# Many Faces of Alvin

Vladimir Shiltsev

Accelerator Physics Center

Fermilab

*1st Story*

# Tevatron Run II

Alvin


Run II

# Tevatron Technical Notes (Beams-Doc)

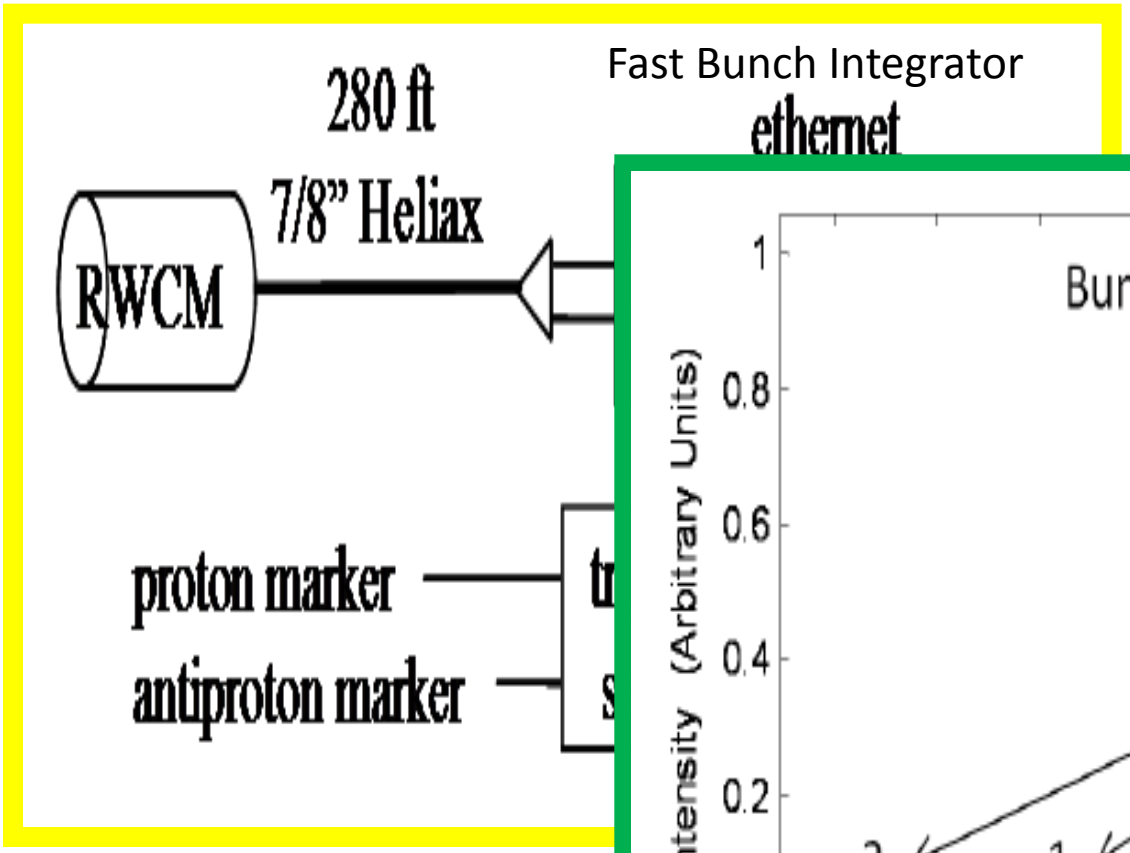
**Alvin Tollestrup of Fermi National Accelerator Laboratory**

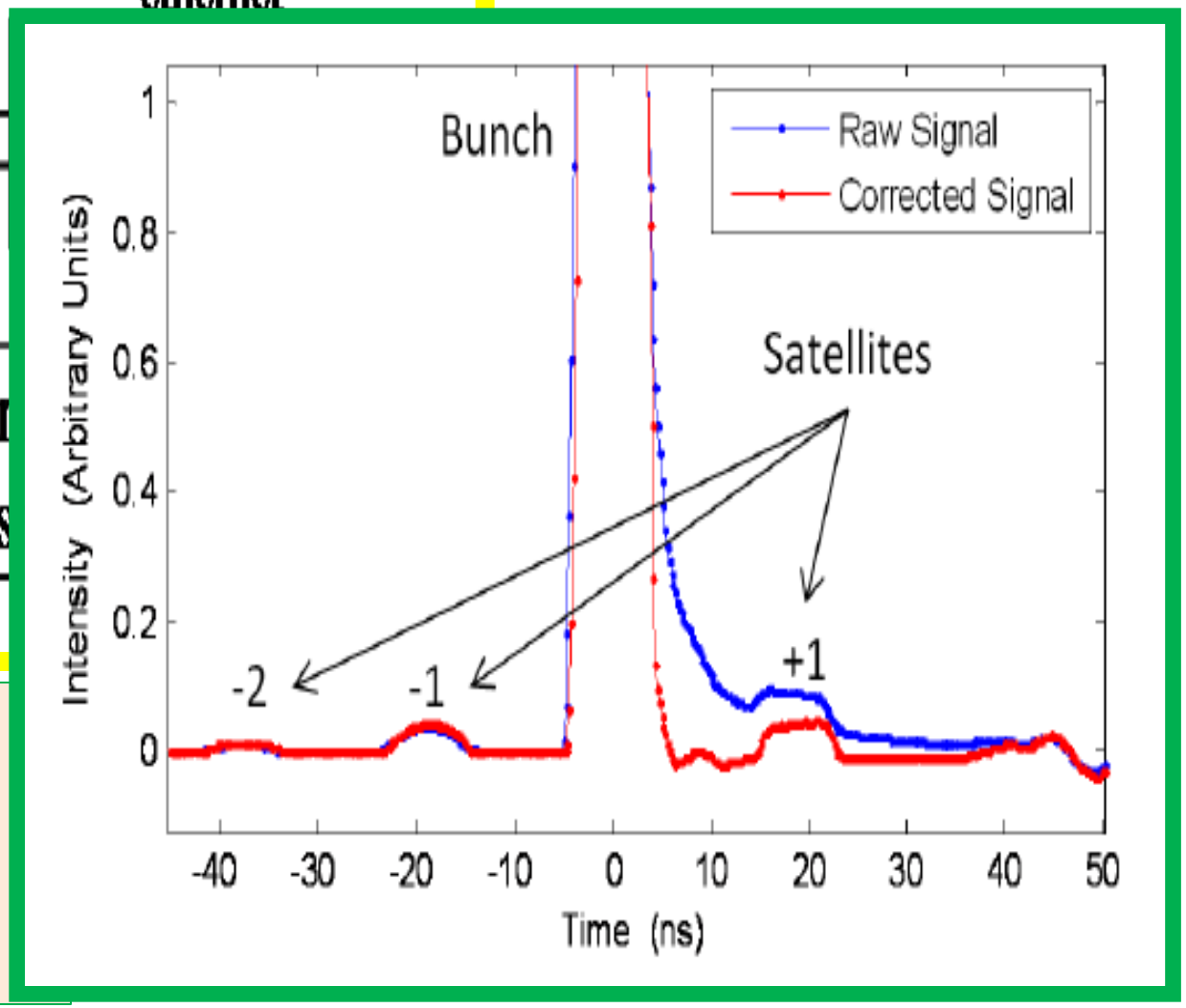
| Beams-doc-# | Title | Au |
|---|---|---|
| 3617-v2 | Run III: Continued Running of the Tevatron Collider Beyond 2011 | Valeri A L *al.* |
| 3345-v1 | What happens in a gas filled RF cavity when beam goes thru it? | Alvin Toll |
| 621-v1 | BEAM LOSS AND BACKGROUNDS IN THE CDF AND D0 DETECTORS DUE TO NUCLEAR ELASTIC BEAM-GAS SCATTERING | Alexandr *al.* |
| 3067-v2 | Instrumentation-Systems-SDA meeting of April 2, 2008 | David P *al.* |
| 2888-v5 | Instrumentation-Systems-SDA meeting of October 3, 2007 | Timofei E *et al.* |
| 2853-v3 | Instrumentation-Systems-SDA meeting of August 1, 2007 | David P *al.* |
| 2328-v3 | Muon Collider Task Force: Introductory documents | Alan Bro |
| 2237-v1 | Cooling muone | Alvin Toll |
| 1997-v1 | Proton Vertical Emittance Blow up by AntiProtons | Vladimir *al.* |
| 1469-v13 | Beam-Beam Effects Paper: Text, Figs and PAC'05 article | Yuri Alex |
| 1864-v1 | Longitudinal Beam-Beam Effects in Tevatron | Vladimir *al.* |
| 1778-v1 | Lower limit on proton lifetime due to beam gas interactions in the Tevatron | Alvin Toll |
| 1337-v2 | notes from Instrumentation/Beam Physics Meetings | Nathan E |

