Accelerator Physics

R. B. Palmer
(BNL)

Friday

4/26/13

Early Memeories

I arrived in the US on October 3, 1960, came to BNL, was welcomed by Ralph Shutt, and moved into an office with Nick Samios at the end of the barrack corridor.

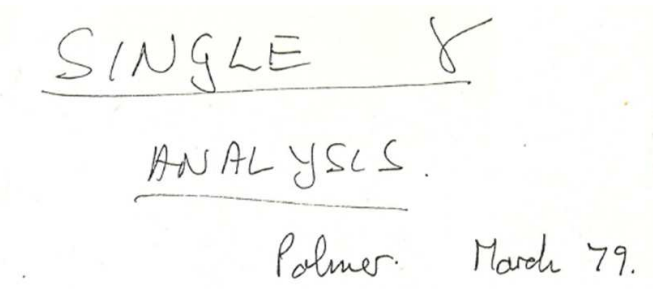
Next day, October 4th I met Bill in his office near the middle of the barrack. I do not forget.

I knew a lot about optics and bubble chambers, and very little about High Energy Physics. I was shocked at how much Nick and Bill knew, and how they seemed to take for granted that I would catch on.

It was a hall mark of Bill's. He always seemed to assumed one knew, already, about the subject under discussion. But we were never as knowledgeable as he. One did one's best, and ran afterwards to the library, or asked Nick across the desk. I learnt a lot that way.

Direct Photons
Discovery at CERN's ISR Experiment 806

This was the only time I worked closely with Bill. I know this is not what I am supposed to talk about, but after Chris Fabian's introduction, I cannot resist. Do not worry, I will come to his contributions to 'Accelerator Physics'.


SINGLE γ

ANALYSIS.

Palmer. March 79.

DIRECT PRODUCTION OF HIGH p_T SINGLE PHOTONS IN pp COLLISIONS AT THE CERN ISR

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T.A. FILIPPAS, E. FOKITIS and C. TRAKKAS
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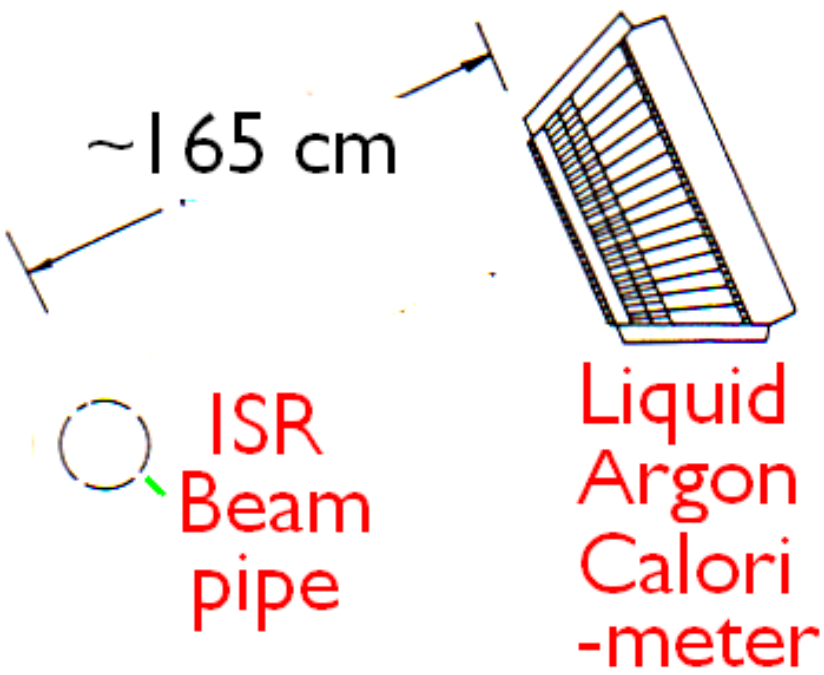
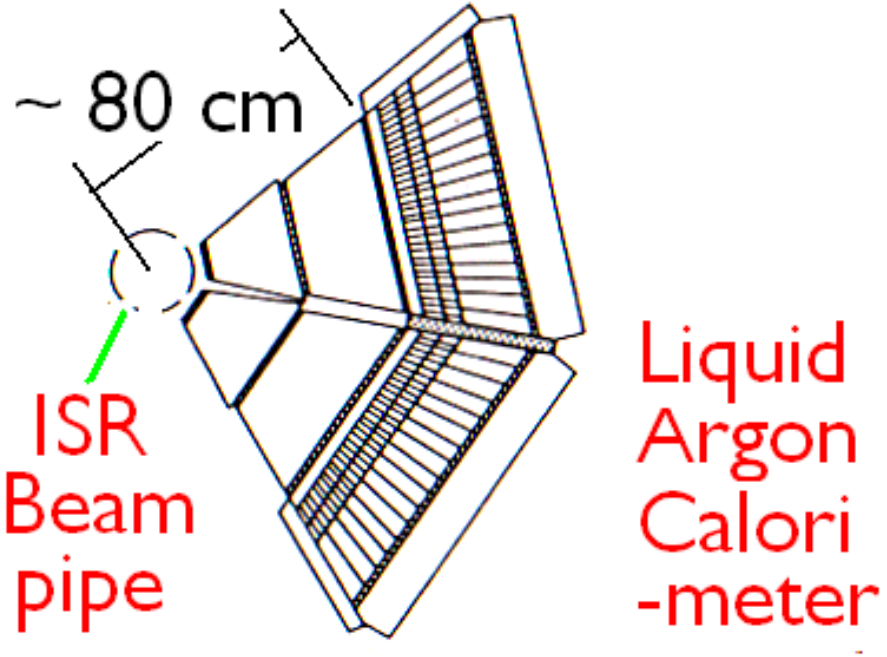
A.M. CNOPS, J.H. COBB [1], E.C. FOWLER [2], D.W. HOOD [3],
S. IWATA [4], R.B. PALMER, D.C. RAHM, P. REHAK and I. STUMER
Brookhaven National Laboratory [5], Upton, NY, USA

