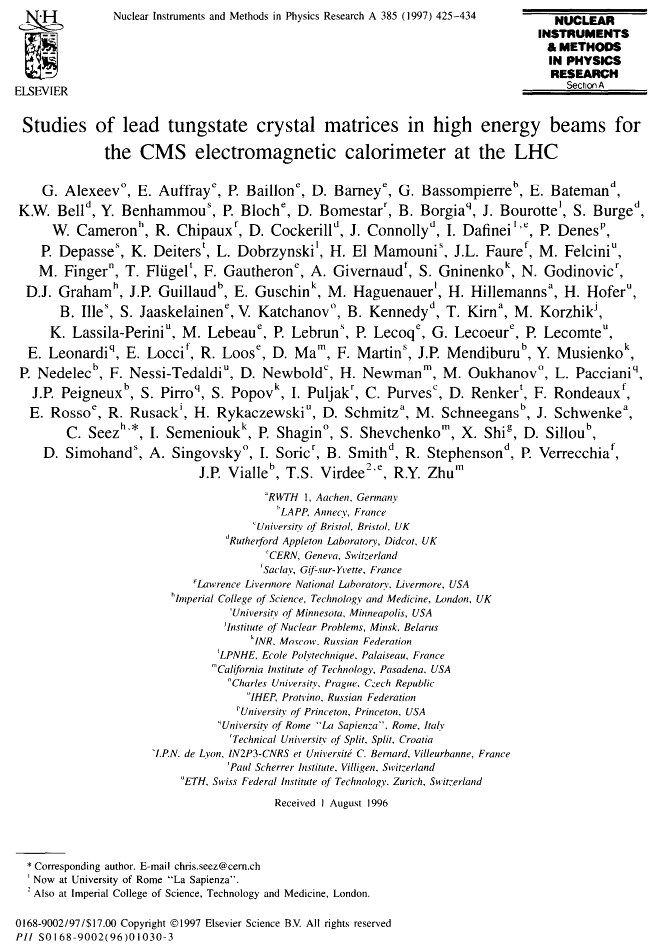


Figure 9: Digamma invariant mass as of 2022

A beautiful paper (Fig. 10) on the first test results, demonstrating that the required resolution was feasible, was published with you as the corresponding author.

Slide 12

In the initial design of CMS the central tracker contained a large number of MSGC's: multistrip gas counters. Silicon counters at the scale required would be unaffordable. Moreover, the proponents of the MSGC's were very outspoken. Jim clearly had a preference for the silicon counters. I have seen, with admiration, how Jim and his colleagues in the CMS management got the collaboration behind this major design change at a relatively late moment. It required diplomacy and technical arguments, based on a profound knowledge of the


Nuclear Instruments and Methods in Physics Research A 385 (1997) 425–434

NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH Section A

ELSEVIER

Studies of lead tungstate crystal matrices in high energy beams for the CMS electromagnetic calorimeter at the LHC

G. Alexeev[o], E. Auffray[e], P. Baillon[e], D. Barney[e], G. Bassompierre[b], E. Bateman[d], K.W. Bell[d], Y. Benhammou[s], P. Bloch[e], D. Bomestar[r], B. Borgia[q], J. Bourotte[l], S. Burge[d], W. Cameron[h], R. Chipaux[f], D. Cockerill[d], J. Connolly[d], I. Dafinei[1,e], P. Denes[p], P. Depasse[s], K. Deiters[t], L. Dobrzynski[l], H. El Mamouni[s], J.L. Faure[f], M. Felcini[u], M. Finger[n], T. Flügel[t], F. Gautheron[e], A. Givernaud[f], S. Gninenko[k], N. Godinovic[r], D.J. Graham[h], J.P. Guillaud[b], E. Guschin[k], M. Haguenauer[l], H. Hillemanns[a], H. Hofer[u], B. Ille[s], S. Jaaskelainen[e], V. Katchanov[o], B. Kennedy[d], T. Kirn[a], M. Korzhik[j], K. Lassila-Perini[u], M. Lebeau[e], P. Lebrun[s], P. Lecoq[e], G. Lecoeur[e], P. Lecomte[u], E. Leonardi[q], E. Locci[f], R. Loos[e], D. Ma[m], F. Martin[s], J.P. Mendiburu[b], Y. Musienko[k], P. Nedelec[b], F. Nessi-Tedaldi[u], D. Newbold[c], H. Newman[m], M. Oukhanov[o], L. Pacciani[q], J.P. Peigneux[b], S. Pirro[q], S. Popov[k], I. Puljak[r], C. Purves[c], D. Renker[t], F. Rondeaux[f], E. Rosso[e], R. Rusack[i], H. Rykaczewski[u], D. Schmitz[a], M. Schneegans[b], J. Schwenke[a], C. Seez[h,*], I. Semeniouk[k], P. Shagin[o], S. Shevchenko[m], X. Shi[g], D. Sillou[b], D. Simohand[s], A. Singovsky[o], I. Soric[r], B. Smith[d], R. Stephenson[d], P. Verrecchia[f], J.P. Vialle[b], T.S. Virdee[2,e], R.Y. Zhu[m]

[a] *RWTH 1, Aachen, Germany*
[b] *LAPP, Annecy, France*
[c] *University of Bristol, Bristol, UK*
[d] *Rutherford Appleton Laboratory, Didcot, UK*
[e] *CERN, Geneva, Switzerland*
[f] *Saclay, Gif-sur-Yvette, France*
[g] *Lawrence Livermore National Laboratory, Livermore, USA*
[h] *Imperial College of Science, Technology and Medicine, London, UK*
[i] *University of Minnesota, Minneapolis, USA*
[j] *Institute of Nuclear Problems, Minsk, Belarus*
[k] *INR, Moscow, Russian Federation*
[l] *LPNHE, Ecole Polytechnique, Palaiseau, France*
[m] *California Institute of Technology, Pasadena, USA*
[n] *Charles University, Prague, Czech Republic*
[o] *IHEP, Protvino, Russian Federation*
[p] *University of Princeton, Princeton, USA*
[q] *University of Rome "La Sapienza", Rome, Italy*
[r] *Technical University of Split, Split, Croatia*
[s] *I.P.N. de Lyon, IN2P3-CNRS et Université C. Bernard, Villeurbanne, France*
[t] *Paul Scherrer Institute, Villigen, Switzerland*
[u] *ETH, Swiss Federal Institute of Technology, Zurich, Switzerland*

Received 1 August 1996

* Corresponding author. E-mail chris.seez@cern.ch
[1] Now at University of Rome "La Sapienza".
[2] Also at Imperial College of Science, Technology and Medicine, London.

