Festeggiando Giorgio Bellettini

PISA, 4 Giugno 2024

Michelangelo L. Mangano
TH Department
CERN

Outline

- Giorgio and I, how it started
- Giorgio and the SSC
- Giorgio and CERN
- Giorgio and technology
- Giorgio and students

Giorgio and I, how it started

- **1986: Cortona,** yearly “Incontri di fisica teorica”
  - Giorgio: “Status of CDF”
  - MLM: “Status of string perturbation theory”

    ➡ in principle, *un dialogo fra sordi ! But dialogue it was, with the promise to touch bases after my arrival at FNAL in September, as new postdoc in the TH group*

- **1987: La Thuile # 1**
  - MLM: Strings → Gluon amplitudes ⇒ “Multigluon amplitudes” (invited by Mario, warmly welcomed by Giorgio)

- **1987-88: FNAL**
  - Gluon amplitudes → jet cross sections → CDF
    - a process driven by the Pisa QCD group (Mauro, Paola, Luciano, …) and blessed by Giorgio …
  - … by mid ’88 I was fully embedded in CDF analysis groups, mostly QCD and EW (first measurement of Z mass Spring ’89, first authorship)

The SSC

- Reagan approval: 1987
- Texas site selection: November 10, 1988
- Contractor decision (URA): Jan 1989
- Opening of temporary offices for the lab south of Dallas: Spring 1989

Giorgio and the SSC

1989

On September 25 at a workshop at Fermilab on solenoidal detectors an ad hoc group of physicists from the major efforts organized through ANL, FNAL, LBL, and institutions in Japan met to try to establish a collaboration whose goal is to design the best possible detector and to submit a letter of intent. To expedite this process the ad hoc group set up a temporary steering committee. The charge to this committee is to:

1) Determine which persons and institutions are committed to working on the design of a solenoidal detector at the present time.

2) Make a proposal for the establishment of an executive board or other governing body to represent the members of the collaboration and guide the work.

3) Help coordinate the working groups on tracking, calorimetry, detector integration, etc. until the collaboration is formed.

4) Initiate the effort to draft a letter of intent.

We emphasize that it is the unanimous opinion of the present steering group that such a collaboration must remain open for physicists to join in the future. A collaboration meeting has been set for December 17-18 at Fermilab.

interim steering committee

G. Bellettini
R. Cashmore
H. Frisch
D. Green
T. Kirk
T. Kondo
Y. Nagashima
D. Reeder
A. Seiden
G. Trilling
B. Williams

From Giorgio to Gr 1 coordinators, in his role of Chair of Gr 1

7 Novembre 1989

A TUTTI I COORDINATORI DI GRUPPO I:
==========

Cari Colleghi,

Vi allego una lettera di un gruppo che si e' formato "ad hoc" per una nuova collaborazione per un solenoid detector allo SSC. Per quanto la lettera sia stata per ora inviata solo a quei gruppi che hanno collaborato in qualche forma agli studi di R/D preparatori svoltisi fino ad ora, e' chiaro che qualunque gruppo dell'INFN che sia interessato sara' trattato con il massimo rispetto.

Si tratta ora di "fondare" la Collaborazione, e per questa fase una risposta e' attesa in linea di principio entro il 17 Novembre. Naturalmente non e' questa una dead-line, e si potra' riparlarne profi-cuamente anche il 1 dicembre e dopo.

Cordiali saluti,

Giorgio Bellettini

Pisa, November 17, 1989

Dear George,
The Dipartimento di Fisica dell'Universita' di Pisa, jointly with the
Sezione di Pisa dell'Istituto Nazionale di Fisica Nucleare (INFN)
would like to join the effort for a letter of intent for a
super-solenoid for the SSC.

Although at the present time we are deeply involved in the CDF upgrades
or in other projects, we intend to contribute to the following R/D and
Design Study Groups that I guess shall be set up in December:

Roberto Amendolia, Franco Bedeschi, Luciano Bosisio, Simone Dell'Agnello,
Aldo Menzione, Giovanni Punzi, David Smith, Francesco Zetti would join
the Silicon Detector Tracking Group. Roberto Amendolia will be the
contact person (VAXPI::AMENDOLIA).

silicon detectors

Rolando Bellazzini, Marco Massai would join the Tracking Group.
Rolando Bellazzini will be the contact person.

tracking

Alessandro Brez, Maria Rita Torquati would join the Trigger and Data
Acquisition Group.

trigger/DAQ

Hans Grassman, Michelangelo Mangano, Riccardo Paoletti and Tom Westhusing
would join the Physics Simulation Group, with Michelangelo as the contact
person (VAXPI::MLM).

Physics simulation

I shall coordinate our effort and help writing the letter of
Intent (VAXPI::BELLETTINI).

coordination

The above-mentioned persons, as well as several other physicists from our
Institution, are planning to attend the December "Constituency" Meeting.

In addition, Luciano Ristori, who is a senior CDF physicist, and is
presently at the University of Catania - Laboratori Nazionali del Sud,
would join the Trigger/DAQ group and act as a contact person for the Pisa
contingent as well (VAXPI::RISTORI).