| | | | | |
|---|---|---|---|---|
| 1519-v2 | Study of the IBS in Tevatron | Vladimir Shiltsev *et al.* | Emittance | 28 Mar 2005 |
| 1477-v2 | Projects in the Accelerator Division suited for University collaboration | William J. Ashmanskas *et al.* | SDA | 15 Dec 2004 |
| 1345-v1 | Documents for New MI SBD | Chandrashekhara M. Bhat *et al.* | Beam Instrumentation<br>Sampled Bunch Display (SBD) | 22 Sep 2004 |
| 1155-v1 | Emittance Growth, Beam Lifetime in the Tevatron at 150 GeV | Valeri A Lebedev *et al.* | Emittance | 03 May 2004 |
| 1074-v1 | Analysis of Store 3261 | Alvin Tollestrup | Beam Studies | 13 Mar 2004 |
| 976-v1 | Meeting on Tev abort gap losses and CDF | Jean Slaughter *et al.* | Meetings<br>Instrumentation | 14 Jan 2004 |
| 963-v1 | Micro Magnet Review 12-17-03 | Pierre Bauer *et al.* | Magnets<br>Magnets | 07 Jan 2004 |
| 881-v1 | Emittance in the Tevatron: Talk 10-15-03 | Alvin Tollestrup | Run II<br>Sampled Bunch Display (SBD)<br>Longitudinal Dynamics | 20 Oct 2003 |
| 722-v1 | Calibration of the SBD using T:IBEAM as a reference | Alvin Tollestrup | Instrumentation | 08 Jul 2003 |
| 693-v1 | Tev SBD, FBI calibrations | Alvin Tollestrup | Talks<br>Meetings<br>Instrumentation<br>Sampled Bunch Display (SBD)<br>FBI<br>Tevatron Group | 27 Jun 2003 |
| 658-v1 | Calibration of the SBD- 6-6-03 | Alvin Tollestrup | Instrumentation<br>Sampled Bunch Display (SBD)<br>Tevatron Group | 06 Jun 2003 |
| 610-v1 | losses at start of acceleration | Alvin Tollestrup | Sampled Bunch Display (SBD)<br>Beam ramp | 21 May 2003 |
| 541-v2 | Tev SBD response and Toy algorithm for unscrambling longitudinal phase space | Alvin Tollestrup | Emittance<br>Run II<br>Instrumentation<br>Sampled Bunch Display (SBD) | 21 May 2003 |
| 556-v1 | Beam Loss and Backgroundis in the CDF and D0 | Alexandr Drozhdin *et* | Energy Deposition | 11 Apr 2003 |
| | | | splay | 07 Apr 2003 |

| | | | | |
|---|---|---|---|---|
| 244-v1 | Response of the FBI and SBD in Store 1834 | Alvin Tollestrup | Sampled Bunch Display (SBD)<br>FBI<br>General | 13 Dec 2002 |

# Report #1 (2002): FBI, SBD, IBEAM, etc



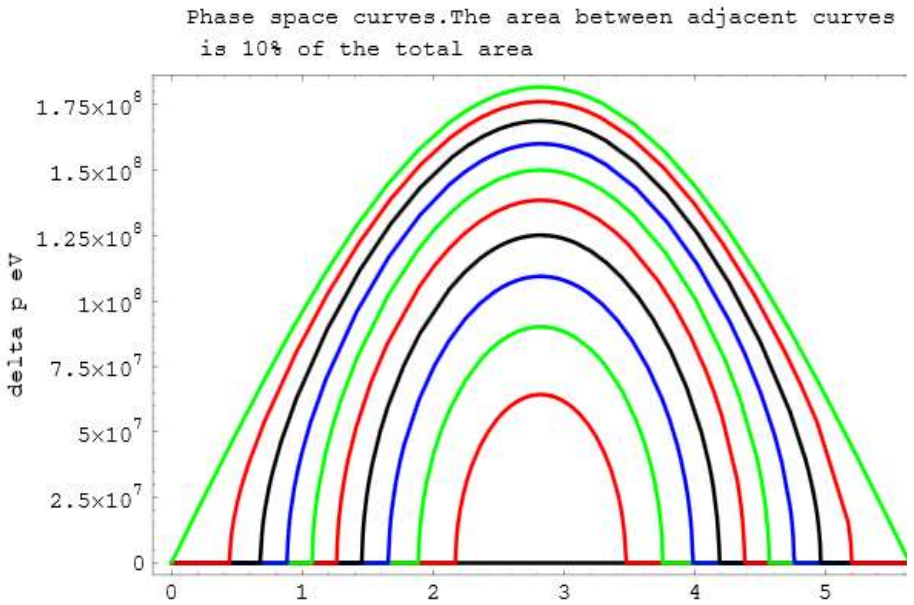



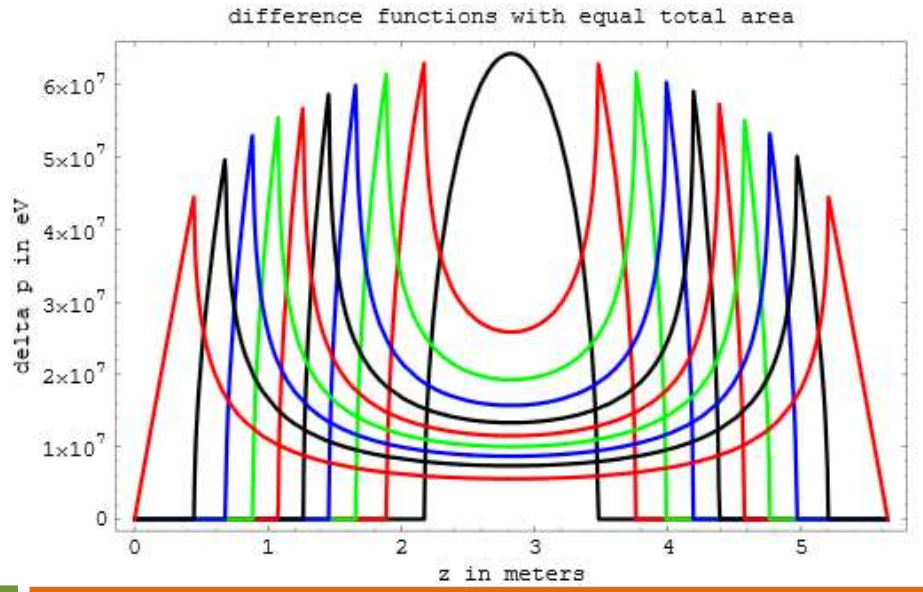

- Issues:
  - Dispersion in the cable
  - Satellites
  - Baseline subtraction
  - Cross calibration

