

# *BNL AGS E821/E962*

*A Precision Measurement of the  
Muon ( $g - 2$ ) Value at the level of  
0.35 ppm*

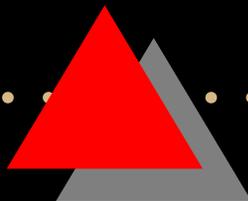
*A Low-Energy Look at High-Energy Physics*

B. Lee Roberts

roberts@bu.edu

Department of Physics

Boston University





# *Collaboration Institutes*

Boston University, Brookhaven National Laboratory, Budker Institute of Nuclear Physics - Novosibirsk, Cornell University, Fairfield University, KEK, KVI and Rijksuniversiteit - Groningen, University of Heidelberg, University of Illinois, University of Minnesota, Tokyo Institute of Technology, Yale University



# *Collaboration Management*

Gerry Bunce - BNL - Project Manager

Bill Morse - BNL - Resident Spokesman

Vernon Hughes - Yale U. - Co-spokesman

Lee Roberts - Boston U. - Co-spokesman



# *E821/E962 Collaboration (4/02)*

R.M. Carey, X. Huang, A. Lam-Ng, I. Logashenko, J.P. Miller, J. Paley, B.L. Roberts

- **BU** H.N. Brown, G. Bunce, G.T. Danby, Y.Y. Lee, W. Meng, W.M. Morse, D. Nikas,

C. Özben, R. Prigl, Y.K. Semertzidis - **BNL** Y. Orlov - **Cornell** D. Winn - **Fair-**

**field** K. Jungmann, **KVI** G. zu Putlitz **Heidelberg** P.T. Debevec, F. Gray D.W. Hert-

zog, C. Onderwater, C. Polly, M. Sossong - **UIUC** A. Yamamoto - **KEK** B. Bous-

quet, P. Cushman, R. McNabb, T. Qian, P. Shagin - **Minnesota** V.P. Druzhinin, G.V.

Fedotovitch, B.I. Khazin, N.M. Ryskulov, Yu.M. Shatunov, E. Solodov - **BINP** M. Iwasaki

- **TyTech** H. Deng, M. Deile, S.K. Dhawan, F.J.M. Farley, V.W. Hughes, S.I. Redin, E.

Sichtermann - **Yale**





# *Why are we here today?*

The President's FY03 Budget says, under "Significant Accomplishments and Program Shifts:"

- "The g-2 experiment at BNL ... results announced in 2001 do not quite agree with the Standard Model..."



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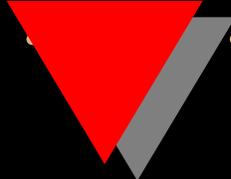
- "The g-2 experiment at BNL ... results announced in 2001 do not quite agree with the Standard Model..."
- "If this result is confirmed, it would be the first clear indication of new physics beyond the standard model."



*and then.....*

Under “Scientific Facilities Utilization” it says:

- “In FY2003, the Alternating Gradient Synchrotron at Brookhaven National Laboratory is terminated for High Energy Physics Research.”



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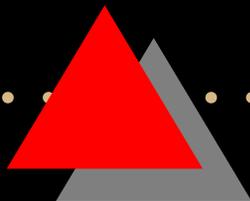
Under “Scientific Facilities Utilization” it says:

- “In FY2003, the Alternating Gradient Synchrotron at Brookhaven National Laboratory is terminated for High Energy Physics Research.”
- or (to borrow from Shakespeare’s *Julius Caesar*) ‘We come not to praise ( $g - 2$ ), but to bury it.’