C.W. FABJAN, T. FIELDS [6], D. LISSAUER [7], I. MANNELLI [8], W. MOLZON,
P. MOUZOURAKIS, K. NAKAMURA [9], A. NAPPI [8] and W.J. WILLIS
Cern, Geneva, Switzerland

ISR Geometries for gamma detection



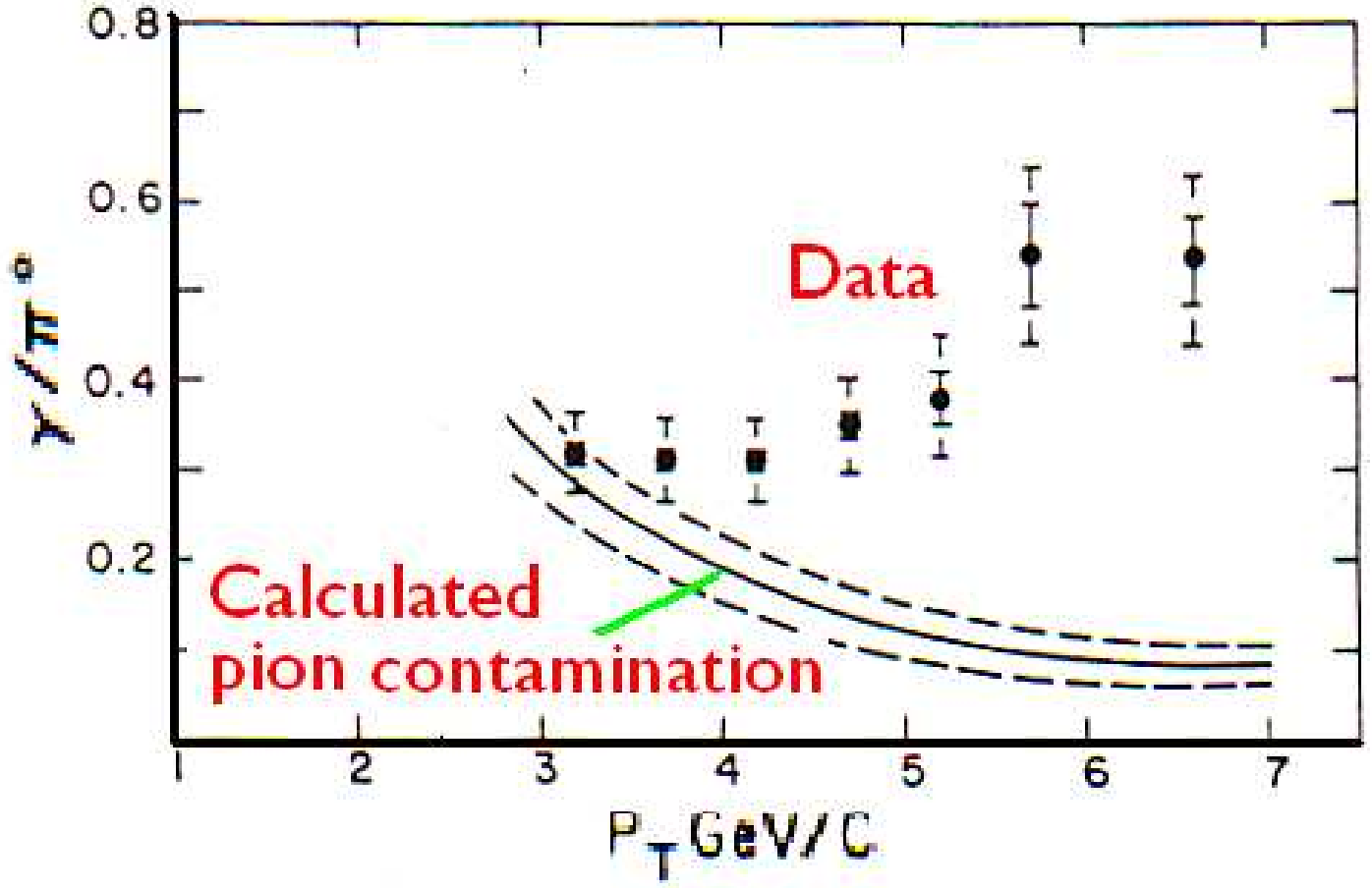