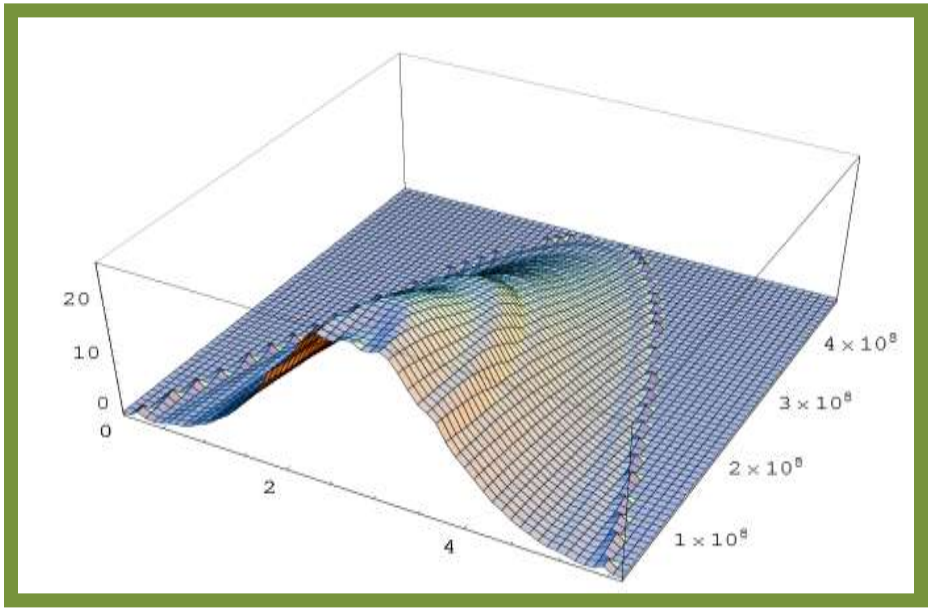
# Focus on Understanding and Trustworthiness

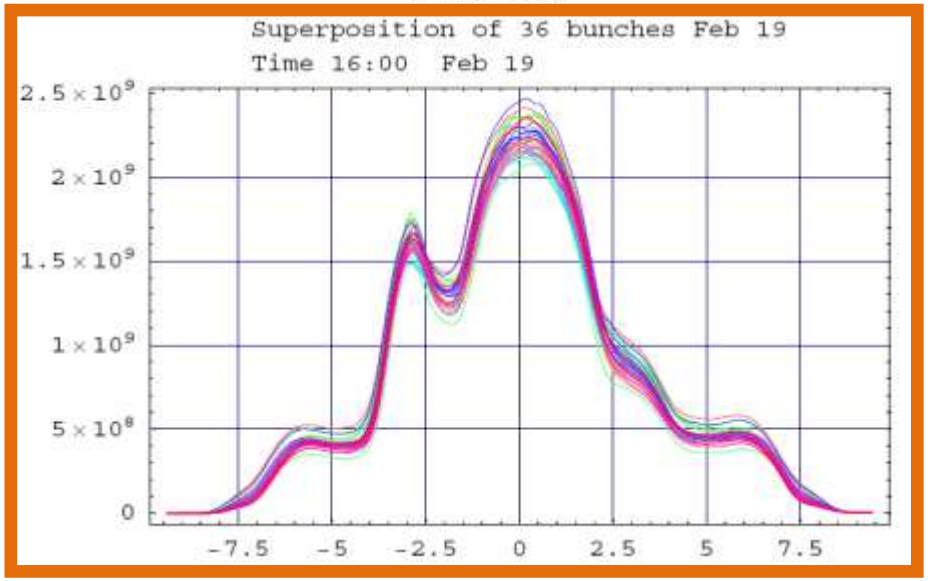
- Initially, the discrepancy btw the three intensity diagnostics instruments was ~4% , sometimes 15% !!
- Finally, Alvin and Tev ops and Instrumentation team brought it up to satisfaction – the "real life" accuracies:
  - IBEAM (DCCT) ~5 e-5 (0.005 %)
  - FBI and SBD (RWM) ~(1-3)e-3 (0.1-0.3%)