PII S0168-9002(96)01030-3

Figure 10: PbWO4 R&D

issues involved. And this is how I know Jim: diplomatic and convincing through a very sound understanding of the issues involved. The 'all silicon solution' was adopted: a 'first' in high energy physics for such a large detector. Meanwhile it had become clear that the required radiation hard front-end electronics would be less expensive than initially thought. The so called 'quarter micron' electronics that had been developed could be made radiation hard relatively easily and the expensive processes monopolized by a few specialised manufacturers where no longer required. Geoff Hall was crucial for developping this 'quarter micron' electronics for CMS, along with the late Peter Sharp. I remember Jim presenting all arguments in favor of the 'all silicon tracker' in a coherent and convincing way: assuring the support of the LHC Committee and, more importantly, of the CMS collaboration. This is the place to also mention the very important role Roger Cashmore played in these (and also in other) discussions, first as LHC Committee member and then as CERN Director of Research.

Let me come back to this other unique device now: the lead tungstate electromagnetic calorimer. So, technically this calorimeter could be built. However, a serious problem of a financial nature arose. In fact in the first meeting with the CMS management that DG Aymar and I had this problem was explained to us. And, again characteristic of the way Jim works, the explanation was clear, a strategy for solving the problem was presented and the CERN directorate was asked to support this strategy. Let me first sketch the problem. The volume of the crystals required was 10 m^3. In the contract that CMS had with the Russian supplier, the price agreed was 1.9$ per cm^3. With still 8 m^3 to deliver, the company, that used to work for the military, increased the price to 5$ per cm^3. As you all have calculated quickly this would lead to a price increase of more than 20 million dollars. The reason the company increased the price was the cost of electricity! This is nearly 20 years ago, in Russia. There was the threat that the electricity supply to the company would be shut off, is what the company told CMS. To cut a long story short: a solution was found. It required resourcefulnes on the side of CMS management, support of the Resources Review Board and negotiations between CERN management and the Russian minister.

What this story illustrates, in my opinion, is how vulnerable a huge project like CMS was. So many things could have gone wrong, but they did not. They did not, thanks to the vision, the courage and the perseverance of a handful of pioneers, Jim Virdee being one of them.

The assembly of CMS was largely completed 'on the surface' followed by the lowering of large parts of the detector into the cavern, down the 100 meters shaft. This operation was extremely complex and delicate. But: it simply had to succeed and of course it did.

Slide 13

In Fig.11 we see the lowering in progress and in

Slide 14

Fig. 12 we see see Jim making sure that everything goes well.

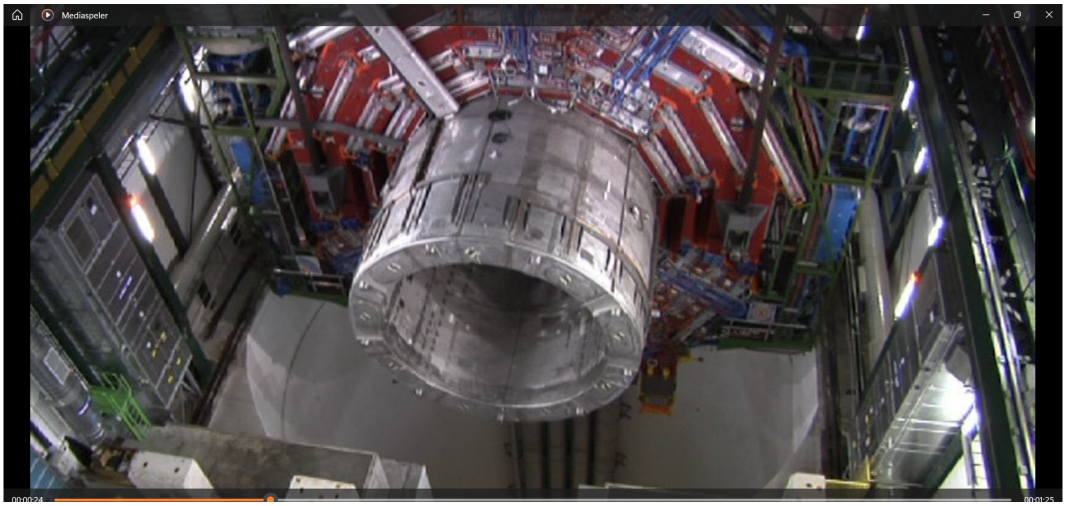


Figure 11: Lowering of CMS 2000 tonnes central part (February 2007)

Figure 12: Jim overseeing the lowering operation

Austin Ball led and oversaw the assembly and in spite of the fact that he never struck me as being overly optimistic, he managed the job perfectly and Tiziano Camporesi commissioned the completed detector for first beam. Paris Sphicas had successfully led the very complex effort to prepare CMS for physics as soon as the first data came in.

CMS works beautifully, with another decade or so of excellent physics ahead.

Whether this excellent physics includes discoveries of new physics, not presently contained in the Standard Model, only time will tell. If it is there, it will be found.

Finally, let me come back to Jim. It is a very incomplete way of representing a successful career, I realize, but nevertheless Fig. 13 summarizes Jim's publications and citations, excluding self citations.

Slide 15

It is impressive. (Even if, as I realized after making the figure, it includes Jasmeer's publications from his PhD work as well.)

$>$ 2022

Today Jim, we celebrate your 70th birthday and you have a few decades of an excellent life ahead of you. Inevitably, in this period you will retire from your professional duties, part time initially, full time eventually. Being your senior by two years, I have some experience with retirement that I would like to share with you. Is it easy to retire, is it easy to get used to? No, it is not! Handing over responsibilities and executive duties to those succeeding us is not easy. A former