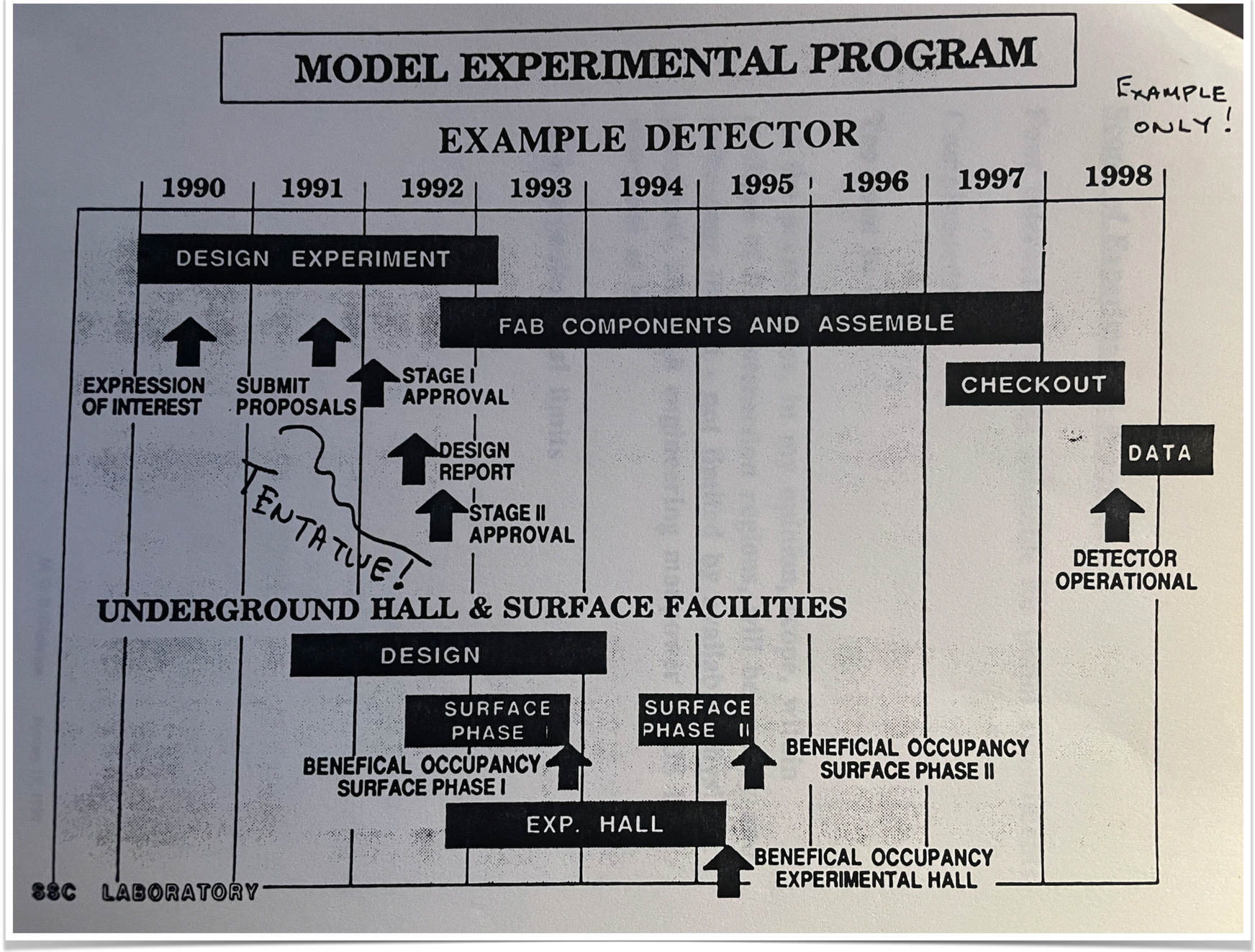
trigger/DAQ

Cordially
Giorgio Bellettini

Meanwhile, at the SSC lab:

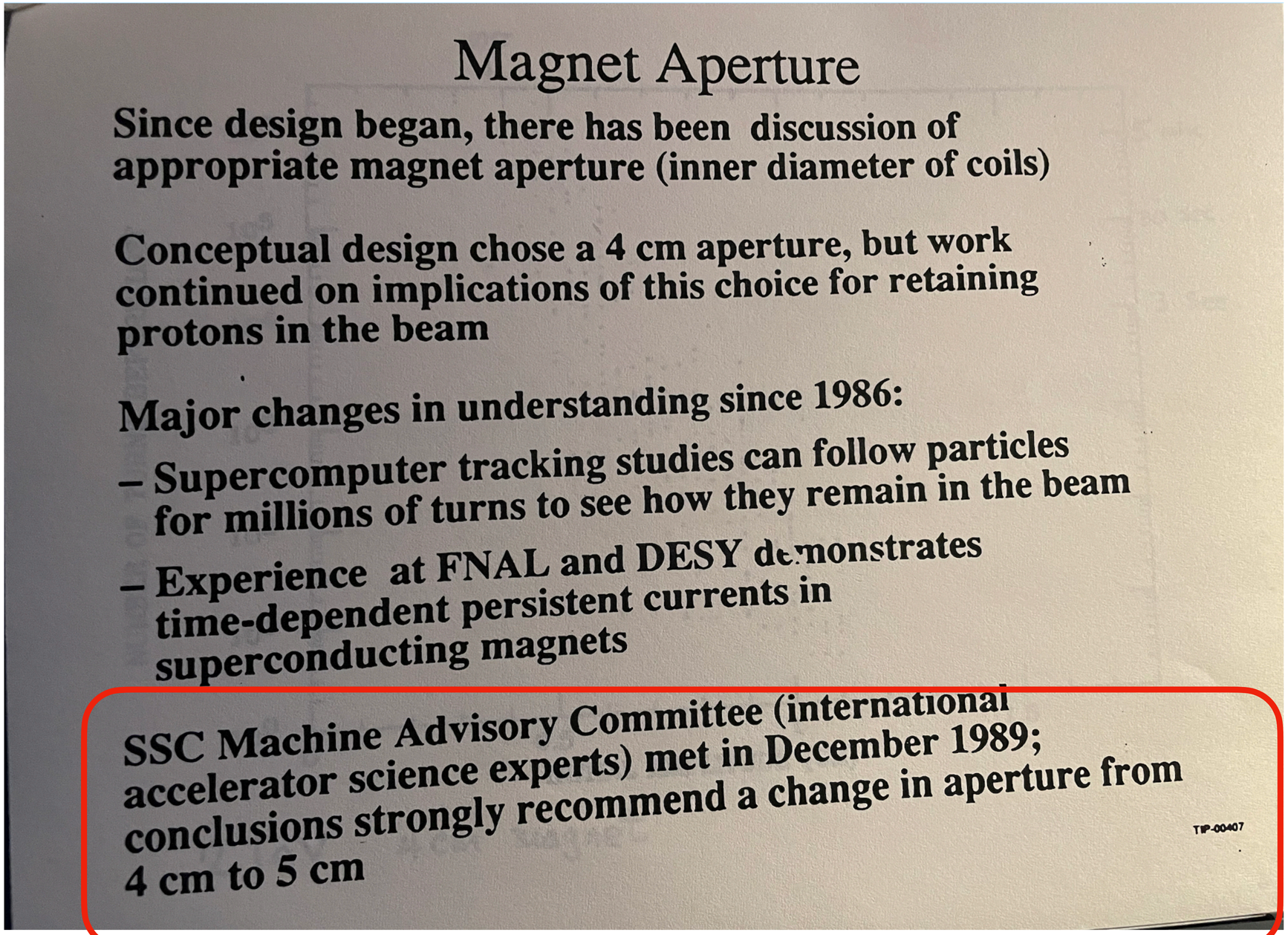
- The 1st PAC meeting was held on February 9-10, 1990.
- Guidelines for Expressions of Interest due May 25, 1990.
- SSCL, with PAC advice, will work to determine the initial program.
- SSCL will maximize both the physics capabilities and the participation of the HEP community.
- Funds for support of engineering design.
- PAC June 7-9 EoI public presentation
  July 14-20 Snowmass PAC meeting
  Nov 1-3 Recommendations on subsystem R&D and EoIs

G. GIlchrise, Jan 19 1990, presentation on “Experimental Program and R&D status and plans”, to the HEPAP sub-panel visit to SSC lab



R. Schwitters, Jan 19 1990, presentation on “Overview of the SSC”, to the HEPAP sub-panel visit to SSC lab

the beginning of the end …



Magnet Aperture

Since design began, there has been discussion of appropriate magnet aperture (inner diameter of coils)

Conceptual design chose a 4 cm aperture, but work continued on implications of this choice for retaining protons in the beam

Major changes in understanding since 1986:

- Supercomputer tracking studies can follow particles for millions of turns to see how they remain in the beam
- Experience at FNAL and DESY demonstrates time-dependent persistent currents in superconducting magnets

SSC Machine Advisory Committee (international accelerator science experts) met in December 1989; conclusions strongly recommend a change in aperture from 4 cm to 5 cm

TIP-00407

The SDC timeline, 1990

- Collaboration governance by-laws defined in Dec ’89 (FNAL mtg)
- Executive Board nominations by Jan 12 ’90
- Approval of experiment governance and EB election by March ’90
- EoI due June 1990 !