# Longitudinal bunch tomography

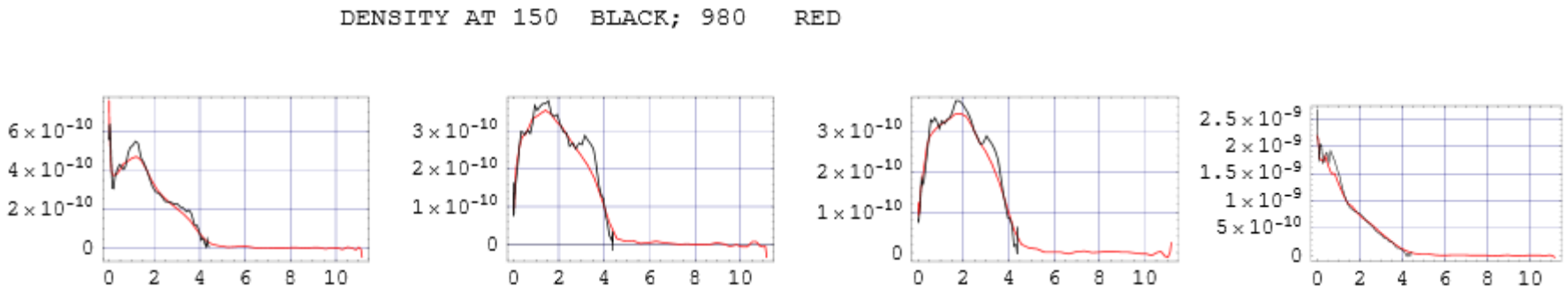


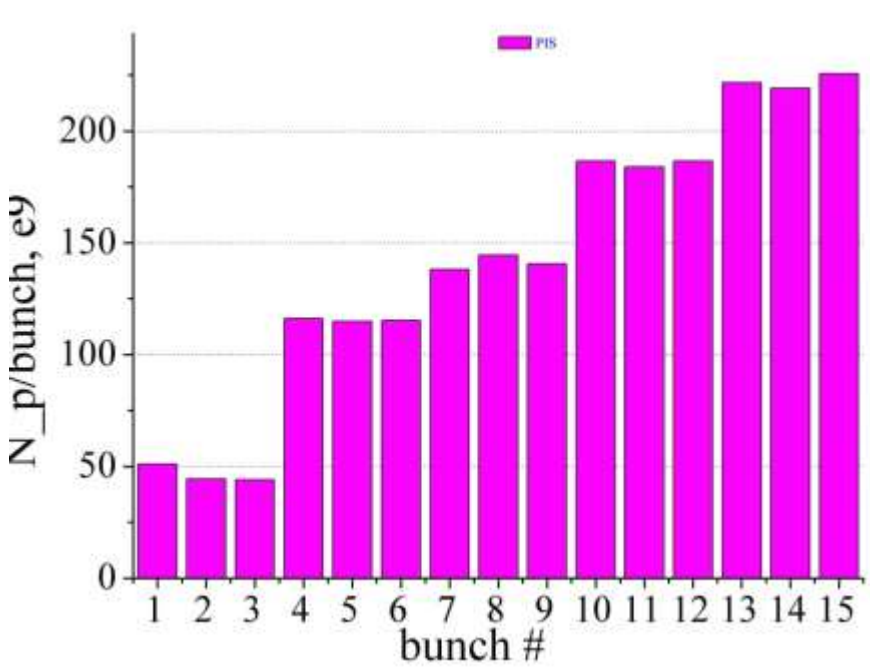



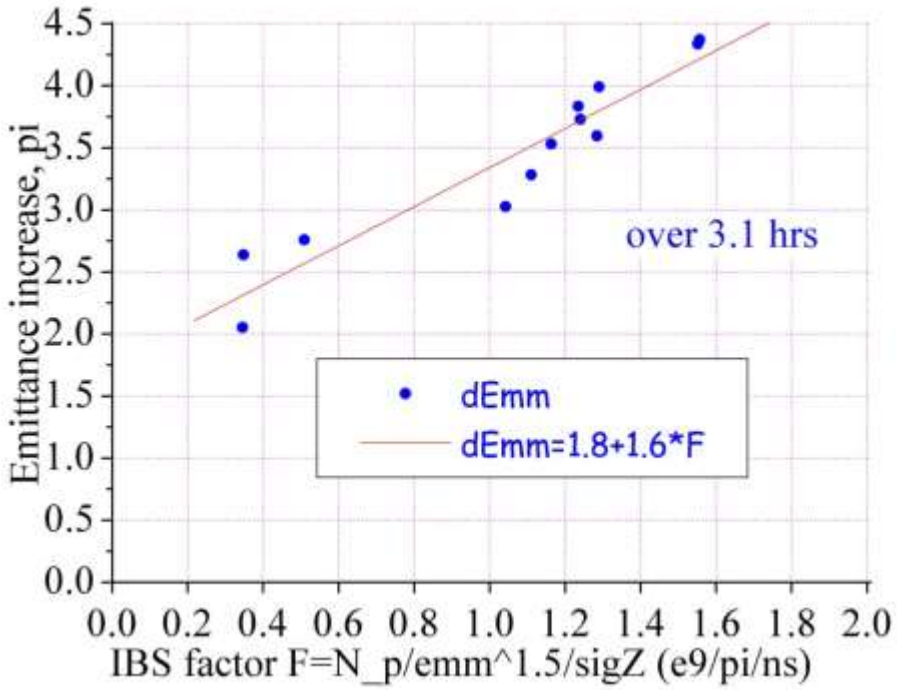



# IBS (Intrabeam Scattering) Growth



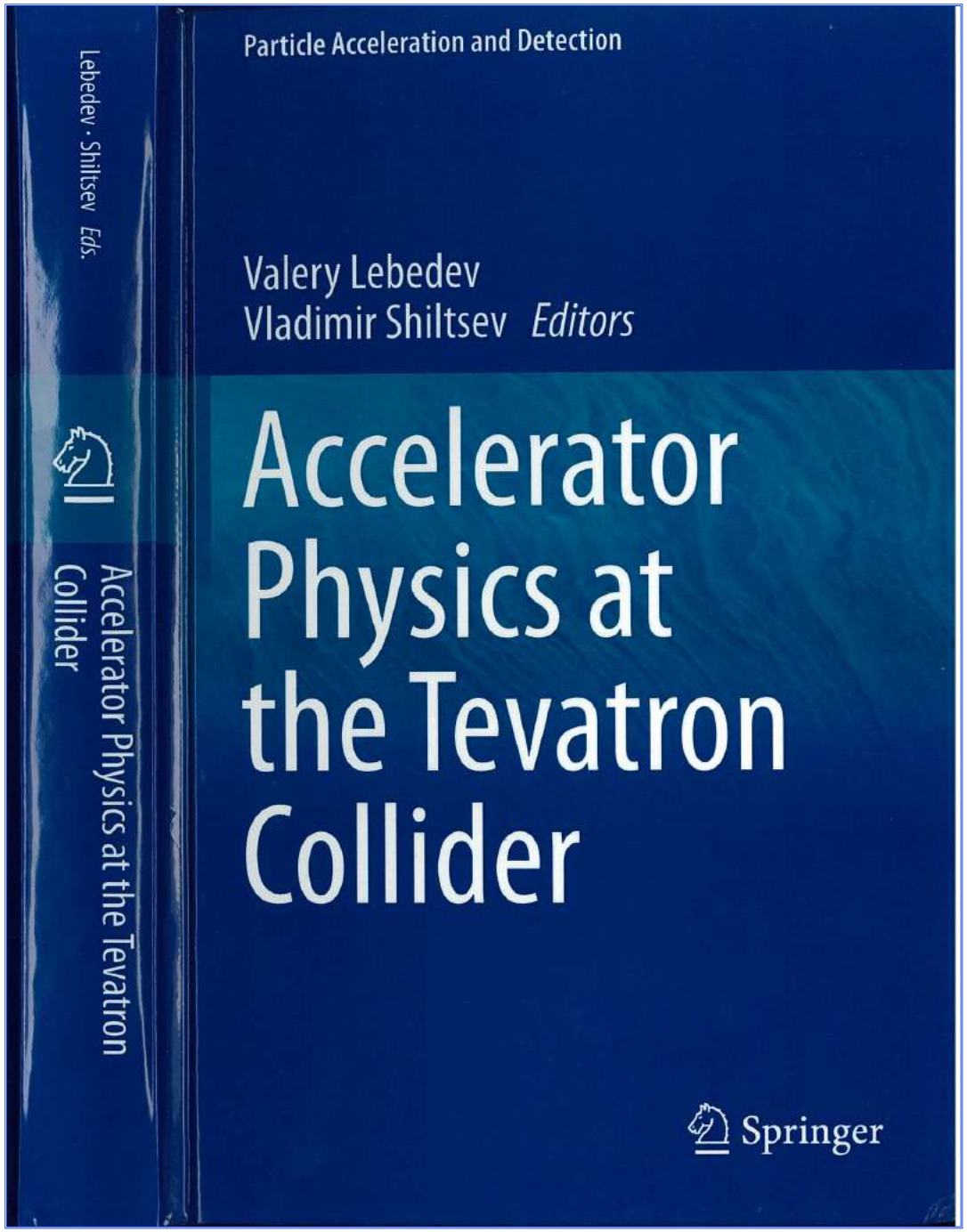



# Other important subjects covered by Alvin

- Beam-gas scattering and losses
  - Effects on beam lifetime
  - Effects on CDF and D0 backgrounds
  - Consequences for collimation system
- Losses at the start of acceleration ramp
- Losses from buckets to the abort gaps (DC beam)
- Emittance evolution
- SDA – Store analysis software package, etc etc

