

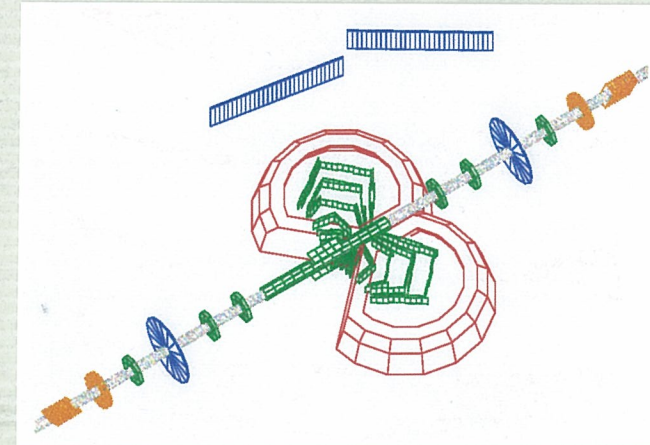




In the beginning, there was only empty space and a very good idea...



# PHOBOS



*Draft*

0.0

## PROPOSAL TO STUDY VERY LOW $P_t$ PHENOMENA AT RHIC

### PHOBOS COLLABORATION

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A. Bialas, W. Czyz

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University of Maryland

S. Manly, plus 2 Ph.D. Students

Yale University



OPEN

\* Spokesperson



Step one was connecting the outside and inside.



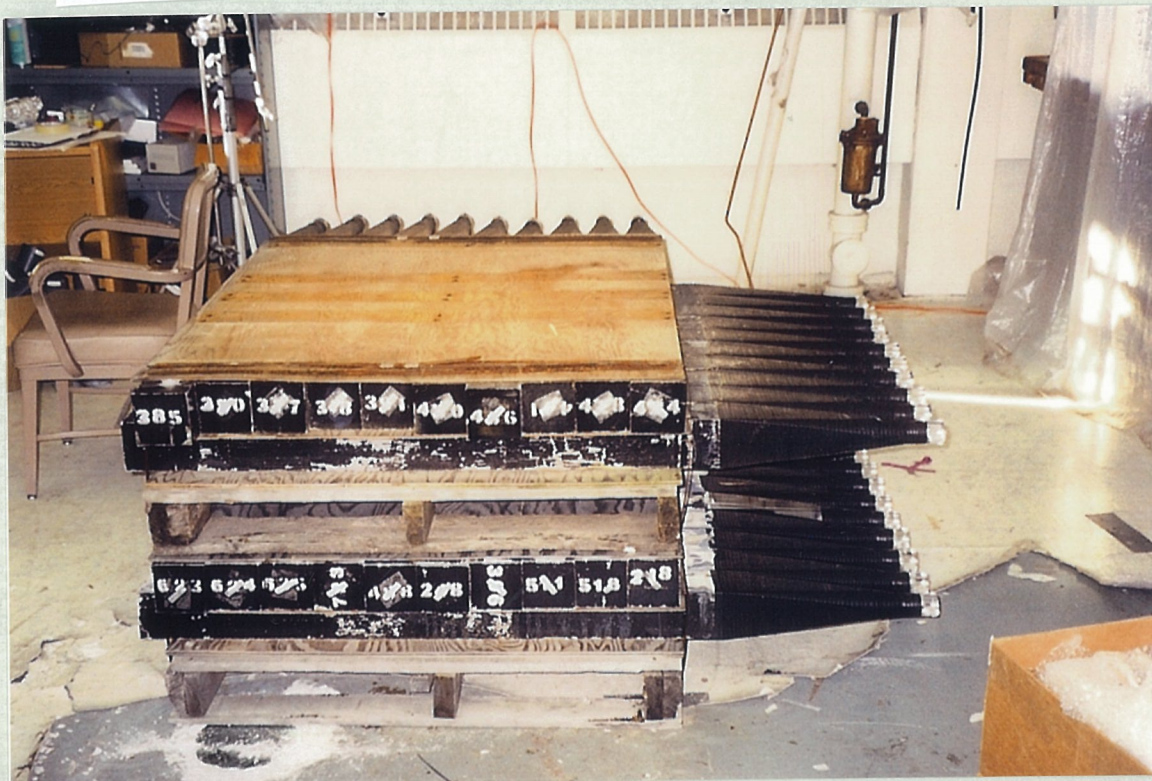
Soon, a counting house arrived, mostly empty but people managed to work.



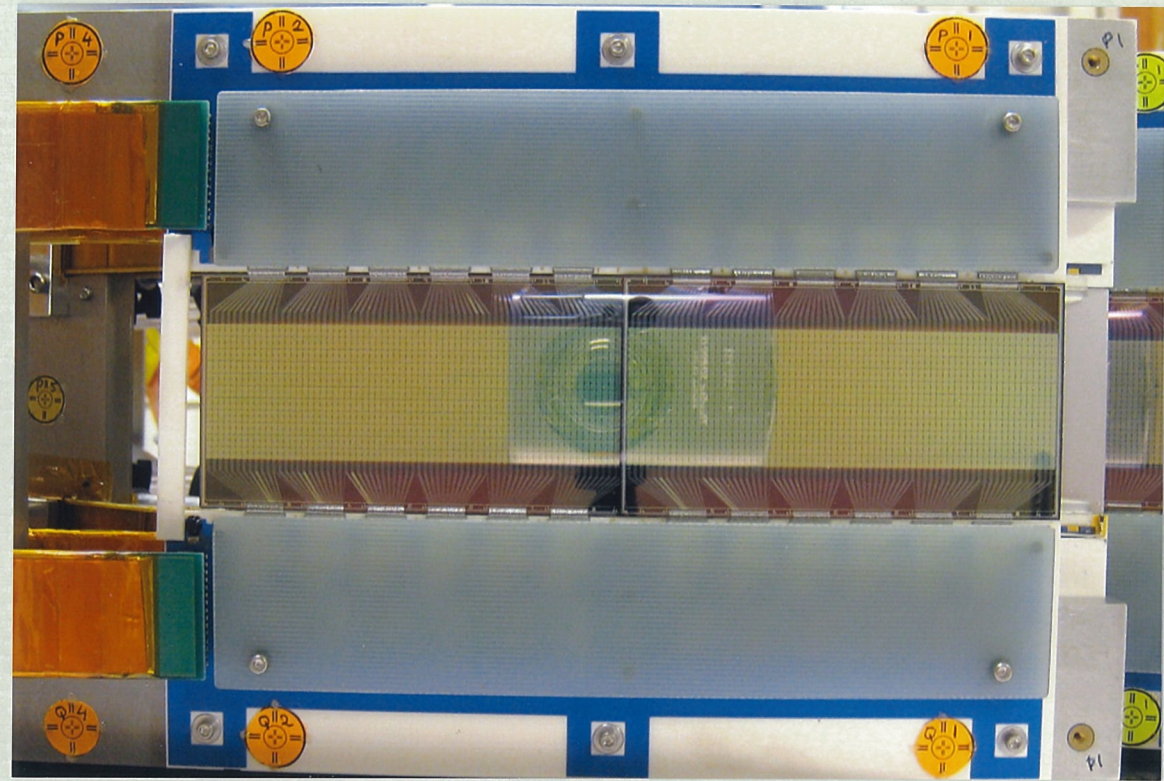


# All of the other ingredients were collected:

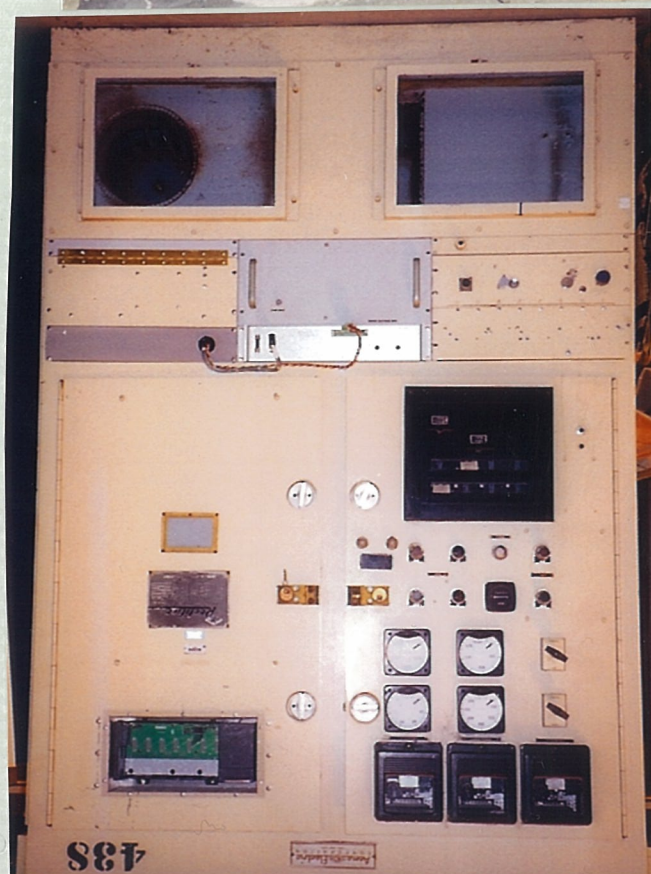
Something old



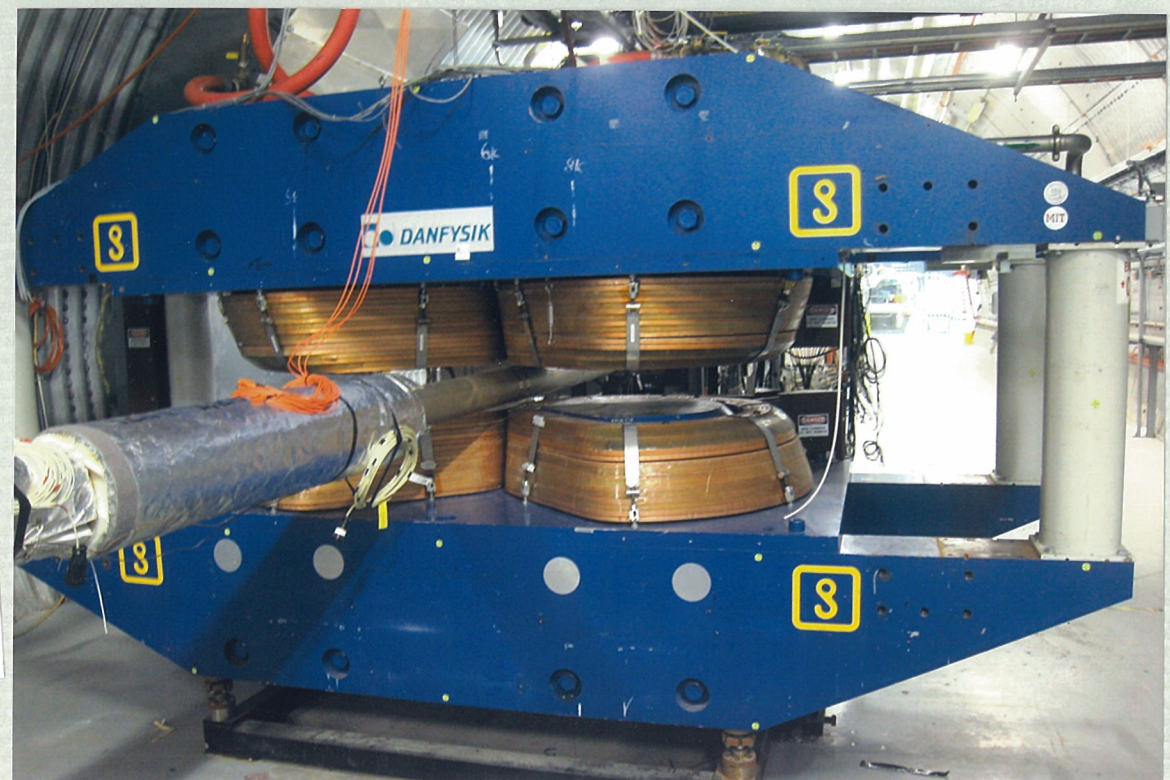
Something new



Something borrowed

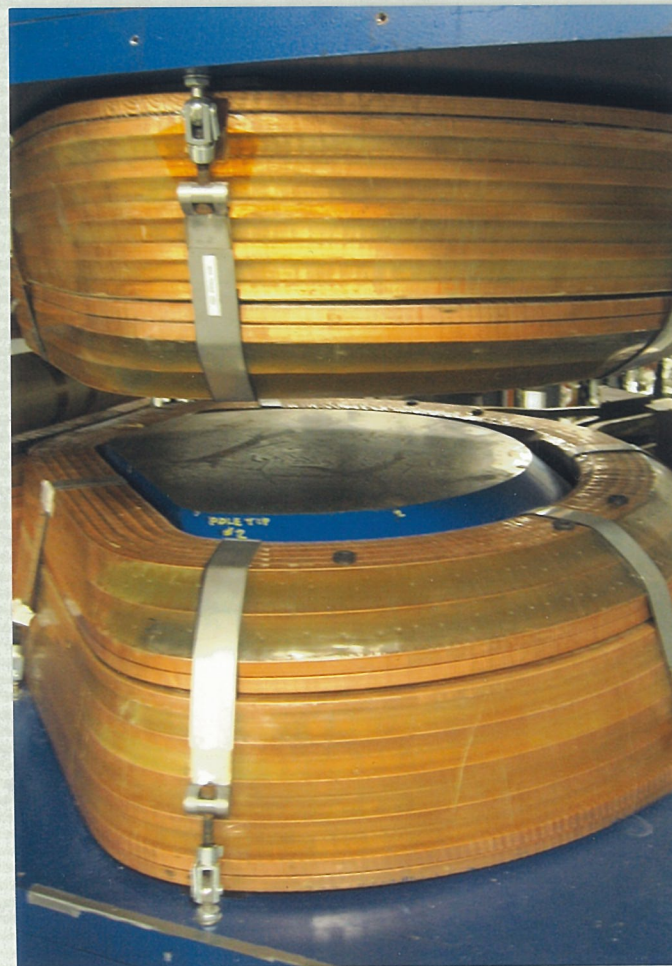
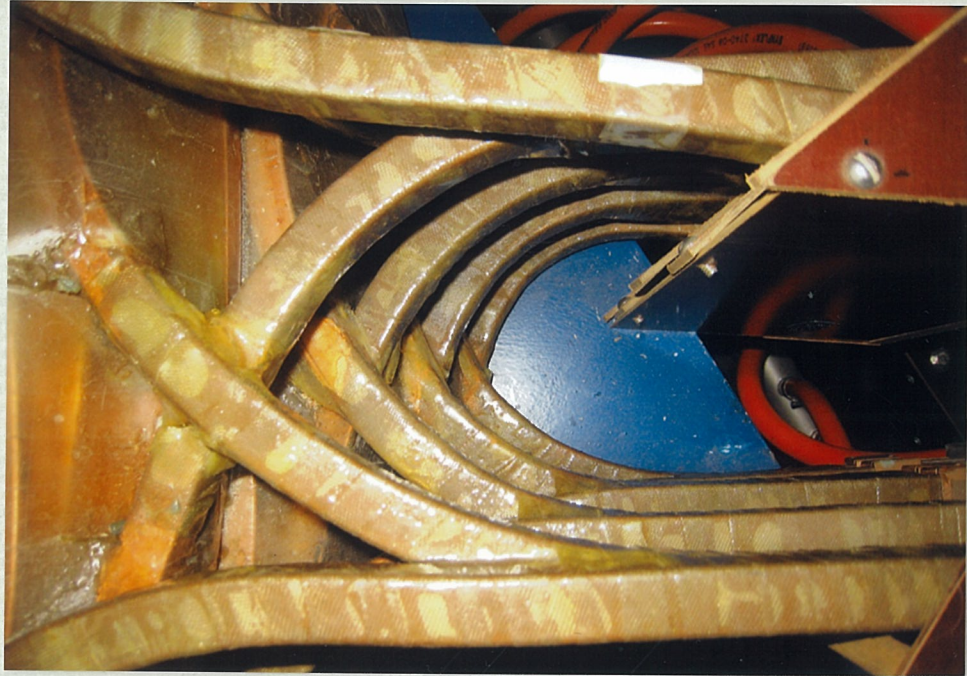


Something blue

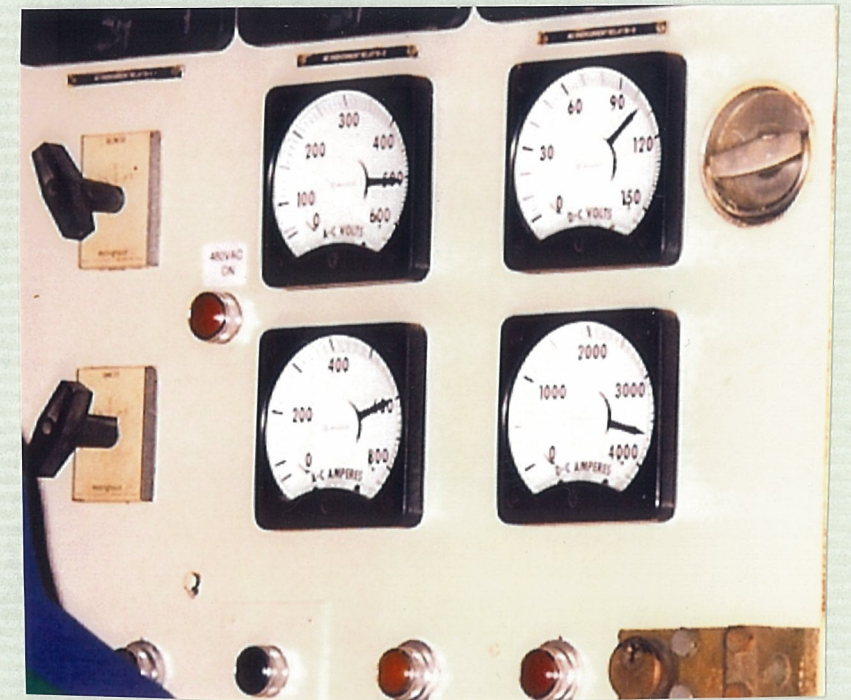




First there was a magnet which required a very unusual coil...







Everyone was very happy when the magnet turned on and even worked! 2T!!

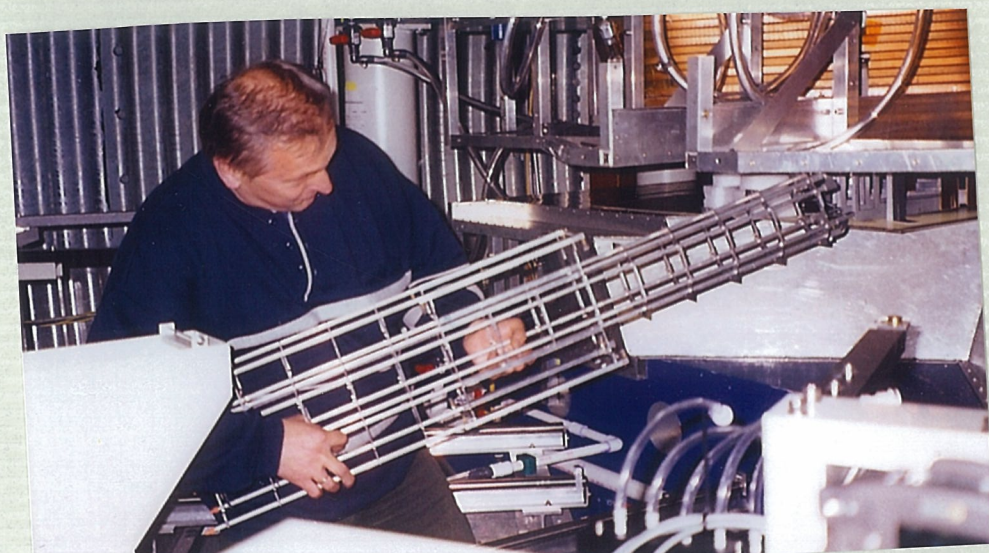
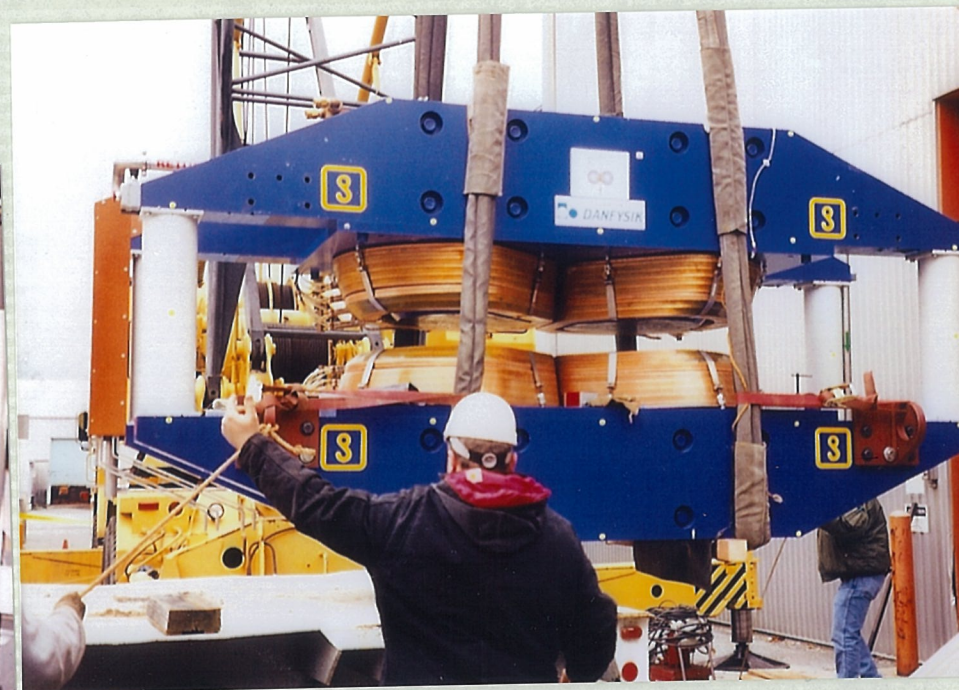
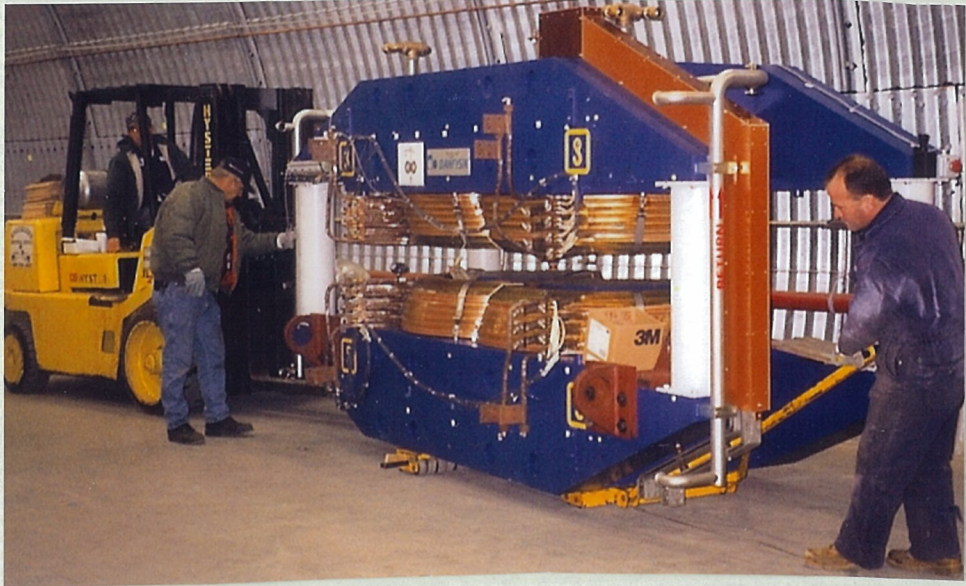


The magnet was built at the AGS, then moved to RHIC.