Special Geometry
for gammas



Earlier Geometry

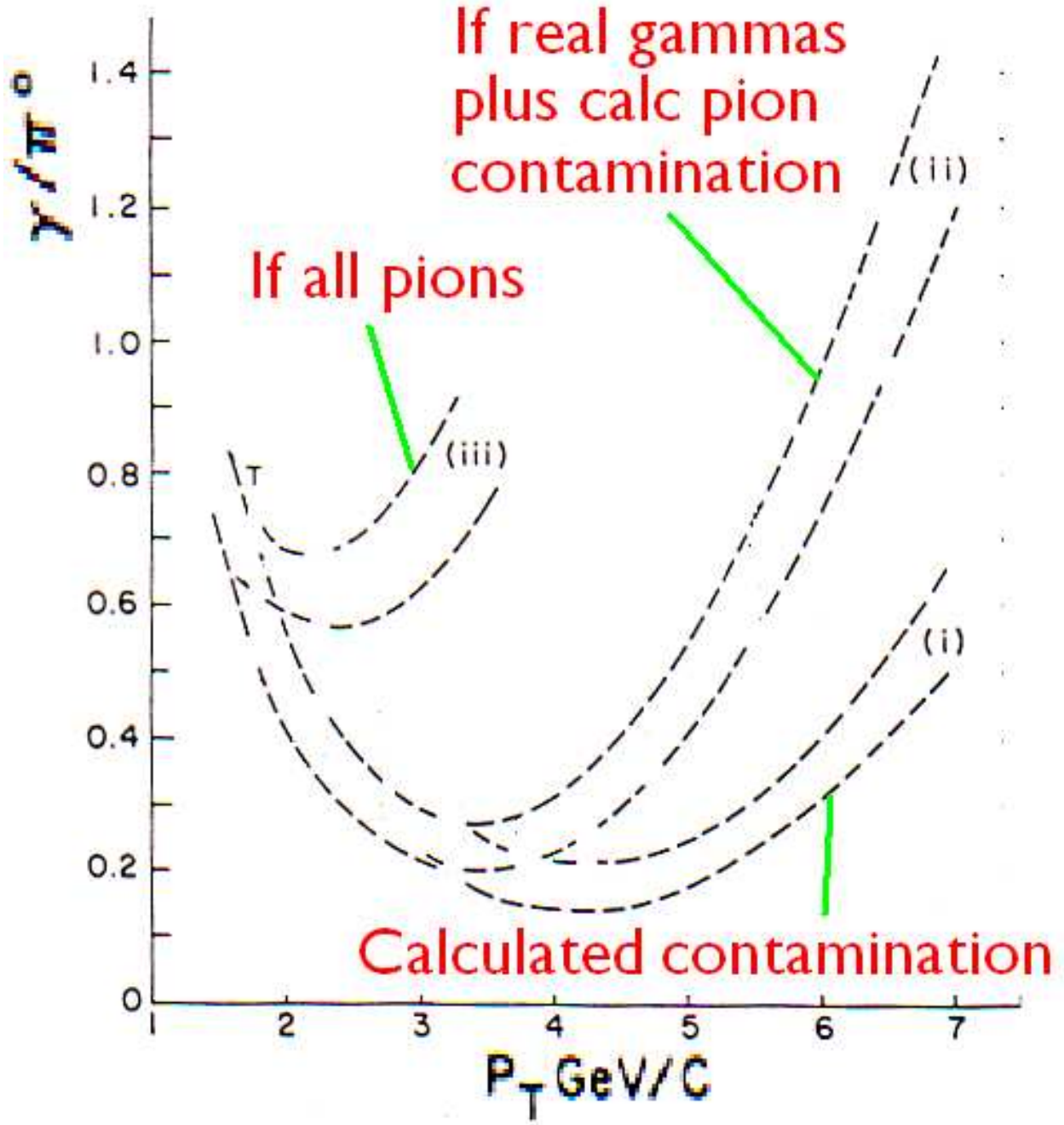
Liquid Argon Detectors moved back from source to reduce contamination from π^o decays to two gammas where gammas are merged or only one seen