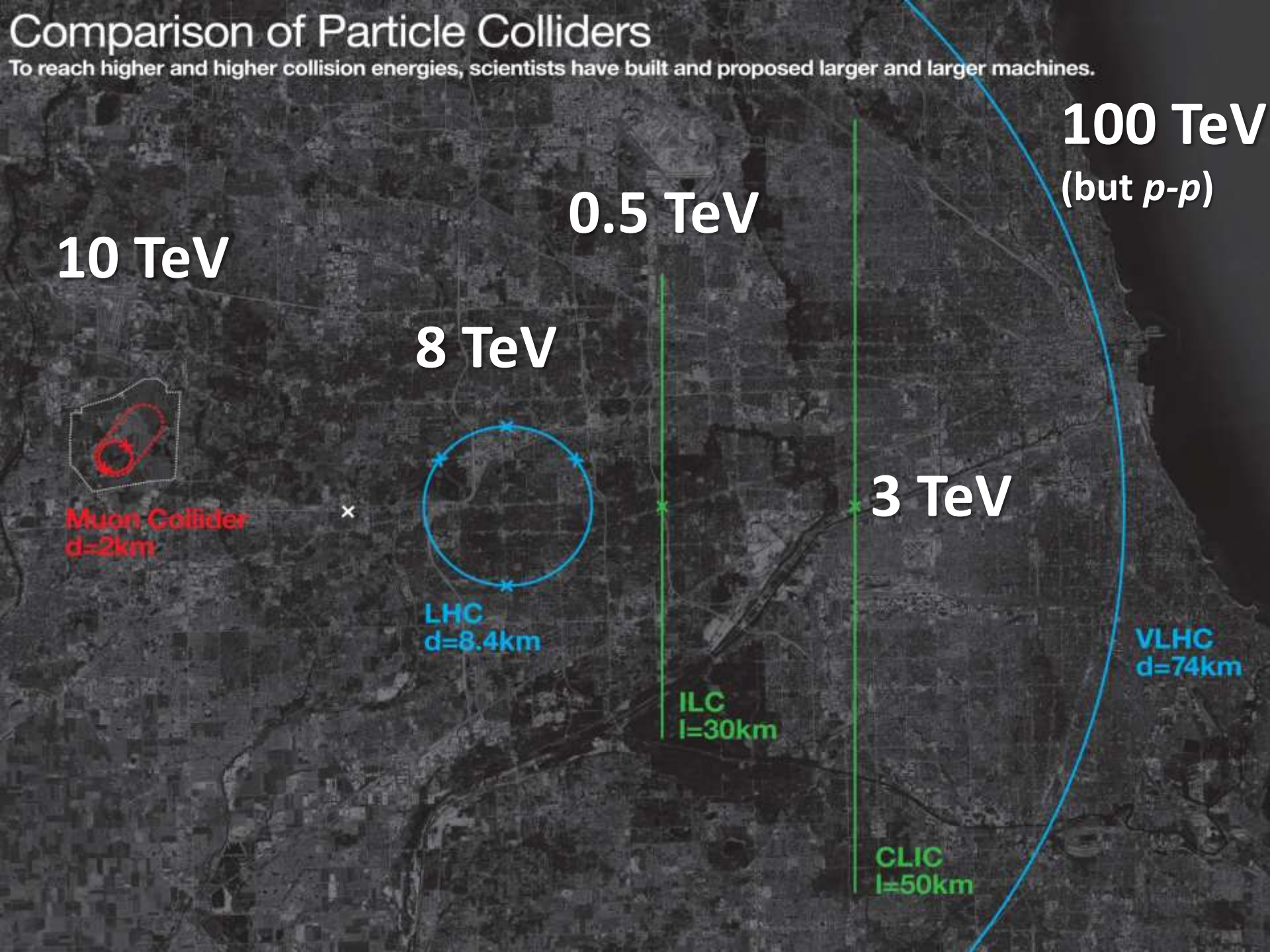
**“Bulldozer effect”** (at the end - the issue fully understood & resolved)


Particle Acceleration and Detection
Valery Lebedev
Vladimir Shiltsev Editors
Accelerator Physics at the Tevatron Collider
Springer
Lebedev · Shiltsev Eds.
Accelerator Physics at the Tevatron Collider

June 2014

*2nd Story*

# Alvin's *Old Love*


Comparison of Particle Colliders
To reach higher and higher collision energies, scientists have built and proposed larger and larger machines.
100 TeV
(but p-p)
0.5 TeV
10 TeV
8 TeV
3 TeV
Muon Collider
d=2km
LHC
d=8.4km
ILC
l=30km
CLIC
l=50km
VLHC
d=74km