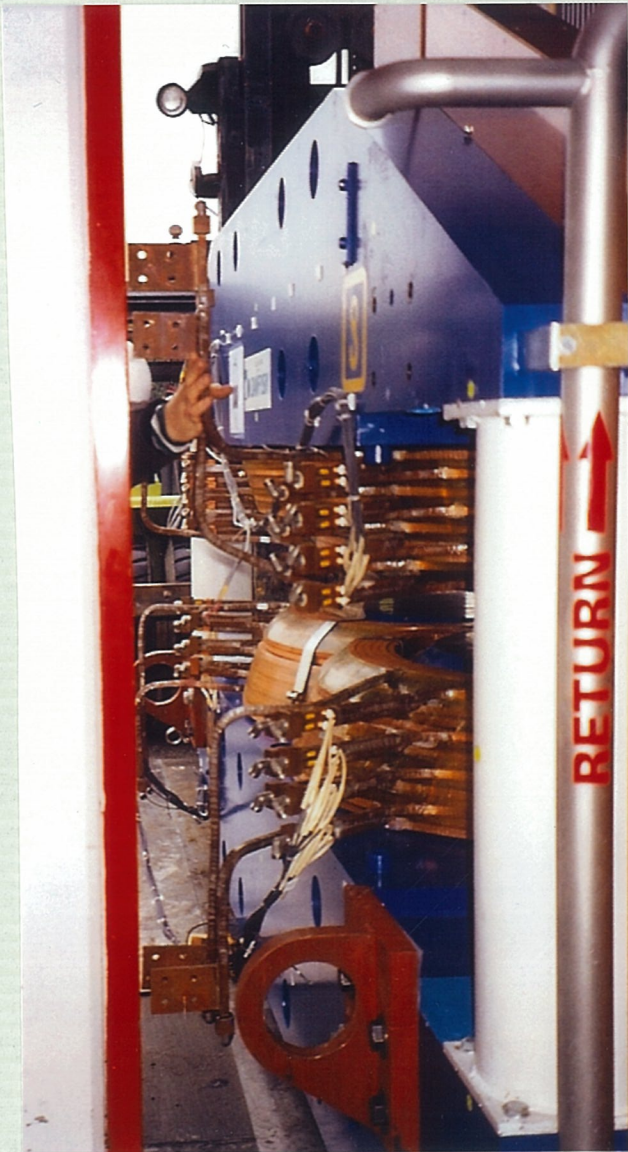




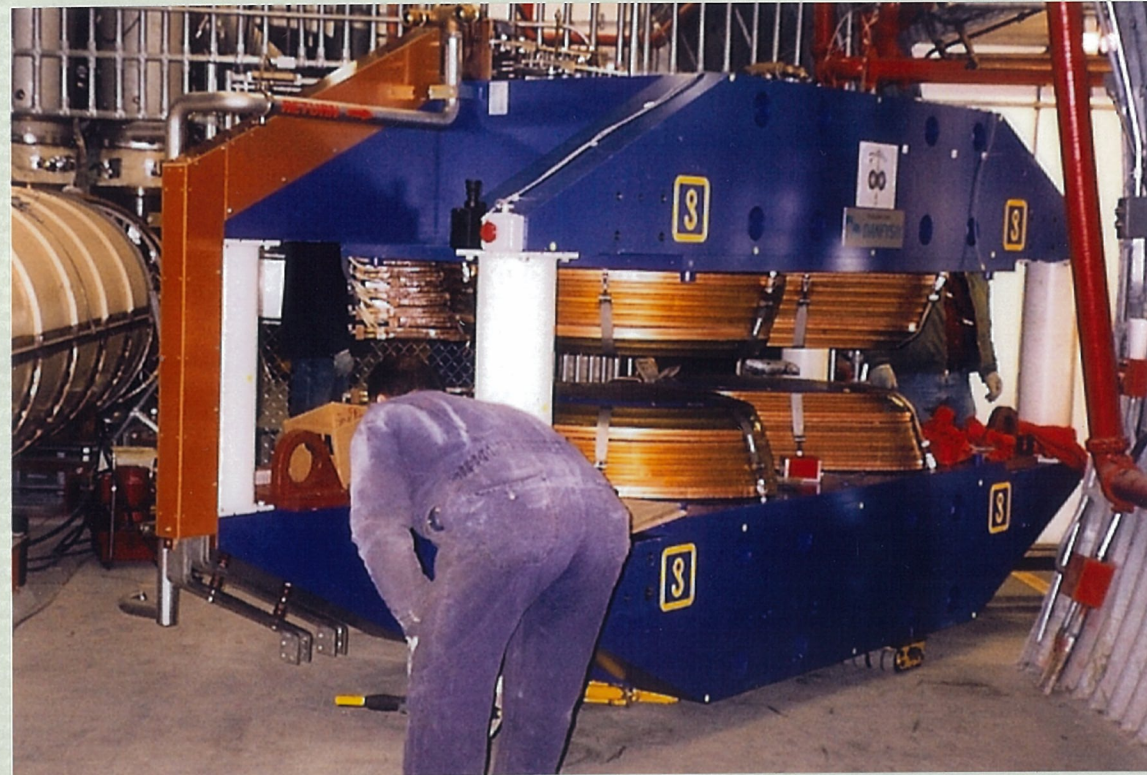
Then, it came time to move into the tunnel using methods both high tech and not so







Some things just barely made it...



And don't forget the final precision alignment step!



While others required special handling...



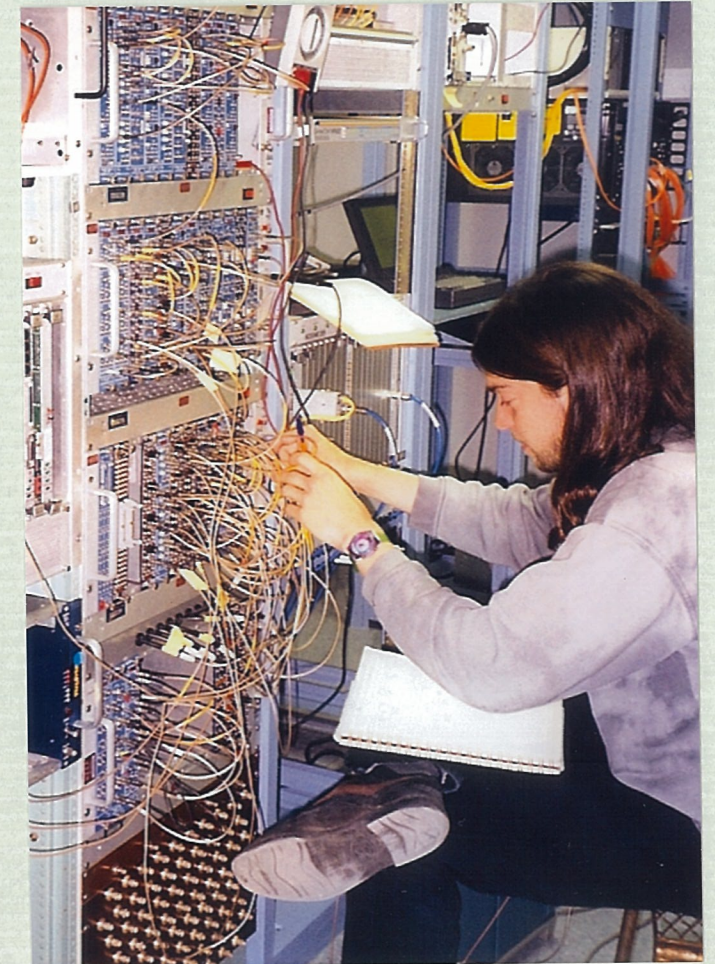
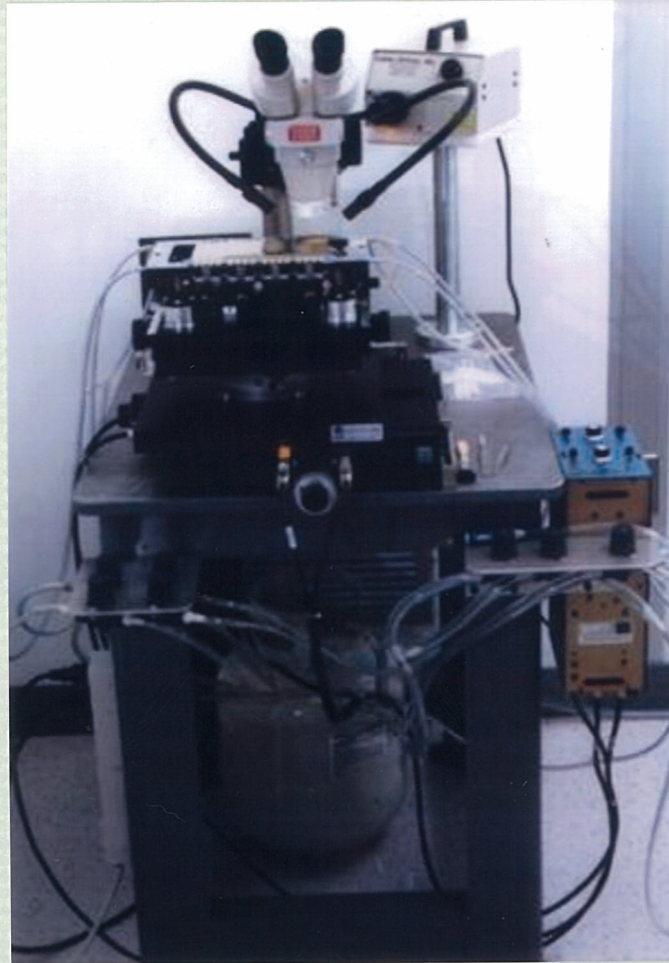
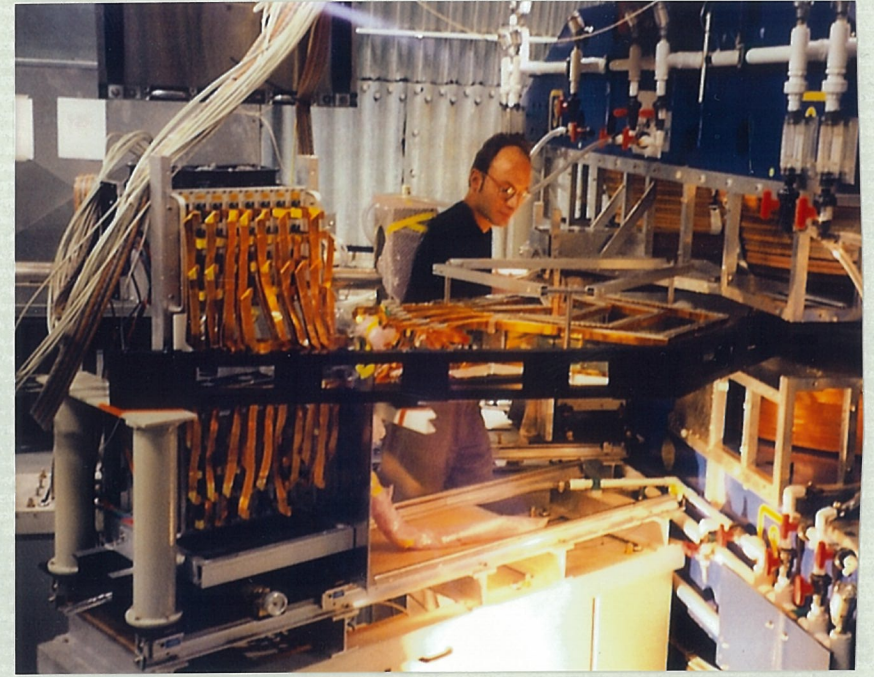
The detector moves to the tunnel!



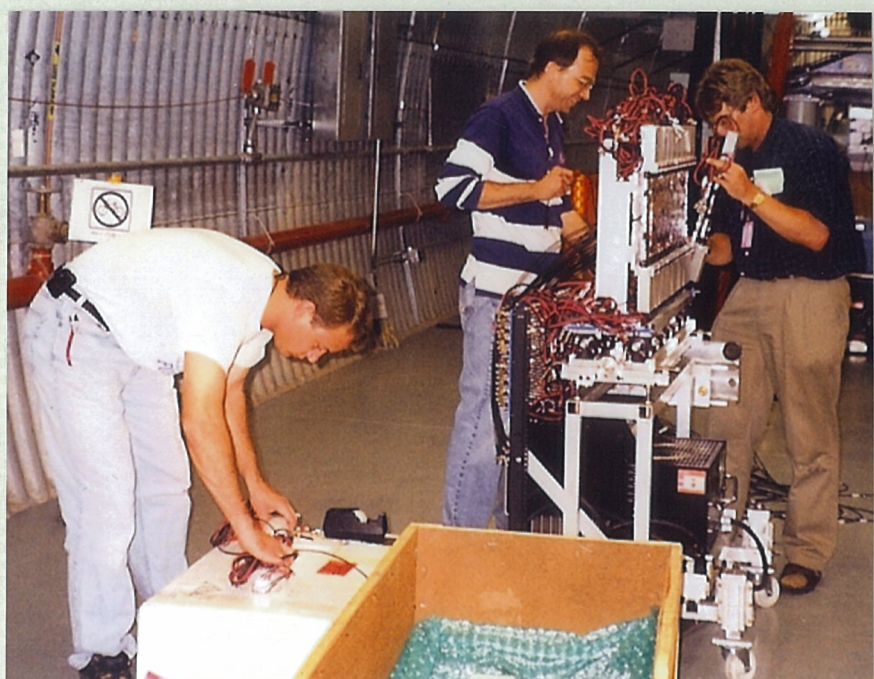




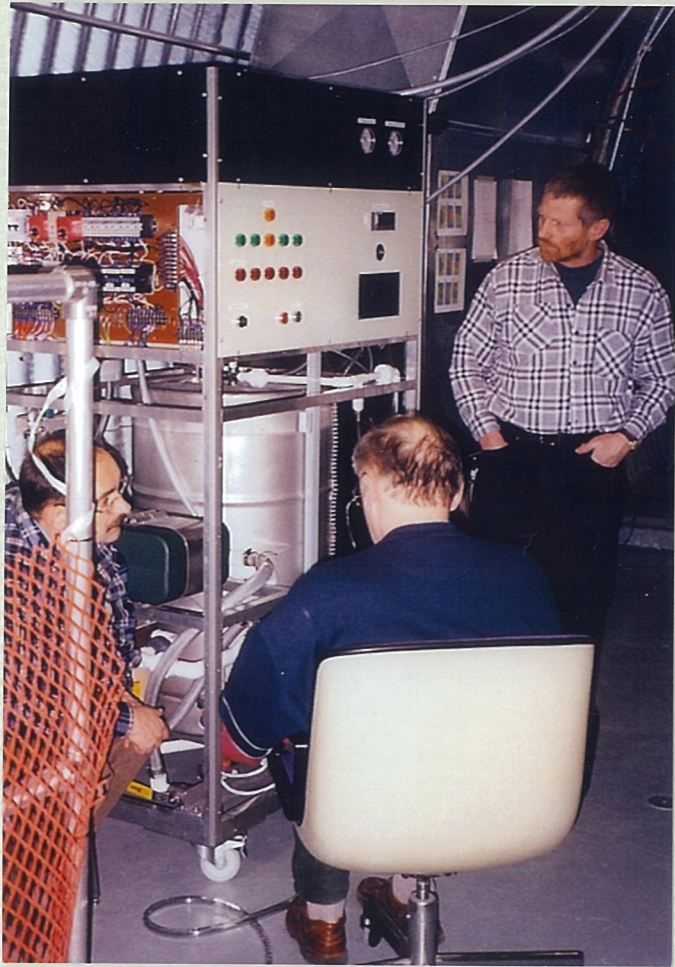
Everyone worked hard on assembly.



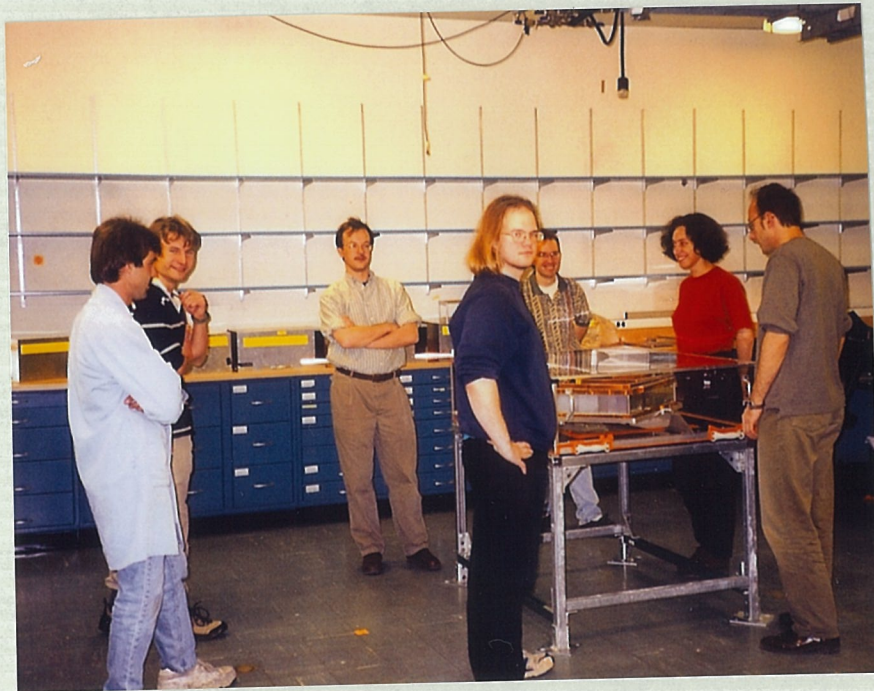








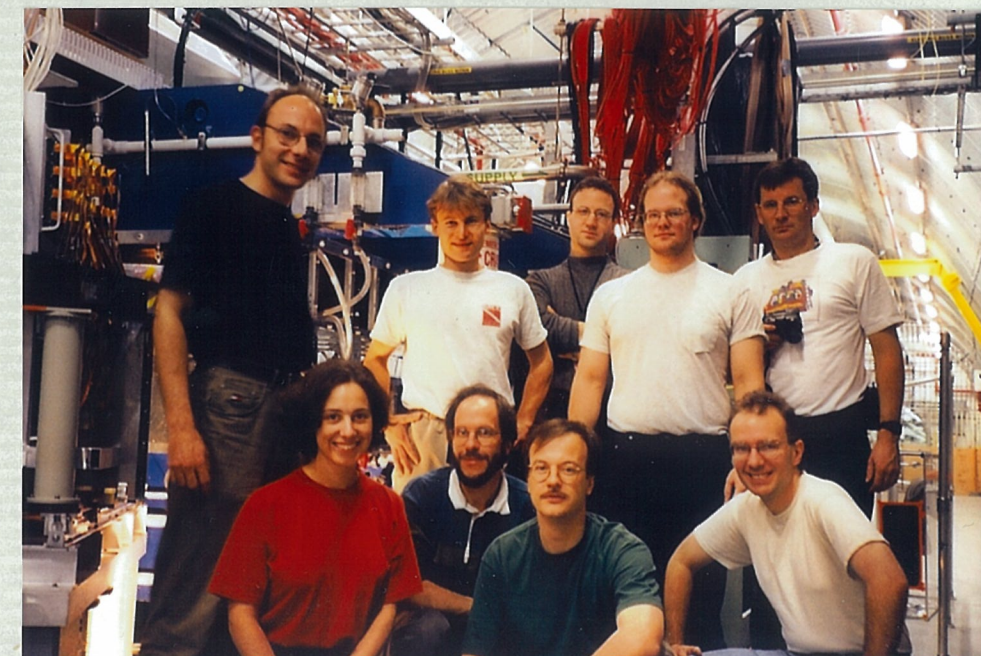
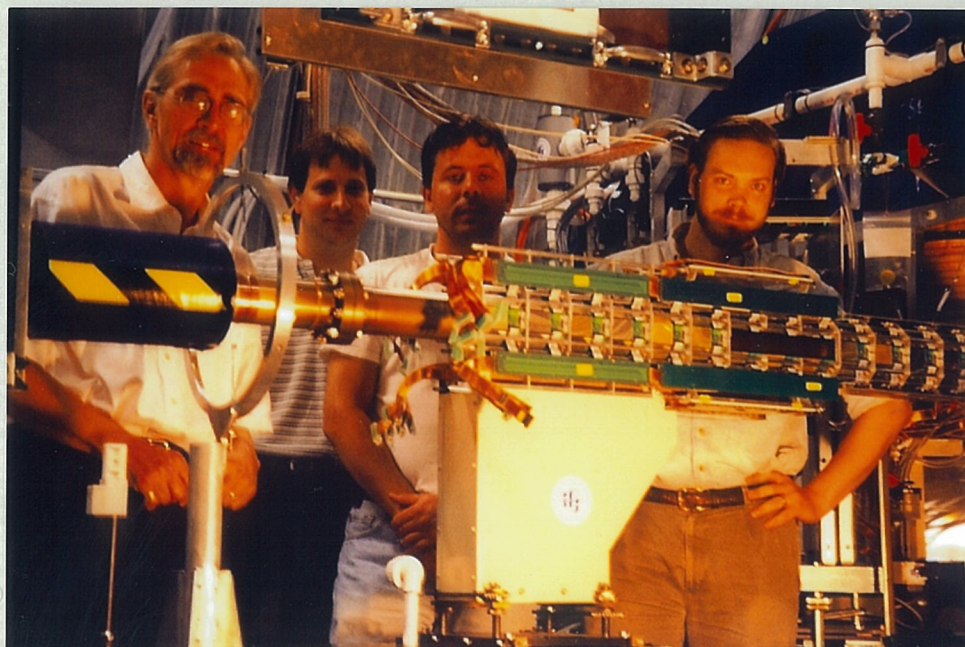
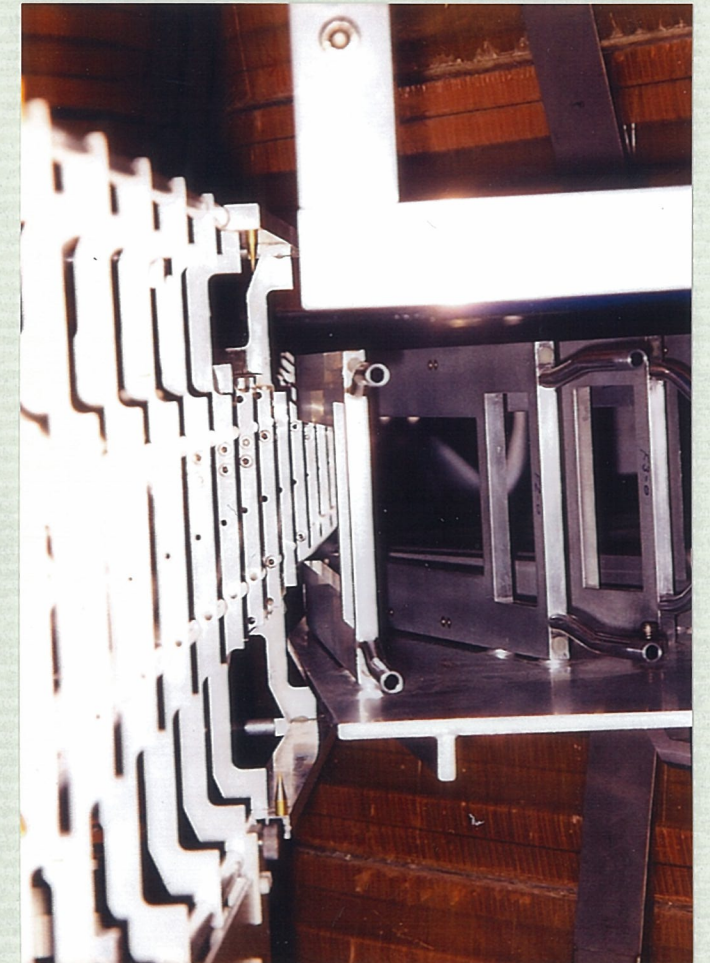
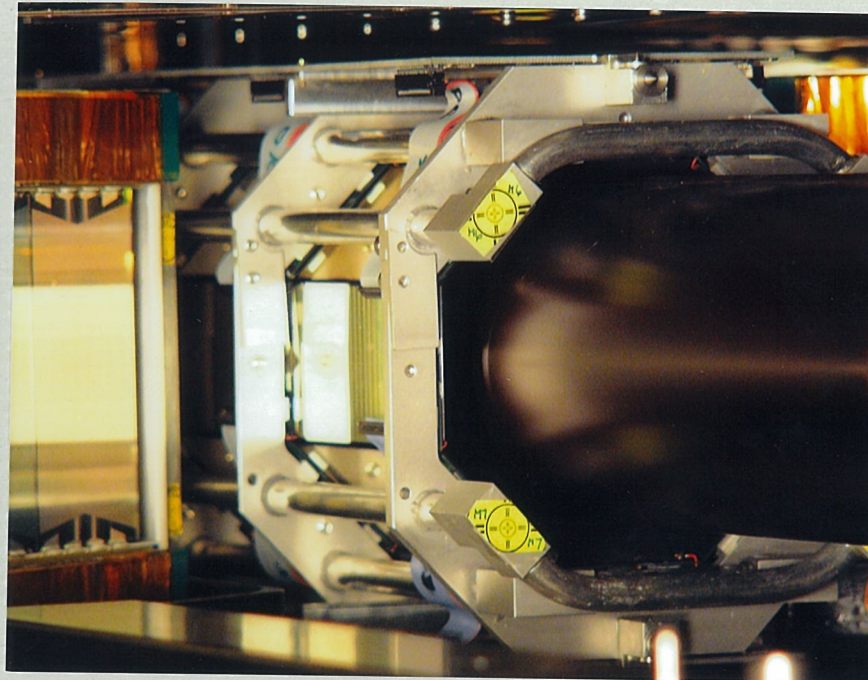
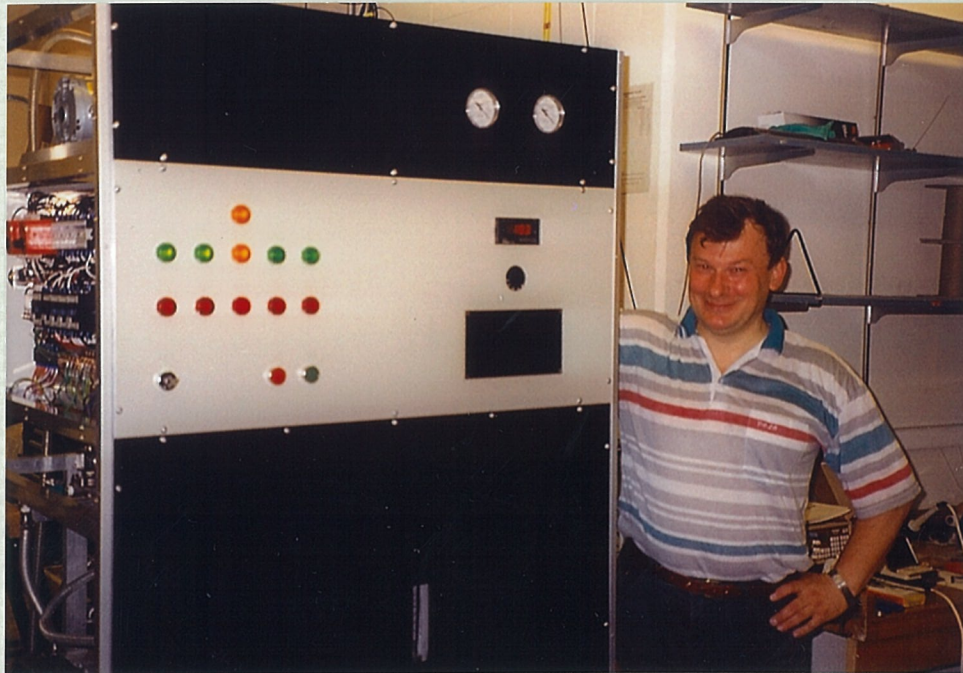
The counting house started to get filled up.