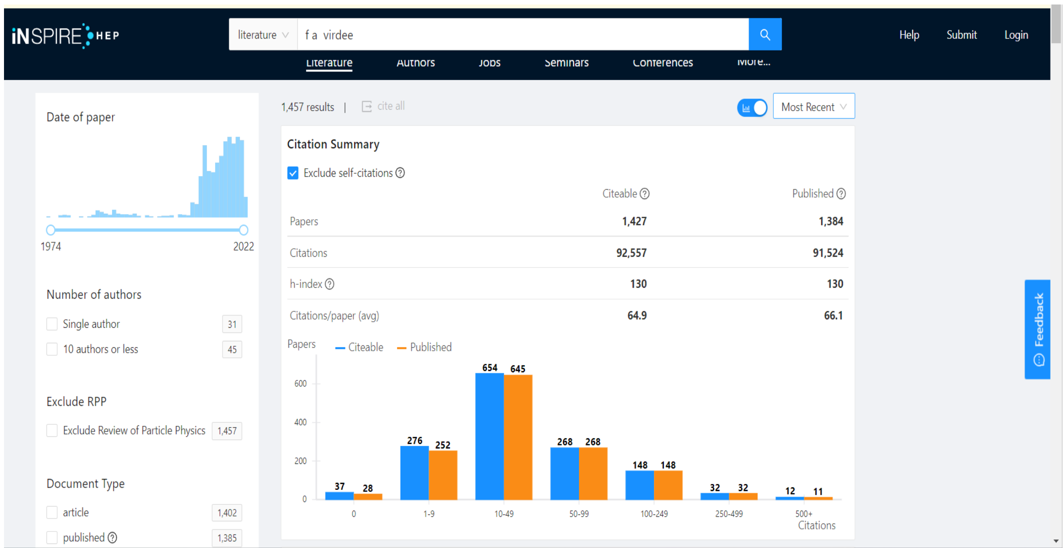


Figure 13: Publications

Dutch cabinet member once told me: I only have problems with two people in this world: my predecessor and my successor. In a generic way, I can confirm that. Yet, we will have to live with it! So here is an advice: view your successors as your children - raising children means to gradually let go of them...

Slide 16

I know you are not quite there yet, but even during partial retirement, enjoy the freedom it brings, together with your loved ones, together with your friends!

Seminar in honor of Prof. Sir T.S. Virdee 14 October 2022 The Kohn Centre, the Royal Society.

Talk given by Jos Engelen,

Professor emeritus University of Amsterdam / Nikhef

Writeup:
www.nikhef.nl/~h02/talk.pdf

February 1979

Soft strong interaction physics using bubble chambers, the latter years

SIGMA HYPERON PRODUCTION
IN A TRIGGERED BUBBLE CHAMBER

862

SIGMA HYPERON PRODUCTION
IN A TRIGGERED BUBBLE CHAMBER

by

Tejinder Singh Virdee

A thesis submitted for the degree
of Doctor of Philosophy of the
University of London

Department of Physics
Imperial College
London SW7

February 1979

MULTICHANNEL ANALYSIS OF HIGH STATISTICS DATA
ON THE REACTION $K^- p \rightarrow \bar{K}^0 \pi^- p$ AT 4.2 GeV/c

PROEFSCHRIFT

TER VERKRIJGING VAN DE GRAAD VAN DOCTOR IN DE
WISKUNDE EN NATUURWETENSCHAPPEN
AAN DE KATHOLIEKE UNIVERSITEIT TE NIJMEGEN, OP GEZAG VAN
DE RECTOR MAGNIFICUS, PROF. DR. P. G. A. B. WIJDEVELD,
VOLGENS BESLUIT VAN HET COLLEGE VAN DECANEN
IN HET OPENBAAR TE VERDEDIGEN
OP VRIJDAG 2 FEBRUARI 1979
DES NAMIDDAGS TE 2 UUR PRECIES

door

JOSEPH JOHANNUS ENGELEN
geboren te Maasniel

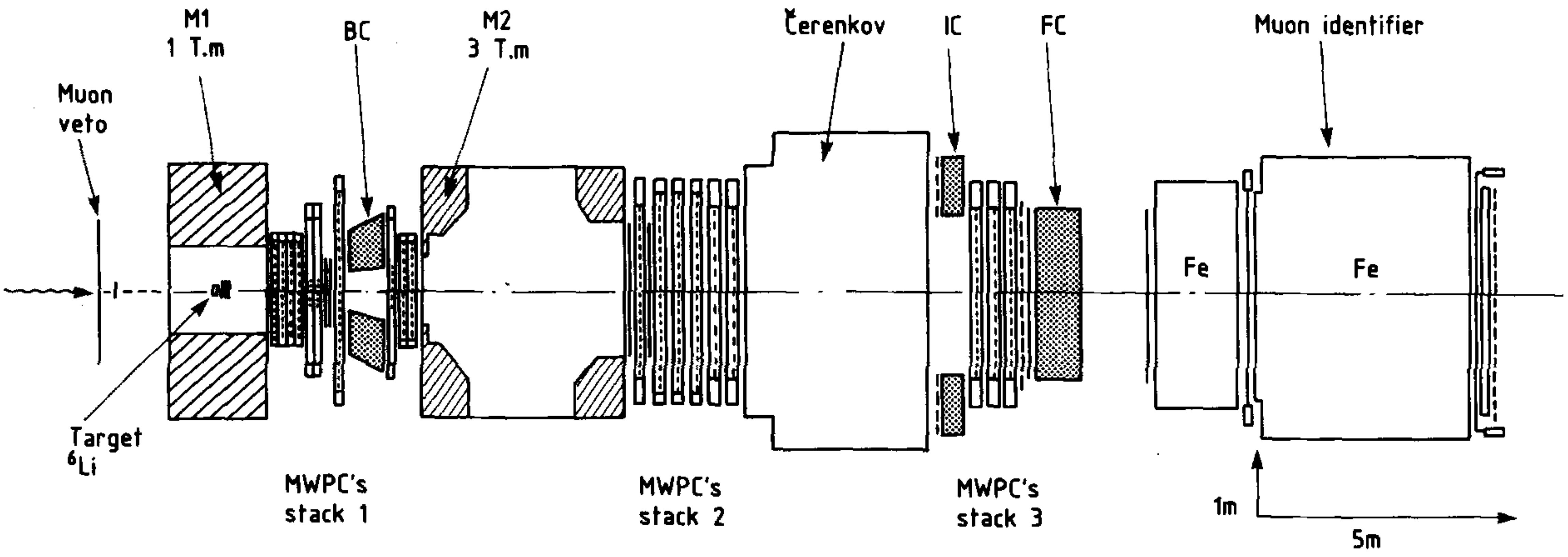
Druk: Krips Repro, Meppel

NA14: 1979 – 1985 (NA14/2)

Hard scattering of real photons <90 GeV>

^{6}Li isoscalar target

AEG magnet La Couronne Goliath ILSA OLGA



NA14 spectrometer. Two dipoles, three e.m. calorimeters, Cerenkov, PWC's, muon filter

Learning how to drive

La ‘quatrelle’

Renault 4L

Learning how to race

Jongens waren we – maar aardige jongens (Nescio in ‘Titaantjes’ (1915))

‘Boys we were – but nice boys’