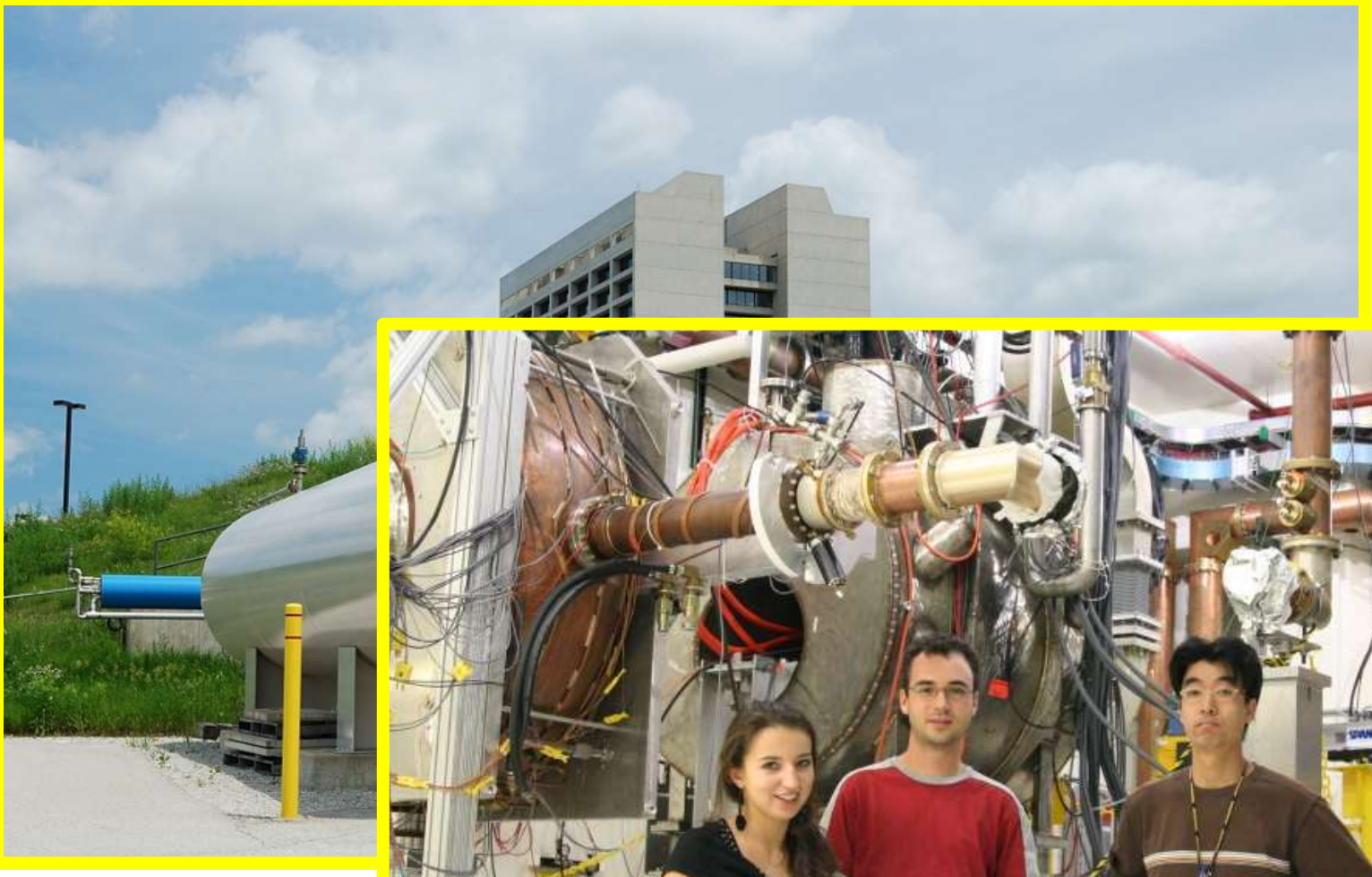
# Alvin's Work on Muon Facilities

NFMCC


**FNAL Feasibility Study on a Neutrino Source Based on a Muon Storage Ring**

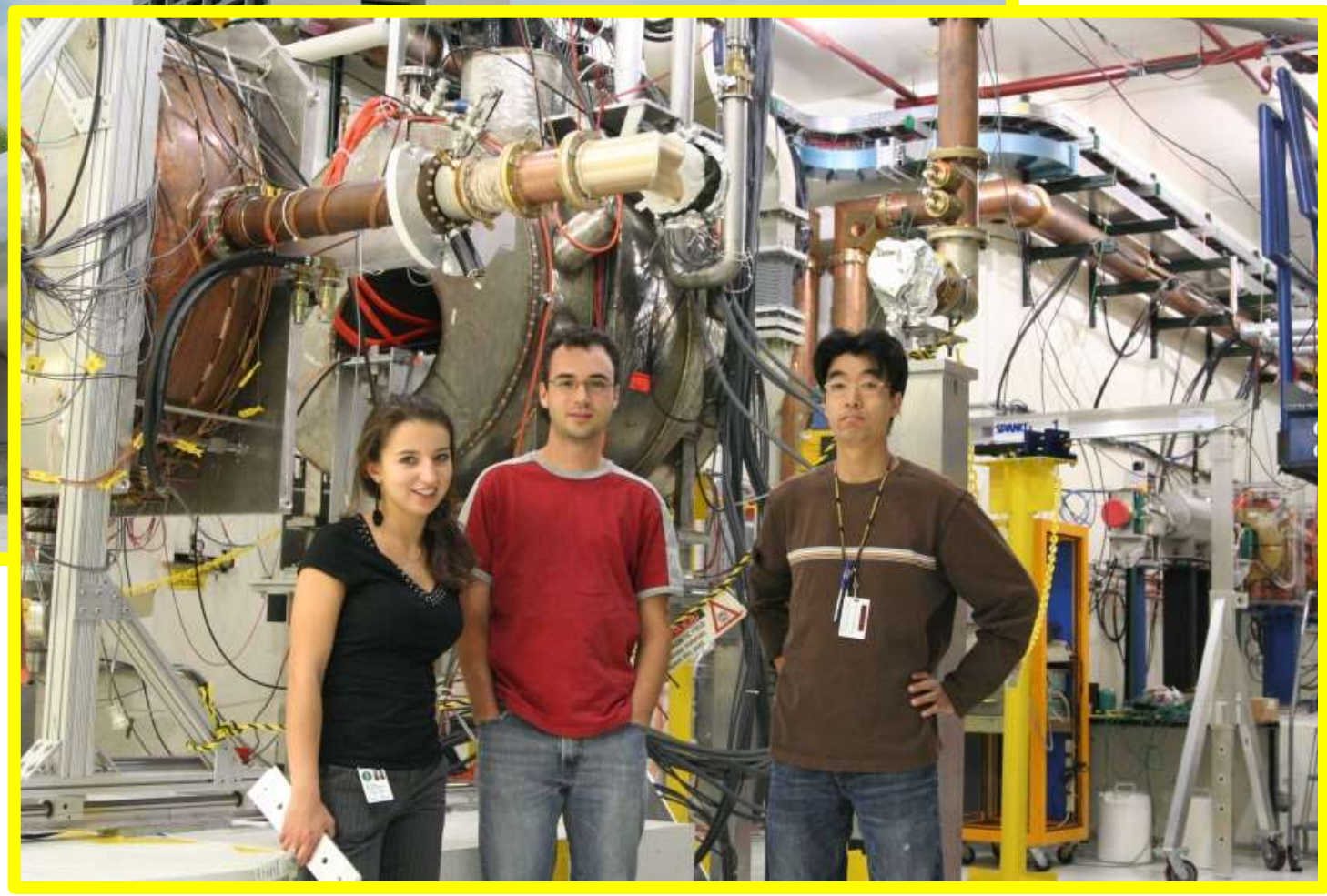

**Fermilab Muon Collider Task Force**


Muon Accelerator Program



# MTA:

*p+* beam
SC magnets
NC RF
“Smart kids”

