45 years of Collaboration in Particle Physics Between Fermilab and USSR/Russian Scientists

Victor Yarba, Fermilab

RASA, November 5, 2017
Introduction about International Cooperation in HEP

• CERN (Geneva) was established in 1954 with physicists from many countries participating as soon as first accelerator started operation.
• JINR (Dubna) was established in 1956 with 10 GeV proton accelerator running by 1958. US highest energy accelerator at that time was 6 GeV.
• First three Soviet physicists came to CERN (director Victor Weisskopf) in 1963 from Dubna (director Dmitri Blohintsev) for 6 months including Vladimir Nikitin (who later was leader of Dubna group in the first Fermilab experiment E-36).
• I came to CERN in 1964 to spend a year working on 30 GeV accelerator.
• In 1967 at IHEP (director Anantoli Logunov), Protvino, 70 GeV proton accelerator started operation and was highest energy accelerator for 5 years.
  – This stimulated many scientists from Europe and US to come to work at the energy frontier machine: Darell Dritcki, Rolland Johnson and others.
In 1972 Fermilab (director Robert Wilson) put into operation the Main Ring 100-400 GeV proton accelerator. As a result Fermilab attracted many physicists including from USSR. First such proposal came from JINR to study elastic scattering of protons using hydrogen gas target

– Vladimir Nikitin (JINR) and Ernie Malamud (Fermilab)

CERN and JINR demonstrated how particle physics scientists from various countries can collaborate and Fermilab continued this spirit well
First HEP Collaboration US-USSR

• US-USSR collaboration in HEP started in 1966 with USSR physicists coming to work at US laboratories
  – For example, Yuri Prokoshkin spent half a year at BNL
• First US group of Prof. Darell Dritski carried out an experiment at IHEP, Protvino in 1970. John Tompkins (recently retired from Fermilab participated in this experiment).
Darel Dritski group on the beam line of 70 GeV proton accelerator at IHEP, Protvino in early 1970’s
First HEP Collaboration US-USSR

• In 1972 first USSR group (JINR, Nikitin) came to Fermilab to perform joint experiment at the Main Ring
• In 1973 Nixon-Brezhnev agreement on Cooperation in Peaceful Uses of Atomic Energy was signed
  – In 1975 the US-USSR Joint Committee for Research of the Fundamental Properties of Matter (JCC-FPM) was established with meetings every year and ~8 representatives from each side
E-36 – First Fermilab Experiment, Joint with JINR, 1973
November 25, 1975

Dr. Vladimir A. Nikitin

JINR
Mail Post Office
P. O. Box 79
Moscow, U.S.S.R.

Dear Nikitin,

I was sorry to have missed the departure of you and your colleagues from Batavia, when I was in Europe. Before you left, I had wanted to express my appreciation and gratitude and admiration to you for bringing your ideas, your talent, your equipment, your colleagues, your wives, and most of all, your friendship, to Batavia.

I am bursting with pride that the first experiment at CERN, turned out so well scientifically — congratulations! But I am also deeply gratified that such a fine experiment was done as a collaboration between scientists of different countries.

Let us hope that this is a resumption of a normal state of affairs. I am looking forward to the time that you will personally be back doing another experiment at the Laboratory. Meanwhile, my congratulations and best wishes to your colleagues, my friends, in the U.S.S.R.

Sincerely,

Robert Wilson

P.S. Jane joins me in sending our special thanks for the beautiful letter objects that Ernie brought back, from you to us. Jane also joins me in sending our love to Valentina.