The first NA14 paper. Written by TSV

$\gamma q \rightarrow \gamma q$

Sensitive to 4th power of quark charge

HO perturbative QCD calculations of inclusive γ signal

MEASUREMENT OF DEEP INELASTIC COMPTON SCATTERING OF HIGH ENERGY PHOTONS

NA 14 Collaboration

P. ASTBURY [c], E. AUGÉ [d], R. BARATE [b], P. BAREYRE [g], P. BENKHEIRI [e], D. BLOCH [i], P. BONAMY [g], P. BORGEAUD [g], B. BOUQUET [d], J.M. BROM [i], J.M. BRUNET [f], H. BURMEISTER [b], M. BURTCHELL [c], S. COSTA RAMOS [e], F. COUCHOT [d], B. D'ALMAGNE [d], M. DAVID [g], A. DE BELLEFON [f], A. DE LESQUENS [g], P. DELLO RUSSO [i,1], A. DUANE [c], J.P. ENGEL [i], J. ENGELEN [b], A. FERRER [d], T.A. FILIPPAS [a], E. FOKITIS [a], P. FRENKIEL [f], E.N. GAZIS [a], J. GIOMATARIS [a], M. GORSKI [k], P. GREGORY [c], W. GURYN [d,2], J.L. GUYONNET [i], T. HOFMOKL [j], A. JACHOLKOWSKA [j], E.C. KATSOUFIS [a], J. KENT [f], P. KYBERD [c,3], B. LEFIEVRE [f], R. LEGENDRE [g], Y. LEMOIGNE [g], K. MAESHIMA [b], T. MARSHALL [g,4], J.G. McEWEN [h], J. MORRIS [c,5], P. MOUZOURAKIS [d,6], R. NAMJOSHI [c,7], B. NANDI [c,8], Ph. NOON [c], S. ORENSTEIN [f,9], T. PAPADOPOULOU [a], J.B.M. PATTISON [b], P. PETROFF [d], D. POUTOT [f], P.G. RANCOITA [g,10], F. RICHARD [d], P. ROUDEAU [d], A. ROUGE [e], M. SCHAEFFER [i], Ch. SEEZ [c], H. SHOOSHTARI [h], I. SIOTIS [c], J. SIX [d], Ch. TRAKKAS [a], D. TREILLE [b], G. TRISTRAM [f], L.V. VAN ROSSUM [g], G. VILLET [g], T.S. VIRDEE [c], A. VOLTE [f], D.M. WEBSDALE [c], J. WEST [c,11] M. WINTER [b,12], W. WOJCIK [b,13], G. WORMSER [d], J.P. WUTHRICK [e] and Y. ZOLNIEROWSKI [g]

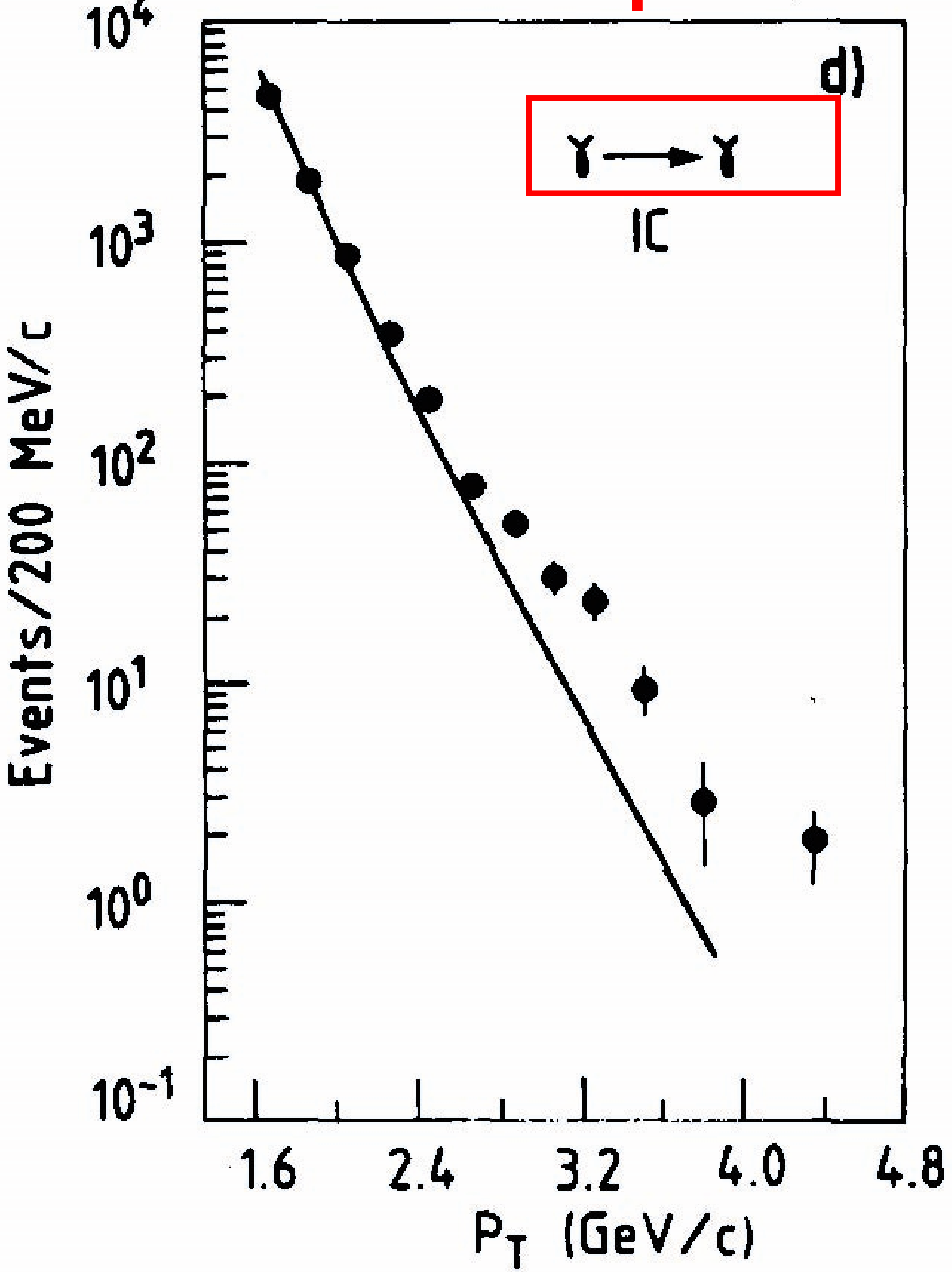
[a] *National Technical University, Athens, Greece*
[b] *CERN, Geneva, Switzerland*
[c] *Imperial College, London UK*
[d] *Linear Accelerator Laboratory (LAL), Orsay, France*
[e] *Ecole Polytechnique LPNHE, Palaiseau, France*
[f] *Collège de France, Paris, France*
[g] *DPHPE, Saclay, France*
[h] *University of Southampton, Southampton, UK*
[i] *CRN et Université Louis Pasteur, Strasbourg, France*
[j] *Institute of Experimental Physics, University of Warsaw, Warsaw, Poland*
[k] *Institute for Nuclear Studies, Warsaw, Poland*