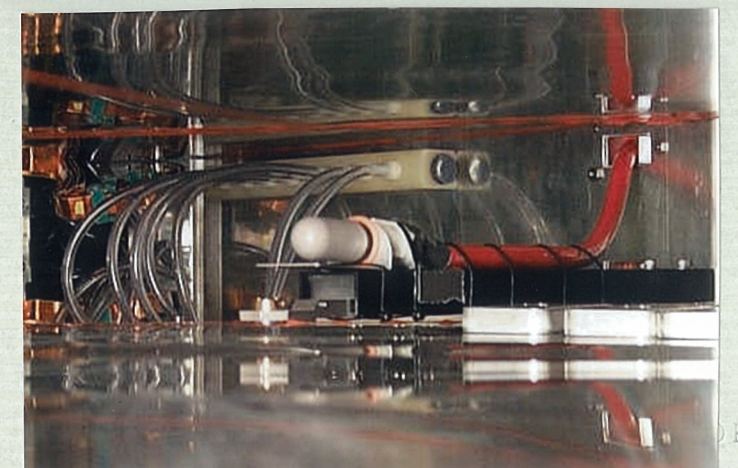
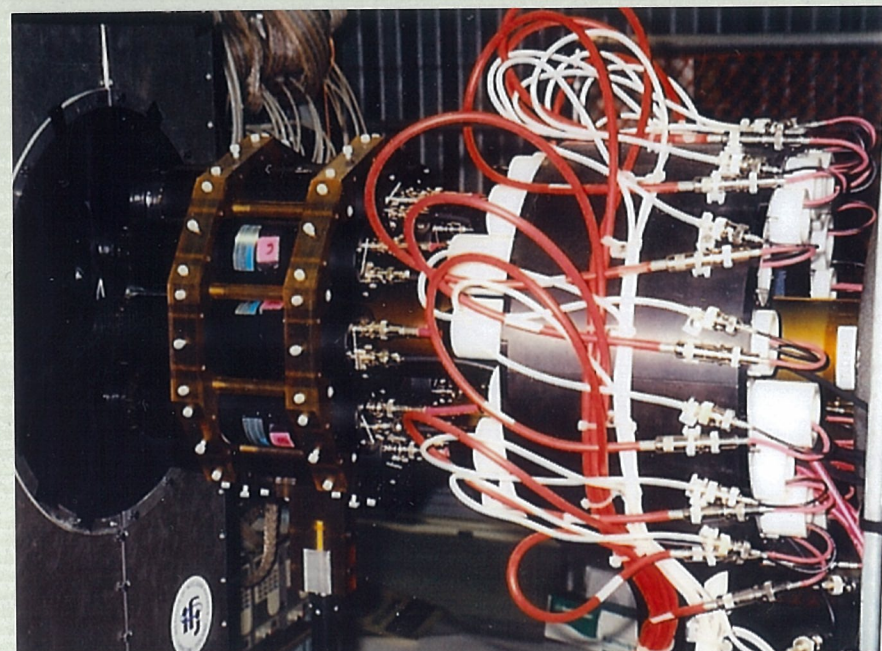
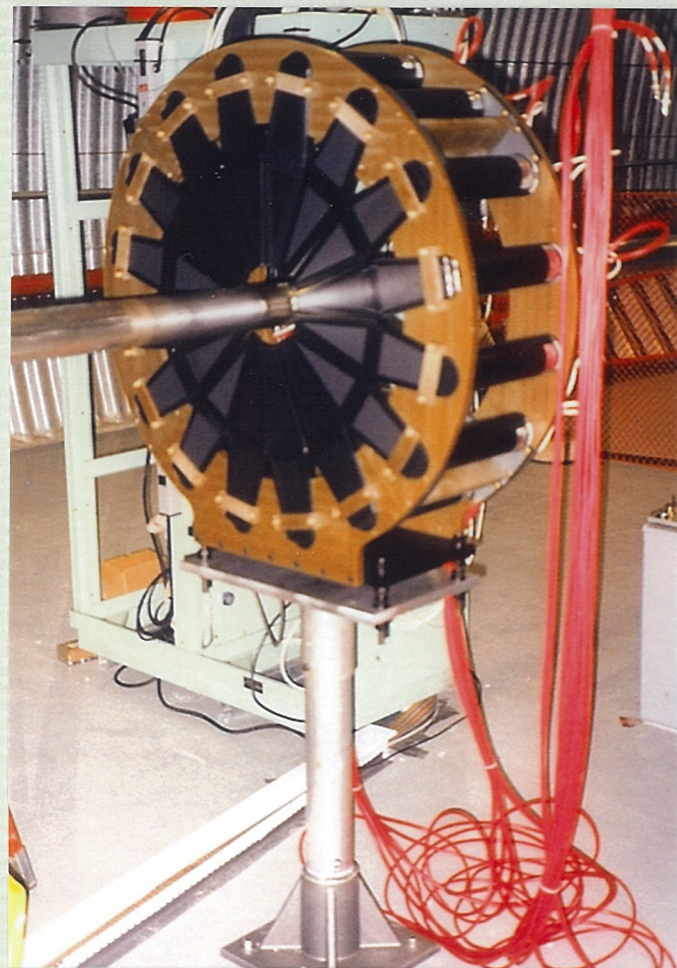
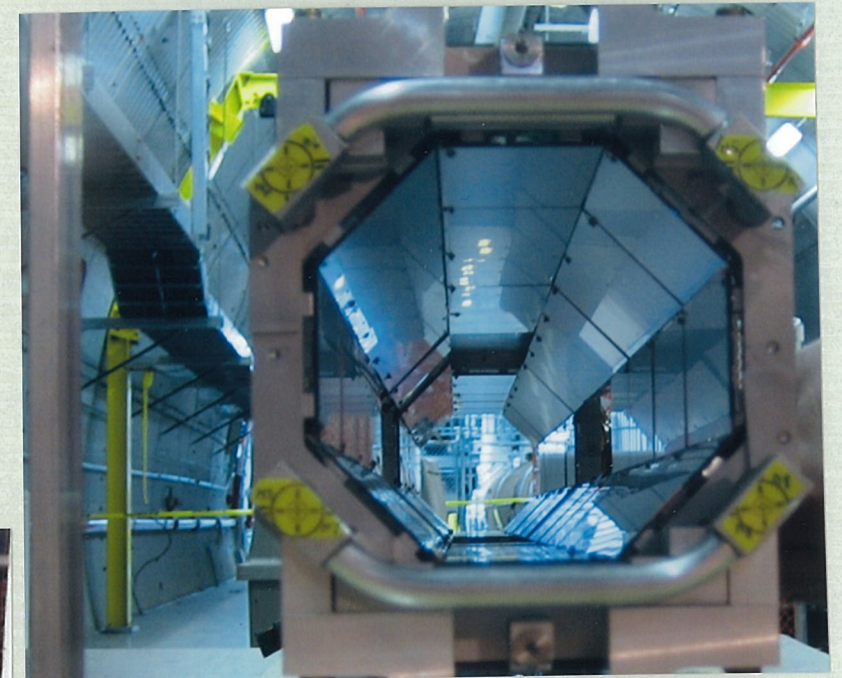
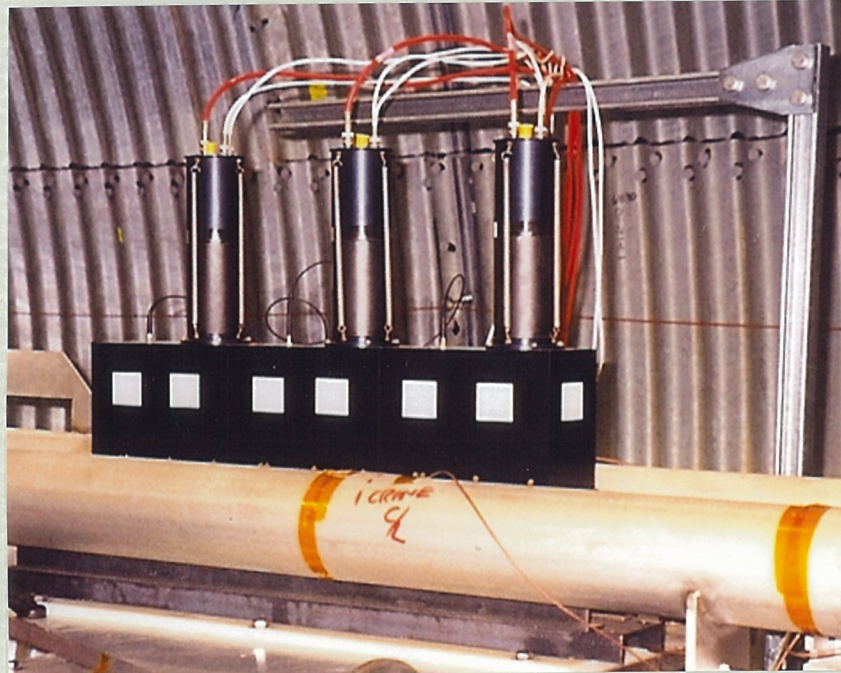
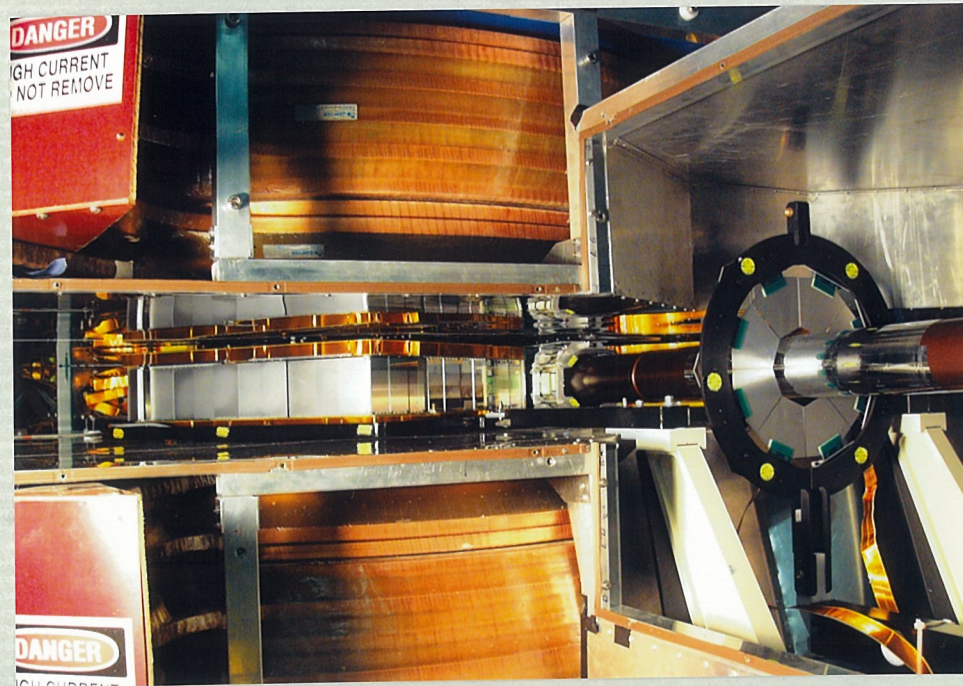
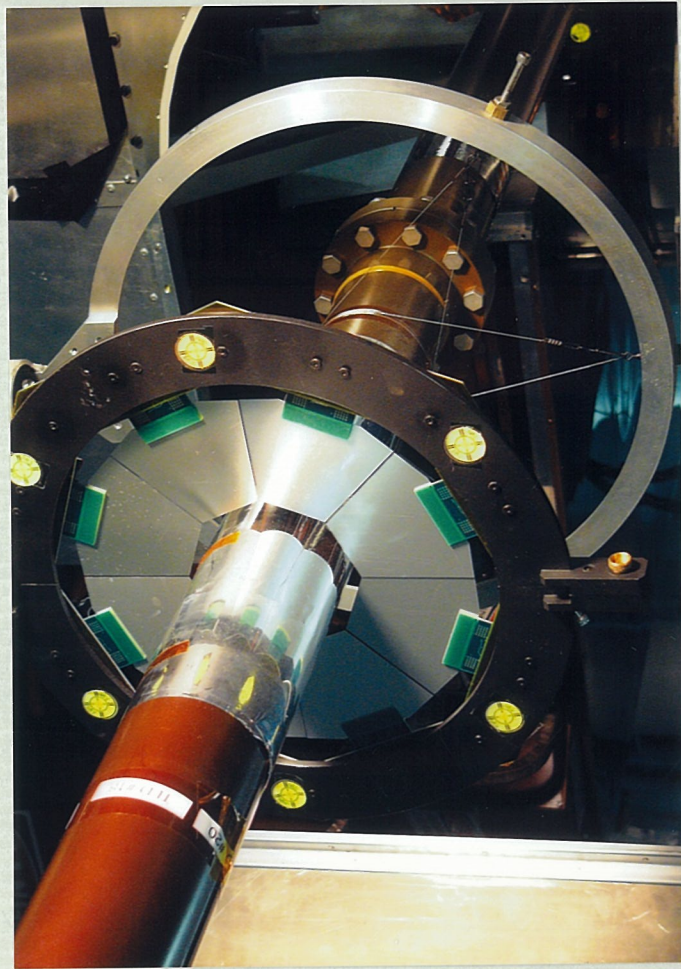


There was a lot to do and some of the clearances were very tight so we were all very proud at the end!

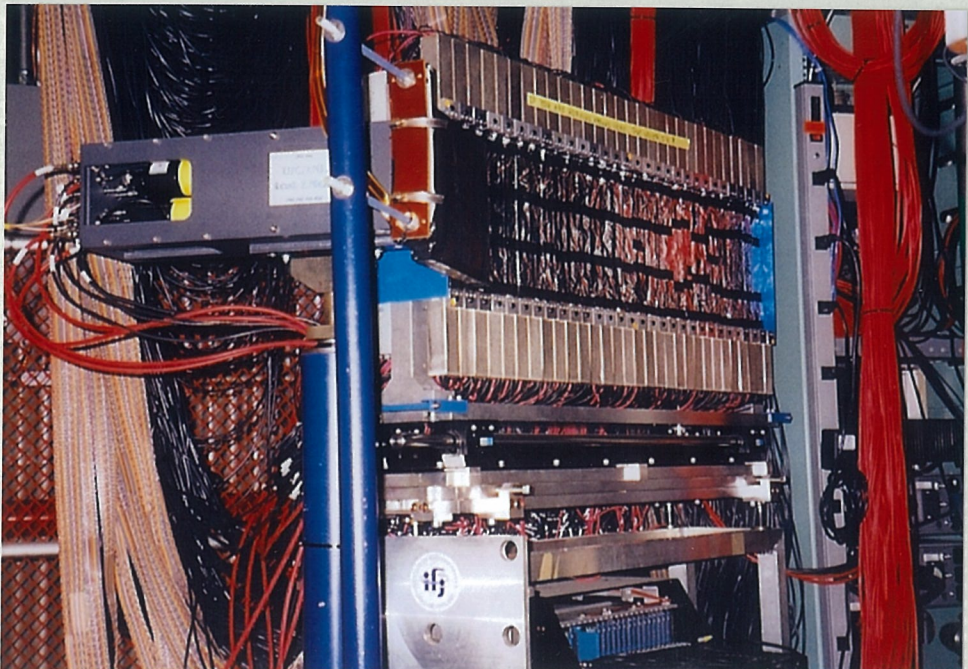
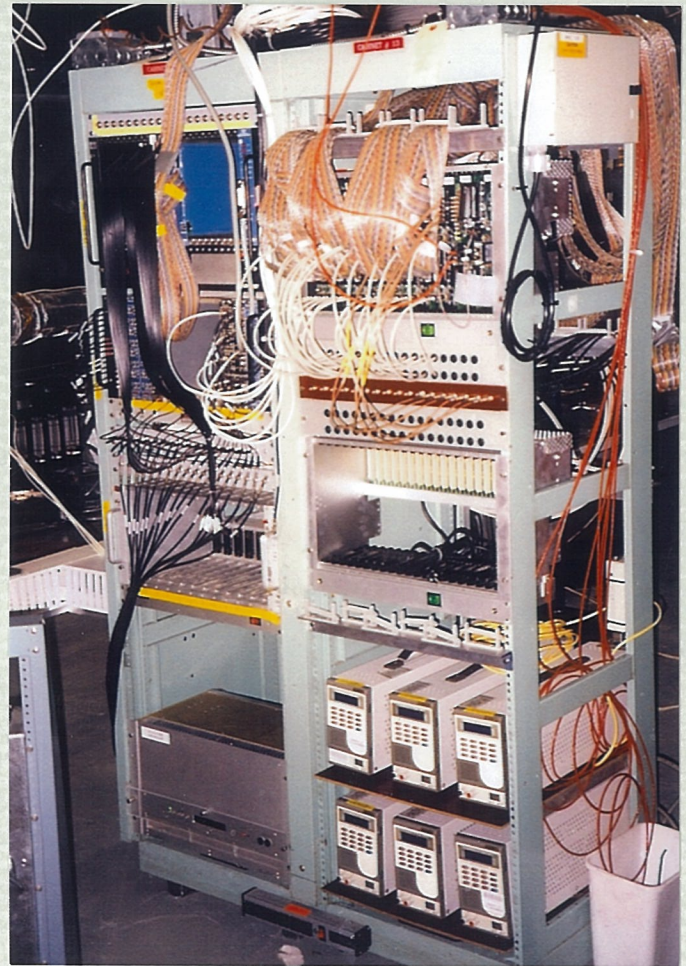
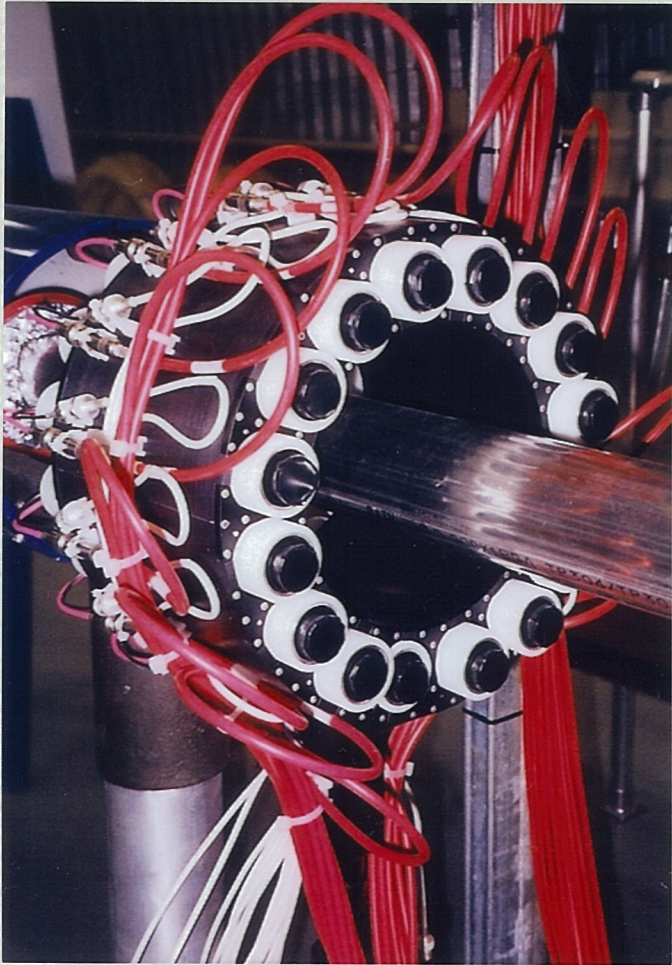
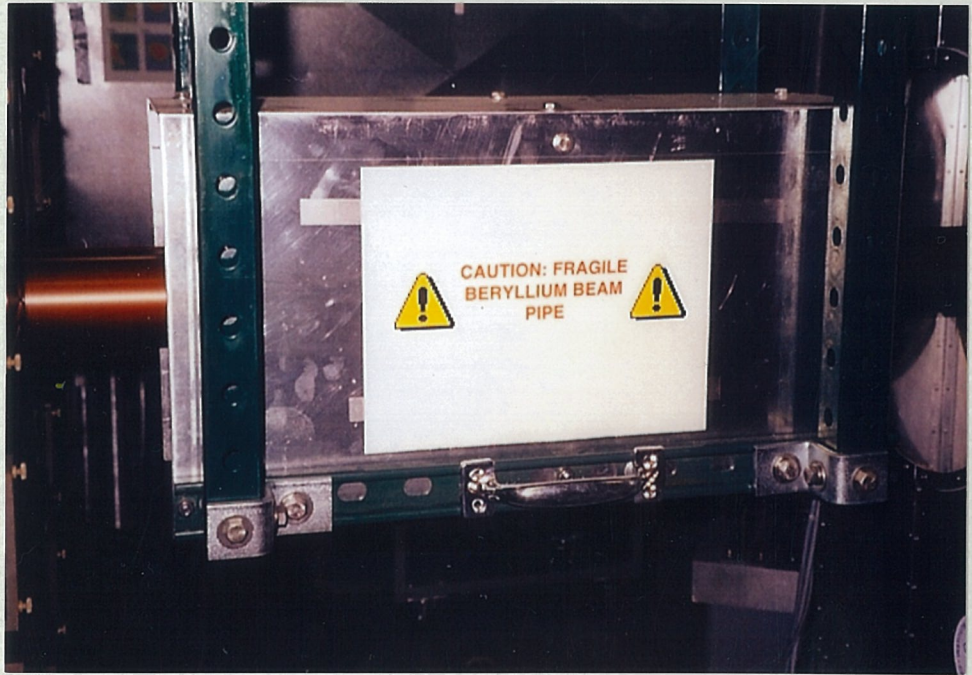
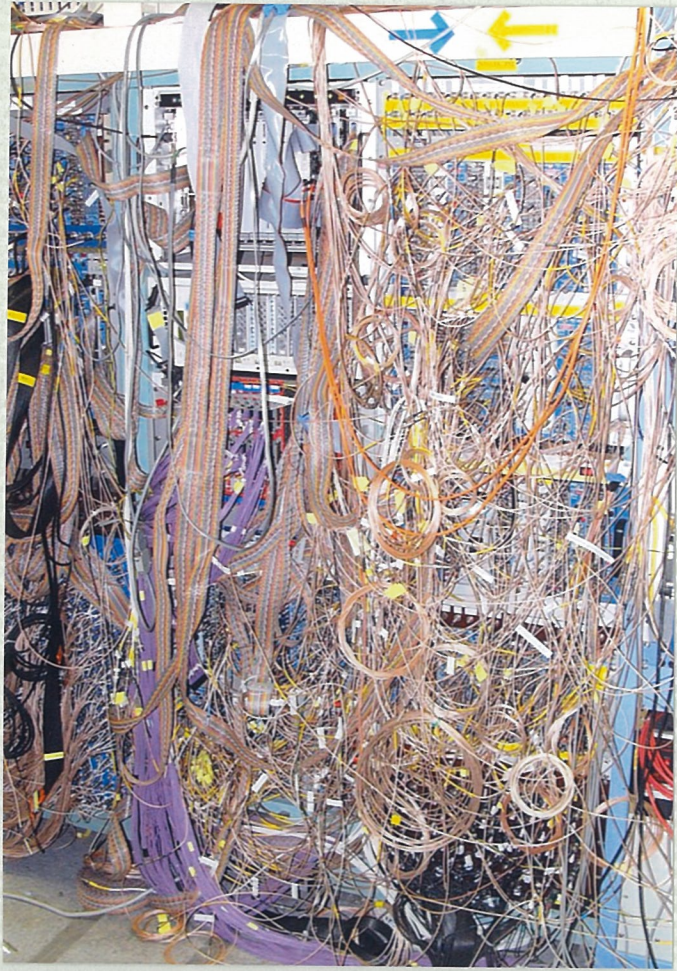
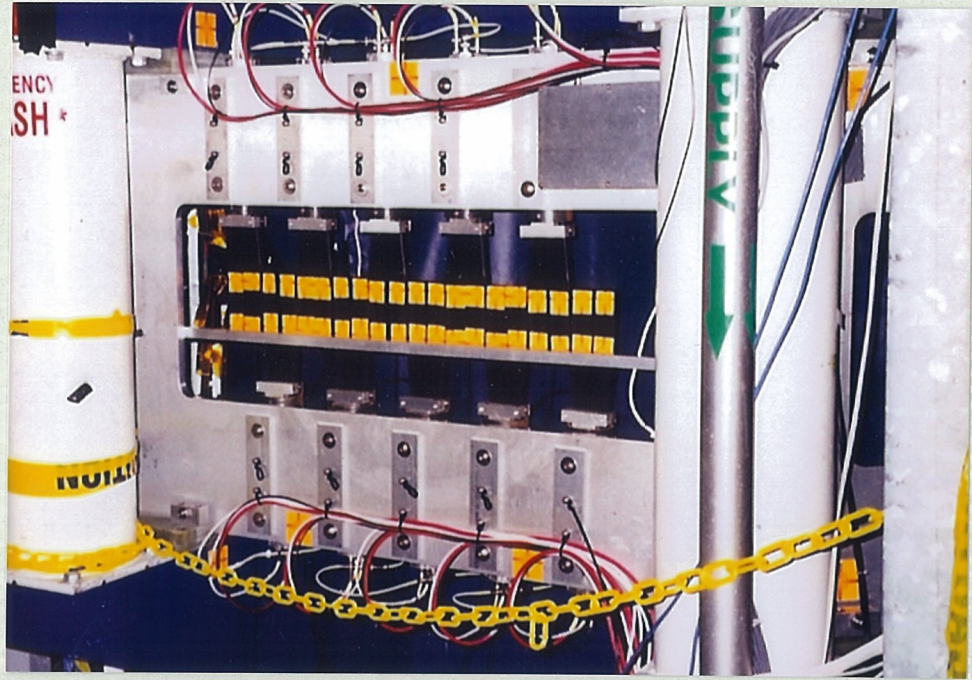