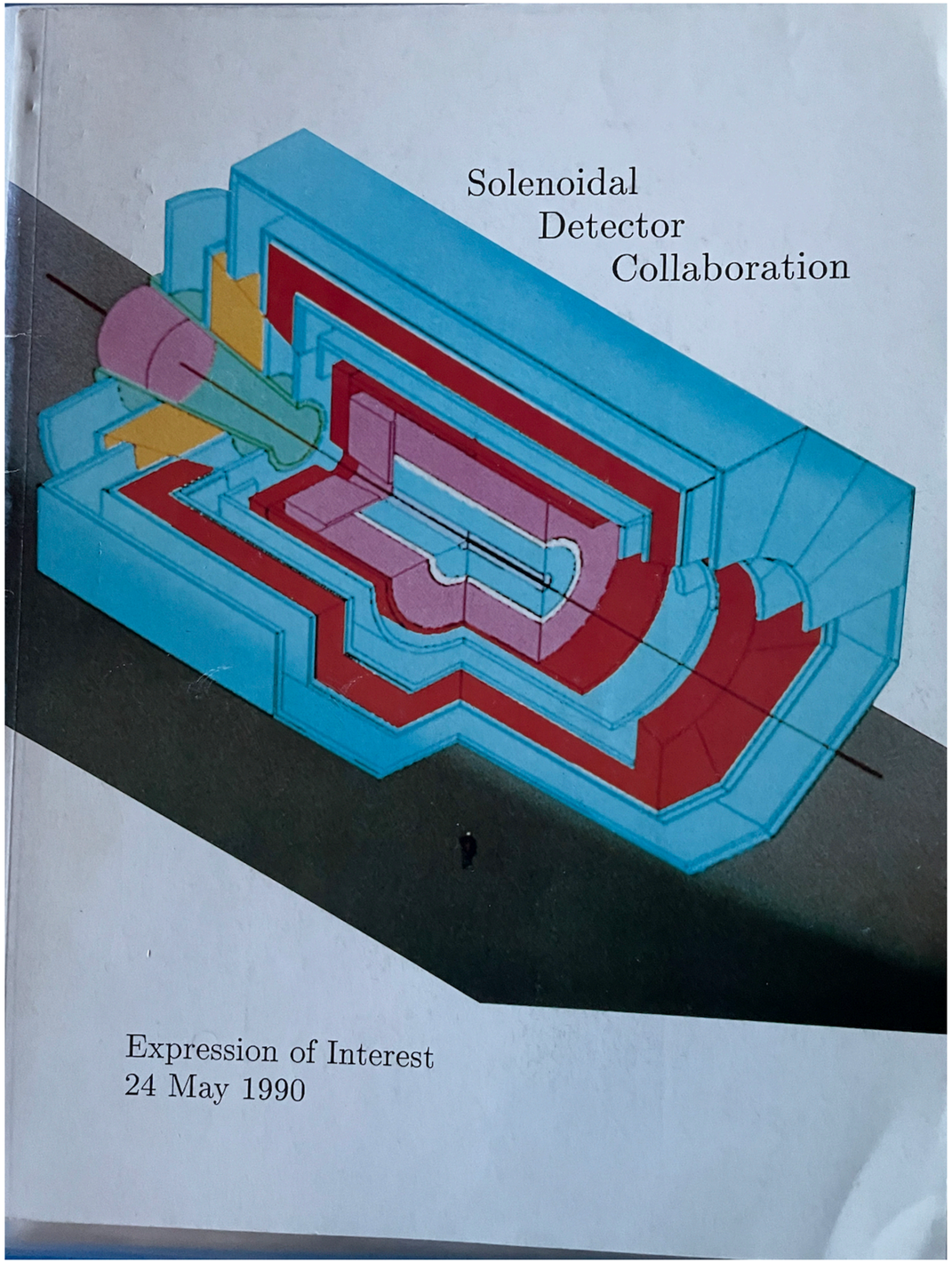
From an internal mail by G. Trilling, Xmas ‘89

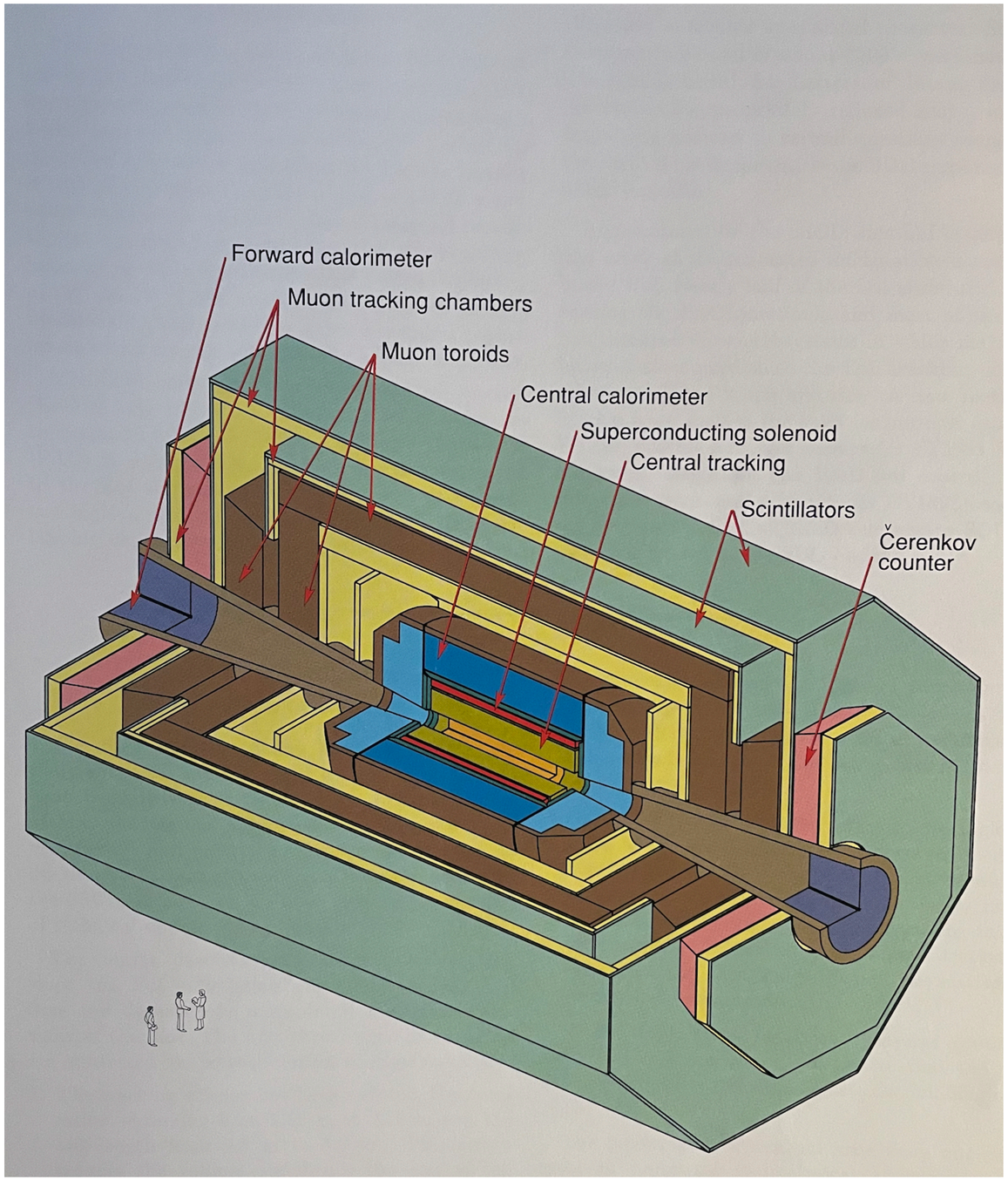
> 3)The future Collaboration meetings are tentatively scheduled for March 11-13, 1990 (Dallas), April 23-25 (KEK), and May 10-12 (Dallas). The April 23-25 dates correspond to a Solenoid Detector Workshop being organized at KEK by our Japanese colleagues. The Dallas dates still need final confirmation by the SSCL. The brief time between the April and May meetings is determined by the desire to have a meeting about two weeks before the EoI due date.

A process whose progress and timeline is unthinkable of today !!

