

“Best Alvin Ever!”

by Vladimir D. Shiltsev and Natalia I. Maltseva (June 2004)

We had arrived in the US from Russia in 1996. Joining Fermilab was a “dream come true” as the Lab was known for its leadership in accelerators and beam physics. Outside of the Lab, its most known symbols were, of course, Bob Wilson and the Tevatron, then the world’s most powerful accelerator. We quickly learned who Alvin Tollestrup was – one of the most prominent accelerator builders, the person who made the Tevatron magnets a reality that shaped not only the US particle physics for several decades but also set up the direction for the next generation of the energy frontier machines, from the SCC to RHIC, from LHC to current ideas on future circular colliders.

Alvin was notorious for being friendly, very sound technically/scientifically and productive. In addition, he and Janine had a special talent of getting together interesting people. Their parties were not just “friends’ gathering” but also opportunities to meet new people, and to discuss broad spectrum of topics and issues, from science to music, from social issues to art, from local community interests to big politics. For us, who got used to such an atmosphere in the academic circles of the late Soviet Union, “Tollestrup’s parties” were like a window into (previously foreign) American society and a grasp of intellectual freedom, standing out of the routine work events and developments (which were exciting and interesting, too, but in a different way).

There were many memorable events over more than two decades of our friendship with Alvin, but here we briefly go over just three stories.

Story 1: “The Tevatron Gang”, December 2002



The photos above are from December 2002. Fermilab had started the Tevatron Collider Run II on March 1, 2001. In 5 years since previous Run I, several significant upgrades were introduced (Main Injector, antiproton source, etc) and expectations were that we should quickly surpass the Run I luminosity records and go for many times higher performance. The reality was not as rosy – the luminosity progress was very slow, operation of the complex was not stable, and we were grossly behind all initial expectations. Luckily, we had enough intellectual power to understand the problems and envision ways to fix the issues and progress. At the end, the bones of the Fermilab accelerator complex were (always) very healthy and as the result of more than 30 mini/medium-scale improvement projects – each giving 5% to 40% of the performance gain – the collider luminosity peaked at the $430 \times 10^{30} \text{ cm}^{-2}\text{s}^{-1}$, that was about 20 times the Run I and 430 times (!) the Tevatron collider design luminosity as envisioned originally by Bob Wilson and Alvin at the inception of the project. The lab had shown once again the benefit of having so many technically strong experts in one place – and we were able to pull all available resources together to support the Collider program. Alvin, as one of the Fermilab leaders, was an important part of all that – he blended with the Tevatron team and campaigned for getting all the smart people he knew from TD, PPD and CD into the AD- world.

On top of that he himself became part of several Tevatron “topical teams” which worked on variety of issues, from controls to beam diagnostics, to magnetic measurements, etc. With his great technical abilities, Alvin, for example, was able to figure out how to measure the longitudinal phase space of the Tevatron proton bunch, understand the dynamics of the IBS and noise effects and deeply study the origins of so called DC beam which was always a serious issue for the CDF and D0 backgrounds until electron lenses were built to clean it up. Later, Alvin very successfully worked on the issues such as beam-gas scattering and corresponding losses, their effects on beam lifetime and on the CDF and D0 detector backgrounds and consequences for collimation system; on the phenomenology of the losses at the start of acceleration ramp, on the transverse emittance evolution and the SDA – store analysis software package.

Preparing for the 2002 “Tollestrup Xmas” party, we decided to emphasize Alvin’s role in the ongoing Tevatron effort and came out with a poster which was a remake of the famous “Uncle Sam: I want you for the US Army” (see on he left). There “Uncle Sam” points an accusing finger of moral responsibility in a recruitment poster for the American forces during World War I. In the “Uncle Alvin” version, we had a smiling Alvin and – on the sides – applications of photos of various Fermilab people doing something useful for the collider. It took us and our two (then little) kids Misha and Liza one evening with a lot of fun to make it, find proper photos, cut them with scissors, glue them to the board. Alvin, with his always joyful character was happy as a kid, too – as depicted on the photo on the right.