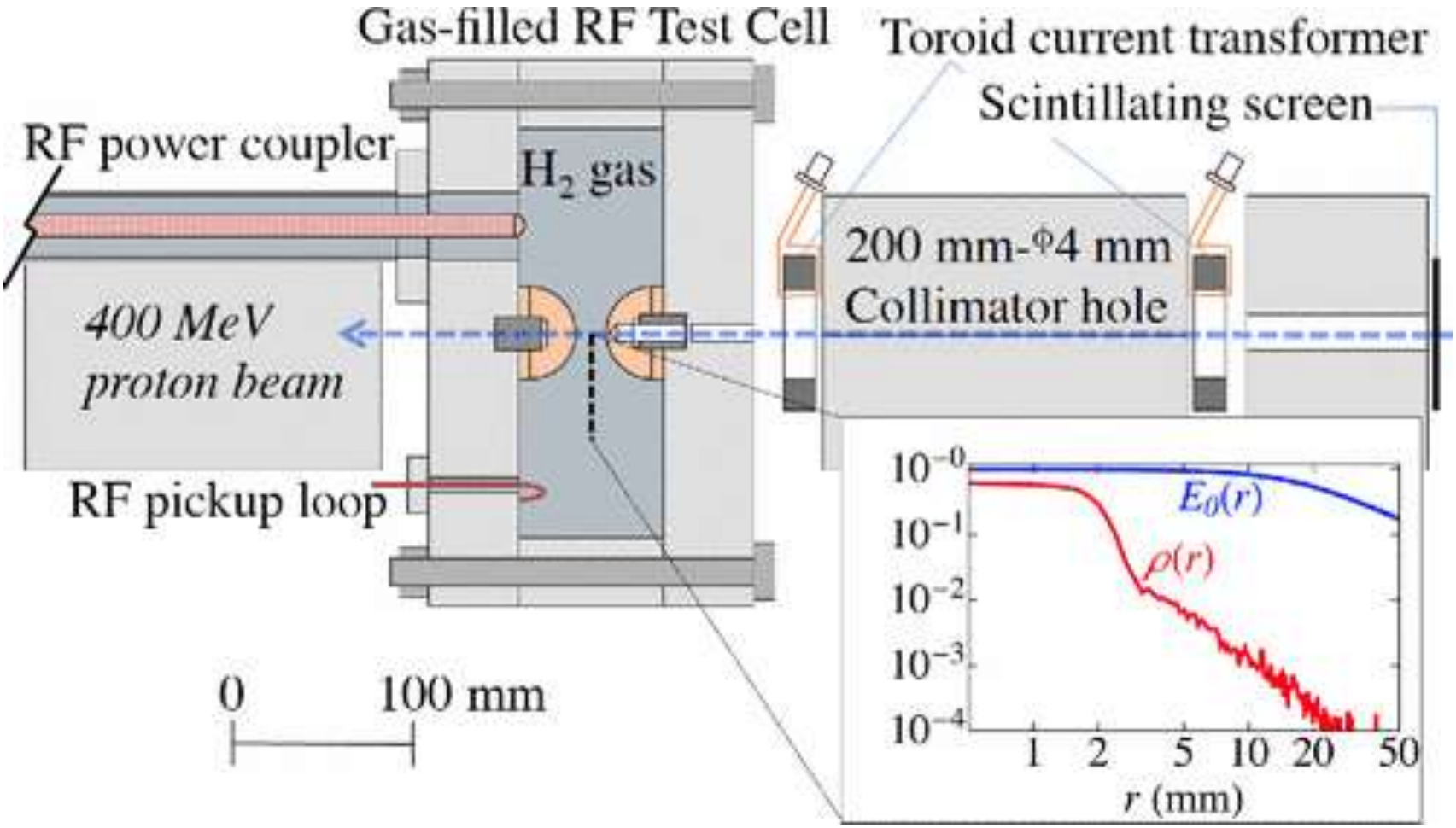


# MTA:

MuCool Test Area

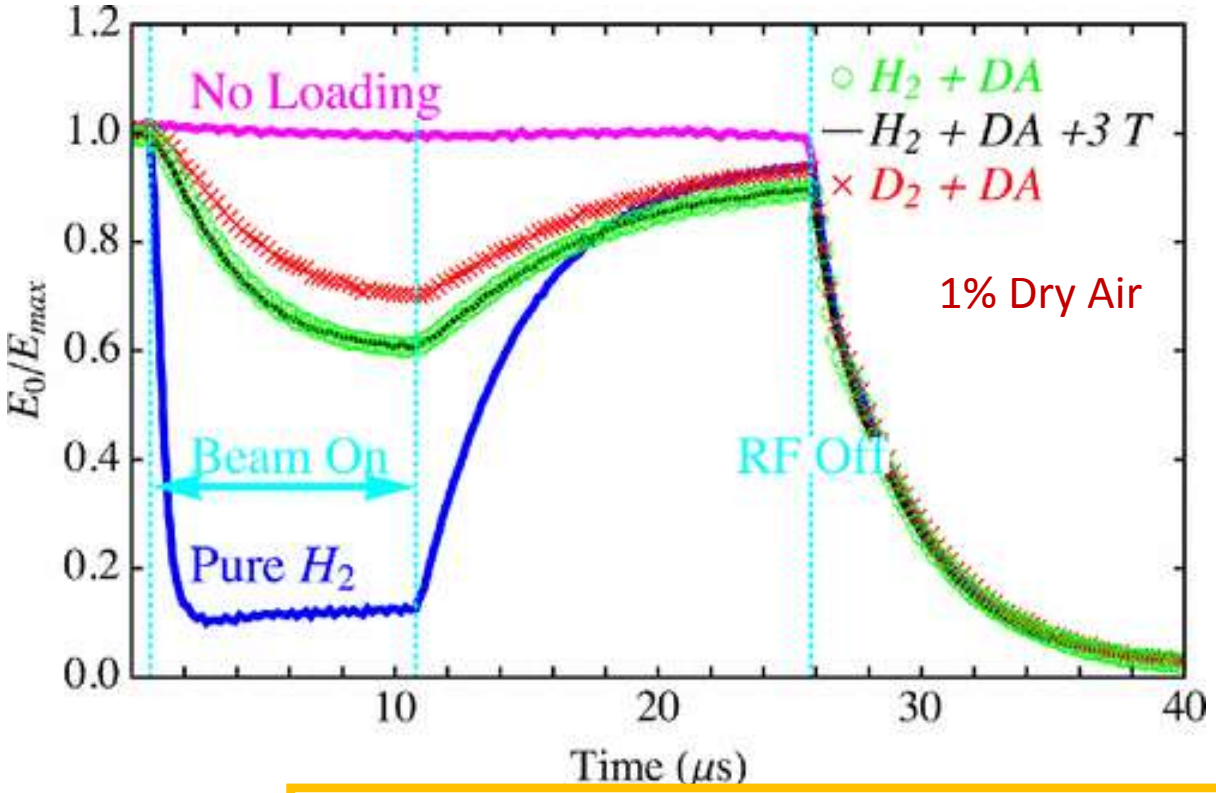
# The MTA Experiment:

## 100 atm pressurized H2 VERY high gradient RF cavities in 3 T with beam




Goal : >40 Mv/m RF gradients in ~3T fields

# Fascinating Results : 50 MV/m !




The trick:
dopant gases O2 to remove free electrons and reduce RF power consumption by x50

PRL 111, 184802 (2013) PHYSICAL REVIEW LETTERS week ending 1 NOVEMBER 2013

**Pressurized $H_2$ 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. Yonehara[1]

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[2]*Muons, Inc., Batavia, Illinois 60134, USA*
[3]*Illinois Institute of Technology, Chicago, Illinois 60616, USA*
(Received 12 July 2013; published 29 October 2013)

# Alvin for *Guinness Book* - ?

APS physics | Journals | Help/Feedback

PHYSICAL REVIEW LETTERS

*moving physics forward*

Highlights Recent Accepted Authors Referees

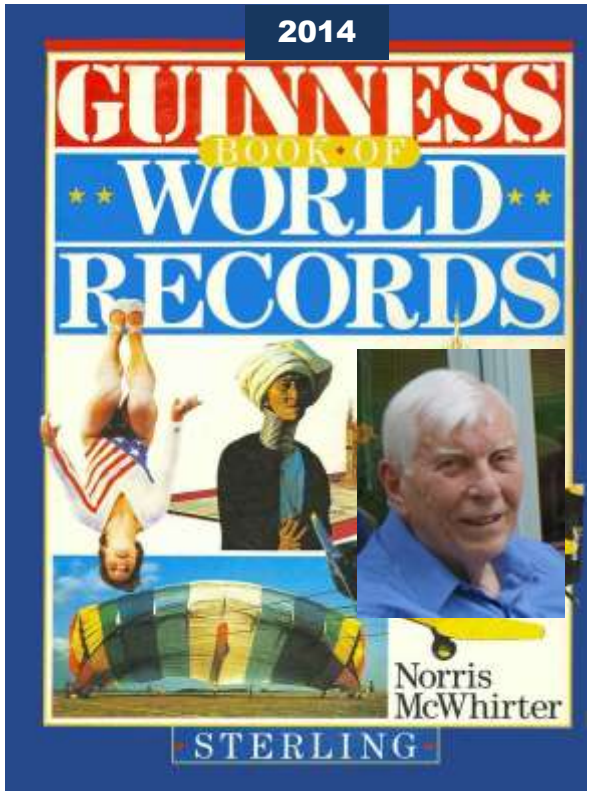
1949

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

A. V. Tollestrup, F. A. Jenkins,** W. A. Fowler, and C. C. Lauritsen

*Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, California*

April 26, 1949

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[3]*Illinois Institute of Technology, Chicago, Illinois 60616, USA*

(Received 12 July 2013; published 29 October 2013)

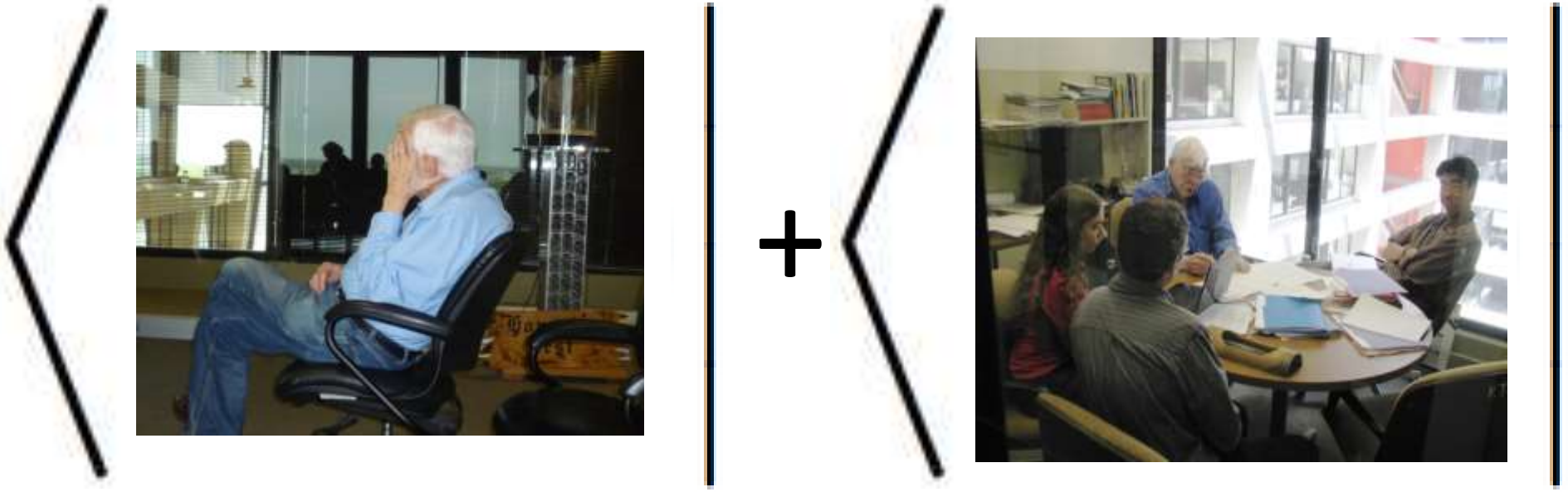
2013

- The longest PR-L track (64 yrs) ?
- The best PRL paper written after 90 ?
- The biggest number of co-authors over scientific career ?