*Before termination, the Rosen Protocol was being followed.*

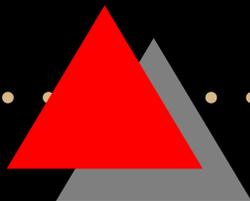
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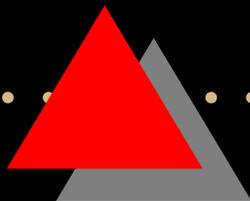
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- A new proposal for additional running was submitted to the BNL management and was approved as a “must do” experiment.
- Strong letters from Wilczek, Ellis, Glashow, de Rafael and Picasso were obtained to support the approval by the Laboratory.
- Based on this process, BNL requested FY03 Funding from DOE for additional  $(g - 2)$  running.





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talking about for g-2 running?*

- Four months of running parasitically with RHIC for **\$4.6 M**



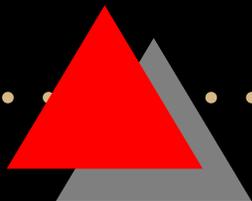
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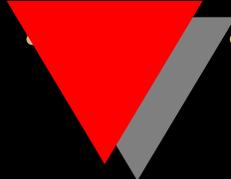
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- How much have we spent on running to date? \$53 M
- For less than **1%** of the HEP program we can finish!





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- $(g - 2)$  **PROVIDES** an unusually sensitive test of the Standard Model of particle physics and a unique window on possible physics beyond.



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- $(g - 2)$  **WILL** help determine the optimum energy scale for future particle accelerators worldwide.
- $(g - 2)$  **PROVEN** success includes our recent publication in Physical Review Letters, which has generated substantial international excitement and is already in the top few percent of “most-cited” papers in physics.



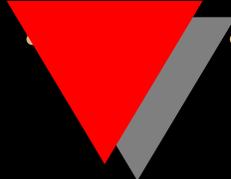
# *What else?*

- **EDUCATION** and training provided for 75 young physicists: 22 post-doctoral fellows, 14 Ph.D. students, 6 other graduate students, and 33 undergraduate students.



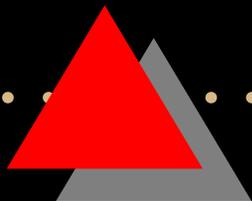
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- Our final result will stand for many years, and will not be improved on easily.
- **TERMINATION** would mean a failure to obtain maximum scientific return on an investment of \$78M in capital and operating funds over the past ten years.



# Where are we now?

<i>Data Set:</i>	$\# e^\pm$	$\sigma_{\text{Stat.}}$ (ppm)	$\sigma_{\text{Syst.}}$ (ppm)
1999*	$\mu^+; 1 \times 10^9 e^+$	1.25	0.5
2000†	$\mu^+; 4 \times 10^9 e^+$	0.63	0.4 - 0.5
2001†	$\mu^-; 3 \times 10^9 e^-$	0.72	0.3

\*Published

†Projected

# Data Summary



Total $e^+$	$5 \times 10^9$	0.56 ppm
Total $e^-$	$3 \times 10^9$	0.72 ppm
Total $e^- + e^+$	$8 \times 10^9$	0.44 ppm
With +6 B $e^-$	$14 \times 10^9$	0.33 ppm