June 2, 1973
First HEP Collaboration US-USSR

- In 1972 first USSR group (JINR, Nikitin) came to Fermilab to perform joint experiment at the Main Ring
- In 1973 Nixon-Brezhnev agreement on Cooperation in Peaceful Uses of Atomic Energy was signed
  - In 1975 the US-USSR Joint Committee for Research of the Fundamental Properties of Matter (JCC-FPM) was established with meetings every year and ~8 representatives from each side
<table>
<thead>
<tr>
<th>Soviet and Russian Labs and Universities</th>
<th>Number of Experiments</th>
</tr>
</thead>
<tbody>
<tr>
<td>JINR, Dubna</td>
<td>28</td>
</tr>
<tr>
<td>IHEP, Protvino</td>
<td>17</td>
</tr>
<tr>
<td>ITEP, Moscow</td>
<td>16</td>
</tr>
<tr>
<td>Lebedev Physical Institute, Moscow</td>
<td>11</td>
</tr>
<tr>
<td>PNPI, St. Petersburg</td>
<td>9</td>
</tr>
<tr>
<td>Moscow State University</td>
<td>8</td>
</tr>
<tr>
<td>Institute of Nuclear Research, Moscow</td>
<td>4</td>
</tr>
<tr>
<td>Kiev National University</td>
<td>2</td>
</tr>
<tr>
<td>Tashkent Physical Technical Institute</td>
<td>2</td>
</tr>
<tr>
<td>Kharkov Physical Technical Institute</td>
<td>1</td>
</tr>
<tr>
<td>Tomsk Polytechnic Institute</td>
<td>1</td>
</tr>
<tr>
<td>Yerevan Physics Institute</td>
<td>1</td>
</tr>
<tr>
<td>Kazakh State University</td>
<td>1</td>
</tr>
<tr>
<td>Budker Institute of Nuclear Physics</td>
<td>1+accelerators</td>
</tr>
</tbody>
</table>
Leon Lederman and Valery Schegelsky (PNPI) signing SELEX collaboration agreement in 1987
Tevatron Collaborations

Over 200 users from Russian groups participated in the Tevatron experiments
JINR/CDF group leader Julian Budagov and his team at JINR assembling CDF scintillation counters
Remote Operation Center of the NovA experiment during Fermilab’s director visiting JINR (Dubna) in 2016
Joint US-Russian DZero muon system installation crew, year 2000
Institute for High Energy Physics (IHEP) of the National Research Centre “Kurchatov Institute” is located about 100 km South from Moscow.
Contributions to Fermilab’s Accelerators

- BINP was critical contributor to the development of the 1st Tevatron electron lenses
  - Electron gun, electron collector, test stands, beam diagnostics, carried out beam dynamics simulations, took part in beam studies
- IHEP Protvino had built magnetic systems for both electron lenses,
  - Including sophisticated 6.5T SC solenoids equipped with numerous corrector coils, also took part in the lens commissioning and magnetic measurements
- JINR Dubna contributed to the theory of coherent stability with electron lenses
- Team from BINP took part in multi-year (~10 yrs) studies of the ground motion for future colliders
Shiltsev and Stancary commissioning electron lens manufactured at IHEP, Protvino
JCC-FPM Meetings

• In late 70’s JCC-FPM meetings were smooth with plans signed each year, thanks to Nixon-Brezhnev agreement
• With Cold War intensified by Reigan administration the meetings became more stressful
  – US Co-chairman had no authority to sign and agreement on discussed plans
  – But HEP communities managed to succeed on all agreed upon items, inspite practically all other cooperation between US and USSR at that time stopped
• Spirit of JCC-FPM meetings was always productive and directors of all laboratories involved did whatever they could to cooperate
  – In US: Fermilab, BNL, SLAC, Los Alamos
  – In USSR: IHEP, ITEP, JINR, ErPhI (Erevan)
Appendix IV

**USSR DELEGATION**

<table>
<thead>
<tr>
<th>Name</th>
<th>Title/Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. V. Chuvilo</td>
<td>Director, Institute of Theoretical and Experimental Physics / USSR Co-Chairman JCC-FPM</td>
</tr>
<tr>
<td>A. T. Amatuni</td>
<td>Director, Yerevan Physics Institute</td>
</tr>
<tr>
<td>V. A. Vassiliev</td>
<td>State Committee on Atomic Energy</td>
</tr>
<tr>
<td>O. I. Sumbaev</td>
<td>Director, INP AS of the USSR, Leningrad</td>
</tr>
<tr>
<td>Y. A. Yarba</td>
<td>Vice Director, Institute of High Energy Physics</td>
</tr>
<tr>
<td>A. V. Zhakovski</td>
<td>State Committee on Atomic Energy</td>
</tr>
<tr>
<td>G. Vernikov</td>
<td>Institute of Theoretical and Experimental Physics</td>
</tr>
</tbody>
</table>