Story 2: “Alvin Symposium”, June 2004

In 2004, Alvin turned 80 and it was decided to celebrate this occasion with a half-day Symposium at Fermilab’s main auditorium, One West. Three mid-career scientists were invited to give talks of relevance to accelerators, detectors and particle astrophysics – the areas Alvin excelled in. We thought that the event should not be “too serious” and came with an idea to turn it into an ancient Greek party. Indeed, according to the **American Heritage Dictionary**, *Συμπόσιον* is “... A convivial meeting for drinking, music, and intellectual discussion among the ancient Greeks.”

Natalia arranged white togas and buckles, kids donated laurel branches from a past costume party, Vaia Papadimitriou brought up a cassette player with Greek dancing music. Greek red wine and glasses were brought up to One West, too.

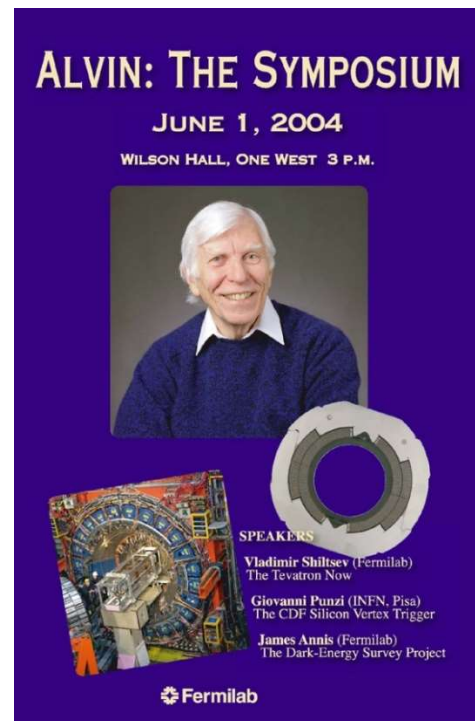


Vladimir Shiltsev, Alvin Tollestrup, Giovanni Punzi, and Jim Annis give a toast in their togas.

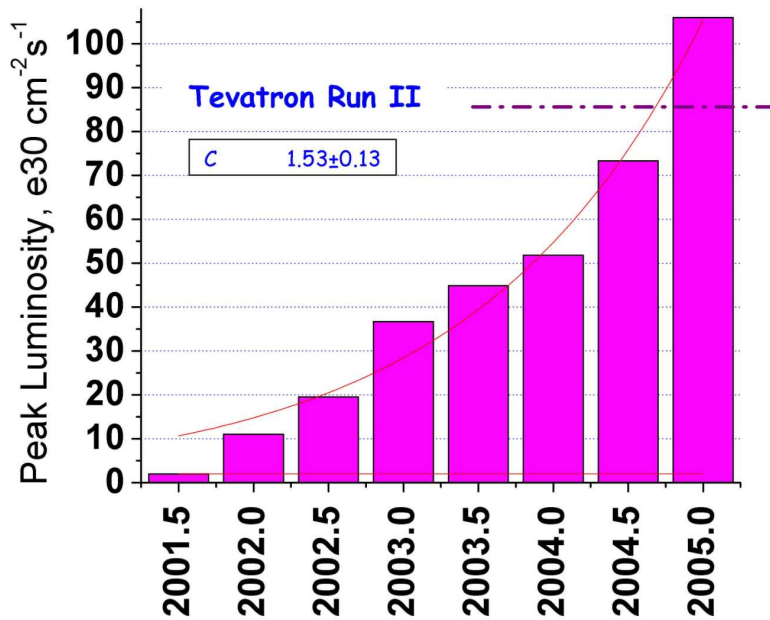
The idea played really well – Alvin was happy, he got a laurel, all speakers toasted Alvin, the audience was excited. *Fermilab Today* – our daily on-line publication, reported next day: “A standing-room-only crowd packed One West on Tuesday, June 1 for a symposium honoring Alvin Tollestrup. The first speaker, Vladimir Shiltsev, honored the Greek definition of symposium (“a convivial meeting for drinking, music and intellectual discussion”) by playing Greek music and providing Tollestrup and the three speakers with togas and Greek wine. After Shiltsev’s discussion of the Tevatron and other particle physics accelerators, Giovanni Punzi spoke on the CDF Silicon Vertex Tracker and Jim Annis discussed the proposed Dark Energy Survey. “*It was neat to have talks by people that are really doing important stuff, instead of the standard kind of thing where you look back at what has been accomplished over the years,*” said Tollestrup. “*It was great that so many people came.*”