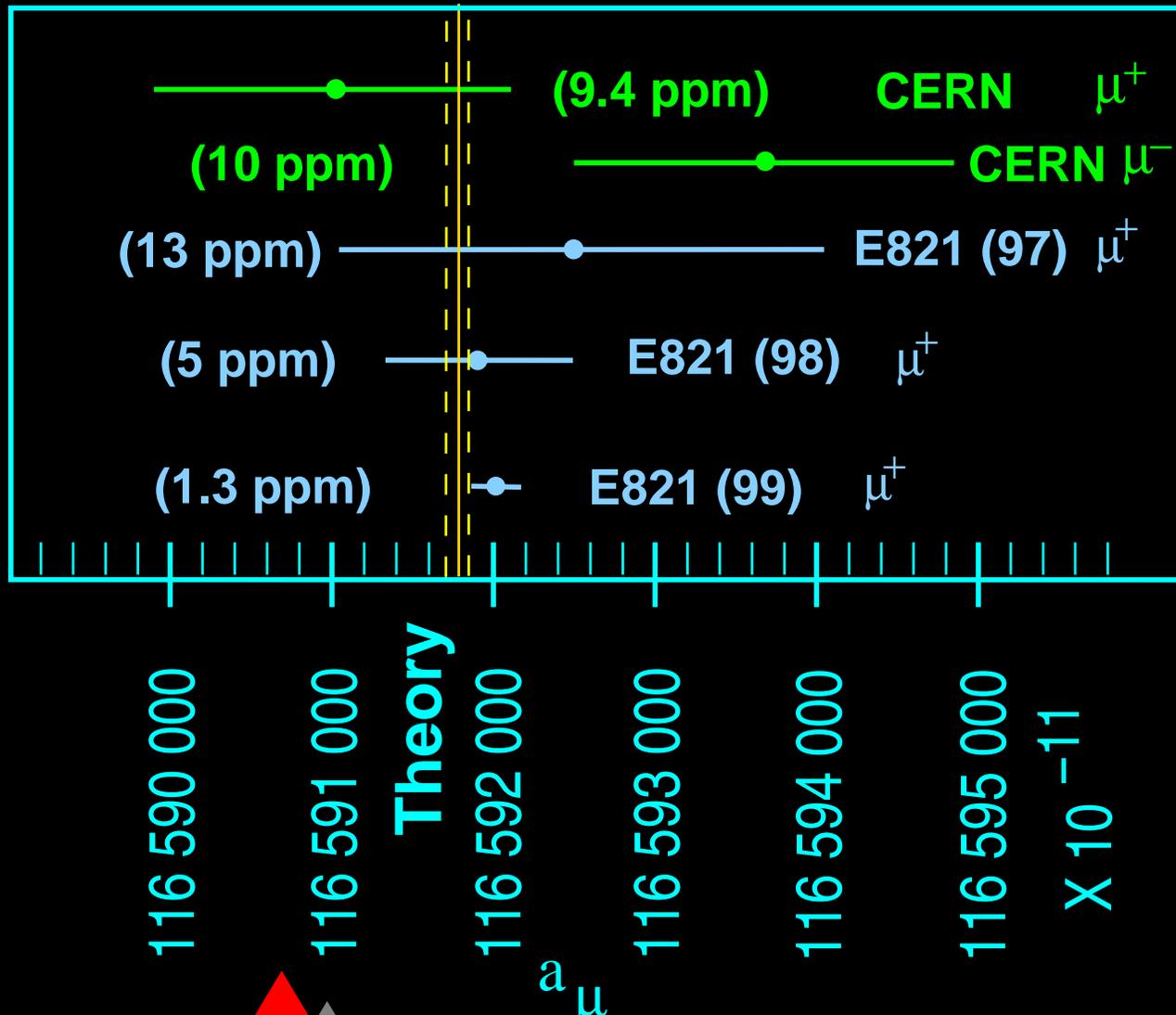
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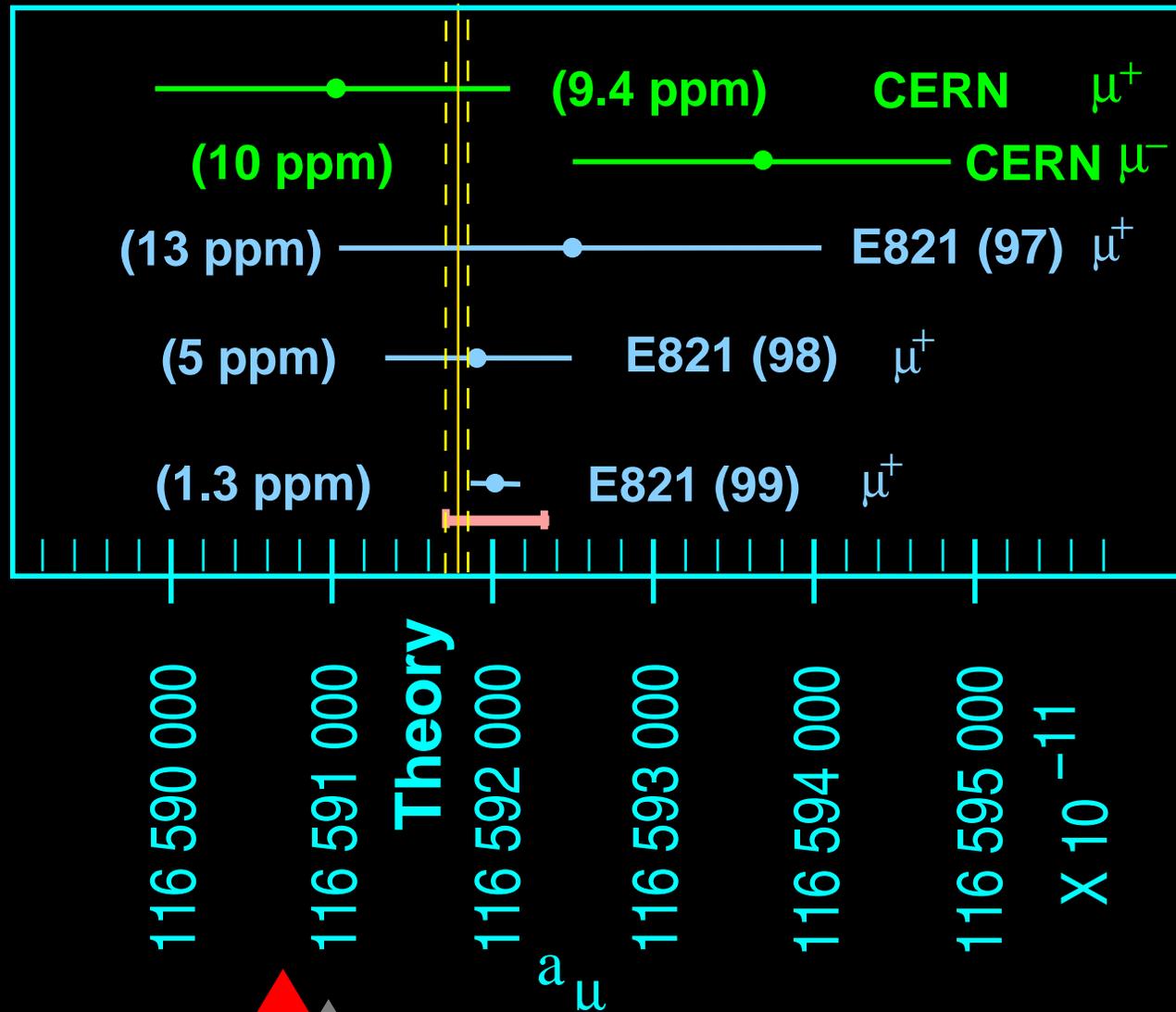
- But only the 3 B  $\mu^-$  data set has a small systematic error. To have full confidence in the final number it is essential to have another run under optimal conditions.

# Agreement with SM?



Experiment –  
Theory = + 1.6  $\sigma$

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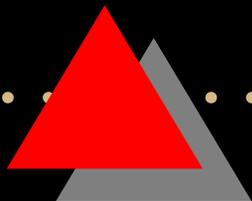


requiring that  
 2000 answer  
 agree with '99  
 result to  $\pm 2\sigma$   
 gives the range  
 of values —  
 SM agreement  
 $-1\sigma$  to  $+5.5\sigma$



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- of the physics and funding priority; e.g.
- “HEPAP strongly affirms the importance of the physics reach of the muon ( $g - 2$ ) experiment and the unique view it gives of physics beyond the Standard Model.”
- “HEPAP strongly endorses funding for Brookhaven AGS operations if additional funding can be obtained from Congress for the Office of Science. This should be among the highest priorities for these additional funds.”