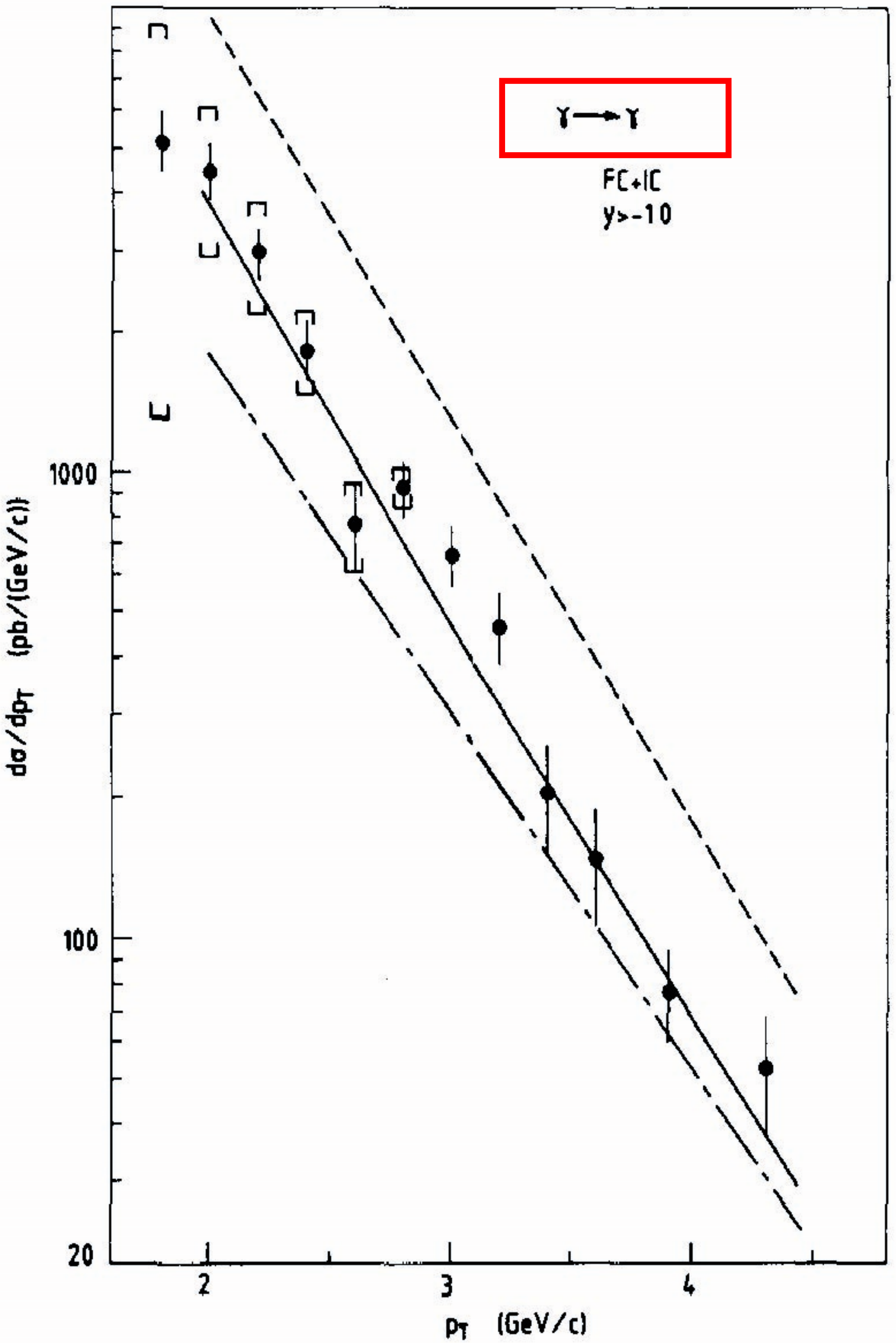
Received 5 January 1985

We present the first results on inclusive photo-production of prompt photons at high transverse momenta. The data were taken in an open spectrometer at CERN using a high intensity photon beam with energy between 50 and 150 GeV. After subtracting the yield of photons from indirect sources, a clear excess is observed for transverse momenta above 2.5 GeV/c. Deep inelastic Compton scattering with appropriate QCD corrections account for this excess. The data disfavour the gauge integer charge quark models so far proposed.

[1] Elettronica Progetti, Bari, Italy.
[2] Present address: Brookhaven National Laboratory, Upton, NY, USA.
[3] Present address: Queen Mary College, London, UK.
[4] On leave from Indiana University, Bloomington, IN, USA.
[5] Present address: Logica Ltd, UK.
[6] Present address: European Parliament, Brussels, Belgium.
[7] Present address: Rutgers University, New Brunswick, NJ, USA.
[8] Present address: Institute of Electrical Engineers, Harlow, UK.
[9] On leave from City College, New York, NY, USA.
[10] On leave from INFN-Milano, Milan, Italy.
[11] Present address: IBM Laboratories, Eastleigh, UK.
[12] Present address: CRN, Strasbourg, France.
[13] Present address: CCPN, Paris, France.