https://www.fnal.gov/pub/today/archive/archive_2004/today04-06-03.html

Given that the time was limited, to some 30 min per talk, I decided to present a new “improbable and funny” idea related to accelerators, now called the “*CPT Theorem for*



accelerators”, instead of going through numerous advances of the Tevatron Collider luminosity. The basic idea was simple and learned from the Tevatron luminosity history – see figure on the right below – the performance of complex system grows exponentially. Indeed, the Tevatron luminosity increases occurred after numerous improvements, some of which were implemented during operation, and others introduced during regular shutdown periods. The major improvements addressed all the parameters affecting the luminosity – proton and antiproton intensities, emittances, optics functions, bunch length, losses, reliability and availability, etc. – and led to fractional increase varying from few % to some 40% with respect to previously achieved level. Such complex percentages - ” $N\%$ gain per step, step after step, with regular periodicity” - should result in the *exponential* growth of the luminosity $L(t+T)/L(t)=exp(T/C)$.



At the talk, it was shown that not only Tevatron but all other colliders had very similar features of the performance evolution, which can be summarized as (so called “CPT theorem for accelerators”):

$$C \cdot P = T$$

where the factor $P=\ln(\text{luminosity})$ is the “performance” gain over time interval T , and C is a machine dependent coefficient equal to average time needed to increase the luminosity by $e=2.71\dots$ times, or boost the “performance” P by 1 unit. Both, T and C have dimension of time, and the coefficient C was called “complexity” of the machine, as it directly indicates how hard or how easy was/it to push the performance of individual machine. The Tevatron stayed on a steady exponential increase path with $C\approx 2.0$ year from 2002 till 2007 – an indication of enormous effort of many people and groups yielding the fastest progress (shortest complexity time C) among other colliders, such as LEP, SppS, ISR, CESR, HERA and RHIC. Note, that the “Moore’s Law” that

describes about half a century trend in the history of computing hardware, namely, that the number of transistors that can be placed on an integrated circuit(IC) has doubled approximately every two years, yielding $C=2/\ln(2)=2.9$ years.

The idea behind the CPT theorem for accelerators, first proposed at the Alvin's Symposium, happened to turn into something practical – e.g, it was used to predict that the LHC (then in construction stage) will get its design luminosity not sooner than in 2014-2016. The LHC achieved it in 2016. The CPT theorem is published in *Mod. Phys. Lett. A*, v.26, (11), pp. 761-772 (2011) and is now widely used to estimate the luminosity commissioning time of the future large energy frontier particle colliders and other big facilities.

Story 3: “Best Alvin Ever!”, last years

With the Tevatron luminosity performance secured ca.2007-2008, Alvin as well as many accelerator scientists started to think about “what’s after the Tevatron”. Fermilab Accelerator Physics Center (APC) was created in June 2007 with mission to carry out R&D to keep the US leading high-energy physics laboratory at the forefront of accelerator science, technology and facility operation. In support of the FNAL high-energy physics research mission, APC scientists and engineers conducted accelerator R&D aimed at next-generation and beyond accelerator facilities; provided accelerator physics support for existing operational programs and the evolution thereof; trained accelerator scientists and engineer and established experimental programs for a broad range of accelerator R&D that can be accessed by both Fermilab staff and the US and world HEP community. APC was a center-place for in-depth design, research and development efforts which allowed the Laboratory to make intelligent decisions on the ILC in the US, on the Muon Collider, as well as originate projects such as PIP-II (through the Proton Driver/Project-X work), LHC-AUP (via LARP) and the IOTA/FAST R&D facility.

Alvin was an initiator of the Muon Collider Task Force, which later was transformed into the US Muon Accelerator Program (US MAP). His office was across mine on the Wilson Hall 13th floor, and it was great pleasure to see how Alvin worked with many students and early career scientists involved into the muon accelerator R&D (see photo below). In his remarkable style, Alvin went with them to the bottom of physics phenomena – for example, those involved in the discharges in a gas-filled high gradient normal conducting RF cavities. Younger physicists got very much attracted to Alvin as he always had time to discuss both science and life with them.