Appendix V

**U.S. DELEGATION**

<table>
<thead>
<tr>
<th>Name</th>
<th>Title/Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>J.E. Leiss</td>
<td>Associate Director for High Energy and Nuclear Physics, Department of Energy / U.S. Co-Chairman JCC-FPM</td>
</tr>
<tr>
<td>D.A. Bromley</td>
<td>Yale University / Director, Fermilab</td>
</tr>
<tr>
<td>L.M. Lederman</td>
<td>Brookhaven National Laboratory / Stanford Linear Accelerator Center</td>
</tr>
<tr>
<td>D. Lowenstein</td>
<td>Director, LAMPF</td>
</tr>
<tr>
<td>W. K.H. Panofsky</td>
<td>Harvard University / California Institute of Technology</td>
</tr>
<tr>
<td>L. Rosen</td>
<td>Department of Energy</td>
</tr>
<tr>
<td>K. Strauch</td>
<td>Department of Energy</td>
</tr>
<tr>
<td>F. Zachariasen</td>
<td>Fermi National Accelerator Laboratory</td>
</tr>
<tr>
<td>B. Hildebrand</td>
<td>State Department, Language Services Division</td>
</tr>
<tr>
<td>P. K. Williams</td>
<td></td>
</tr>
<tr>
<td>R. Rubinstein</td>
<td></td>
</tr>
<tr>
<td>G. Tunik</td>
<td></td>
</tr>
</tbody>
</table>

JCC-FPM membership in 1984, Fermilab, Batavia
Detailed planning of cooperation at 1984 JCC-FPM meeting
JCC-FPM tour of IHEP 70 GeV accelerator tunnel in 80’s
JCC- FPM meeting at Fermilab in 1990
Overview of the Collaboration

- Over 45 years ~500 scientists, engineers and technicians from USSR/Russia participated in Fermilab experiments and projects
- Over 70 joint experiments were performed
- Contributions in design and constructions of detectors and accelerators equals to 10’s of millions dollars
- Many experiments were jointly conceived, results analyzed and published
  - Including such fundamental discoveries as the top quark
JCC-FPM Experimental Agreements

• All joint experiments were arranged in very clear agreements
  – Contributions of the equipment
  – Intellectual contributions and data analysis
  – Visits of the personnel from both sides to the collaborating institutions

• After USSR dissolved into 15 countries by late 90’s JCC-FPM agreement was not extended by US side mainly due to Russian cooperation with Iran on nuclear reactors
  – But even after that active collaboration on CDF, DZero, CMS and now on muon and neutrino experiments continues
    • Recently with major new challenges
Challenges of the Cooperation

• USSR officials were very worried about scientists or engineers not coming back after visiting US
• In 1985 Dr. Kulikov from PNPI “disappeared” at airport before his return flight
  – He later joined SLAC
  – Had rather negative impact on the cooperation, so agreement with Fermilab was not to hire scientists in similar cases
• Another case was Victor Kryshkin
  – He was concerned that he was approached by agents and was flown back to USSR on a short notice
Some Differences in Culture Created Funny Stories

• Darrel Dritski group was visiting IHEP to perform experiment at 70 GeV accelerator in early 70’s
  – In September practically all IHEP scientists spent time helping collective farms to pickup potatoes harvest
  – Darrel group wanted to participate and to get some fraction of collected potatoes for them…

• High level officials in Moscow were contacted to address this “international incident”
  – The decision was to give each American one bag of potatoes for free… without them participating in the harvesting…
Part of the Fermilab’s Russian community. Many of them are staying in US for a long time as residents or citizens and continuing traditions.
Collaboration between USSR/Russian scientists and Fermilab during over 45 years period stimulated scientific progress in understanding fundamental properties of matter and developed better understanding between people around the world.