# Lots and lots of detectors and associated hardware

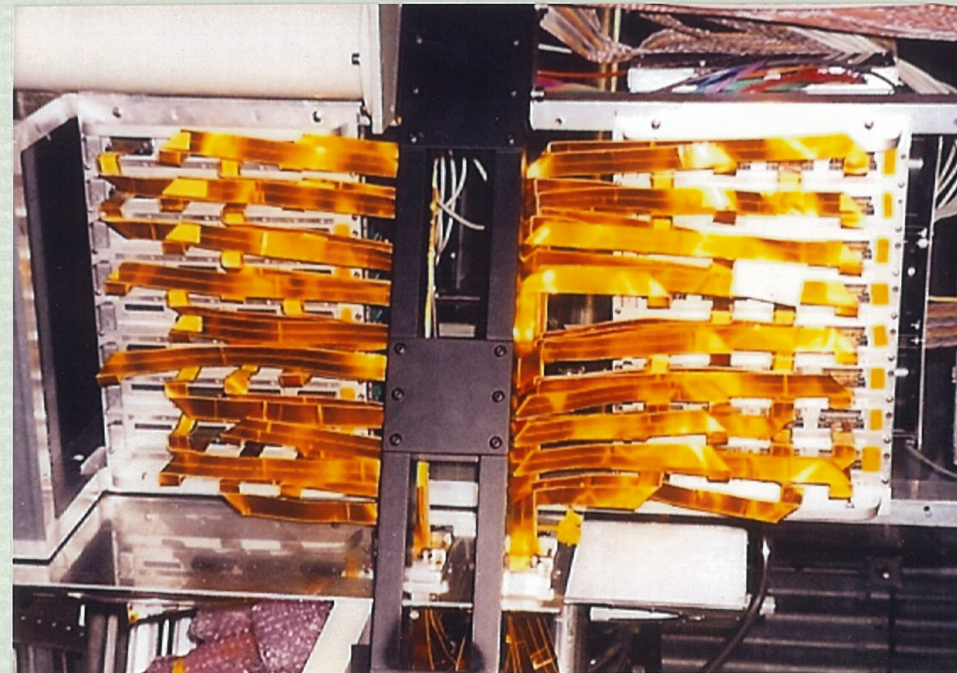
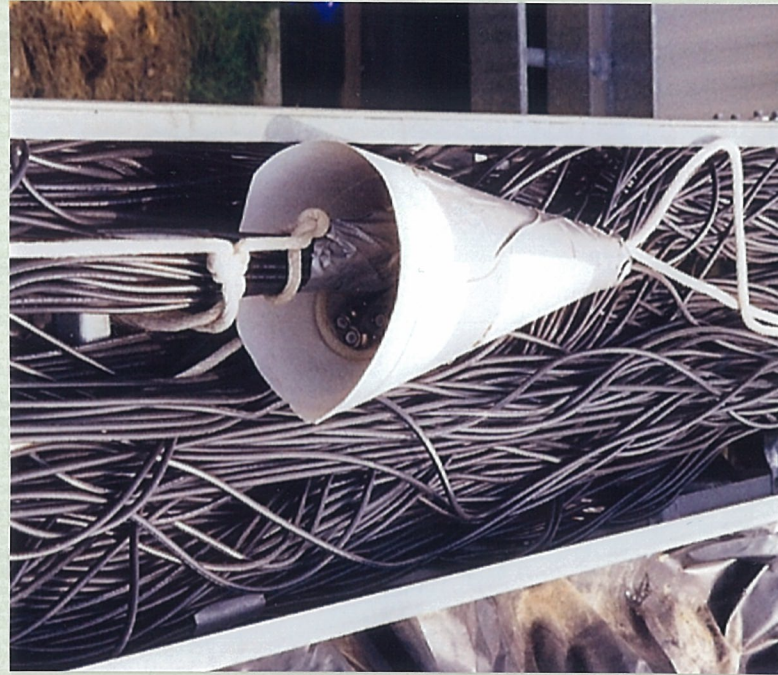




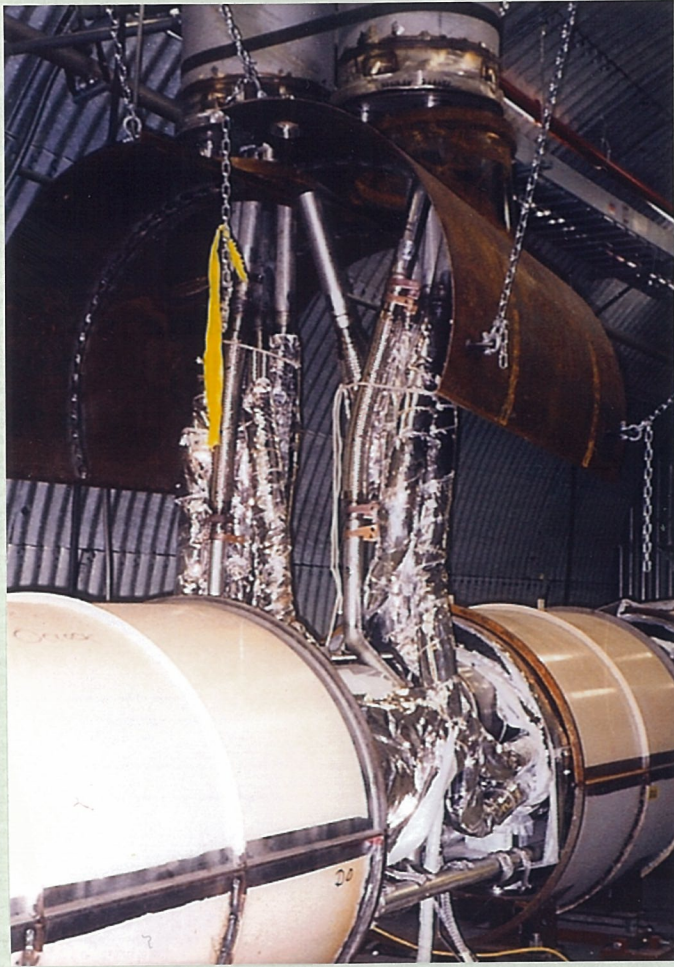




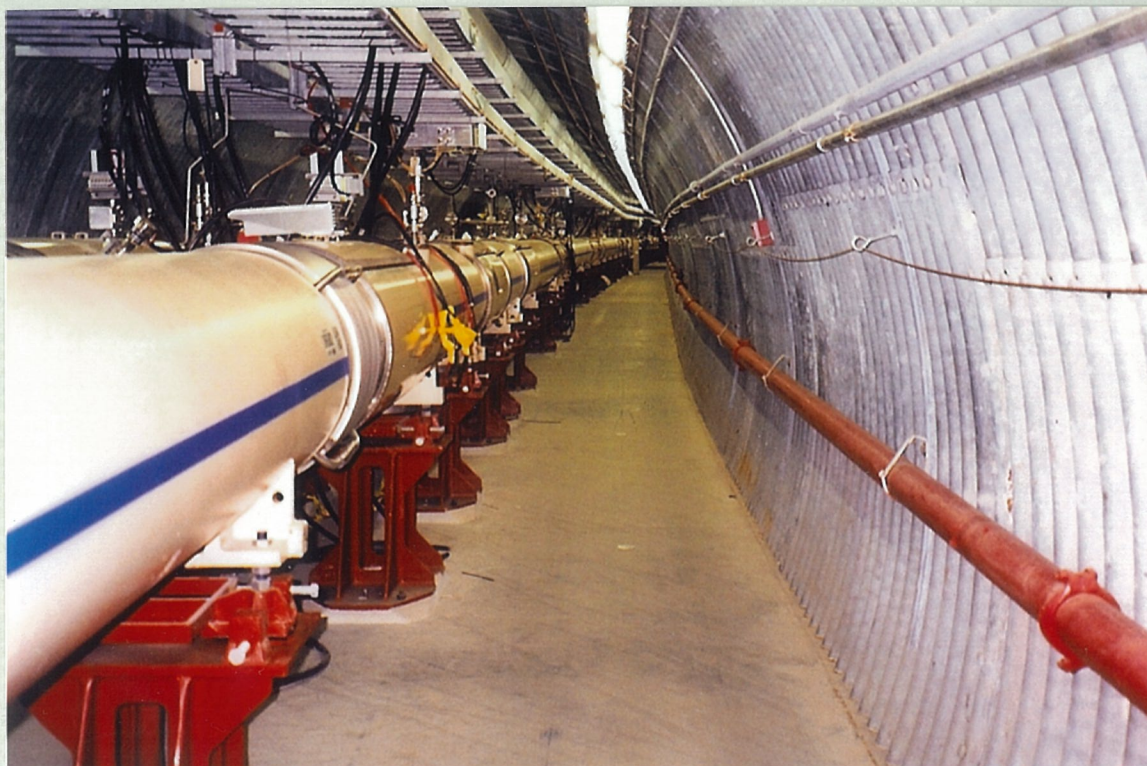
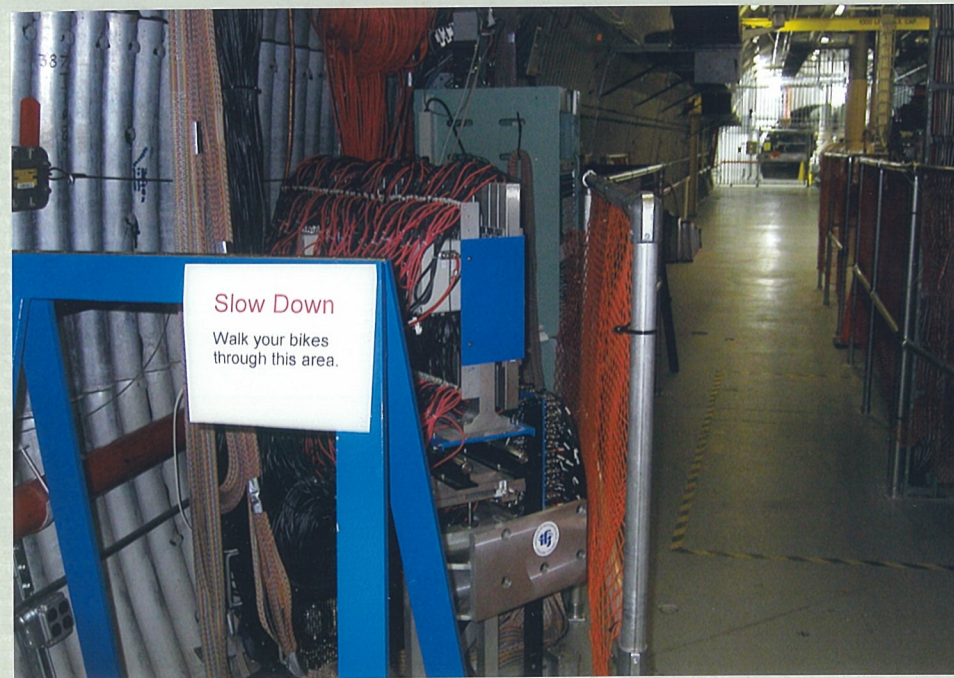
And there always seemed to be more and more cables...







Meanwhile, the RHIC accelerator and other systems were making progress.







Of course, everything wasn't always perfect

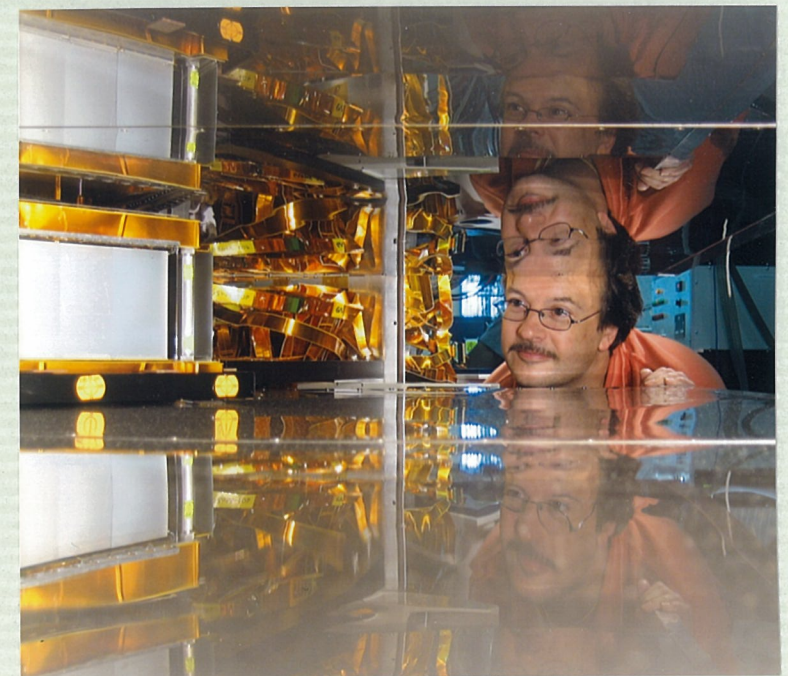
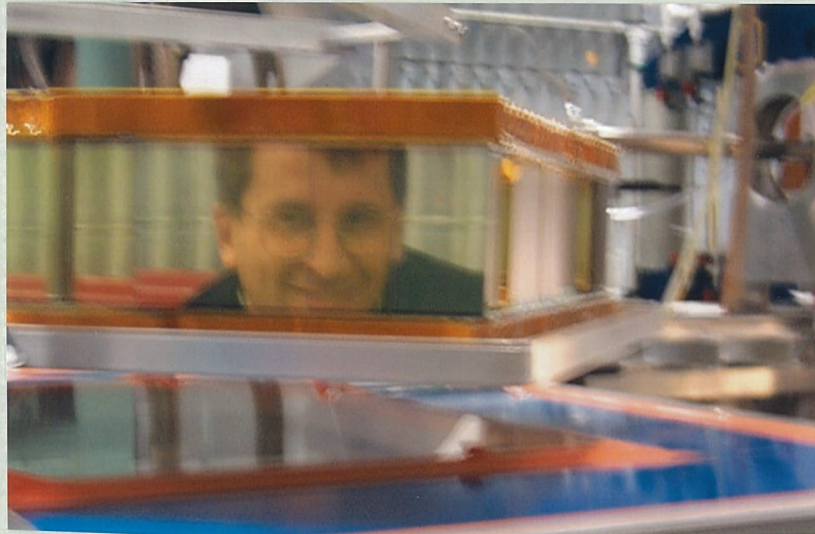
Phobos pioneered the fight against global warming







For some reason, none of us could resist the lure of the gap!

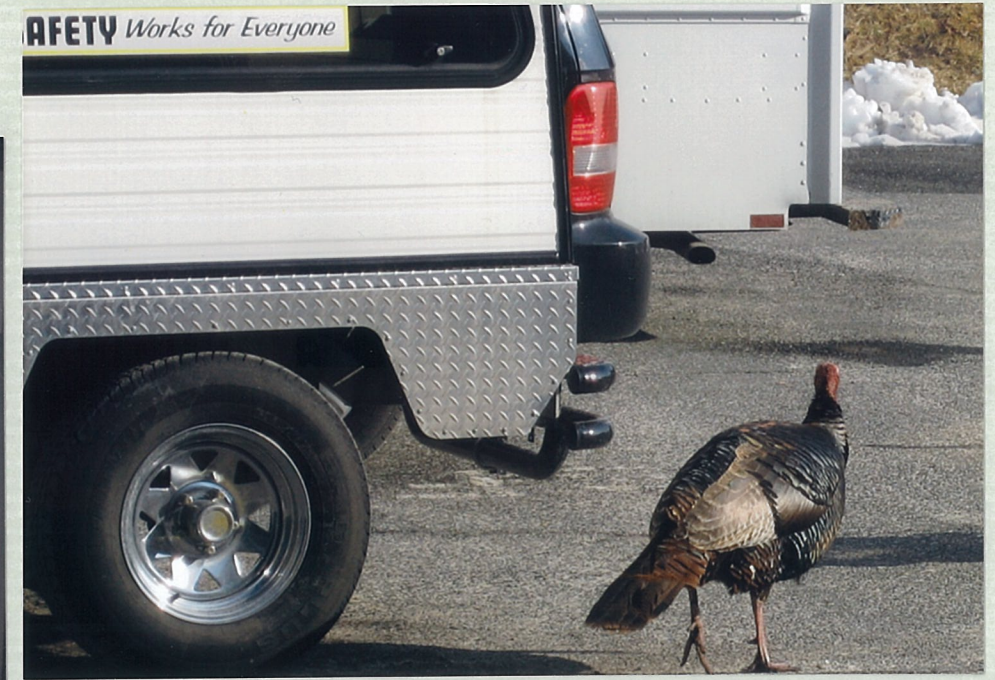
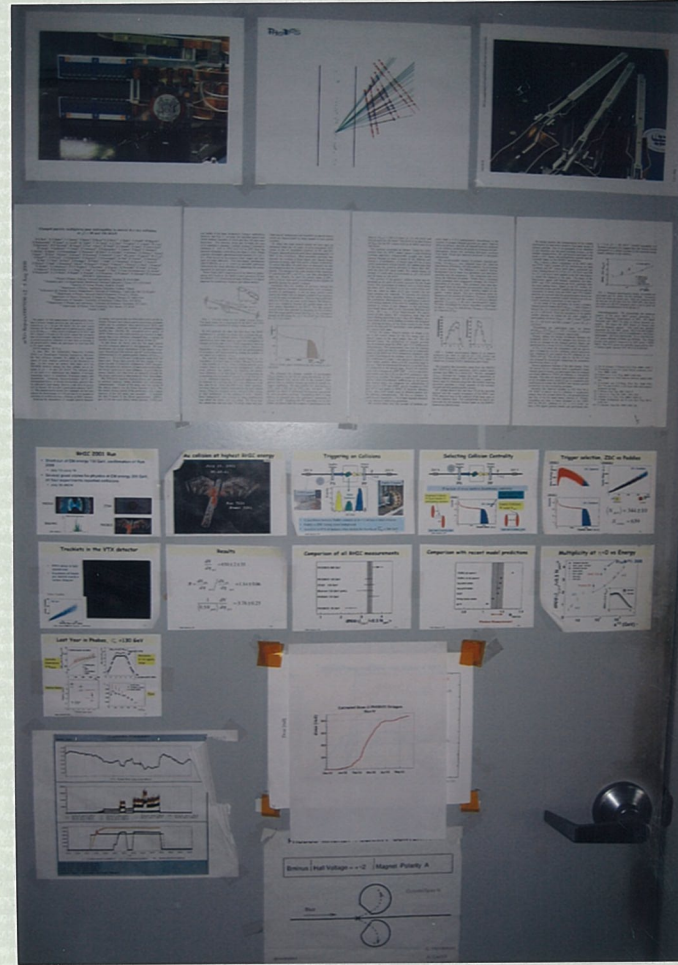




Things were getting busy in the counting house while outside, nature occasionally paid a visit.



Phobos made extensive use of high tech tools



They might need a different version of the training program for this guy!