Observed Data

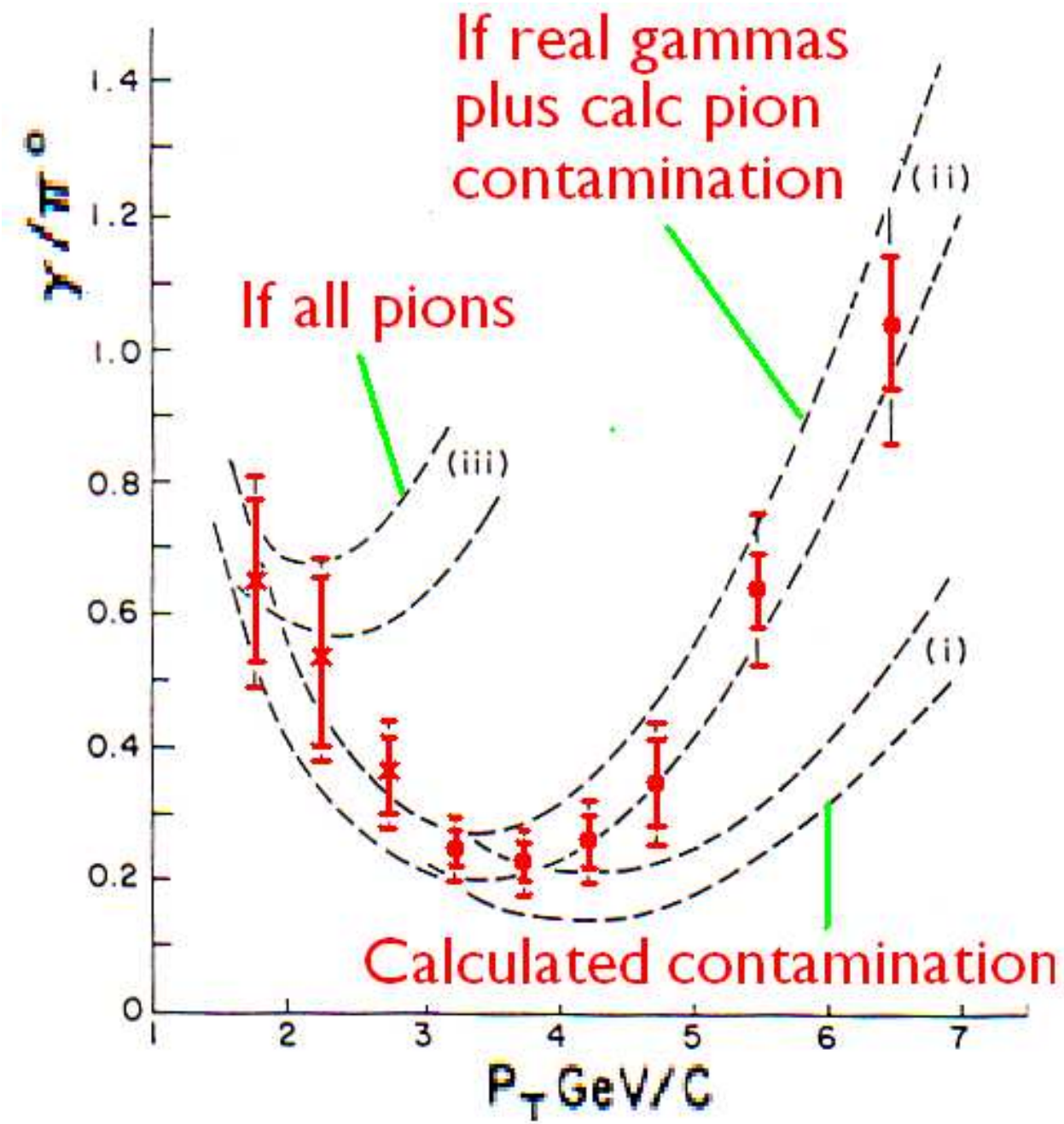


- But how can one be sure of not underestimating contamination?
- Moving detectors away would reduce this: Another run?
- Bill: Use earlier data that was nearer: giving more contamination
- If this fits our calculated contamination, it is a good check

What we predicted before running the data tapes



What Anna Marie and I saw at 3 am



Accelerator physics

Bill was supposed to be a High Energy Physics Experimenter with particular interest in new detector ideas.

But he was interested in everything and knew about everything. So it is not surprising that I first heard about the idea of a Muon Collider from him.

The idea came from Budker at Novosibirsk. I would love to know how he came to know of it.

Over the 20 year span that I have now been working on it, Bill has repeatedly encouraged me and followed our progress.

Photo-cathodes & Pulsed Power Acceleration

The electron brightness of a photo-cathode gun depends strongly on the electric field gradient on the cathode. The higher the gradient, the less the space charge blow up of its emittance.

In addition, a higher gradient can enhance the photo-cathode efficiency (current/laser power).

High efficiency photo-cathodes and low emittance guns became a strong interest in the Light Source Department and Instrumentation Division: an interest that lead, in part, to the Accelerator Test Facility (ATF), in which Bill played a role.

Switched Power, using a single short pulse of electric field on a photo-cathode, would allow higher gradients, without breakdown, than a longer pulse of rf.

But how do we make a short pulse of electric field?

Basic Idea for a Switched Power Gun

A short laser pulse on a ring photo-cathode creates a ring electric field that, as it proagates in towads the center, is amplified