We were all aware that the SSC would not have started imminently… This excitement in 89-90 was not driven by an appealing timeline, but by the opportunities offered by a new and challenging approved project to work on concretely !!

cfr today …


Solenoidal
Detector
Collaboration
Expression of Interest
24 May 1990


Forward calorimeter
Muon tracking chambers
Muon toroids
Central calorimeter
Superconducting solenoid
Central tracking
Scintillators
Čerenkov counter

From the EoI

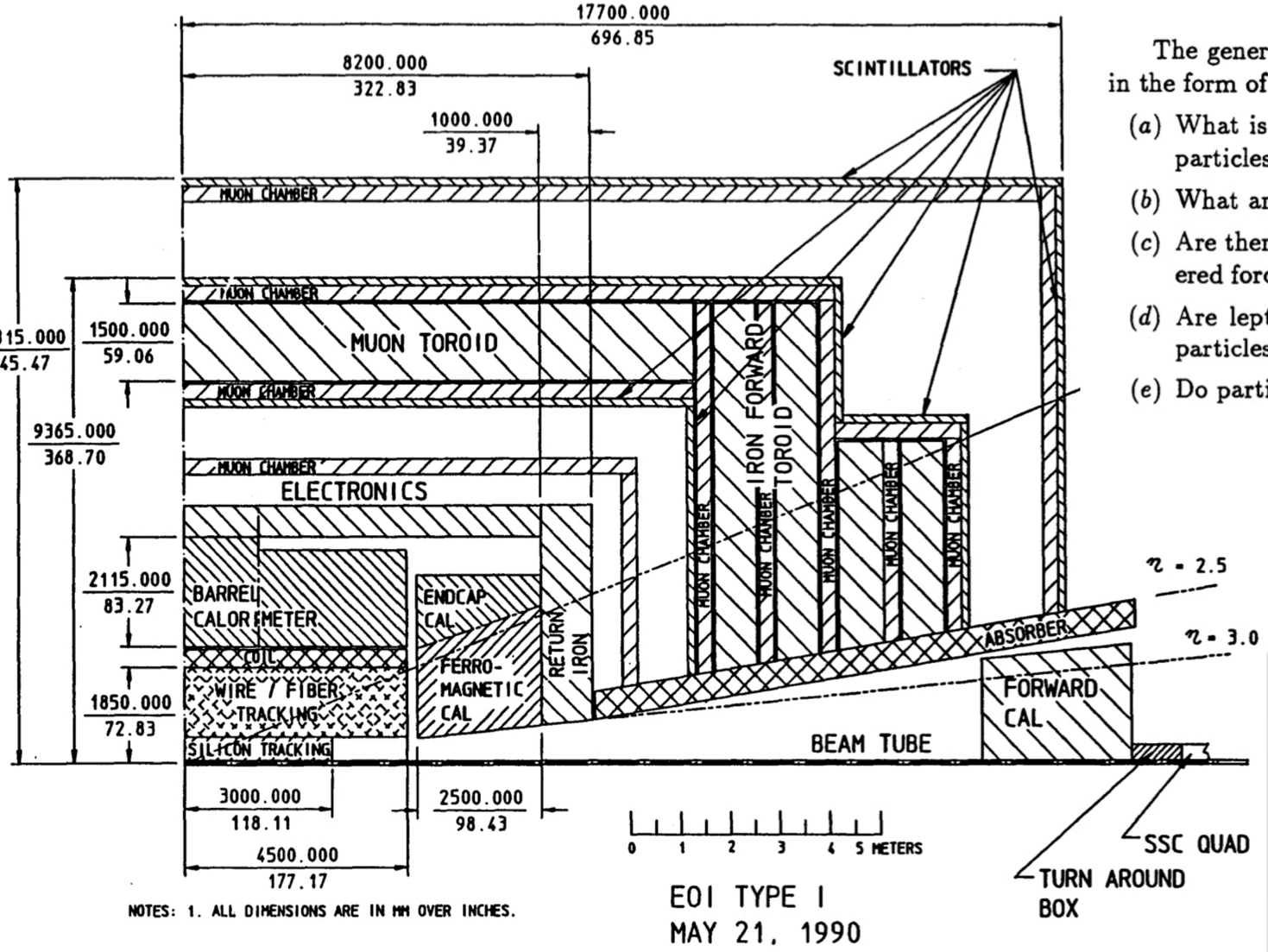


FIG. 4. Quadrant plan view of the short-coil solenoidal detector with iron-laced endcap calorimeters (Type-I). This drawing also shows an iron toroid for the intermediate-angle muon system, an alternative to the air-core toroids shown in Figs. 3 and 5.

The general, exploratory nature of our proposed research program can be expressed in the form of specific questions:

(*a*) What is the mechanism for electroweak symmetry breaking, the process by which particles obtain mass?

(*b*) What are the properties of the t (top) quark?

(*c*) Are there additional heavy bosons to indicate the presence of new, as yet undiscovered forces?

(*d*) Are leptons and quarks elementary or are they composed of more fundamental particles?

(*e*) Do particles exhibit a larger symmetry pattern such as supersymmetry?

Management for the Solenoidal Detector Collaboration

SPOKESPERSON:
G. Trilling (LBL)

DEPUTY SPOKESPERSONS:
G. Bellettini (University of Pisa)
D. Green (FNAL)
T. Kondo (KEK)

TECHNICAL MANAGER:
M. Gilchriese (LBL)

SSC PAC feedback to EoI

SDC
SOLENOIDAL DETECTOR NOTES

REPLY BY THE SOLENOIDAL DETECTOR COLLABORATION TO
QUESTIONS FROM THE PROGRAM ADVISORY COMMITTEE

July 12, 1990

General Questions:

Questions specific to the SDC detector:

Question 1. Describe the capabilities of the SDC for searching for a standard model Higgs in the following mass regions:

$80 < M_H < 180$ **GeV**

$M_H \sim 200$ **GeV**

$M_H \sim 400$ **GeV**

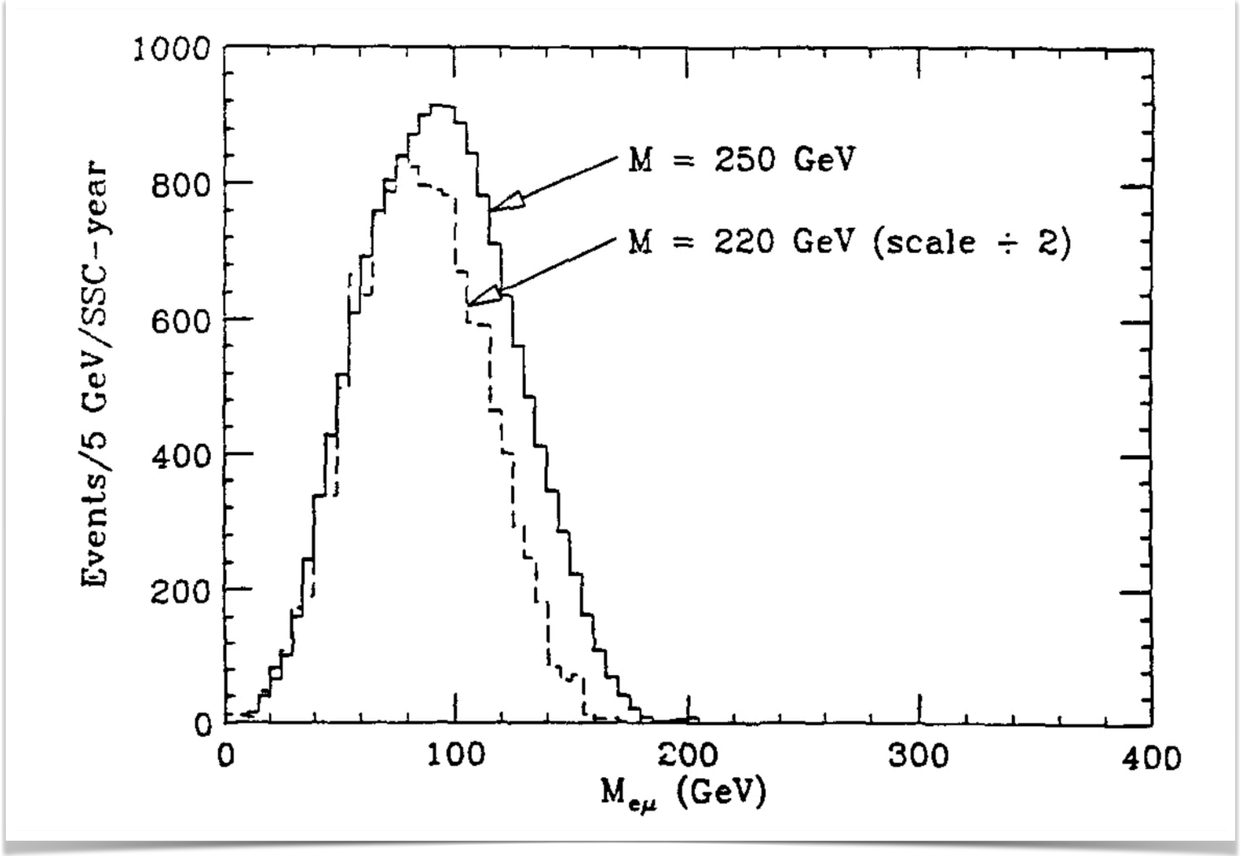
$M_H \sim 800$ **GeV**

Address the question of signal/noise, triggering strategies and sensitivity.

For an integrated luminosity of about $10^{40}\,\mathrm{cm}^{-2}$, the SDC detector will be able to discover a standard Higgs boson in the mass range $125 < M_H \lesssim 800$ GeV from decays to $4e$, 4μ, and $2e2\mu$ final states and, in the region near 800 GeV, in the mode $Z \rightarrow (e^+e^-$ or $\mu^+\mu^-) +$ missing-E_t. Several possibilities for detecting the standard Higgs for $M_H < 125$ GeV are being investigated. At present, the most promising is production of $W^*H \rightarrow \ell\nu\gamma\gamma$, but this will very likely require an integrated luminosity substantially greater than $10^{40}\,\mathrm{cm}^{-2}$.

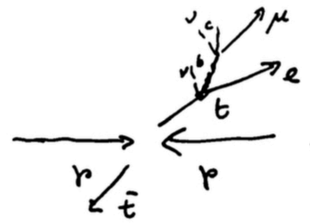
Question 3. Assume a top quark of mass 250 GeV.
How is it discovered in your detector?
How accurately can its mass be measured?
Can its decay properties be determined? For example if the top decays to a charged Higgs with a mass of 150 GeV, at what branching ratio level can this process be detected?

It will be straightforward to discover the top quark in the SDC detector through (a) events with an isolated electron and an isolated muon of opposite charge; (b) events with one isolated electron or muon plus several jets; and (c) events with an isolated electron (from top decay) plus a non-isolated muon of opposite charge (from the b decay product



Top Mass determination

A. Bay, A. Geltieri, A. Palounek



topology

$t \to e\, b\, \nu$ isolated e
$\hookrightarrow \mu\, c\, \nu$ non-isolated μ

$M(e\text{-}\mu) \propto M_{top}$

- Trigger

  $E_T(e) > 35$ GeV

  Full efficient at $E_T = 40$ GeV

- Require

  isolated e $E_\perp(e) > 40$ GeV

  non-isolated μ $P_\perp(\mu) > 20$ GeV

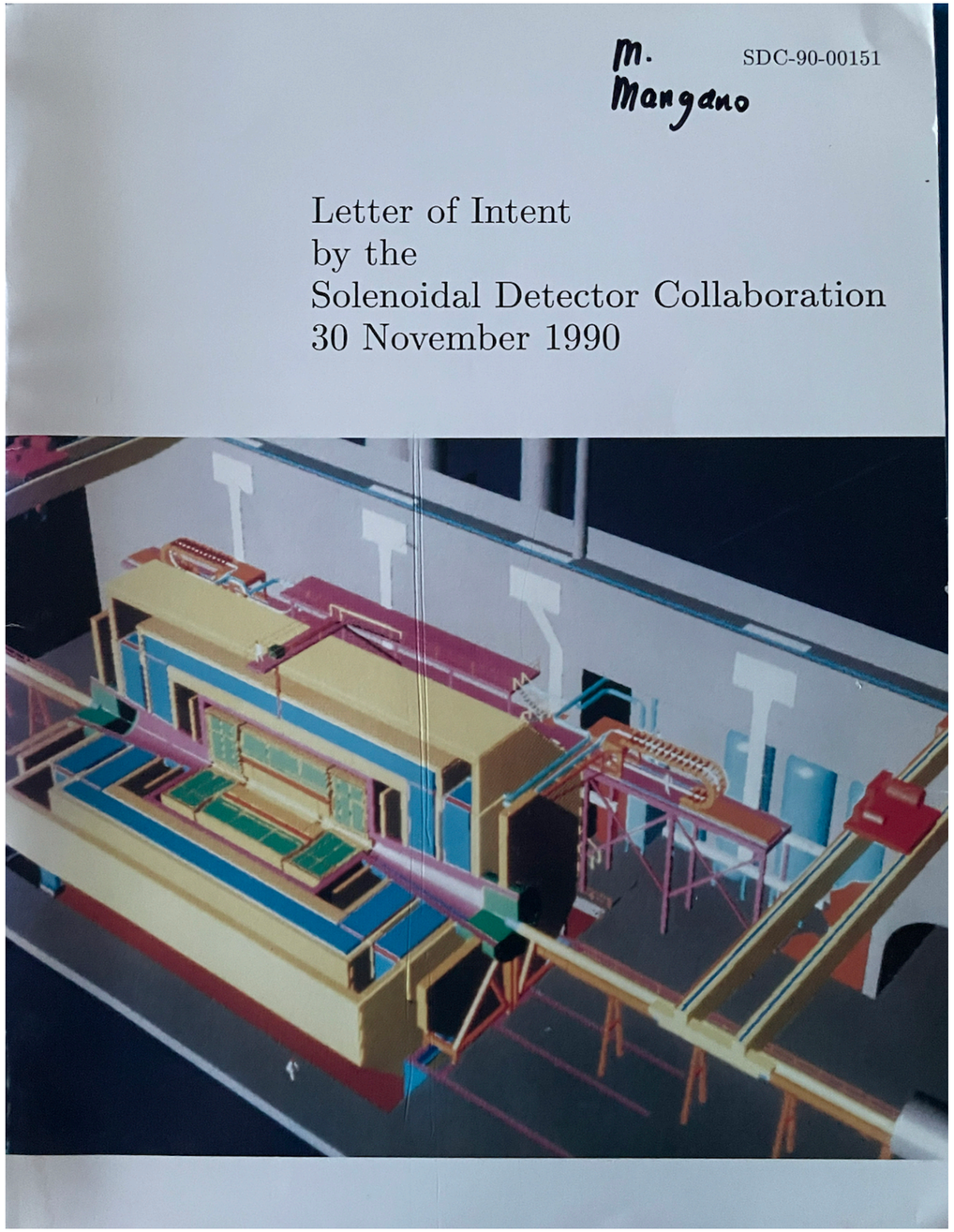
  $P_\perp(e\mu) > 120$ GeV/c

SSC PAC outcome of the review of EoI's:

- select 4 for submission of LoI by Nov 1990:
  - BCD (Lockyer)
  - L* (Ting, Hofer)
  - EMPACT (Marx)
  - SDC (Trilling)

SSC PAC outcome of the review of LoI's:

- only SDC selected to move forward to a Technical Proposal, to be ready by April 1992



January ’91, the expedition to Dubna

with Franco Bedeschi and Franco Rimondi …
the mandate from Giorgio: stimulate the JINR scientists participation in SDC and seed concrete contributions

We arrived a day after the start of Desert Storm, Jan 17 1991, during the 1st Iraq war … spending evenings at Hotel Dubna watching air raids over Iraq, wondering w.t.f. was going on, since TV was only in Russian …

We gave talks to the “locals”, discussions followed with future collaborators and friends (Budagov, Tsyganov, Vorozhtsov, Khasanov, Poroshin, Tokar, Vodopianov, …), and visits to silicon facilities in the Moscow headquarters of Russia’s NASA,

The JINR group got massively engaged in SDC:

Muon system:
- barrel toroid: 2 prototype modules (80 tons), and full-scale production later (16,000 tons)
- trigger scintillator counters (Pisa, Dubna, Kharkiv collaboration)

End-caps hadronic calorimeter (FNAL, Pisa, Dubna, Kharkiv collaboration)

When the SSC was canceled, the bonds created during this experience blossomed in the collaboration of JINR and Eastern Europe Institutions in CDF, bringing valuable knowledge and resources to Pisa

SSC vs LHC

Caro Signor Console,

abbiamo ricevuto e letto con interesse i messaggi del Ministero e dell'Ambasciata riguardanti la partecipazione Italiana ai programmi scientifici del Superconducting Super Collider (SSC).

Riteniamo che tali messaggi contengano una benvenuta apertura di interessi e disponibilita' verso tale partecipazione. In particolare apprezziamo la conferma della compatibilita' e complementarieta' fra l'impegno nei programmi scientifici del CERN e l'impegno nella sperimentazione al SSC. Ci rendiamo altresi' conto che i due programmi, LHC e SSC, possano manifestare dal punto di vista gestionale dei delicati meccanismi di interferenza; per questa ragione, riteniamo che l'Istituto Nazional di Fisica Nucleare (INFN) sapra' trovare al suo interno il giusto equilibrio fra i due intenti.

In risposta a richieste esplicite sollevate dal Ministero e dall'Ambasciata -- in particolare riguardanti l'eventuale dicotomia fra fase I (costruzione) e fase II (utilizzazione scientifica) -- Ci permetta di aggiungere le seguenti considerazioni: […]

3) […] A rappresentanza dei paesi Europei, il Professor Giorgio Bellettini, dell'Universita' di Pisa, e' uno dei tre Deputy Spokespersons.
4) […] elemento essenziale del TP sara' una matrice di responsabilita' in cui le Istituzioni partecipanti dovranno dichiarare il loro impegno a realizzare determinate componenti del rivelatore. L'impossibilita' da parte di un'Istituzione di assumersi tali responsabilita' entro la presentazione del TP, la sua approvazione e la firma degli accordi tra SSC ed SDC (Ottobre 1992), rischia di relegare tale istituzione ad un ruolo secondario.
5) In conclusione, non solo esistono gia' in questa fase programmi puramente scientifici che si prestano alla partecipazione dei nostri ricercatori, ma addirittura tale partecipazione immediata e' fondamentale per assicurarci un ruolo di primo piano nella fase di utilizzazione di SSC.

I ricercatori dell'INFN partecipanti in SDC attualmente stanno insistendo con le appropiate Istanze all'interno dell'Istituto perche' l'INFN assuma al piu' presto una responsabile posizione di sostegno di questa iniziativa.[…] Le inviamo i nostri migliori saluti,

per SDC-Italia, Michelangelo MANGANO

well, we all know the end of the story, October 21 1993 … we learned this during an SDC collaboration mtg at the SSC lab …

… and we quickly flew back to Fermilab, to wrap up the work on CDF Top Evidence papers !

You just heard from Hans memories the top discovery and Giorgio's role …

… but allow me just few words from my own perspective, off the slides' record, to highlight unique aspects of Giorgio's personality and profound ethical principles

Giorgio and CERN

the early years

ELSEVIER

Physics Letters

Volume 14, Issue 2, 15 January 1965, Pages 164-168

Absolute measurements of proton-proton small-angle elastic scattering and total cross section at 10, 19 and 26 GeV/*c*

G. Bellettini, G. Cocconi, A.N. Diddens, E. Lillethun *, J. Pahl **, J.P. Scanlon ***, J. Walters †, A.M. Wetherell, P. Zanella

CERN European Organization for Nuclear Research, Geneva, Switzerland

Received 18 December 1964, Available online 9 October 2002.

Giorgio and CERN

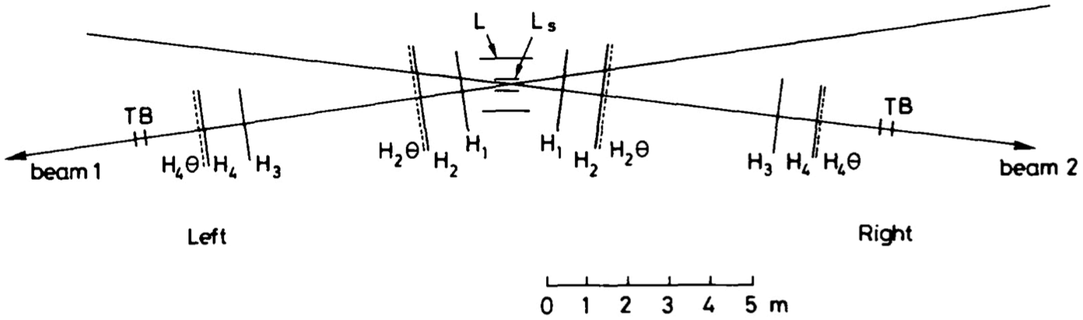
ISR early 70's, leadership established
Chair of Gruppo 1 1971-74
LNF Director 1974-77

Volume 44B, number 1 PHYSICS LETTERS 2 April 1973

MEASUREMENT OF THE TOTAL PROTON-PROTON CROSS-SECTION AT THE ISR☆

S.R. AMENDOLIA, G. BELLETTINI*, P.L. BRACCINI, C. BRADASCHIA,
R. CASTALDI**, V. CAVASINNI, C. CERRI*, T. Del PRETE,
L. FOA*, P. GIROMINI, P. LAURELLI, A. MENZIONE,
L. RISTORI, G. SANGUINETTI, M. VALDATA,
Istituto Nazionale di Fisica Nucleare, Sezione di Pisa
Istituto di Fisica dell'Università, Pisa
Scuola Normale Superiore, Pisa, Italy