Direct photons



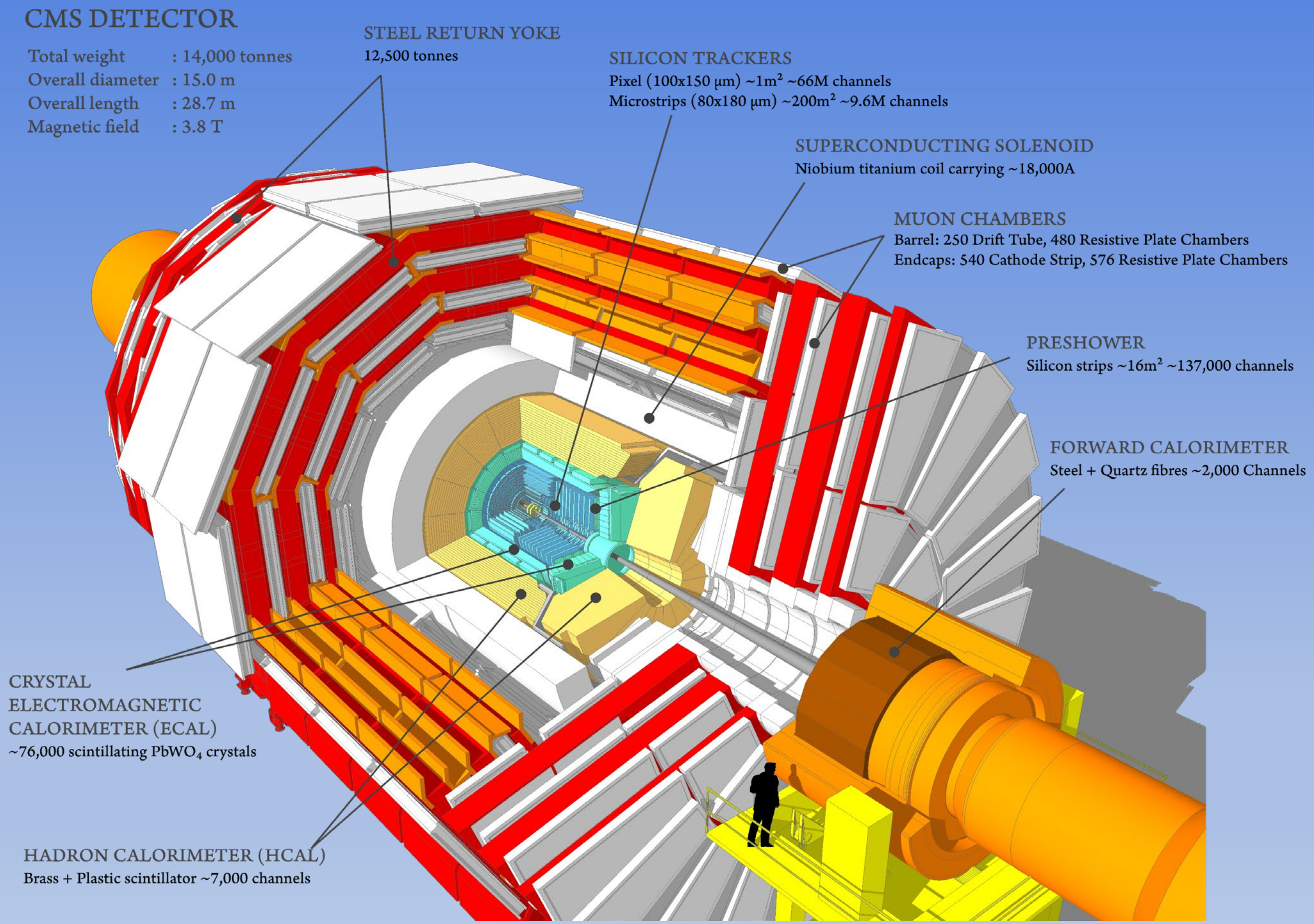


> 1985: UA1 + R&D (warm liquid calorimetry), PbWO4, H→ 2 gamma, CMS

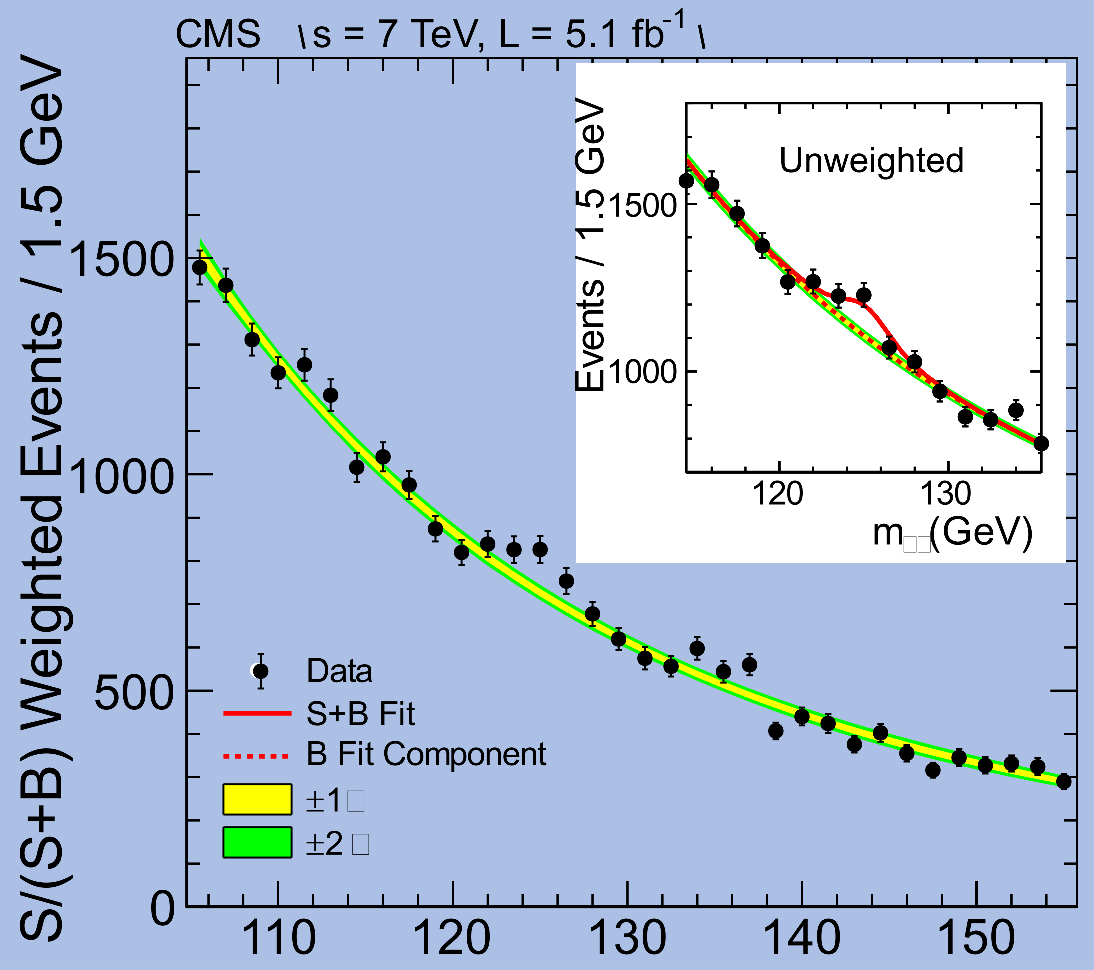
Important workshops: Aachen 1990
Evian 1992