On one of Alvin's birthdays, we have made a big gold-star medal with inscription “Best Alvin Ever!” – and delivered it to him at the party in Chez Leon (see photos), to his pleasure and common joy of the audience.



Alvin's sharp wit and scientific productivity at late years were simply remarkable. Among ourselves we had ask whether it's possible that he had the biggest number of co-authors over scientific career (among all physicist of all times)? Or could be that he has the longest record of publications in the Physical Review Letters – our main scientific publication? (from 1949 to 2013 - see his 1st and the last PRL papers' front pages below). Trying to get some answers, in the Spring 2020 I had communication with the APS Editor-in-Chief Michael Thoennessen – see below.

Neutron-Hydrogen Mass Difference from the D–D Reactions*

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April 26, 1949

PRL 111, 184802 (2013)

PHYSICAL REVIEW LETTERS

week ending
1 NOVEMBER 2013

Pressurized H₂ rf Cavities in Ionizing Beams and Magnetic Fields

M. Chung,¹ M. G. Collura,¹ G. Flanagan,² B. Freemire,³ P. M. Hanlet,³ M. R. Jana,¹ R. P. Johnson,² D. M. Kaplan,³
M. Leonova,¹ A. Moretti,¹ M. Popovic,¹ T. Schwarz,¹ A. Tollestrup,¹ Y. Torun,³ and K. Yonehara¹

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On Feb 10, 2020, Vladimir Shiltsev to Michael Thoennessen (APS Editor-in-Chief)

Dear Michael,

I wonder whether you can help me with following - Alvin Tollestrup, one of Fermilab father-founders

https://en.wikipedia.org/wiki/Alvin_V._Tollestrup

died yesterday at the age of 95. Alvin was very active researcher all his life, including his late years. In particular, in 2013 (at the age of 89) he published an article in PRL

<https://journals.aps.org/prl/issues/111/18>

In preparation of obituaries, we wonder whether he was THE OLDEST author who ever published in PRL or preceding Phys Reviews. Quick Google search was not conclusive (tentatively, yet).

I'd greatly appreciate if you either let me know if such statistics exists or point me out to smb else who might have a clue.

Thank you in advance - Vladimir

APS DPB Chair (2018), former PRAB EB
Distinguished Scientist, Fermilab
APS Fellow, AAAS Fellow, IEEE Fellow

On Feb 12, 2020: Michael Thoennesen to Vladimir Shiltsev

Dear Vladimir,

Wow, that is impressive. Unfortunately, I don't think that we have that information. We certainly do not know the age of our authors. I do not think that we can get a conclusive answer so that you could make the claim that he was oldest author. I think if you just state the fact that he published a PRL at age 89 is very impressive.

Sorry that we cannot answer your question.

Best Wishes

Michael

Michael Thoennesen,
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Google Scholar reports our six joint publications with Alvin (see below).

To conclude, we should thank the Providence for the privilege to know Alvin for these twenty some years. Alvin was a man who worked and lived with passion, humor and integrity. He was a highly intelligent, genuinely warm and wonderful, vibrant individual with a rare friendliness and charm of personality —one we will miss greatly. Rest in peace, our “Best Alvin Ever”!

Natalia I. Maltseva, *Research Scientist, Center for Structural Genomics of Infectious Diseases, University of Chicago, Argonne National Laboratory*

Vladimir D. Shiltsev, *Distinguished Scientist, Fermilab; Fellow of APS, IEEE, AAAS; Member of Academia Europaea (The Academy of Europe); 2019 Nishikawa Prize, 2004 EPS Accelerator Prize; 2018 APS Outstanding Referee, 2017 George Gamow Prize (RASA), 2016 Robert Siemann Prize (APS); Honorary Alumni NSU-FMSh (2017), Honorary Member Lomonosov Foundation (NARFU, 2016); 2018 APS DPB Chair, 2013 Silver Archer Award – USA.*

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