G. FINOCCHIARO, P. GRANNIS*, D. GREEN, R. MUSTARD and R. THUN
State University of New York, Stony Brook, New York, USA



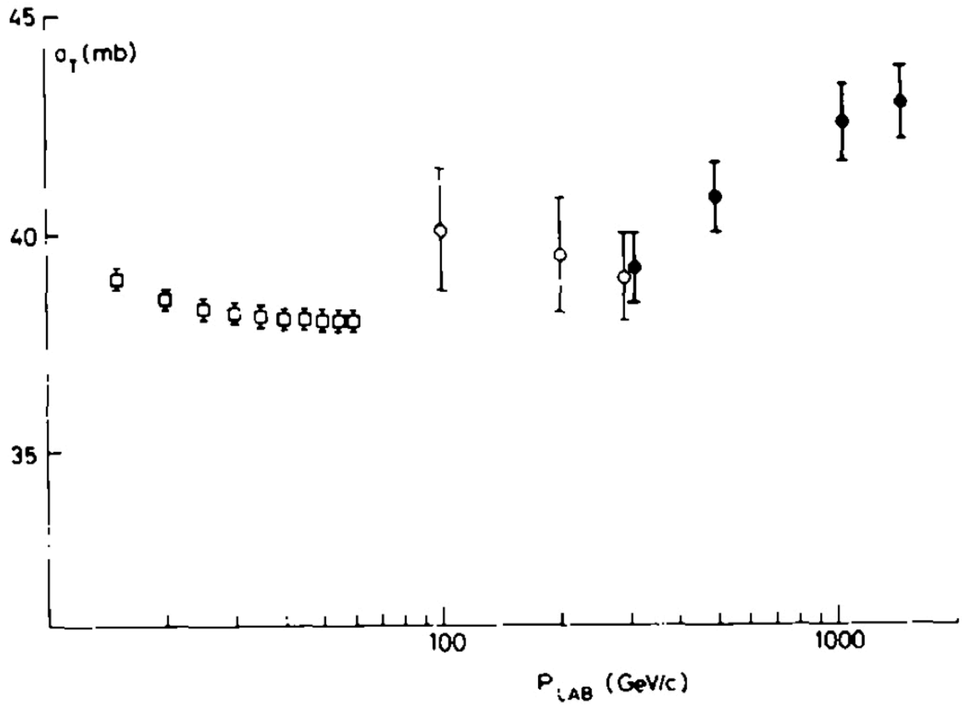


Fig. 3. Plot of the results versus equivalent beam momentum. The Serpukhov [5] and NAL [6–8] data are shown for comparison. □: Data of ref. [5]. ○: Data of refs. [6–8]. ●: This experiment.

The possibility of rapidly rising total cross-sections at very high energies has been considered theoretically by Heisenberg [10], and by Cheng and Wu [11]. The presence of an energy dependence in σ_T indicates that if an asymptotic limit exists, it has not been reached at ISR energies, and points up the interest in extending all total cross-section measurements to higher energies.

… of course see also:

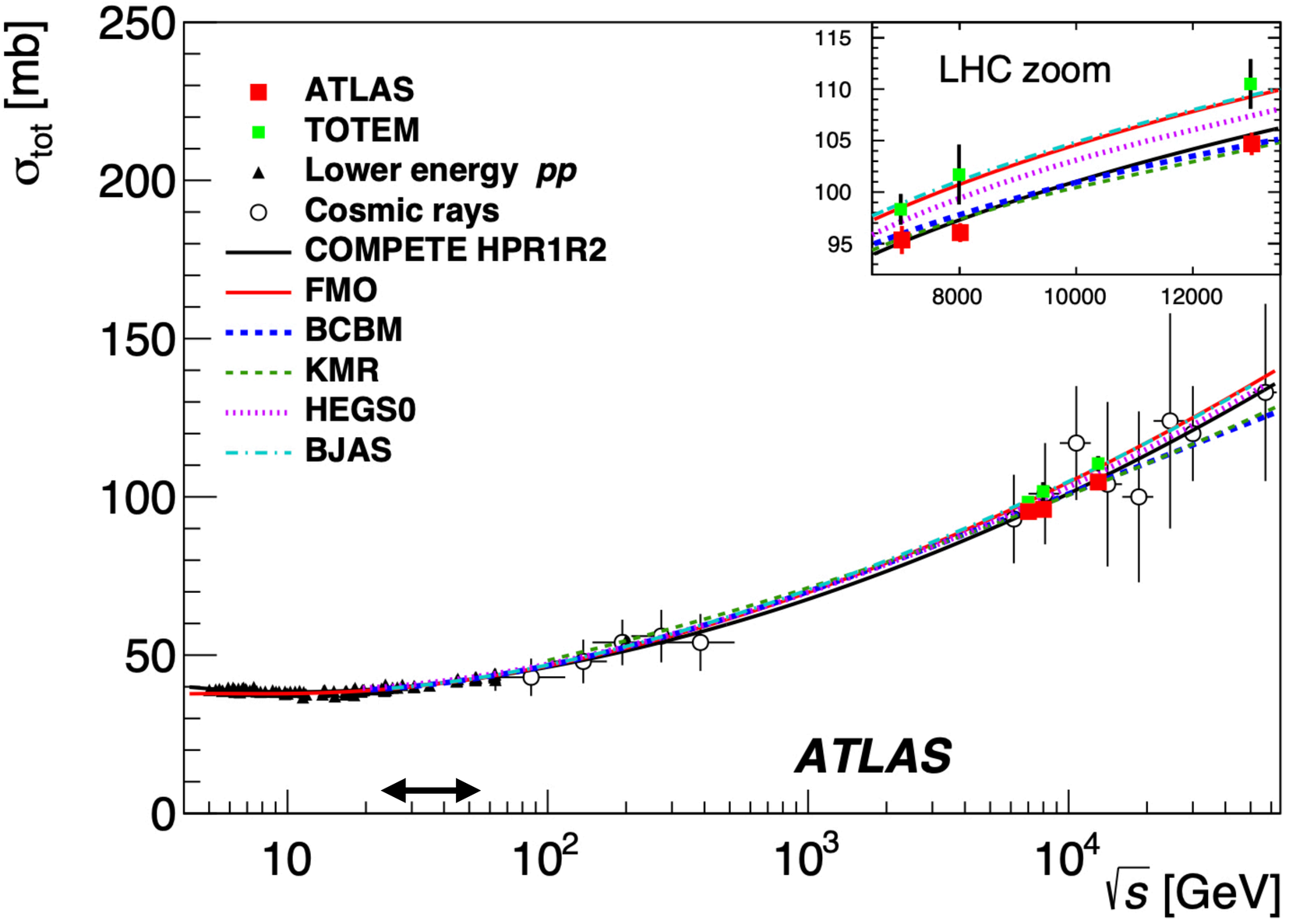
ELSEVIER

Physics Letters B

Volume 44, Issue 1, 2 April 1973, Pages 112-118

The energy dependence of the proton-proton total cross-section for centre-of-mass energies between 23 and 53 GeV

U. Amaldi *, R. Biancastelli, C. Bosio, G. Matthiae, J.V. Allaby, W. Bartel, G. Cocconi, A.N. Diddens, R.W. Dobinson, A.M. Wetherell



ISR: $\sqrt{S}$ = 23.6 — 53.2 GeV

Giorgio and CERN

Strategic roles:
Chair of the ISR Committee 1980-85
SPC member 1992 - 98

with Keith Potter, during van Hove's last Research Board at CERN, 1980

with L. Okun during an SPC visit to UA2, 1981

Giorgio and CERN

Since his term as SPC member, Giorgio regularly returned to CERN for the “old boys” September Council mtg … including 2023, for the inauguration fo the Science Gateway …

Giorgio and technology

Not renowned for his familiarity with computers, e-mail, latex, plotting tools, etc.etc. …

But ambitiously visionary in exploiting new technologies for challenging tasks !

Giorgio and technology

Not renowned for his familiarity with computers, e-mail, latex, plotting tools, etc.etc. …

But ambitiously visionary in exploiting new technologies for challenging tasks !