LHCC < - - > CMS
CERN management < - - > CMS
Resources Review Boards < - - > CMS

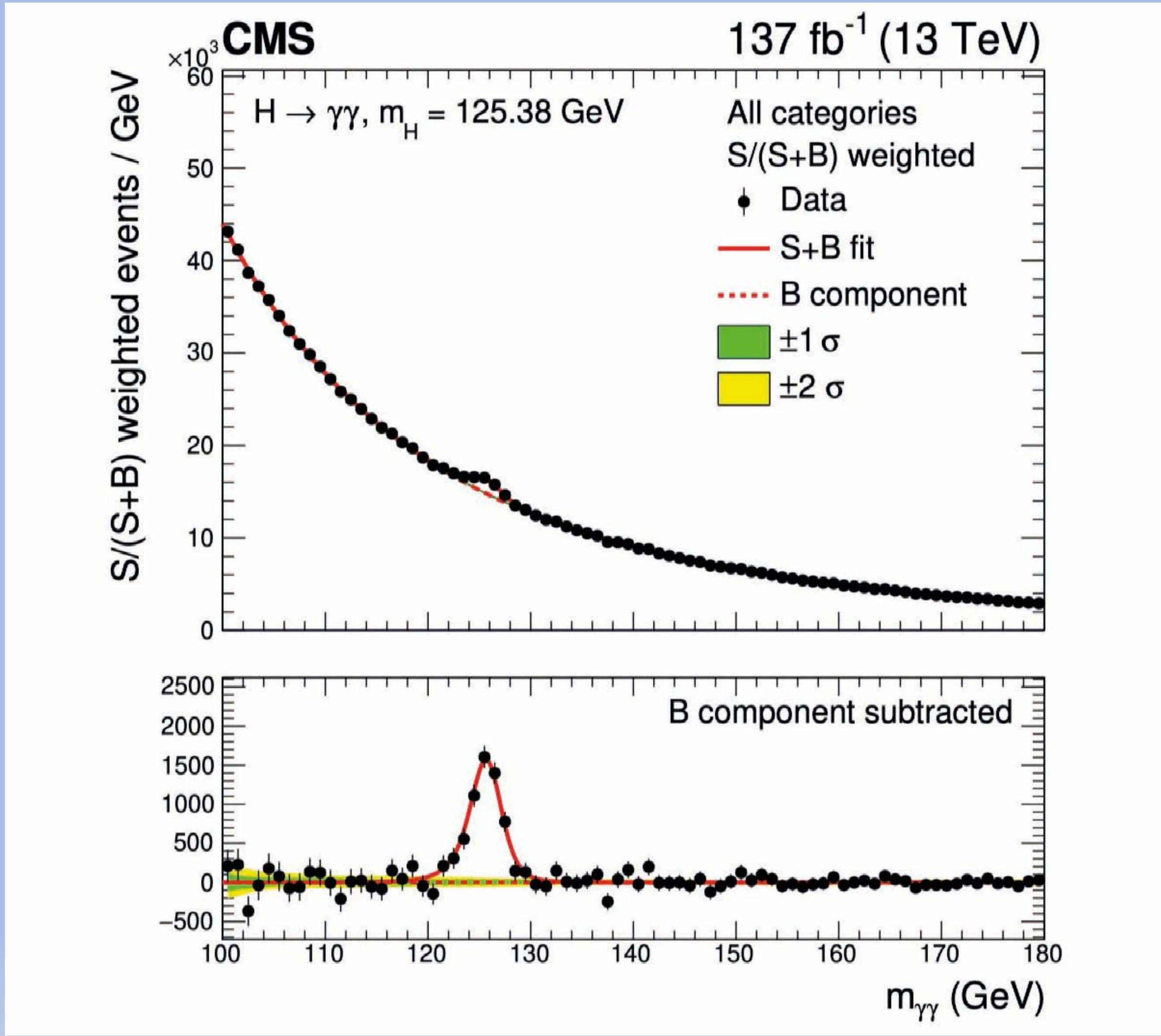
The Compact Muon Solenoid



Discovery – 2012:



2021, 25 x statistics:



View PDF | Access through your institution | Purchase PDF

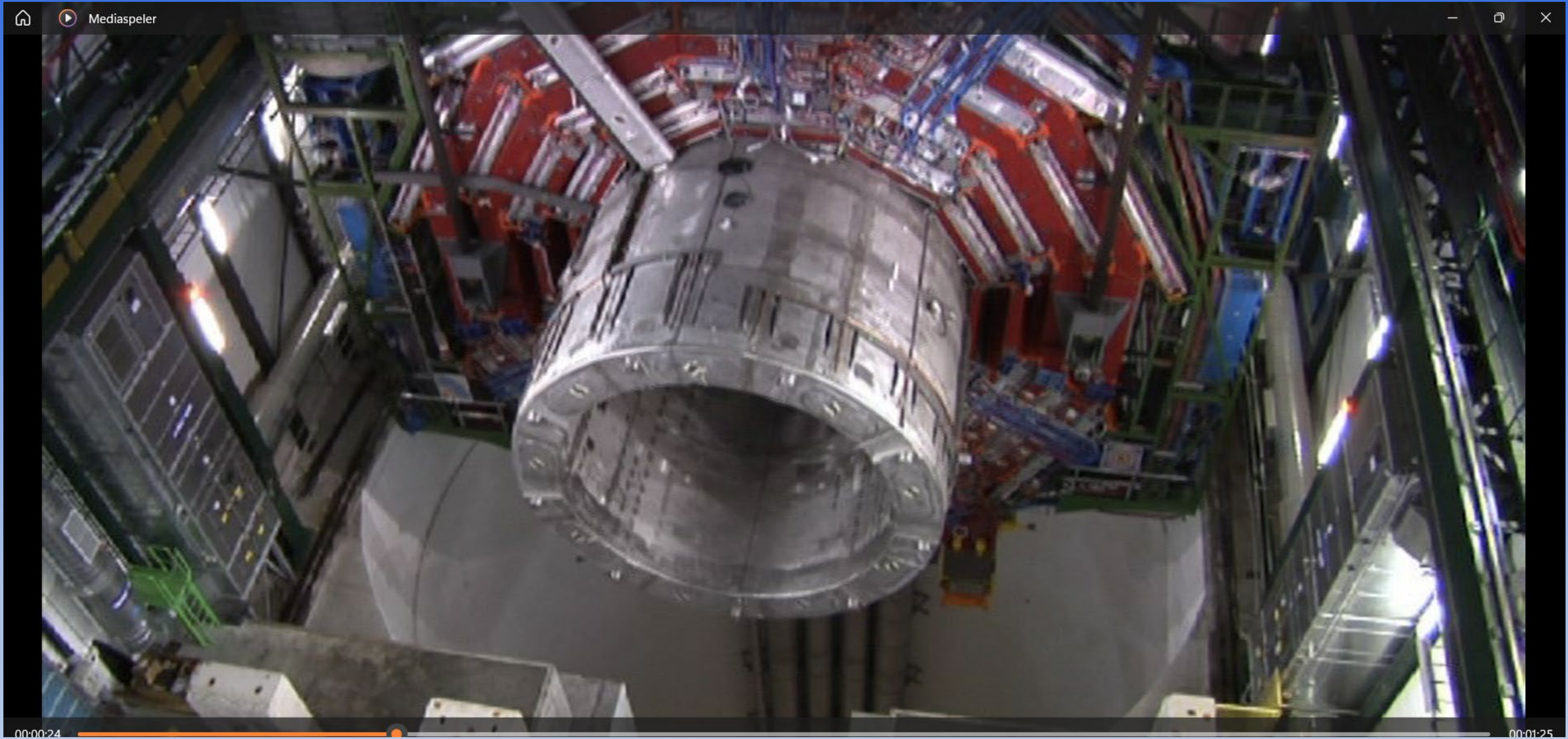
ELSEVIER

Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment

Volume 385, Issue 3, 1 February 1997, Pages 425-434

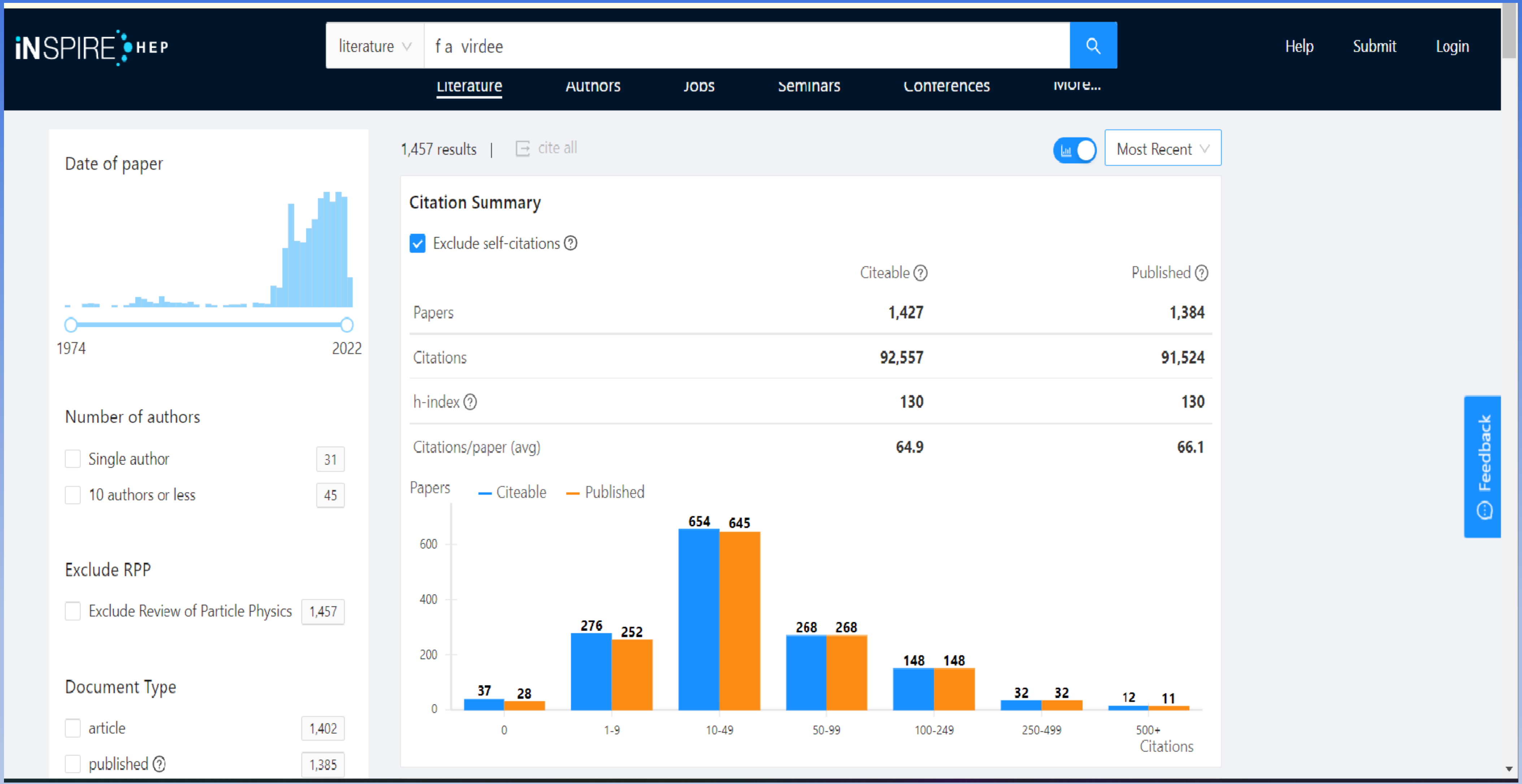
Studies of lead tungstate crystal matrices in high energy beams for the CMS electromagnetic calorimeter at the LHC

G Alexeev [o], E Auffray [e], P Baillon [e], D Barney [e], G Bassompierre [b], E Bateman [d], K.W Bell [d], Y Benhammou [s], P Bloch [e], D Bomestar [r], B Borgia [q], J Bourotte [l], S Burge [d], W Cameron [h], R Chipaux [f], D Cockerill [d], J Connolly [d], I Dafinei [e, 1], P Denes [p], P Depasse [s], K Deiters [t], L Dobrzynski [l], H El Mamouni [s], J.L Faure [f], M Felcini [u], M Finger [n], T Flügel [t], F Gautheron [e], A Givernaud [f], S Gninenko [k], N Godinovic [r], D.J Graham [h], J.P Guillaud [b], E Guschin [k], M Haguenauer [l], H Hillemanns [a], H Hofer [u], B Ille [s], S Jaaskelainen [e], V Katchanov [o], B Kennedy [d], T Kirn [a], M Korzhik [j], K Lassila-Perini [u], M Lebeau [e], P Lebrun [s], P Lecoq [e], G Lecoeur [e], P Lecomte [u], E Leonardi [q], E Locci [f], R Loos [e], D Ma [m], F Martin [s], J.P Mendiburu [b], Y Musienko [k], P Nedelec [b], F Nessi-Tedaldi [u], D Newbold [c], H Newman [m], M Oukhanov [o], L Pacciani [q], J.P Peigneux [b], S Pirro [q], S Popov [k], I Puljak [r], C Purves [c], D Renker [t], F Rondeaux [f], E Rosso [e], R Rusack [i], H Rykaczewski [u], D Schmitz [a], M Schneegans [b], J Schwenke [a], C Seez [h], I Semeniouk [k], P Shagin [o], S Shevchenko [m], X Shi [g], D Sillou [b], D Simohand [s], A Singovsky [o], I Soric [r], B Smith [d], R Stephenson [d], P Verrecchia [f], J.P Vialle [b], T.S Virdee [e, 2], R.Y Zhu [m]


Mediaspeler
00:00:24
00:01:25


Mediaspeler
N3
:49

'find author virdee' (= Jim + Jas)



Happy birthday Jim!

And:

‘I know you are not quite there yet, but even during partial re-tirement, enjoy the freedom it brings, together with your loved ones, together with your friends!’