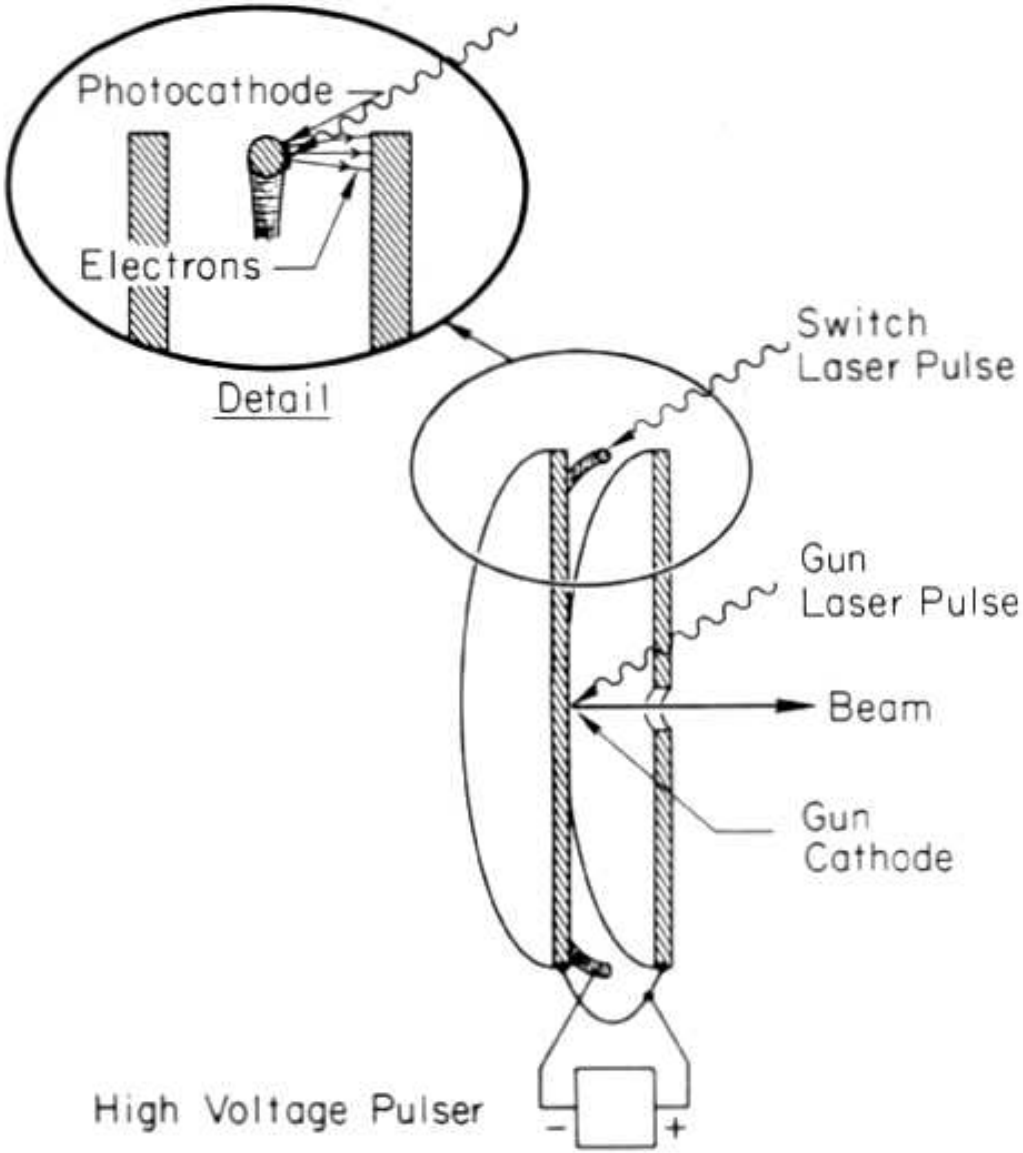


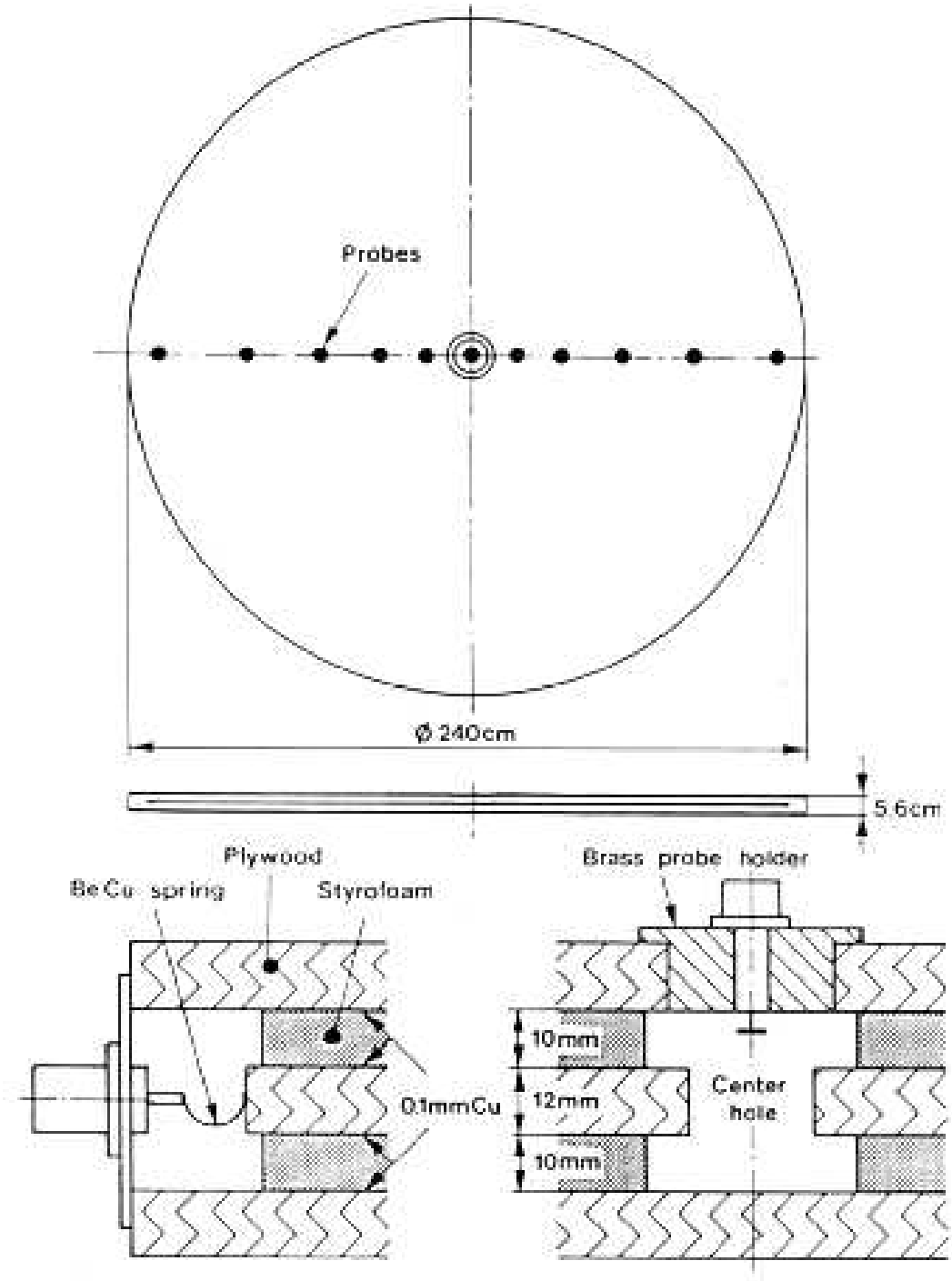
Fig. 1: A Switched Power Electron Gun.