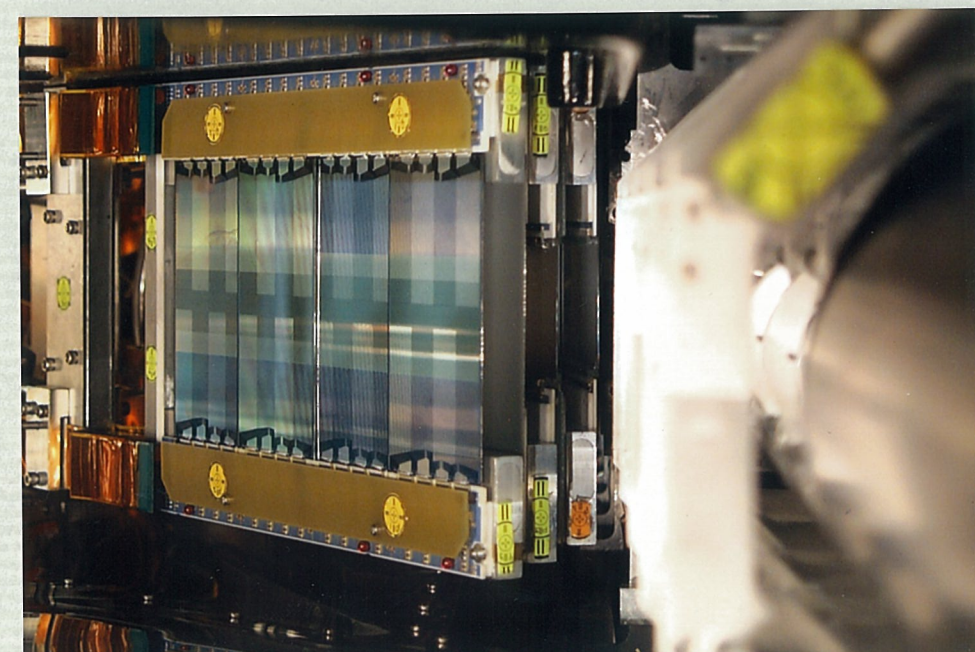
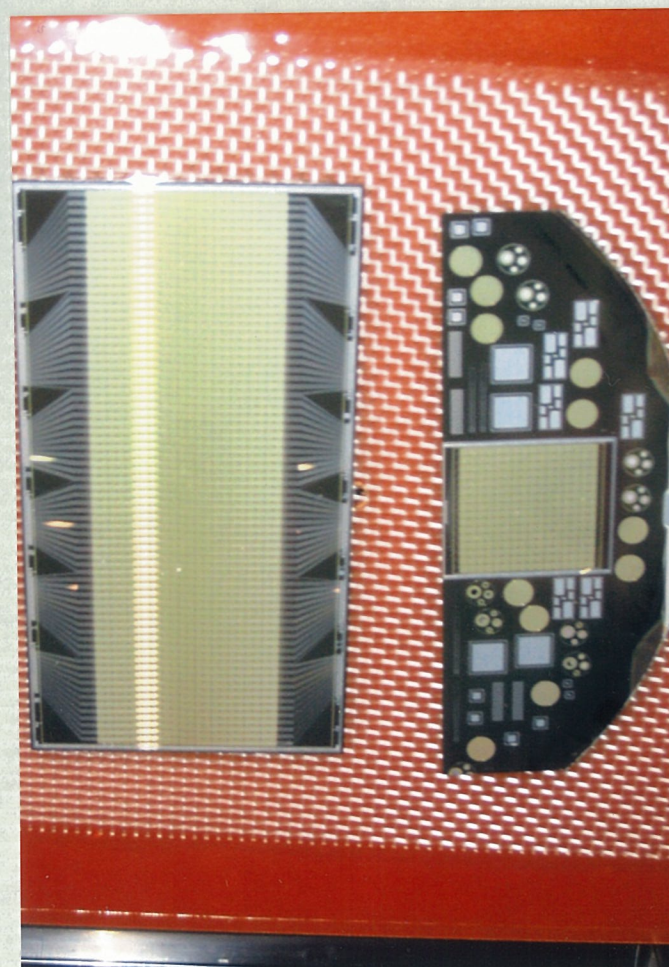
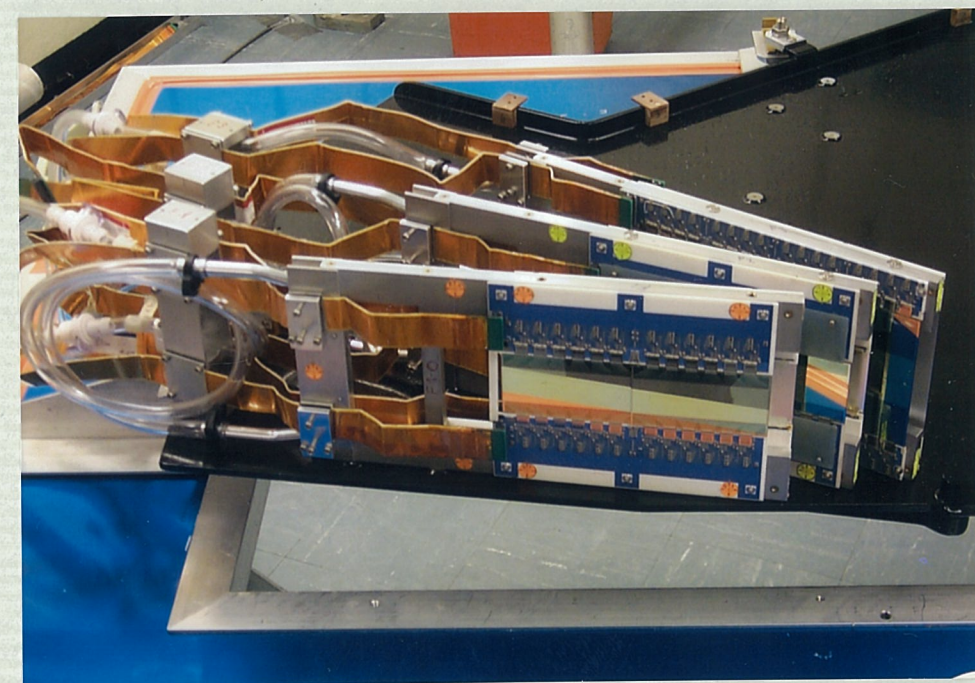
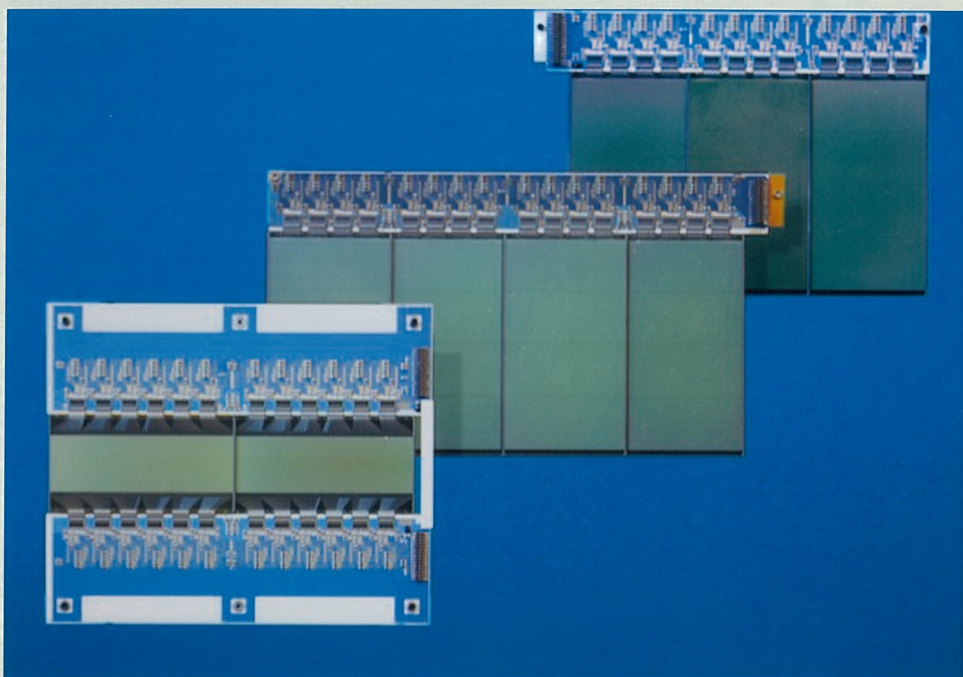
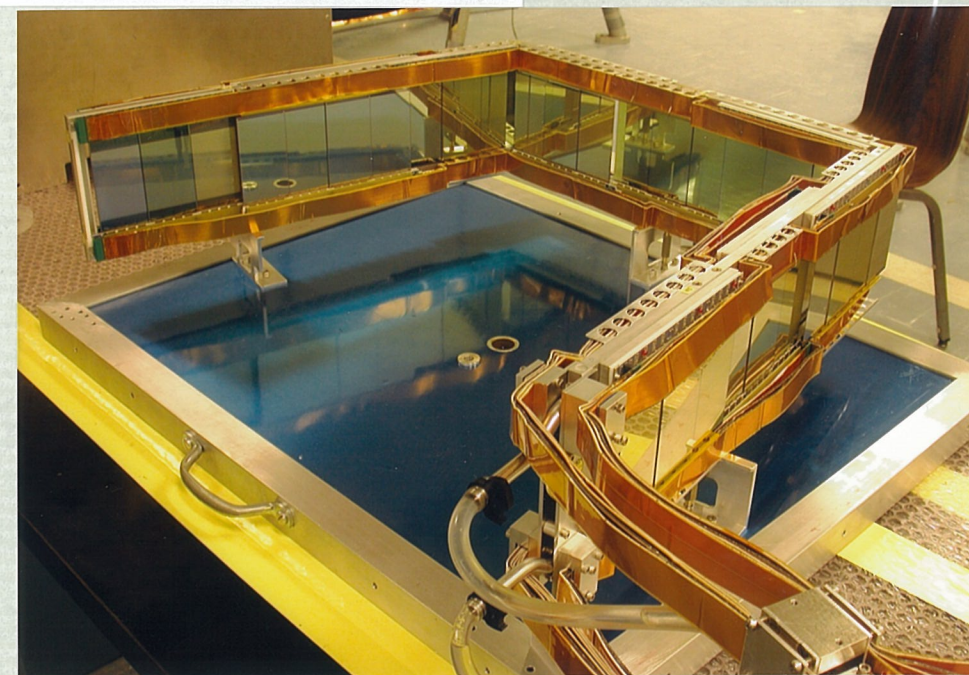
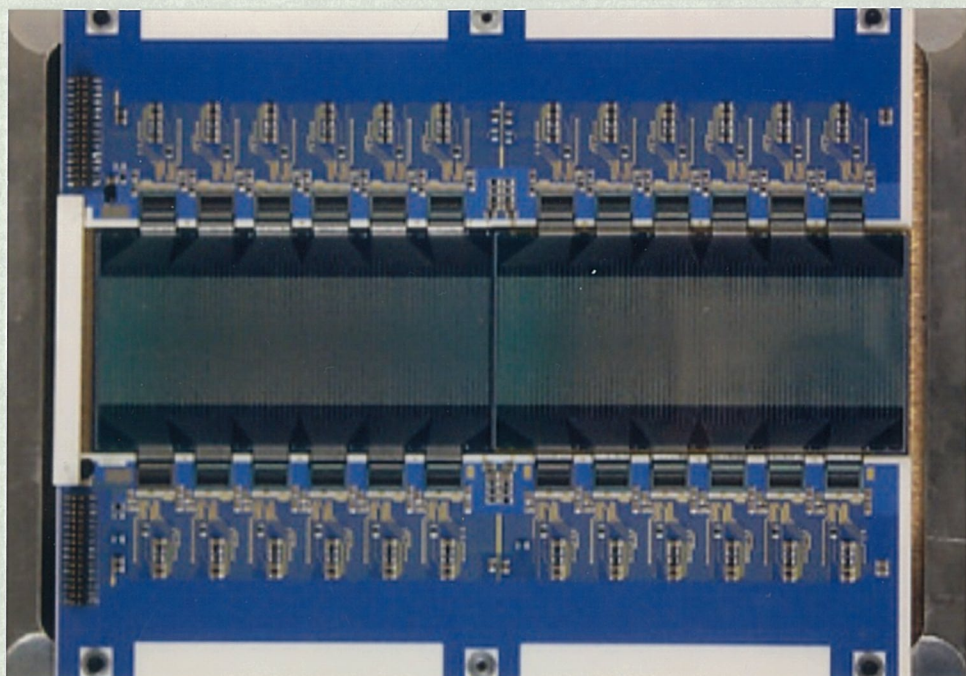


Someone who just realized that the access card doesn't work in the emergency exit.



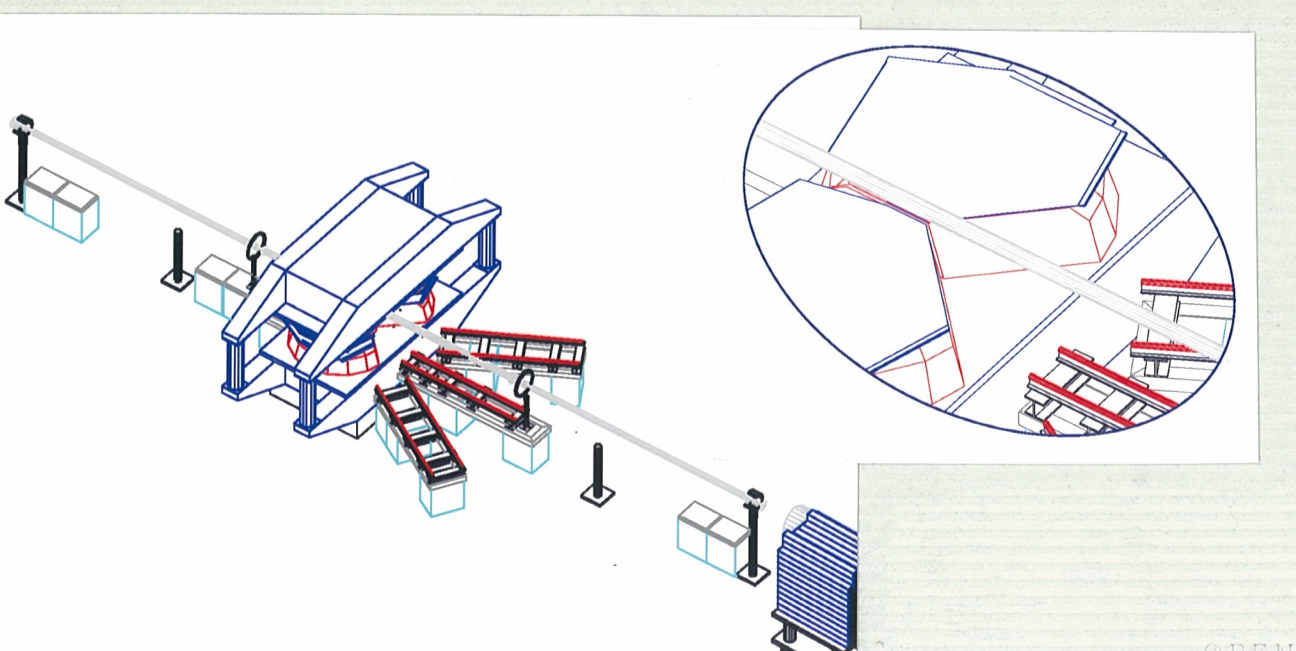
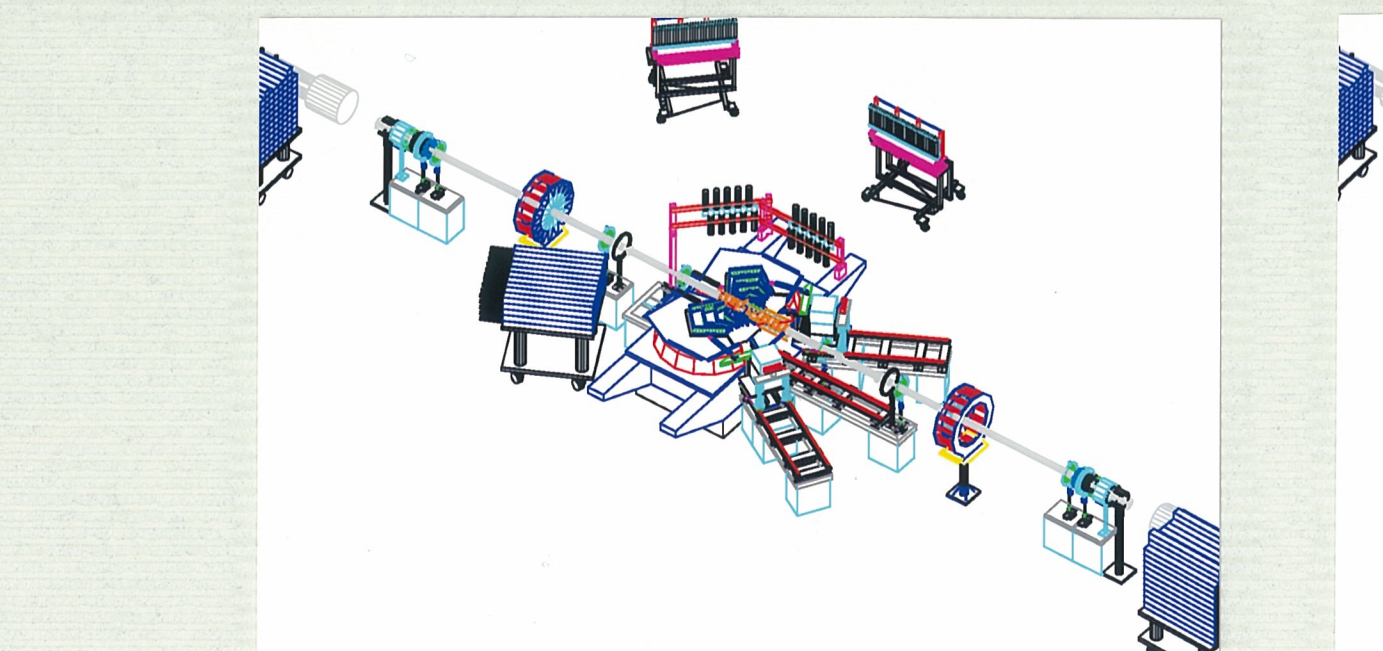
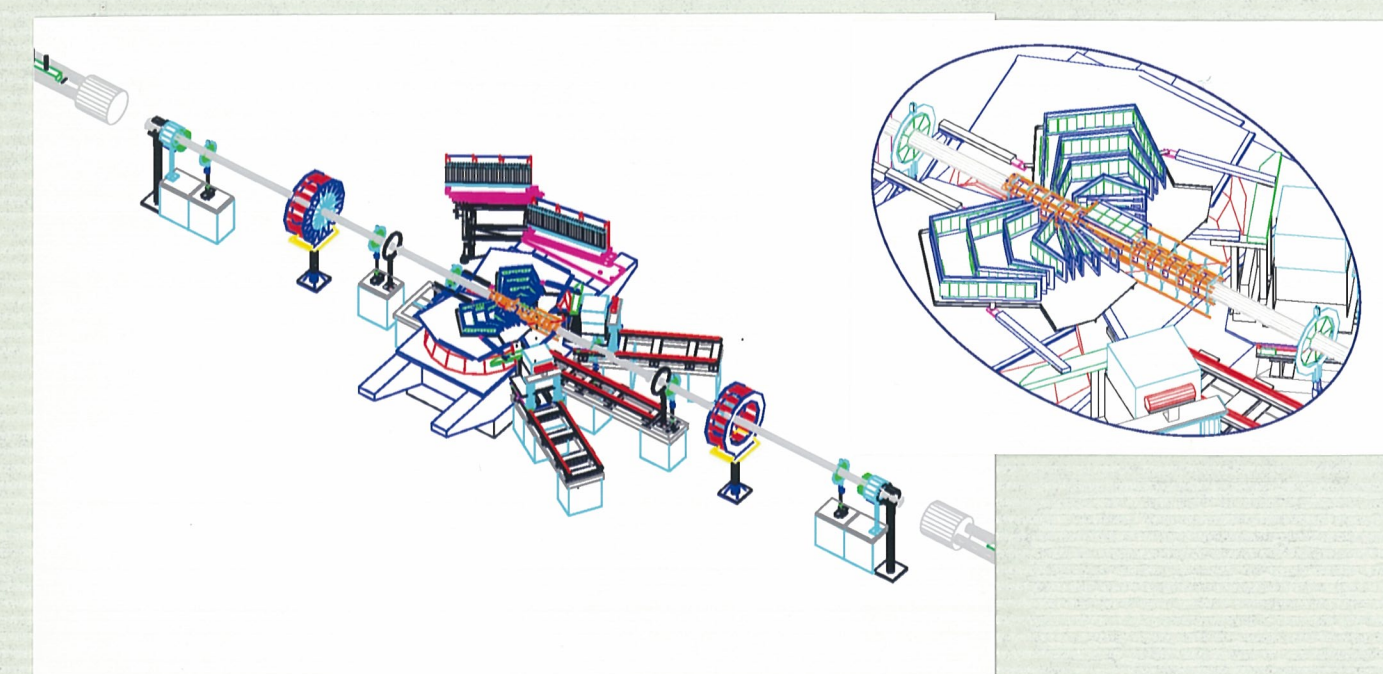
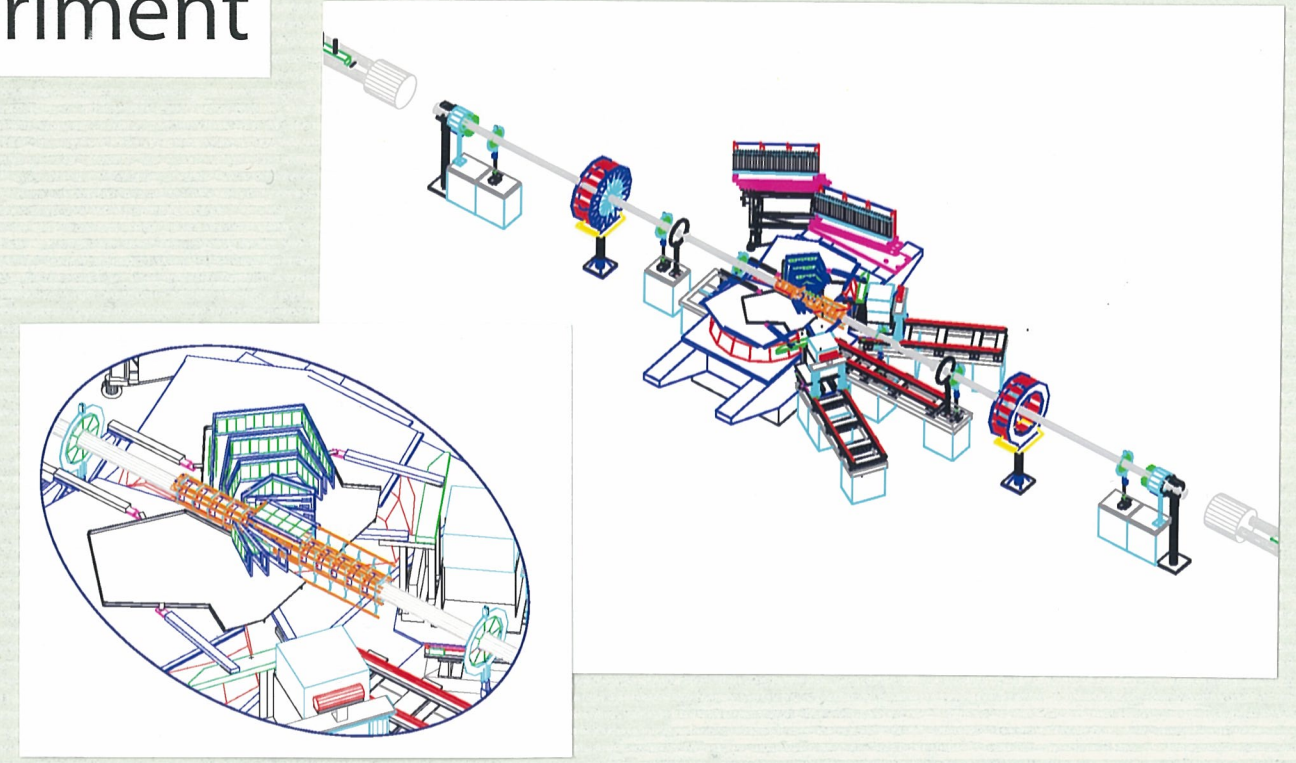
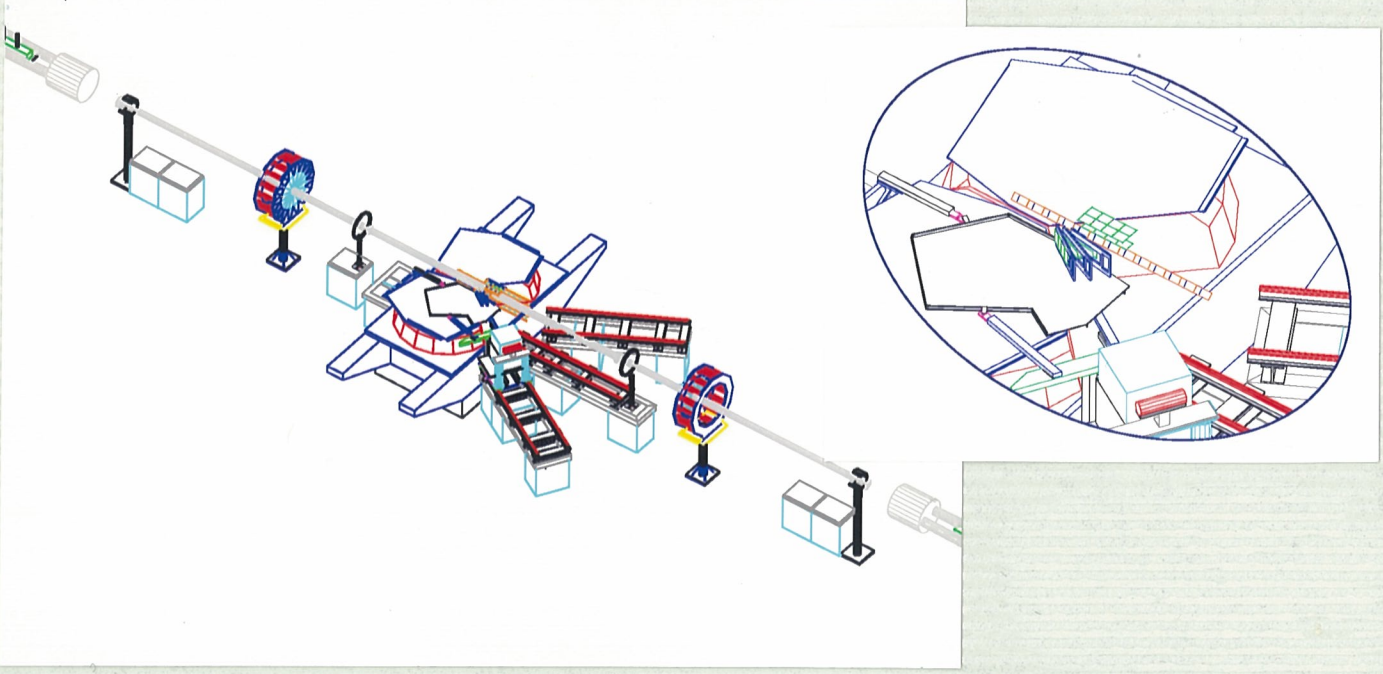


# A few of the many intricacies of the Si detectors



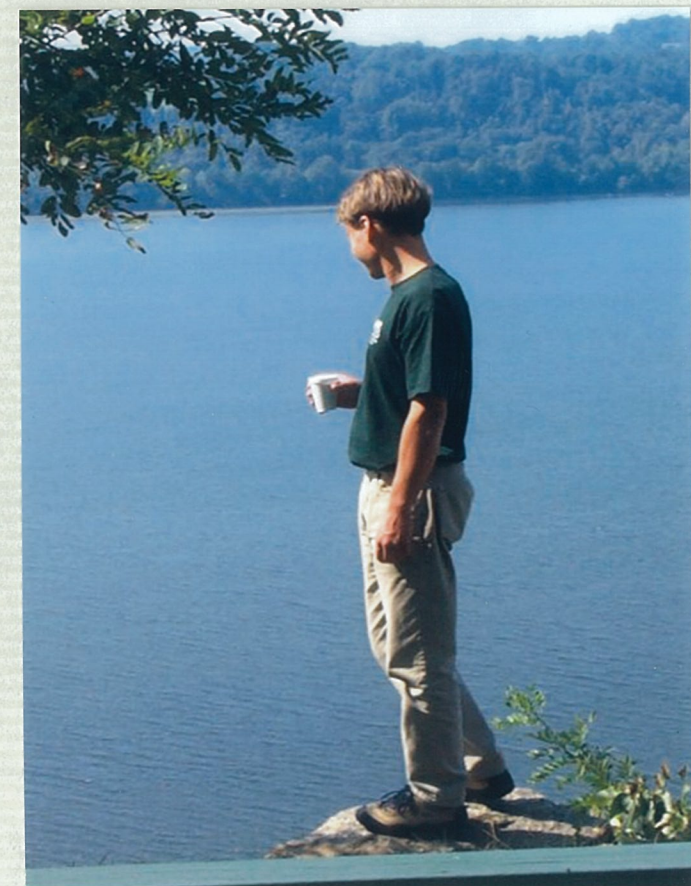


# The many faces of the experiment

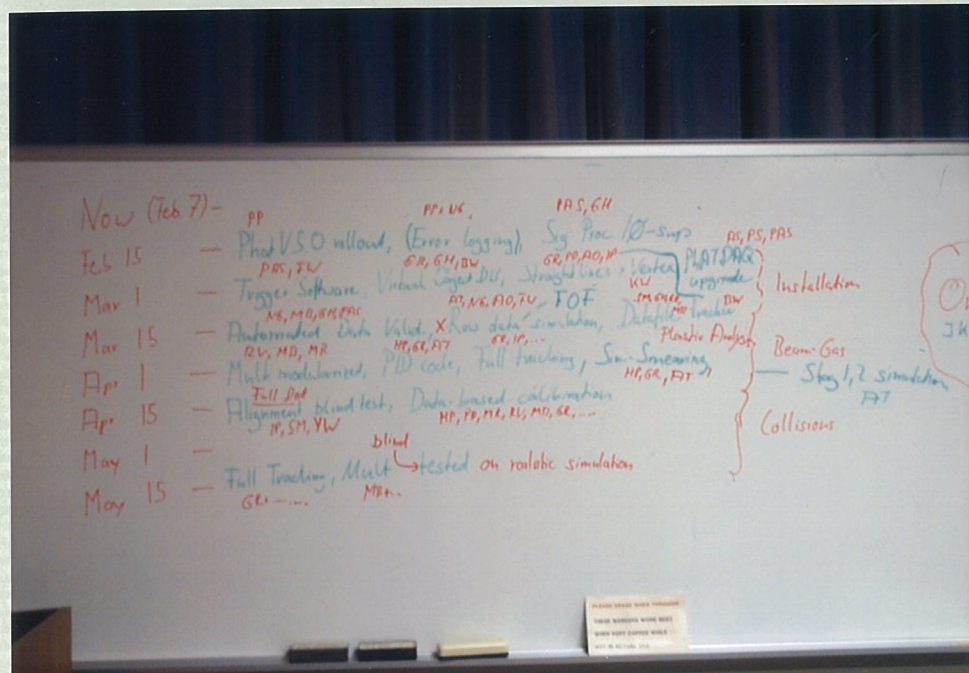




As time went on, we had lots and lots of meetings, some of them in wonderfully pleasant surroundings and some not.