FNAL-S.Piero a Grado TV link, mid 90's, a first in HEP

Giorgio and technology

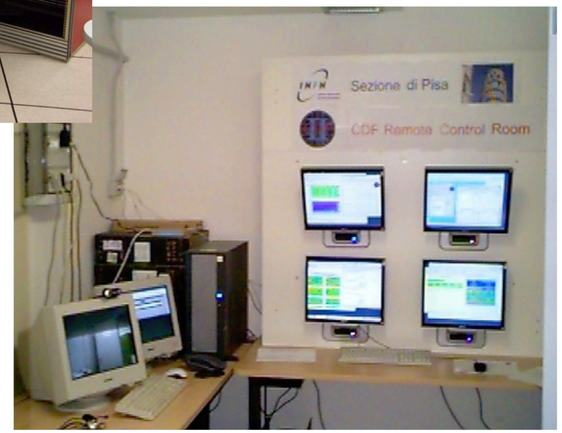
Not renowned for his familiarity with computers, e-mail, latex, plotting tools, etc.etc. …

But ambitiously visionary in exploiting new technologies for challenging tasks !

FNAL-S.Piero a Grado TV link, mid 90's, a first in HEP

Remote CDF control room in Pisa, 2006, another first in HEP

Section of the CDF control room at Fnal devoted to the Consumer Monitors



CDF control room in Pisa
(more monitors to be added)

Fabiani, Scuri, INFN Pisa

https://pos.sissa.it/050/027/pdf

Giorgio and students

Fermilab U.S. DEPARTMENT OF ENERGY Office of Science

The Italian Summer Students Program at Fermilab

Emanuela Barzi, Giorgio Bellettini, **Simone Donati**[1], Marco Mambelli

EPS 2023

August 21, 2023

[1]University of Pisa and INFN Pisa

In partnership with:

UNIVERSITÀ DI PISA

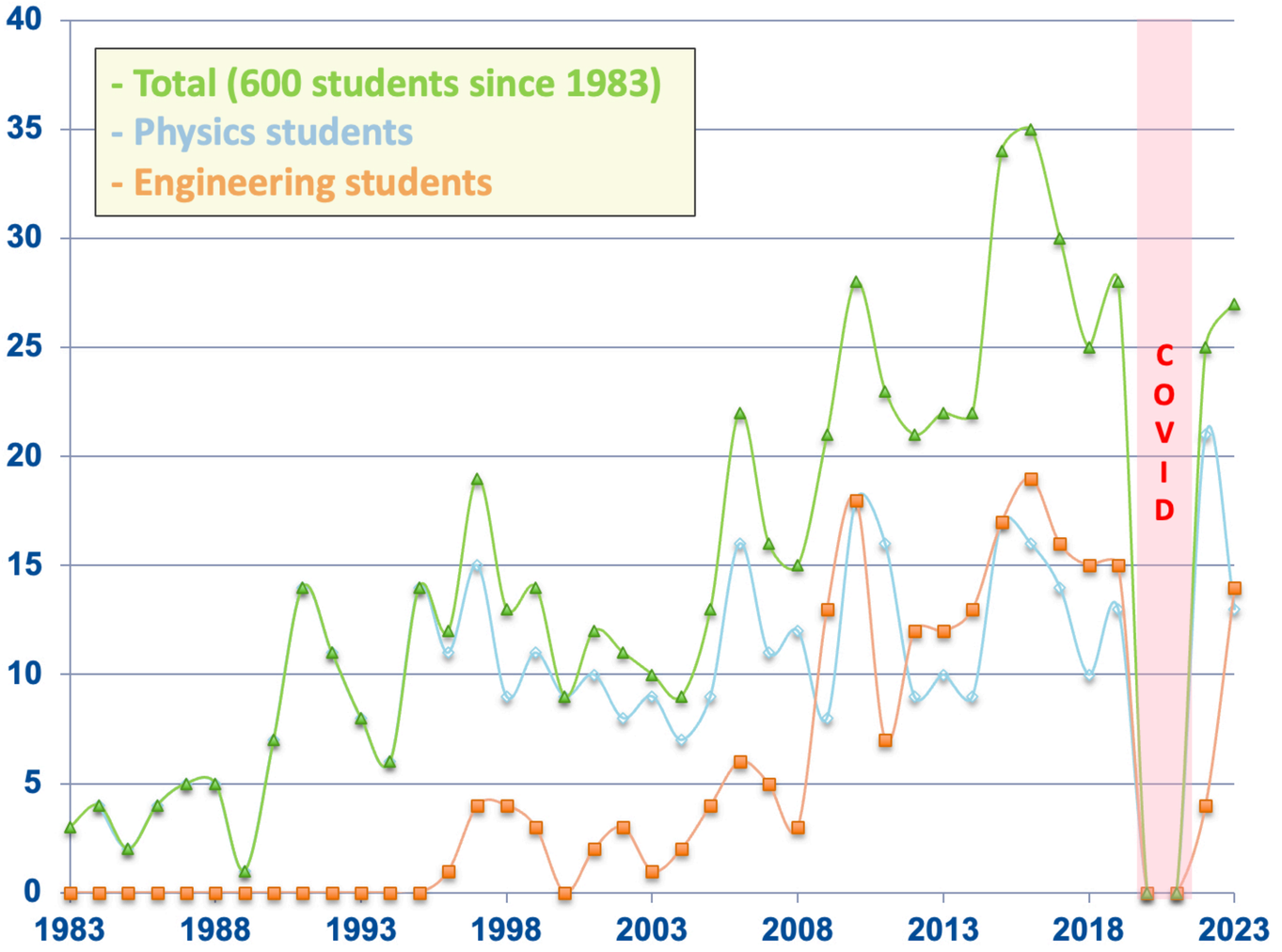
INFN

European Commission

This work was supported by the European Union's Horizon 2020 research and innovation program under the Marie Sklodowska-Curie Grant Agreement no 734303, 822185, 858199, 101003460, 101081478
And by the Fermi National Accelerator Laboratory, managed and operated by Fermi Research Alliance, LLC under Contract No. DE-AC02-07CH11359 with the U.S. Department of Energy

Part of a more global initiative by Giorgio to create an Italian community at CERN, across experiments, a community fully integrated in the local context, and positioned to share our cultural heritage with fellow scientists from all over the world

Summer Students Statistics (1983 – 2023)



Giorgio and students

The list of students who attended the Italian Summer Student programme at FNAL is astonishing, it's a "who's who" directory of young leaders in major HEP experiments … including theorists as well, like
Fabio Maltoni, Marco Nardecchia, Leonardo Senatore, Germano Nardini

Unanimous consensus among all those I contacted that
- this experience at FNAL was a key milestone in building their career
- the interaction with Giorgio left a sign, thanks to the respect and interest he always showed towards them, and thanks to his example that authority results from intellectual leadership, not from academic hierarchy

Students whose thesis was formally supervised by Giorgio, during the CDF years

Undergrad
Apollinari, E.Barzi, Andrea Bocci, Chiarelli, DellAgnello, Donati, Incagli, Diego Tonelli, Tartarelli, Caterina Vernieri

PhD
Cobal, Dell'Agnello, Leone, Paoletti

Giorgio has been a mentor to all CDF students no matter who the formal advisor was …

See Tommaso Dorigo's memory of his experience of interaction with Giorgio, when he was a student
https://www.science20.com/tommaso_dorigo/giorgio_the_unstoppable-256081

Thanks Giorgio for all you've given to all of us,

and best wishes for your next decade in physics!