*3rd Story*

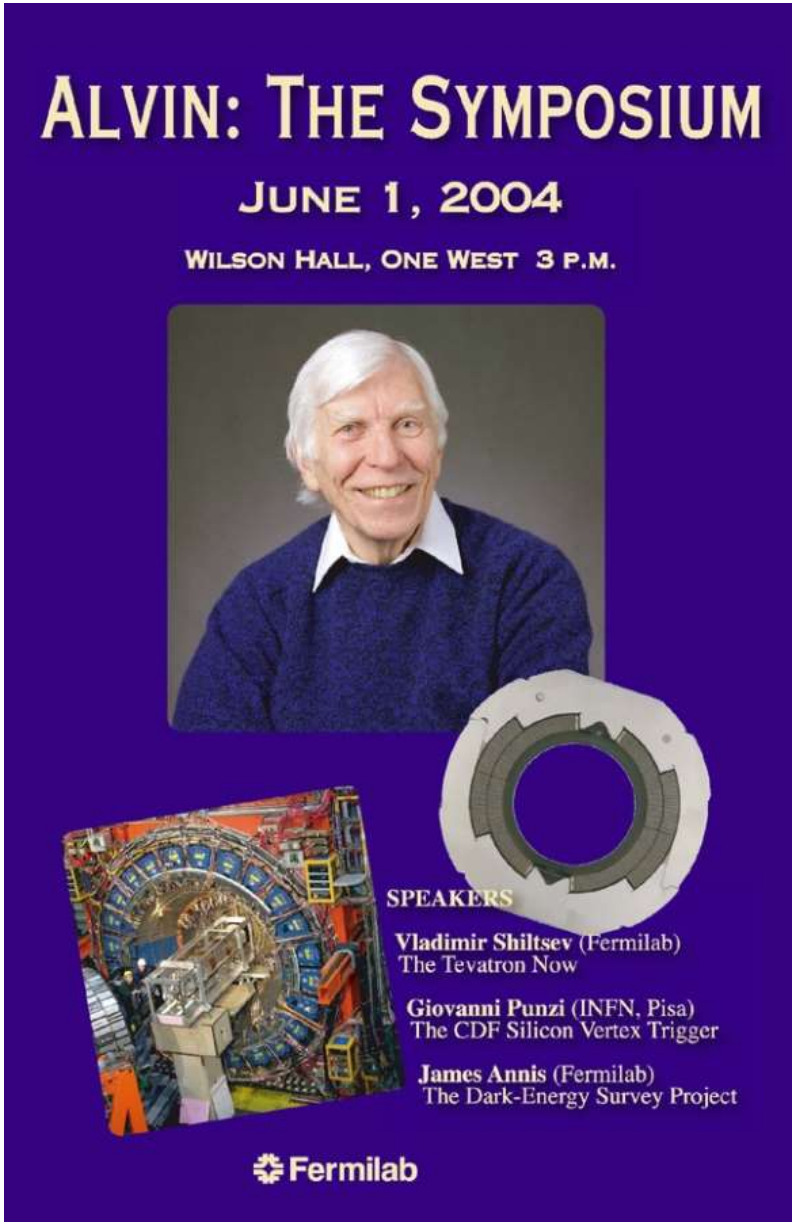
# Alvin As People's Magnet


# Alvin's *Wavefunction*:



1% 99%

# Alvin's Parties – Always Fun!

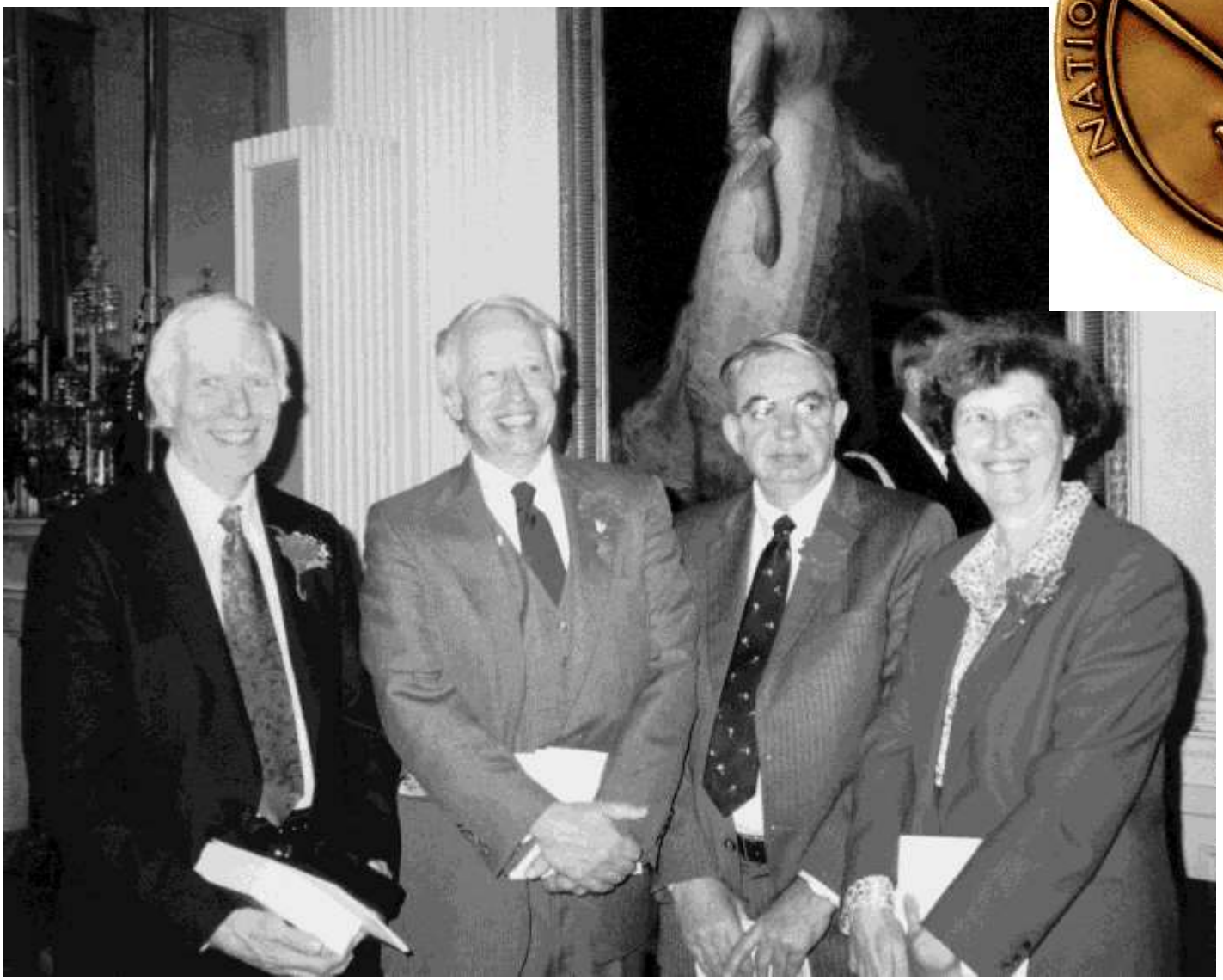



## Συμποσιον

*"… 3. A convivial meeting for drinking, music, and intellectual discussion among the ancient Greeks."*

**American Heritage Dictionary**

# Alvin's Medals - 1973

# Alvin’s Medals - 2013


# Long Live *Best Alvin Ever !*