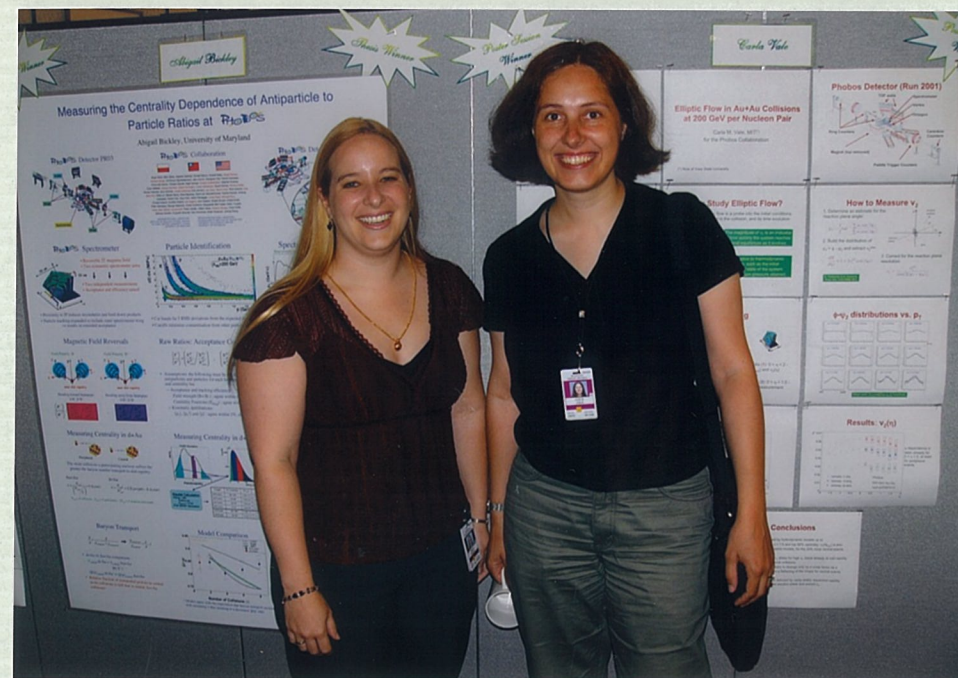




A few meetings were in the most pleasant surroundings



Award winning students!



A solid grasp of statistics is critical for physicists.





# Collaboration Meetings

2000

2002

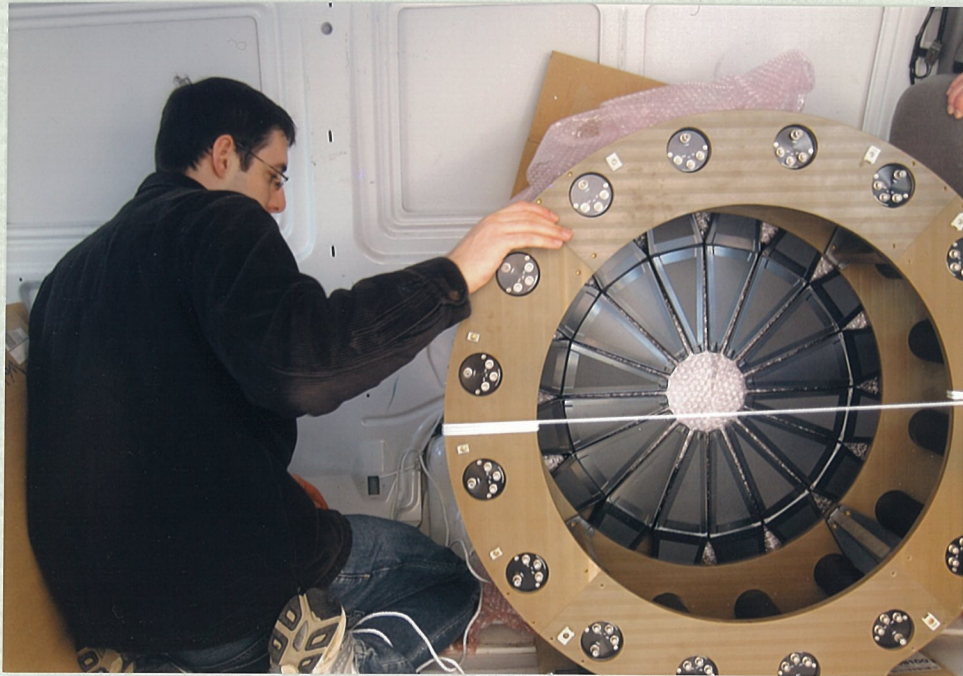


2003

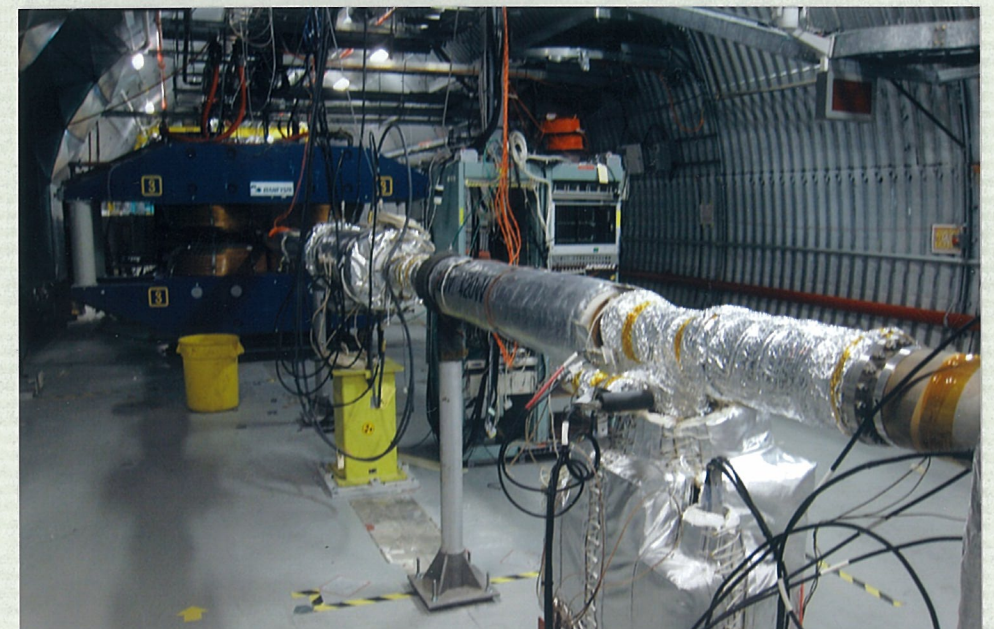
2005







All good things must come to an end and, so, sadly, Phobos has been dismantled.



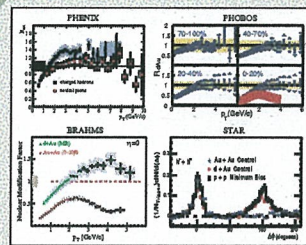


# But PHOBOS left behind a great legacy

## Several Widely

### PHYSICAL REVIEW LETTERS

Articles published week ending 15 AUGUST 2003  
Volume 91, Number 7

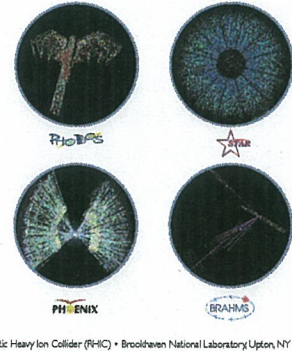


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## Hunting the Quark Gluon Plasma

RESULTS FROM THE FIRST 3 YEARS AT RHIC  
ASSESSMENTS BY THE EXPERIMENTAL COLLABORATIONS

April 18, 2005



Relativistic Heavy Ion Collider (RHIC) • Brookhaven National Laboratory Upton, NY 11974-5000

Office of Science  
RELATIVISTIC HEAVY ION COLLIDER

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## Energy Dependence of Particle Multiplicities in Central Au + Au Collisions at $\sqrt{s_{NN}} = 200$ GeV

B.B. Back<sup>1</sup>, M.D. Baker<sup>2</sup>, D.S. Barton<sup>3</sup>, R.R. Betts<sup>4</sup>, M. Ballintijn<sup>5</sup>, A.A. Bickley<sup>6</sup>, A. Budzanowski<sup>7</sup>, W. Busza<sup>8</sup>, A. Carroll<sup>9</sup>, J. Cai<sup>10</sup>, M.P. Decowski<sup>11</sup>, E. Garcia<sup>12</sup>, T. Gburek<sup>13</sup>, N.K. George<sup>14</sup>, K. Gulbrandsen<sup>15</sup>, S. Gustaf<sup>16</sup>, C. Halliwell<sup>17</sup>, J. Hamblen<sup>18</sup>, A.S. Harrington<sup>19</sup>, C. Henderson<sup>20</sup>, D.J. Hofman<sup>21</sup>, R.S. Hollis<sup>22</sup>, R. Holzmann<sup>23</sup>, E. Johnson<sup>24</sup>, J.L. Kane<sup>25</sup>, J. Katz<sup>26</sup>, N. Khan<sup>27</sup>, W. Kuo<sup>28</sup>, W. Kucewicz<sup>29</sup>, P. Kulinski<sup>30</sup>, C. Law<sup>31</sup>, M. Lemler<sup>32</sup>, J. Ligea<sup>33</sup>, W.T. Lin<sup>34</sup>, S. Manly<sup>35</sup>, D. McLoud<sup>36</sup>, J. Michalowski<sup>37</sup>, A. Mignerey<sup>38</sup>, J. Milosavljevic<sup>39</sup>, M. Nunez<sup>40</sup>, R. Nouicer<sup>41</sup>, A. Olszewski<sup>42</sup>, R. Pak<sup>43</sup>, J.C. Park<sup>44</sup>, M. Racz<sup>45</sup>, H. Pernegger<sup>46</sup>, C. Reed<sup>47</sup>, L.P. Remberg<sup>48</sup>, M. Reuter<sup>49</sup>, C. Roland<sup>50</sup>, G. Roland<sup>51</sup>, L. Rosenberg<sup>52</sup>, J. Sagerer<sup>53</sup>, P. Sarin<sup>54</sup>, P. Sawicki<sup>55</sup>, K. Skudlarczyk<sup>56</sup>, J. Skudlarczyk<sup>57</sup>, S. Stachel<sup>58</sup>, G.S.F. Stephens<sup>59</sup>, P. Steinberg<sup>60</sup>, A. Stogin<sup>61</sup>, M. Stork<sup>62</sup>, Z. Szafranski<sup>63</sup>, A. Sukhanov<sup>64</sup>, K. Szwed<sup>65</sup>, J.L. Tang<sup>66</sup>, R. Teng<sup>67</sup>, A. Trzpek<sup>68</sup>, C. Vale<sup>69</sup>, G.J. van Nieuwenhuizen<sup>70</sup>, R. Verrier<sup>71</sup>, B. Wadsworth<sup>72</sup>, F.L.H. Wolfs<sup>73</sup>, B. Wosiek<sup>74</sup>, K. Wozniak<sup>75</sup>, A.H. Wuosmaa<sup>76</sup>, B. Wyslouch<sup>77</sup>, and P. Zychowski<sup>78</sup>

PHOBOS Collaboration

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<sup>2</sup>Chemistry and C.A. Department, Brookhaven National Laboratory, Upton, New York 11973-5000  
<sup>3</sup>Institute of Nuclear Physics, Krakow, Poland  
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<sup>6</sup>Department of Physics, University of Illinois at Chicago, Chicago, Illinois 60607-7019  
<sup>7</sup>Department of Chemistry and Biochemistry, University of Maryland, College Park, Maryland 20742  
<sup>8</sup>Department of Physics, University of Maryland, College Park, Maryland 20742  
<sup>9</sup>Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627  
<sup>10</sup>Department of Physics, Yale University, New Haven, Connecticut 06520  
(Received 10 July 2003)

We present the first measurement of pseudorapidity distribution of primary charged particles near midrapidity in Au + Au collisions at  $\sqrt{s_{NN}} = 200$  GeV. For the most central collisions, we find the charged-particle pseudorapidity density  $dN_{ch}/d\eta_{ch}d\eta_{pT}$  at  $\eta_{ch} = 0$  to be  $0.82 \pm 0.02$  for  $\eta_{pT} = 0.05$  to  $0.15$  and  $0.75 \pm 0.02$  for  $\eta_{pT} = 0.15$  to  $0.25$ . This is the first measurement of the pseudorapidity density per participant by more than one experiment.

PACS numbers: 25.75.-g

DOI: 10.1103/PhysRevLett.91.022302

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## Energy Dependence of Particle Multiplicities in Central Au + Au Collisions at $\sqrt{s_{NN}} = 200$ GeV

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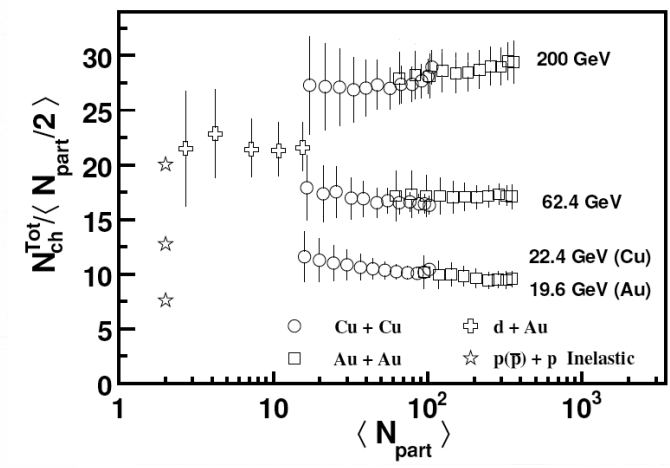
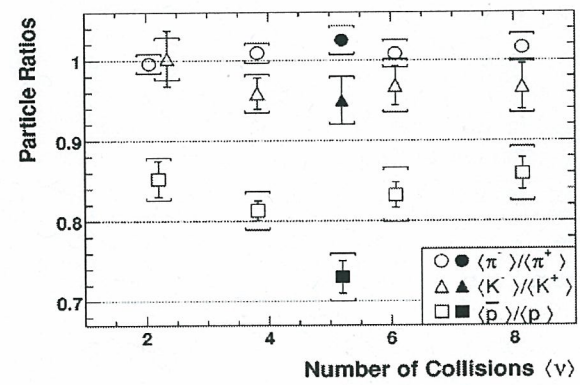
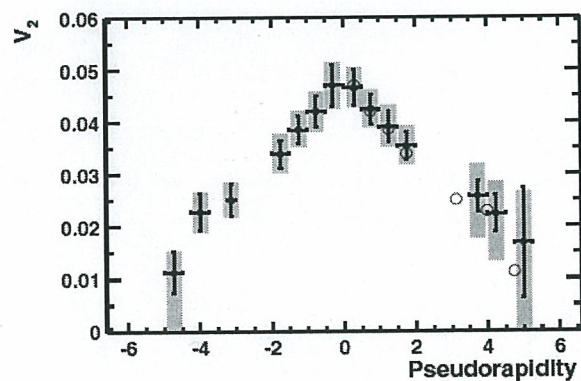
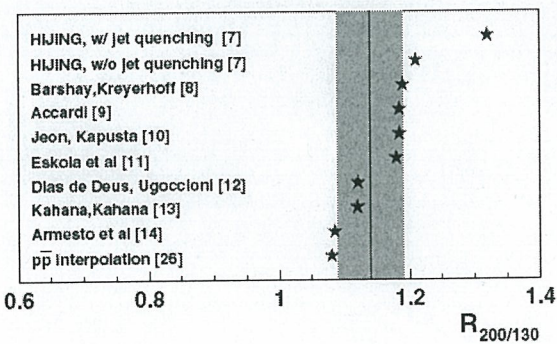
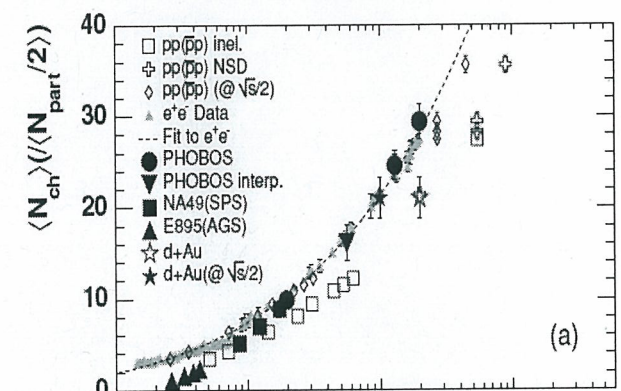
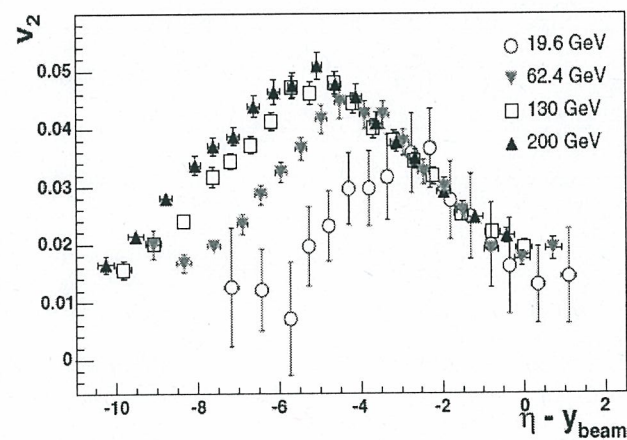
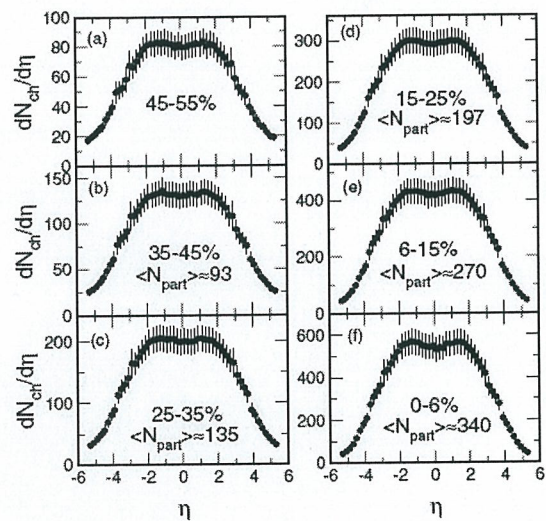
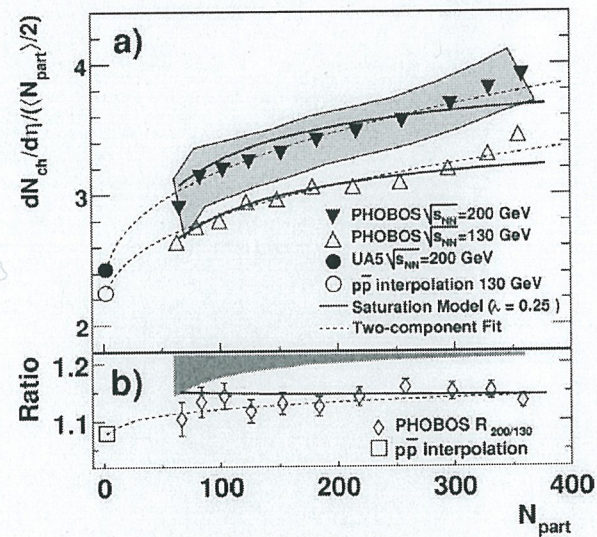
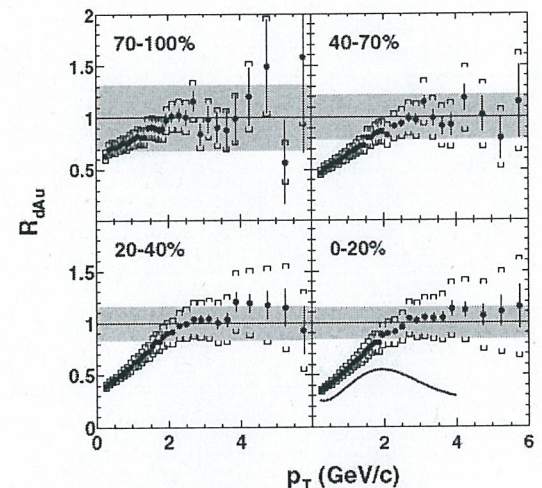
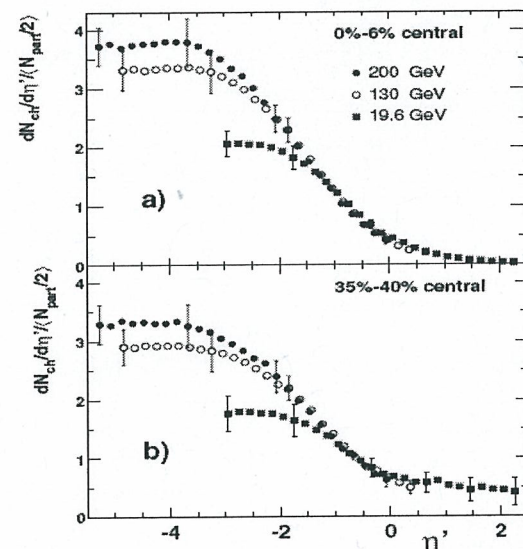
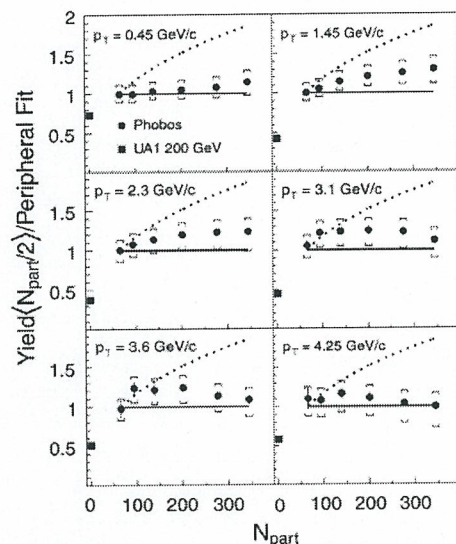
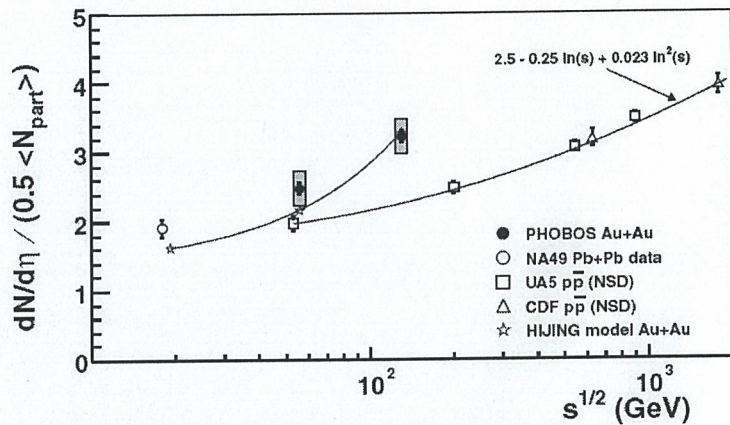
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PHYSICAL REVIEW LETTERS