The Model at CERN

Today one would sta with simulations.

But then, Bill and h friends built a model

W. Willis
F. Caspers
H. Haseroth
J. Nott
S. Aronson



Exp. Data from the Model

A gain of ≈ 8 was achieved

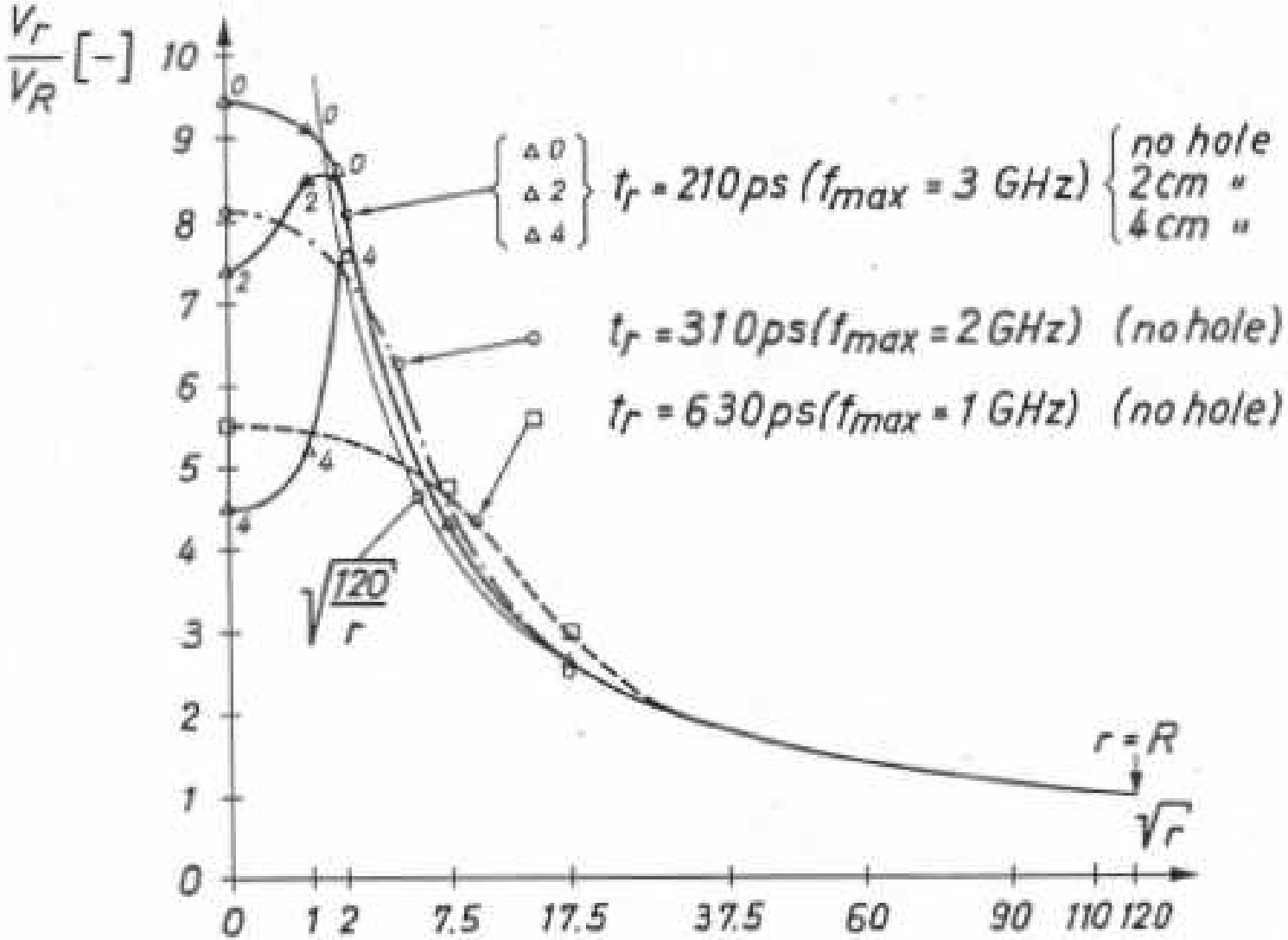
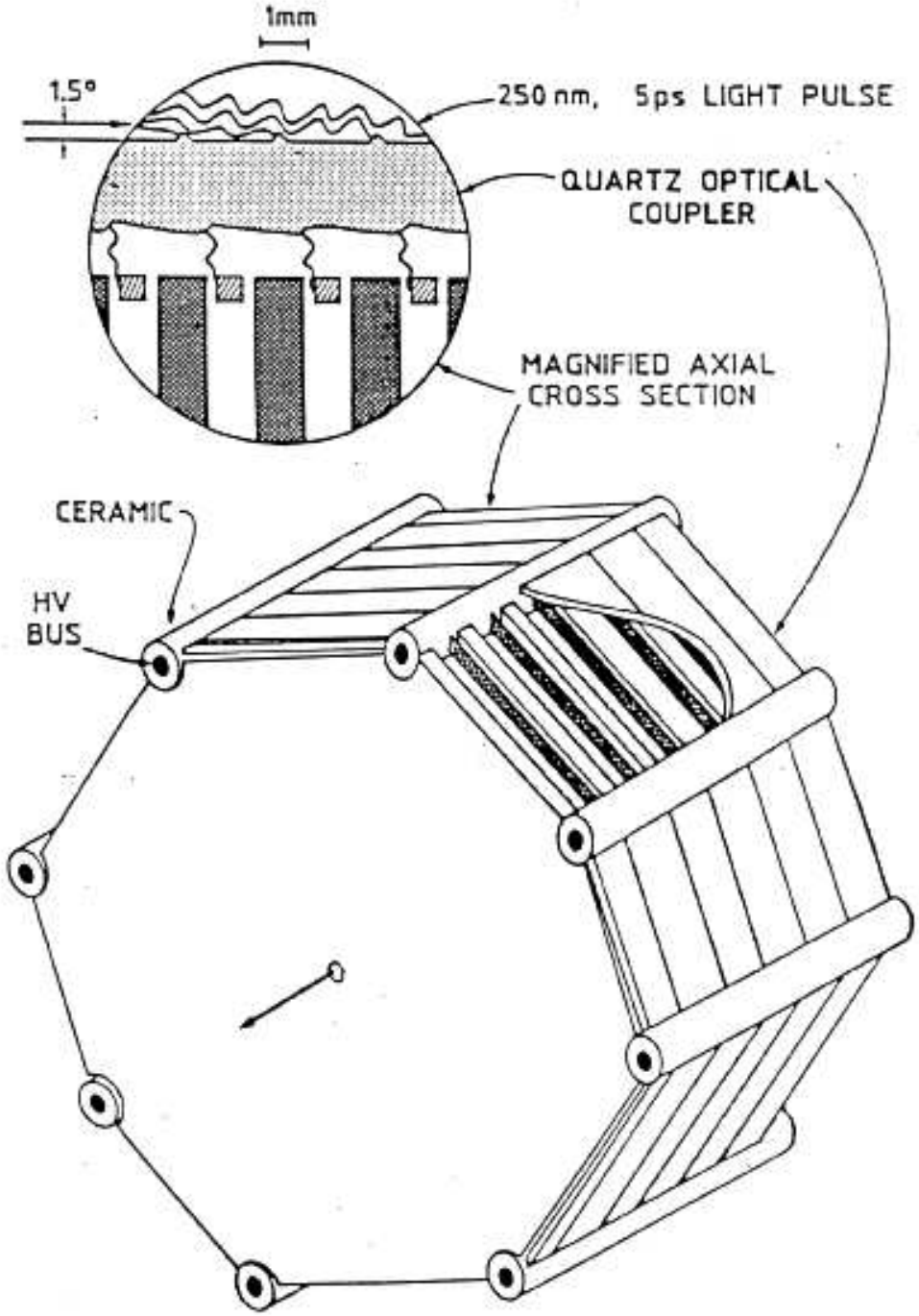