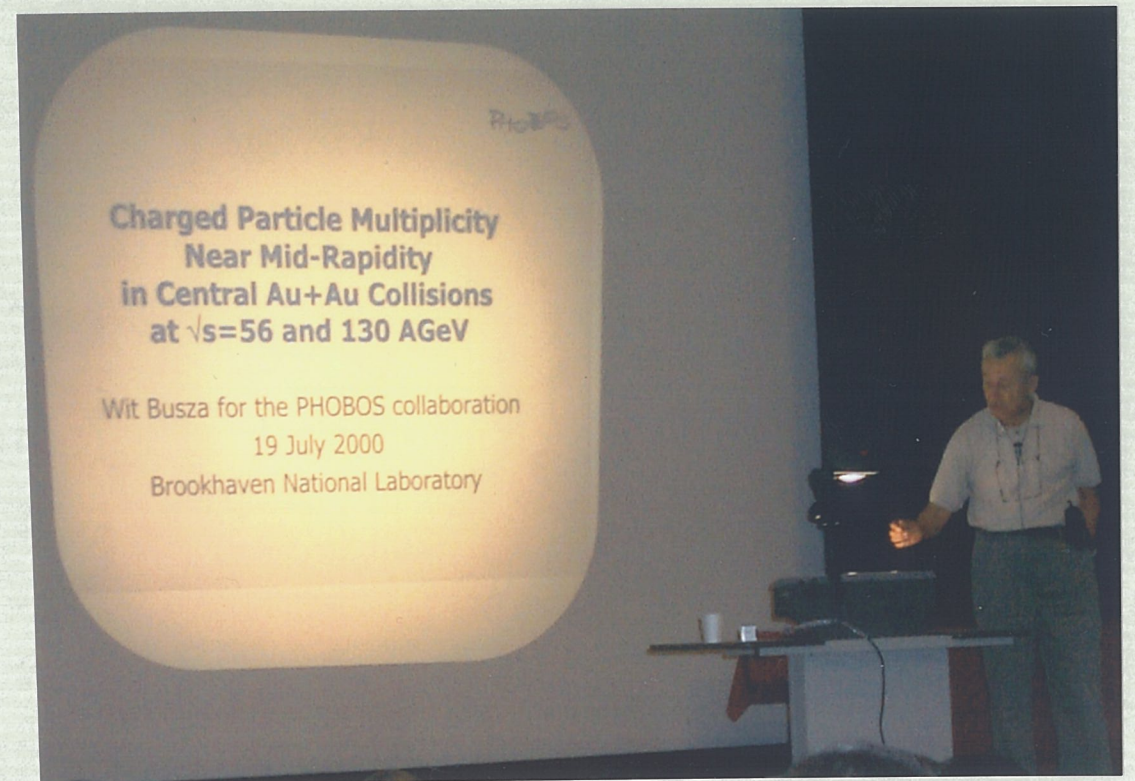
# Filled With Many

# Exciting Discoveries





Throughout it all, Wit was always there to point the way



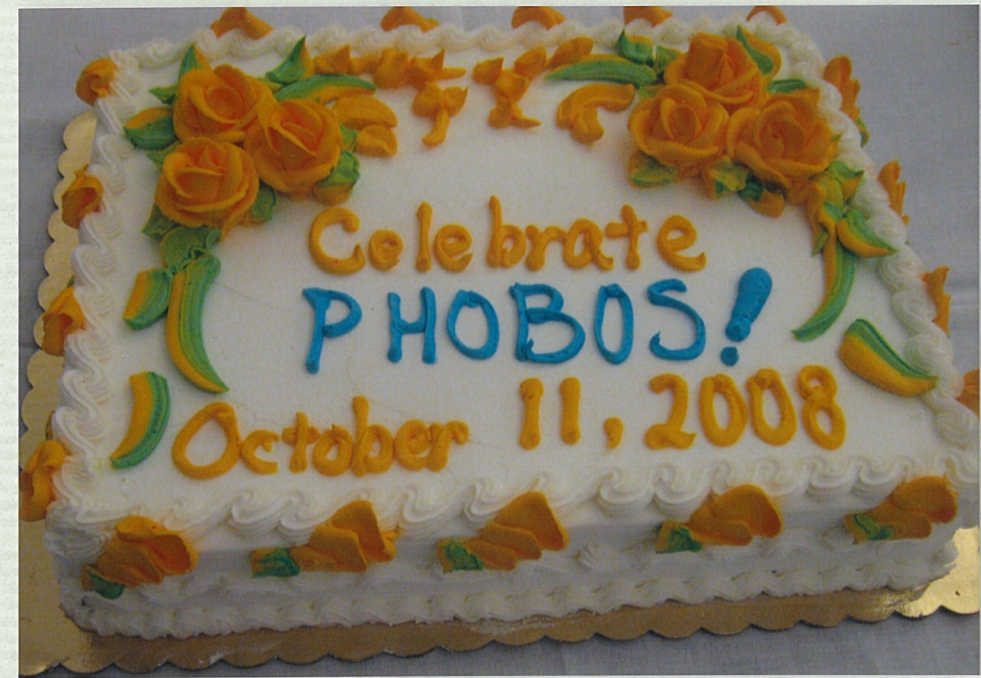


The University of Maryland's Donaldson Brown Center

*Alie*



*Barbara Bernie*  
*Shirley N. Folek Wes Li*  
*George Rouman Petr Richard B.*  
*Knyaztof Blunk Wand a Don*  
*Gunter Gabor Aust. J. Richard M. Marguerite*  
*Dave K*











The Henryk Niewodniczański  
**INSTITUTE OF NUCLEAR PHYSICS**  
**POLISH ACADEMY OF SCIENCES**

ul. Radzikowskiego 152, 31-342 Kraków, POLAND

October 23, 2008

Dear Wit,

After many years of fruitful collaboration the Krakow Group would like to thank you for your excellent work as a spokesman of PHOBOS experiment. We all have been impressed with the way you have led the collaboration and we have learnt plenty from you.

When we started working in PHOBOS, we even could not dream that this collaboration would be so productive, would give so many new and important results, would give us a lot of satisfaction and, last but not least, would be for all of us a great pleasure.

Thank you Wit!

We wish you and your family all the best!

Krakow Group:

Barkas  
 Adam  
 Andrzej  
 Krzysztof  
 Marek  
 Roman  
 Tomasz  
 Jurek  
 Andrzej  
 Gruczek  
 Andrzej



Acknowledgements

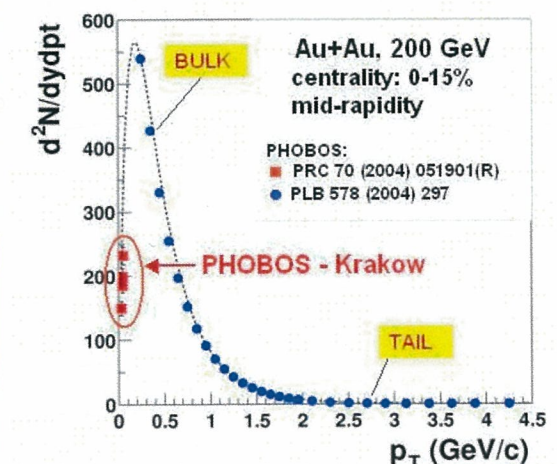
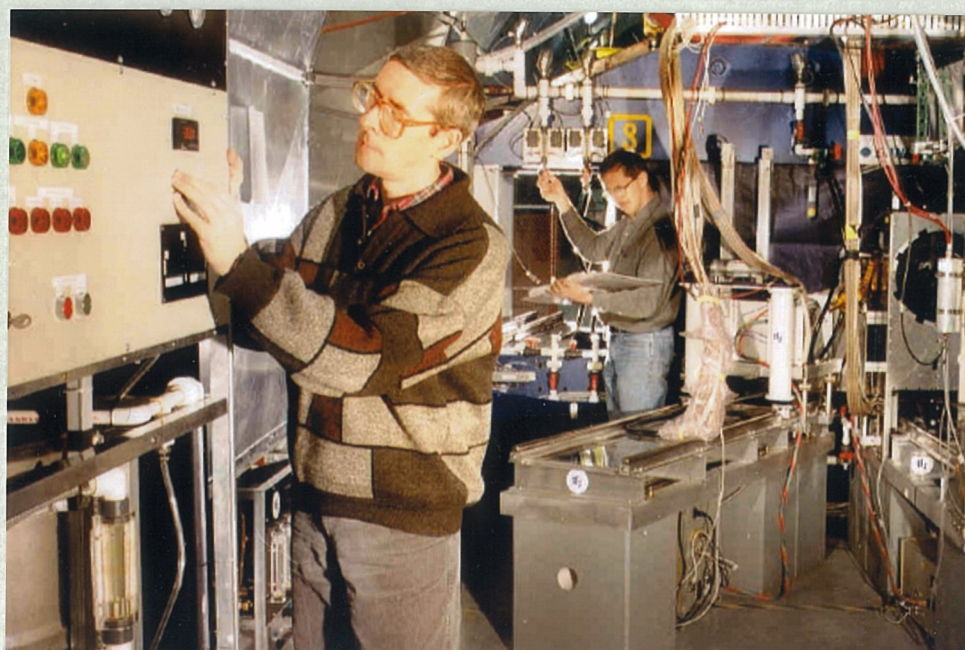


Dear Wit,

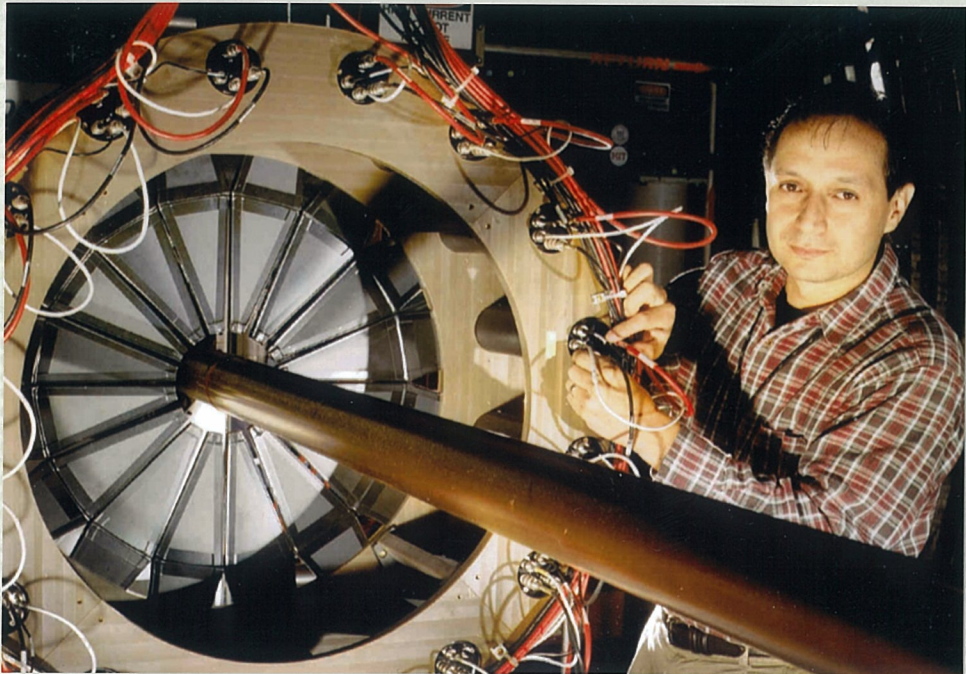
We would like to thank you very much for our very good and fruitful collaboration on construction of the PHOBOS experiment. It lasted more than 10 years and gave a lot of professional satisfaction as well as much pleasure and fun to Krakow hardware group. We were always impressed by your competence as the collaboration leader but may be even more by your attitude to each collaborator.

Wit, it was a great pleasure to work with you. Many thanks and good luck to you and the whole family.

Marek Stodulski  
 on behalf of the Krakow hardware group







Dear Wit,  
 Thanks for making us  
 proud to be members of PHOBOS!  
 Under your guidance we always met  
 the challenge to produce the  
 most physics/dollar invested.  
 (Bang for the Bucks)

Thank you for  
 your great leadership.  
 Marguerite Bek Tonjes

The Maryland Group!

Dear Wit,  
 Thank you for being our intrepid leader. Your  
 pep talks were always inspiring and carried us  
 through the challenges. I will never forget that  
 even after I left Phobos you showed up in the  
 Phenix counting house just to check in on things  
 despite the blizzard going on outside!  
 Your dedication truly shows.

Best Wishes,  
 Abby

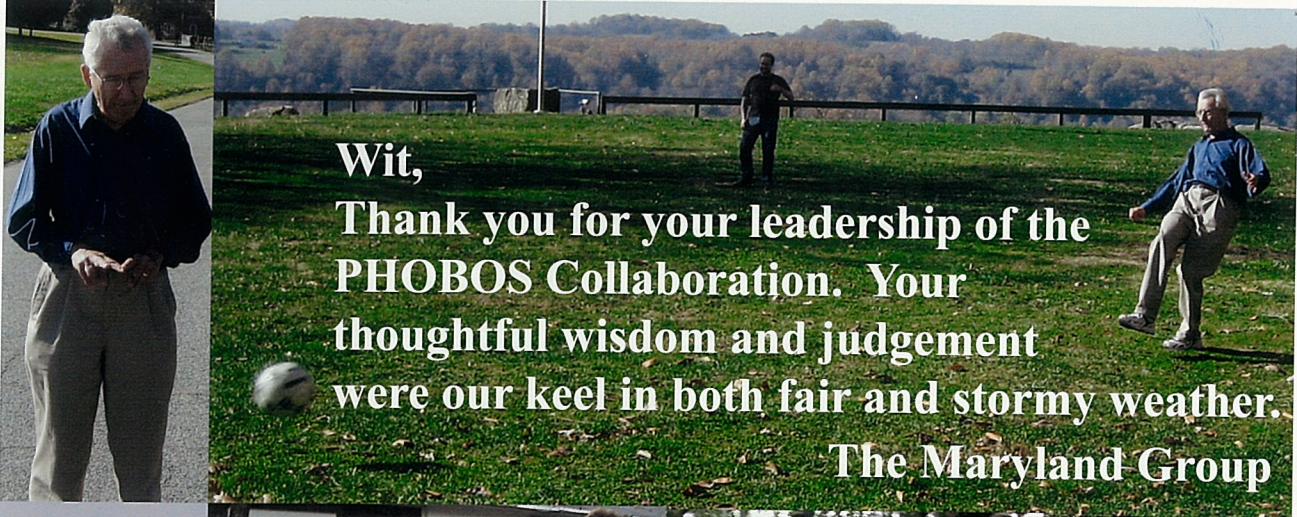
Abigail Bickley  
 Assistant Professor  
 National Superconducting Cyclotron Laboratory  
 Michigan State University  
 East Lansing, MI 48824-1321  
 517-333-6480 (office)

I've always found your enthusiasm  
 to be contagious! Thank you for  
 a Fantastic decade at PHOBOS

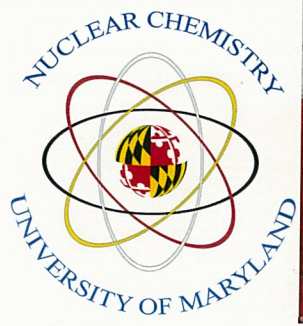
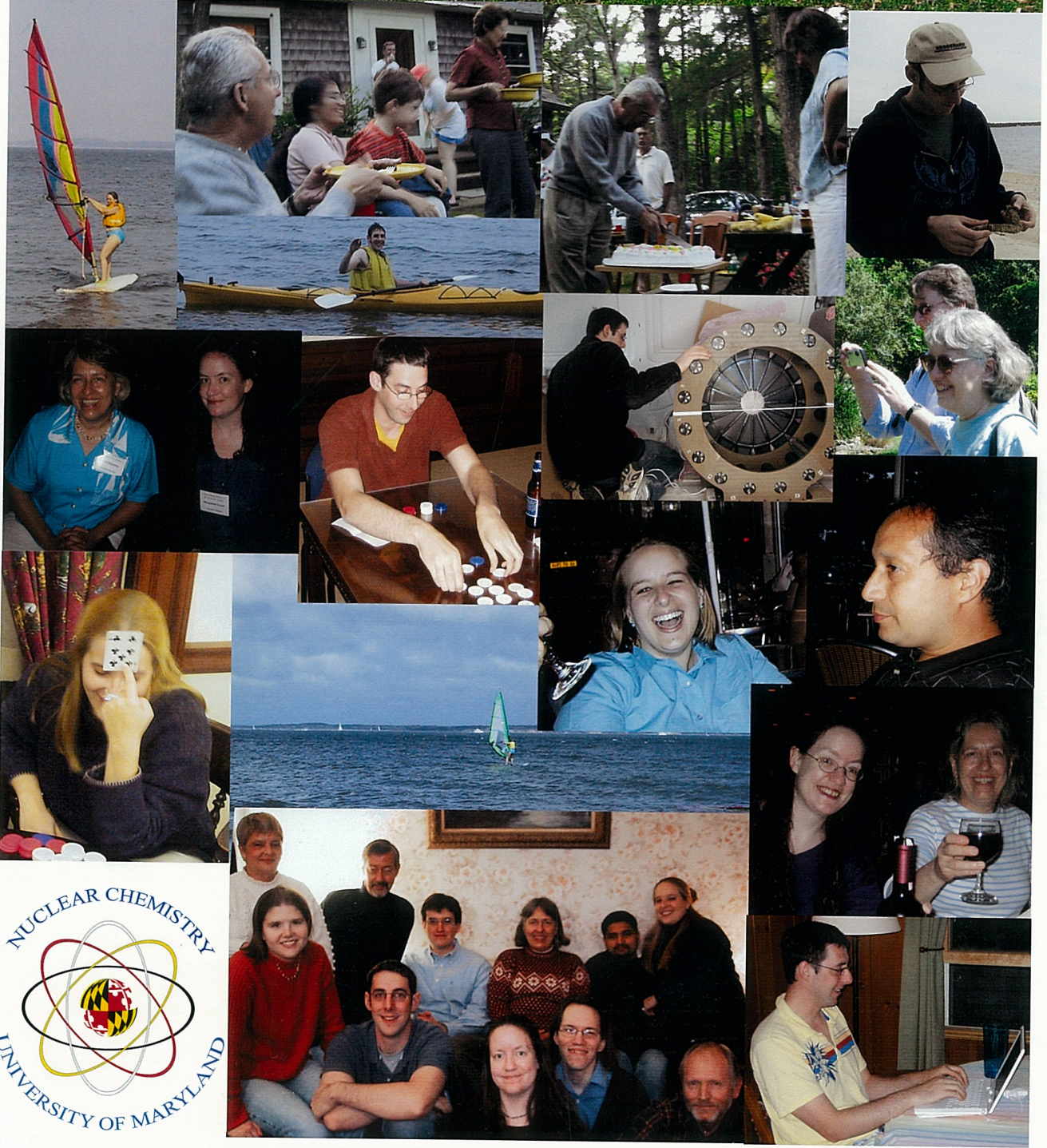
Richard Binzel



10 October 2008



Wit,  
Thank you for your leadership of the  
PHOBOS Collaboration. Your  
thoughtful wisdom and judgement  
were our keel in both fair and stormy weather.  
The Maryland Group



Dear Wit,

As the PHOBOS collaboration assembles for it's final celebration meeting, I would like to express my thanks to you and to the entire collaboration. I won't be able to attend the meeting, as I am in the process of moving to CERN to start a new position as a CERN Fellow working on the LHC. But I will certainly be there in spirit, celebrating the accomplishments of a fine experiment!

I thoroughly enjoyed my PhD years on PHOBOS. It was a great experiment, staffed by great people. I loved that we as a collaboration did not let our small size intimidate us away from trying to make a big impact. And the fact that PHOBOS did make such a significant contribution to the field is a real testament to its people and its leaders.

I look forward to continuing to meet and interact with fellow PHOBOS alumni as we all continue our various research projects. I'm very proud to be part of such an illustrious group!

Best wishes to all,

Conor Henderson.



Dear Wit,

Over the many years that we've worked together, through the Single Arm Spectrometer at Fermilab, SLD at SLAC, and Phobos at RHIC, one thing has never changed: whenever you address a group of your colleagues, you begin with "Friends!"

Nowadays, that word usually means "I want something from you." A politician who says, "My friends and fellow Americans..." wants you to vote for him. An organization that says, "Dear friend of the Steam Train Museum..." wants money to repair the tracks. An *amicus curiae* wants to influence a court decision. But, cynic though I am, I believe you use that word to mean exactly what it says. We haven't always been in perfect alignment; but the occasional differences that have floated to the surface of our sea of agreement have always been discussed with civility and humor and settled with honor.

And so, my colleague, collaborator, and co-conspirator, I treasure our shared memories, and your achievements, crowned with the Phobos experiment, and salute you... my friend!

*Robin*  
Robin Verdier  
October 7, 2008







Eötvös Loránd Tudományegyetem  
Természettudományi Kar  
Fizikai Intézet  
Atomfizikai Tanszék

Dear Wit,

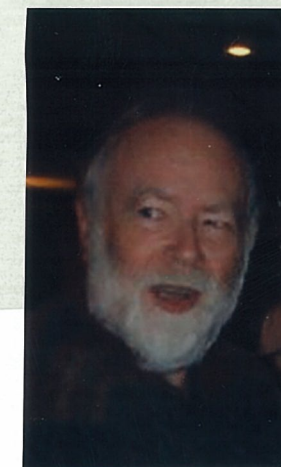
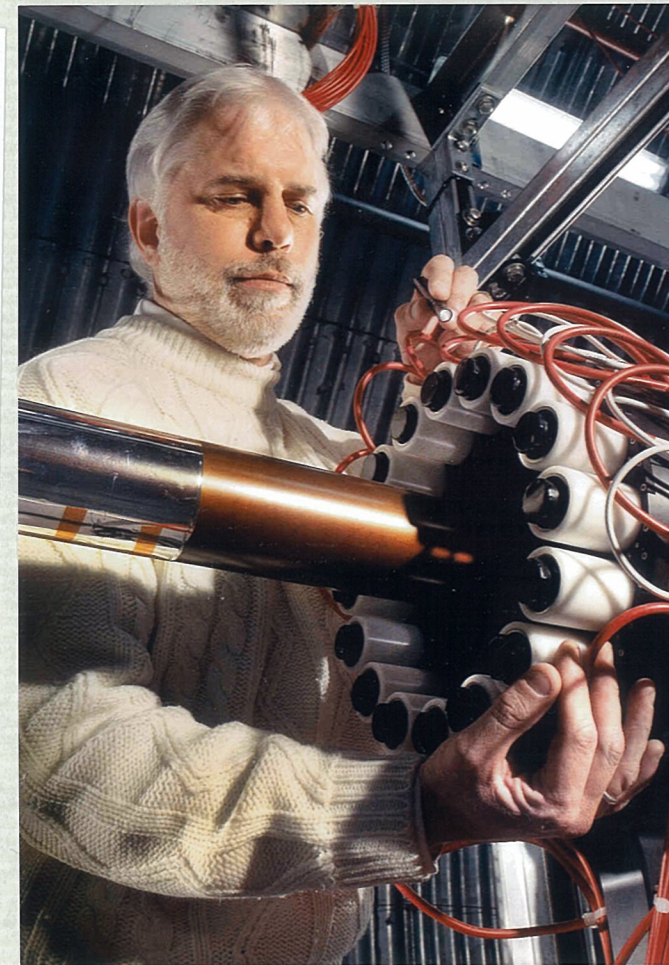
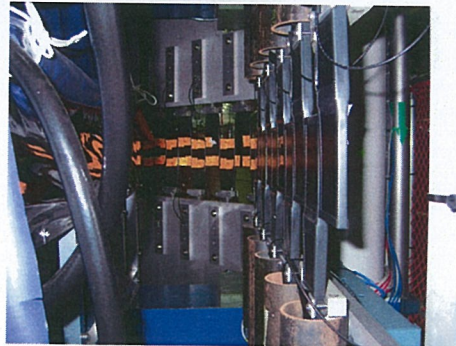
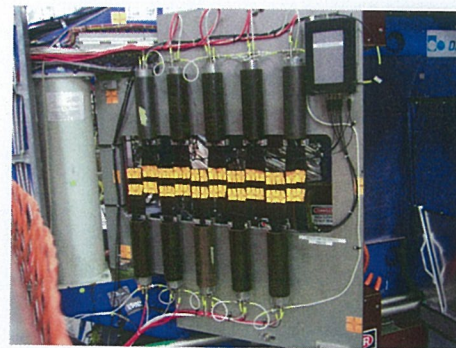
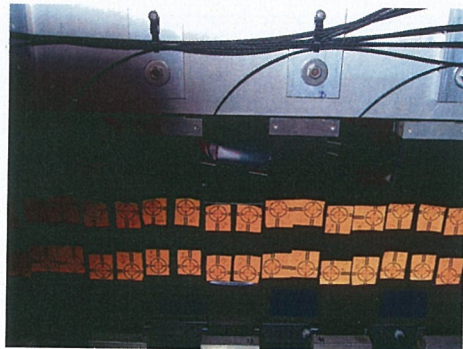
I am very glad that I had a chance to be part of the PHOBOS challenge.

I enjoyed the atmosphere, and the support of my PHOBOS friends all the time, and I am proud of the achievements of the Collaboration. I especially remember two sentences from You: „If you have never done such a thing, this is the best time to try now!” when I arrived, and „you have a nice piece of work here!” 8 months later (see pictures below). All this gave me the sense of how important it was that You could hold all our efforts together with Your famous *words of wisdom*. Thank you for this experience - with all my best wishes:

Budapest, Oct. 9th, 2008.