Fig. 3

Enhancement vs radius for different rise-times

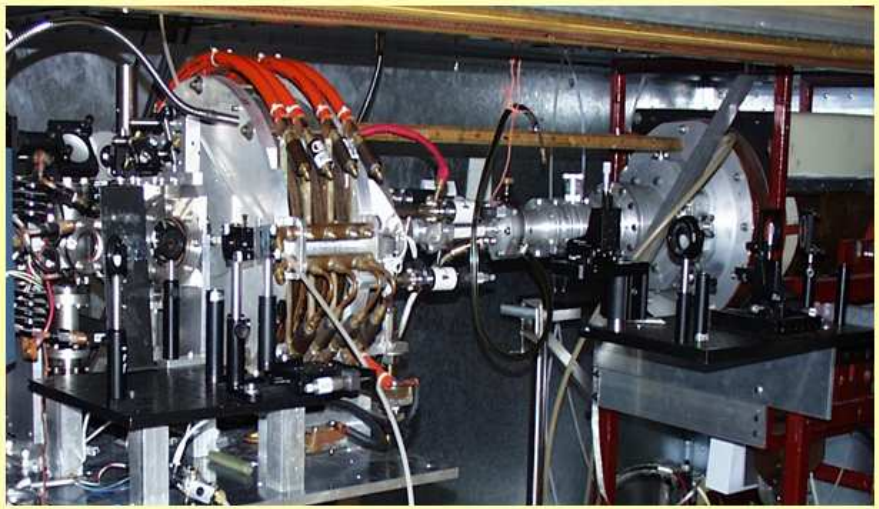
Extension to a Li

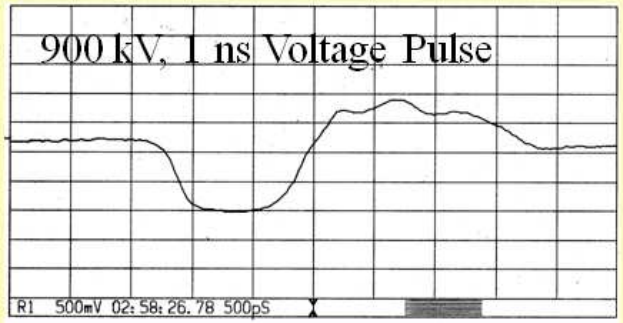
This shows their extension of the ideas to a longer linac with very high gradients

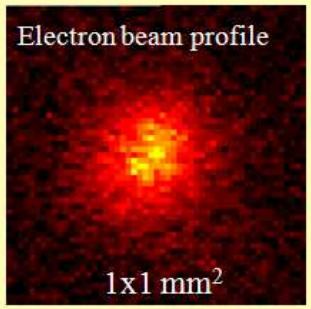


Alternative root to very high & short pulses

Bill was also part of this effort in the Instrumentation Devision (with Treveni Rao, Velko Radeka and Thomas Tsang)



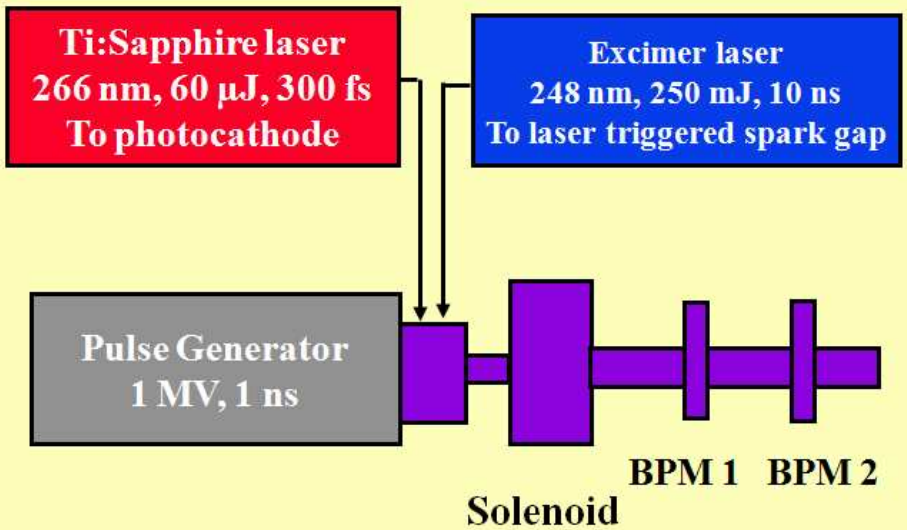




Spot size ~65 μm rms

Charge ~0.4 pC

emittance ~0.7 mm mrad



System Capabilities

Voltage range: 150 - 900 kV, 1 ns FWHM

Cathode laser: 60 μJ, 300 fs FWHM, 266nm

System timing jitter: <1 ns

Accelerating gradient: >1 GV/m

Maximum current density: >100 kA/cm²

Maximum charge: >60 pC from 300 fs laser

Pulse Field Detection

BNL–45393

A STUDY OF ELECTRO-OPTICAL MODULATORS FOR TRANSFER OF DETECTOR SIGNALS BY OPTICAL FIBERS*

T. Tsang, V. Radeka, T. Srinivasan-Rao, and W. J. Willis†

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†BNL and Columbia University, New York 10027

This allowed a direct observation of the 1 MV/m gradients that were achieved

Early Proposal for a 1 A^o Free Electron Laser: as is now operating at SLAC

It was Bill who suggested the workshop that was held at Sag Harbor on April 22-27, 1990 (organized by Juan Gallardo and me), that laid out the parameters for such an FEL.

In an email on Dec 2010, Bill added to a discussion started by Herman Winick, with Claudio Pellegrini, Juan Gallardo, and James Murphy:

"I think I sat in on the 1987 workshop at BNL and saw that indeed the brightness was going up rapidly, and the work driven by the linear colliders was going to change outlook for the light sources too.... Talking about an ultimate goal of 1A would set the resources of the two applications on the same scale: a big jump for the sources, but talk is cheap, and can get the ball rolling. Bob bought it."

It was one of so many "balls" that Bill set rolling. What a guy!