Gábor Veres

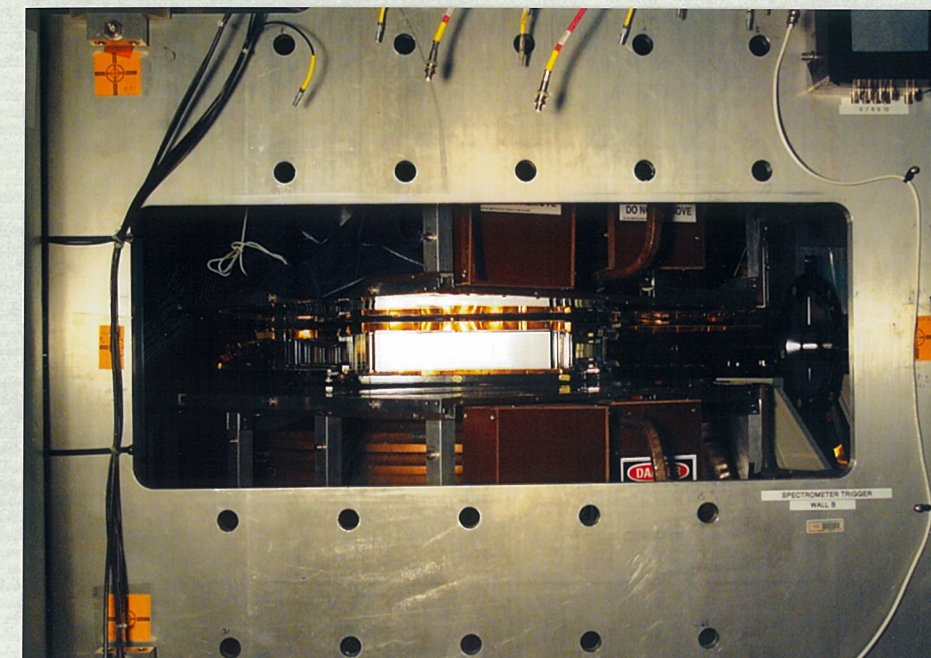
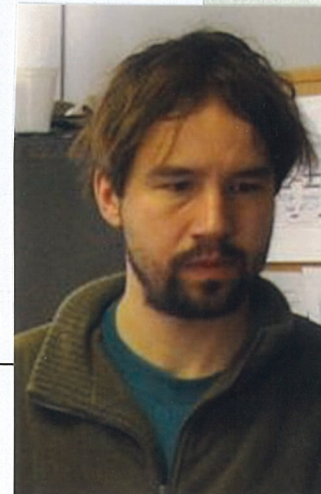
assistant prof., Eötvös Loránd University, Budapest  
former postdoctoral fellow, MIT LNS, PHOBOS



CONGRATULATIONS TO PHOBOS AND TO WIT!  
A MAGNIFICENT JOB!

From Don McLeod

I truly regret not being able to participate in PHOBOS past its construction and the very beginning of commissioning, because it was already the most effective and able collaboration I had worked in including long experience at Fermilab. It was a joy to work with you, even through some tense moments and major changes of plans. I'm also sorry I couldn't participate effectively in my last year (just a few distractions!) or even in a small way from Colorado (bandwidth!). I've followed your progress from afar with keen interest. Best wishes for the future! It's going to be hard to top PHOBOS.



Cím: 1117 Budapest, Pázmány Péter sétány 1/A  
Tel.: (36-1) 372-2772; -209-0555/6345/6312 • Fax: (36-1) 372-2753  
E-levele: atomph@ludens.elte.hu



Dear Wit

I am truly sorry not to be able to make it to the Maryland meeting this weekend. My brother will be visiting for a few days from Australia.

I did want to share a few thoughts regarding PHOBOS and the collaboration that, without doubt, has been the most interesting, successful and enjoyable of my, by now quite long !!, career.

Under your skilful, steady and consistent leadership the PHOBOS collaboration worked fantastically well through all the challenges that faced us. The political climate of a "small" experiment, the funding profile, the ups and downs of designing and constructing the experiment, the difficult issues laid out on the table and hard decisions made, the struggles with RHIC etc etc. All this to produce a – pun intended – smashing success. Pound for pound, the best at RHIC and in many ways also the best in absolute terms.

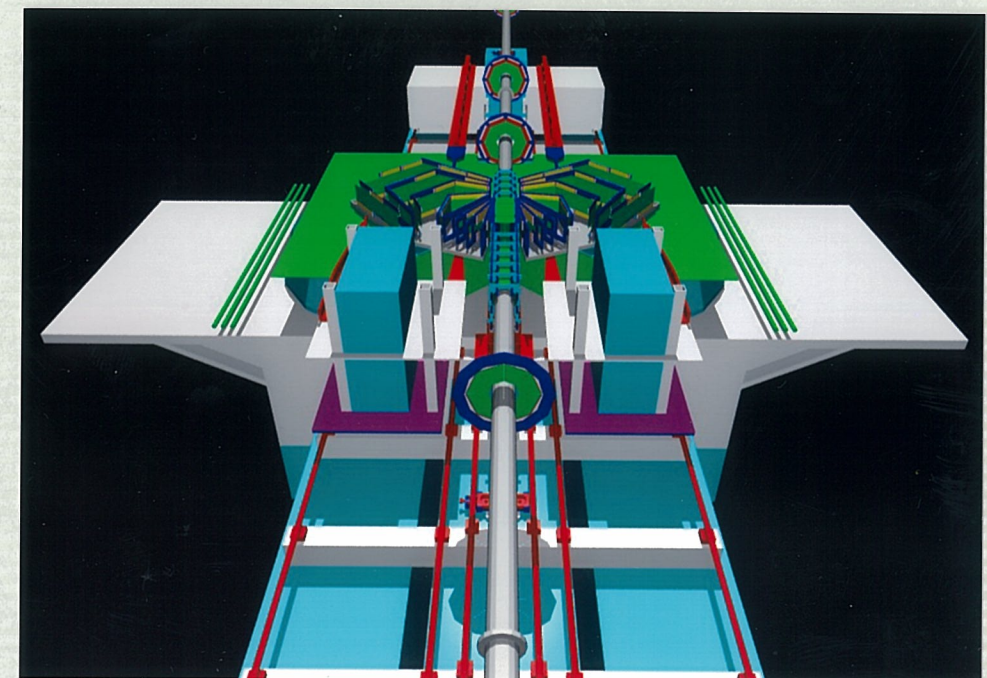
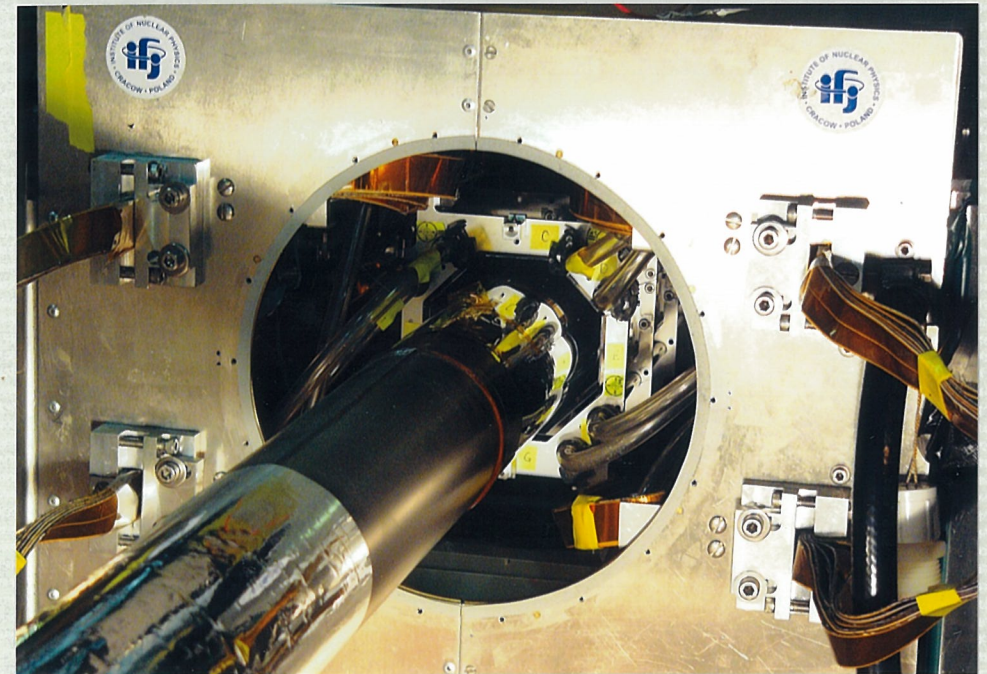
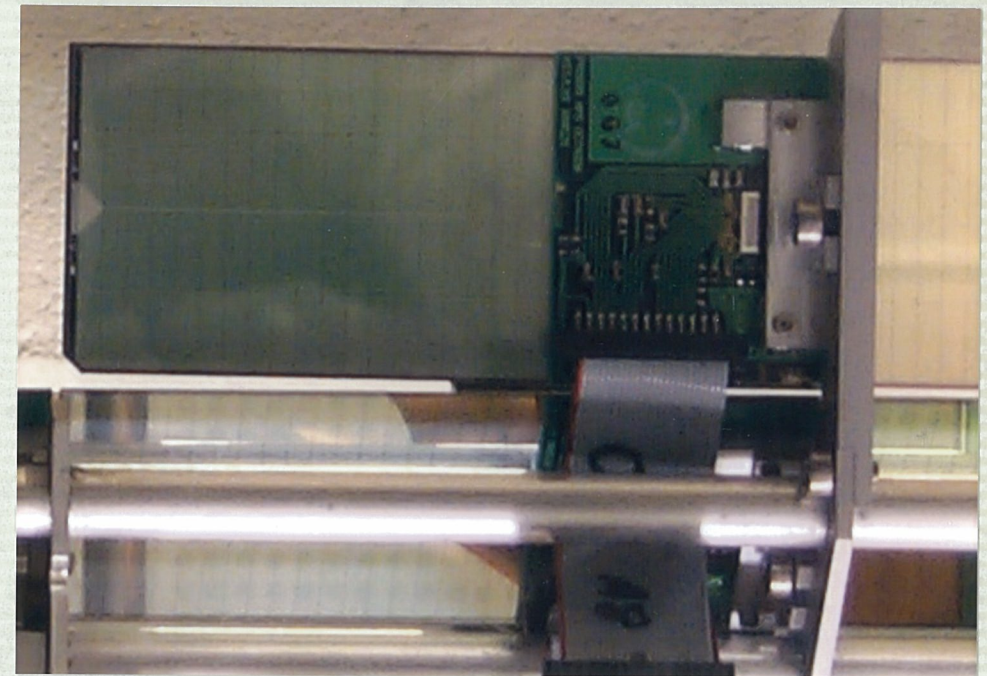
It has been a pleasure to work with you and with all our collaborators – no not just collaborators - friends!!

Enjoy the meeting – raise a glass for me

Cheers

Russell

Russell Betts





Dear Wit,

Thank you very much for the invitation to attend the last Phobos collaboration meeting. Unfortunately, I am not able to attend, but I would like to share with you a few of my own thoughts as you celebrate the experiment.

I fondly look back at my own six years of (active) Phobos participation. I firmly believe that Phobos is one of the few collider experiments that allowed a graduate student to go through the entire experiment cycle: participate in the design, construction, data-taking and finally the analysis of the physics data (the only thing I - wisely? - missed was decommissioning). The size of the experiment was such that all collaborators could essentially know the entire experiment, not just the little part that they were focussing on. For a graduate student, this is incredibly valuable as you can get the feel of all the aspects of the experiment (try that with STAR or any of the LHC experiments). I learned a tremendous amount in that time. Even though my own physics interests have changed over time, I have taken the lessons I learned in Phobos with me and my contributions to the success of the KamLAND experiment are largely due to the training I received at Phobos.

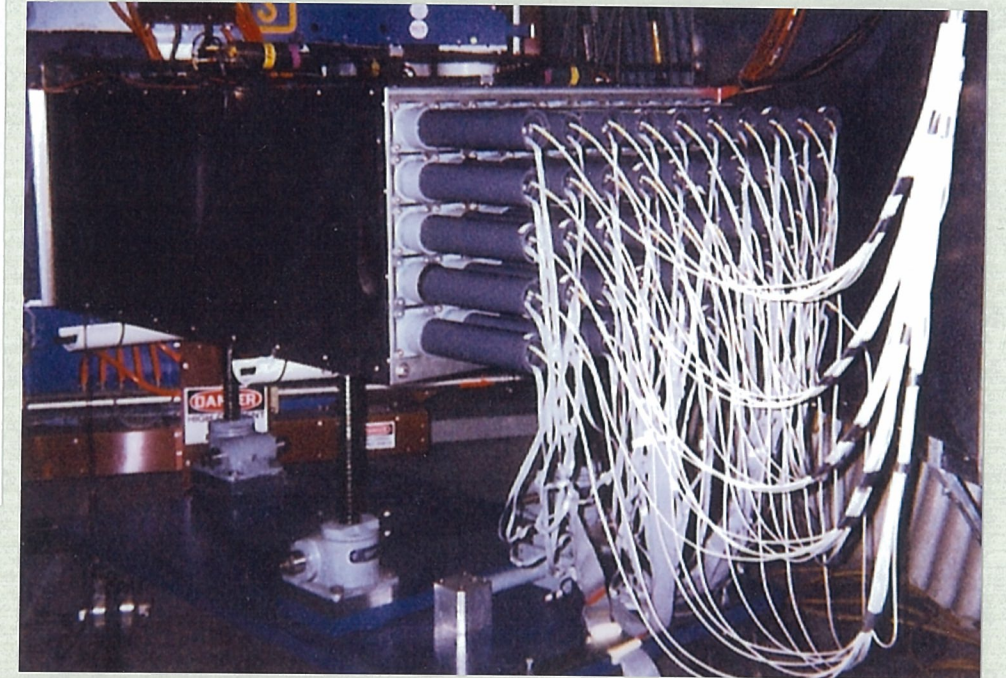
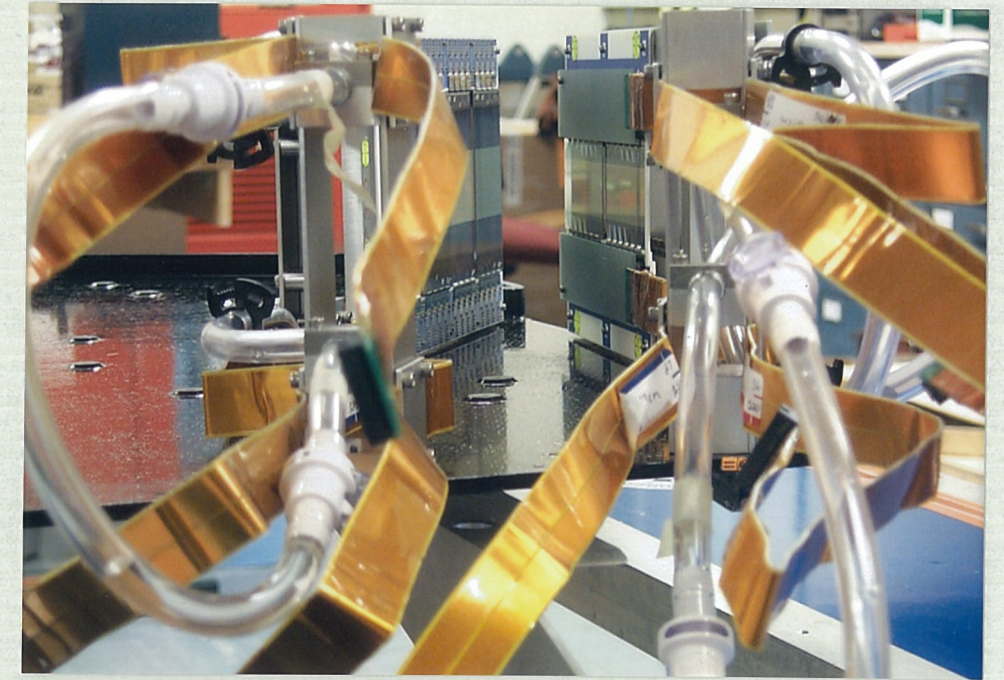
The Phobos experiment is a success by any measure (e.g. 13 PRLs with 6 of them with more than 100 citations!) and as spokesperson you can justifiably be extremely proud of this. There was risk involved at almost every stage of the experiment - to most of us it was clear that this was much more so than for instance for STAR or Phenix - cancelling Phobos could buy that EMcal for STAR or help with the muon system for Phenix or perhaps just finish the accelerator. We were also exposed to risk with the detectors themselves, be it the ambitious initial electronics, the silicon or simply the fact that a single blast of the beam into our detector could kill the experiment. You guided us, with consultation, through many of these issues, making the right decisions when it was necessary. I would like to personally thank you for this leadership.

Finally, I would also like to point out the very high quality of the people involved. I think that you and Bolek have done a fantastic job of gathering a terrific group of people making it all possible. In the end it is not just about getting the money or the tools - without the right people it would just not work. The great achievements of Phobos are due to the fact that the right people were involved.

I hope that you and all the other current and former members of Phobos will have a splendid weekend in Maryland and I hope that it is not completely "over" and that the remaining Phobos analyses will get completed and written up - not an easy task as new ventures are clearly emerging on the horizon!

All the best,  
Patrick.

=====  
Patrick Decowski | Physics Dept. ; UC Berkeley





There were lots of ideas for the logo



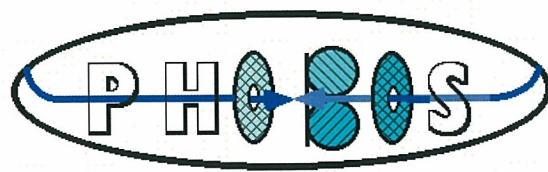
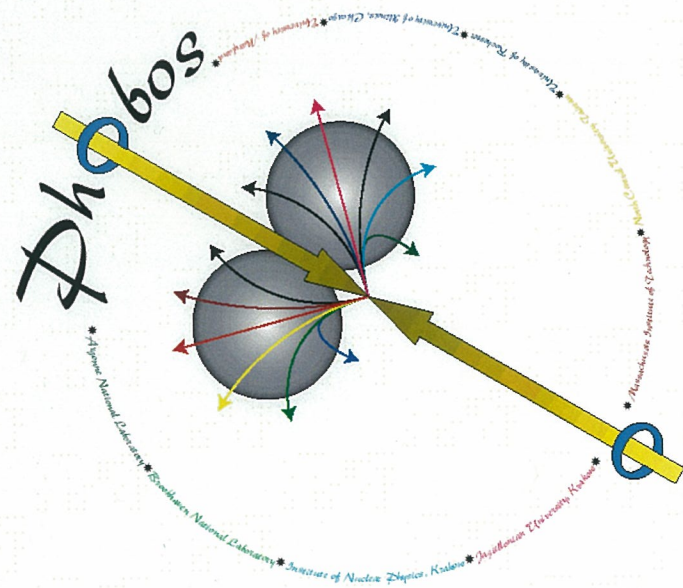
PHOBOS

Phobos

PHOBOS

PHOBOS

PHOBOS



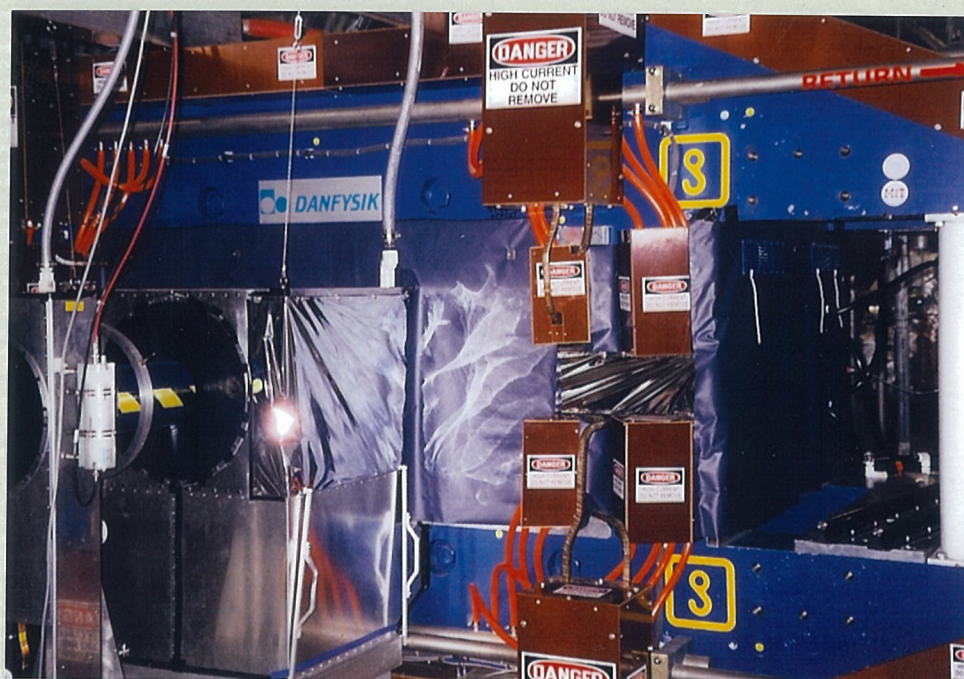
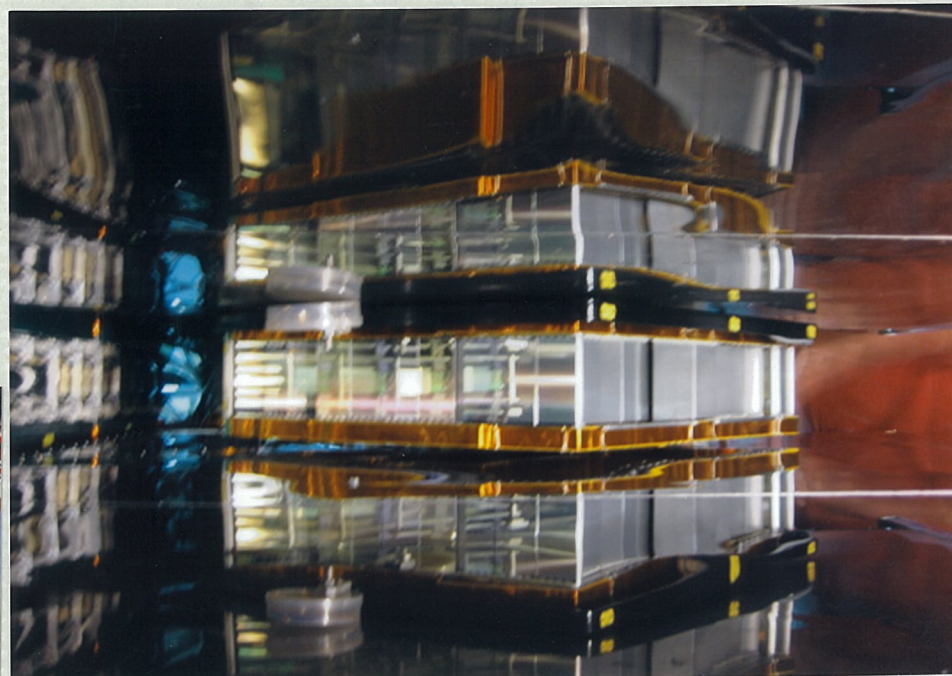
PHOBOS

The mug was also very popular



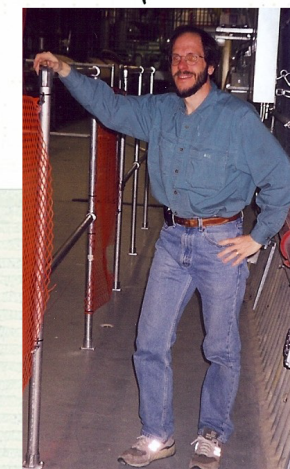


# A few final additions...



To Wit,

It was both an honor and a pleasure to work with you on the **PHOBOS** experiment. Your leadership was largely responsible for the quality and breadth of the **PHOBOS** physics program. Even more important from my personal perspective, your guiding example nurtured a spirit of unity, cooperation, and common goals which made **PHOBOS** a "collaboration" in the very best sense of the word.



Many Thanks!

George Stephens 10/2008







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for the U.S. Department of Energy

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December 23, 2008

Dear Wit,

We just wanted to send a note of appreciation and thanks from the Brookhaven Group. PHOBOS was a unique opportunity for all of us, using what looked like a small experiment to do such big physics. And from its design to its implementation, it was a testament to your deep and lasting interest in fascinating physics topics many others had ignored, and your ability to assemble a such a great collaboration as PHOBOS, where the quality of the data was king, but where new ideas could be discussed (sometimes quite actively) and such surprising results could emerge. The main principle of the experiment -- that data was always richer than the various models we use to describe them -- has had a lasting effect on all of us and we will take it with us on future projects.

All the best to you and congratulations again on the success of PHOBOS. We were honored to part of it.

Warm regards,  
The BNL Group (past and present!)

Mark Baker, Don Barton, Alan Carroll, Zhengwei Chai, Nigel George, Steve Gushue, George Heintzeman, Burt Holzman, Rachid Nouicer, Robert Pak, Lou Remsberg, Peter Steinberg, Andrei Sukhanov, Iouri Sedykh, The South African Student League (Bruce, Maciek, Helen, Mike, Shaun, Artur)

