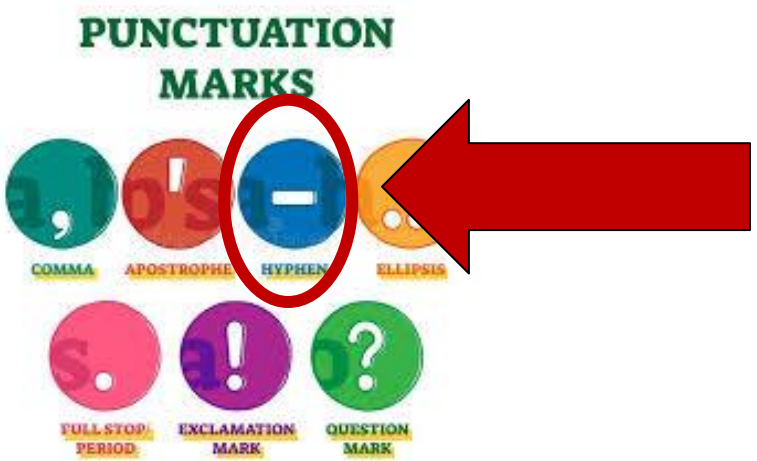
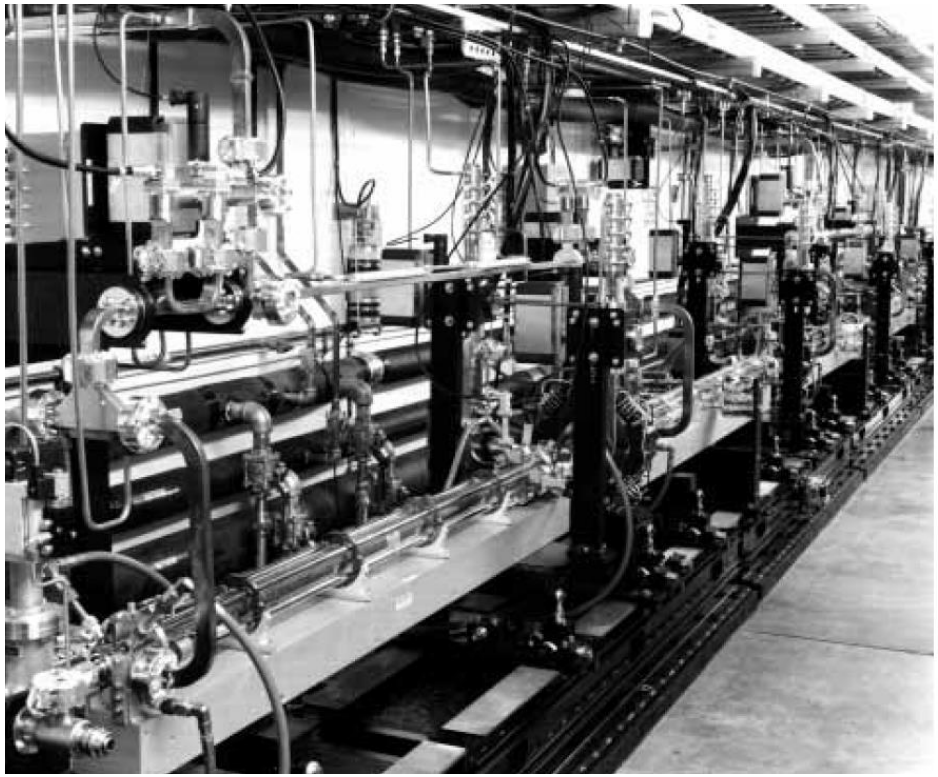
Fosterfest - 'ILC & ILC Technology'



Barry Barish
11-Sept-24

Pre-History Before the ILC/GDE

Room Temperature X-band Klystrons (SLAC & KEK)



NLCTA @ SLAC
Next Linear Collider Test Facility

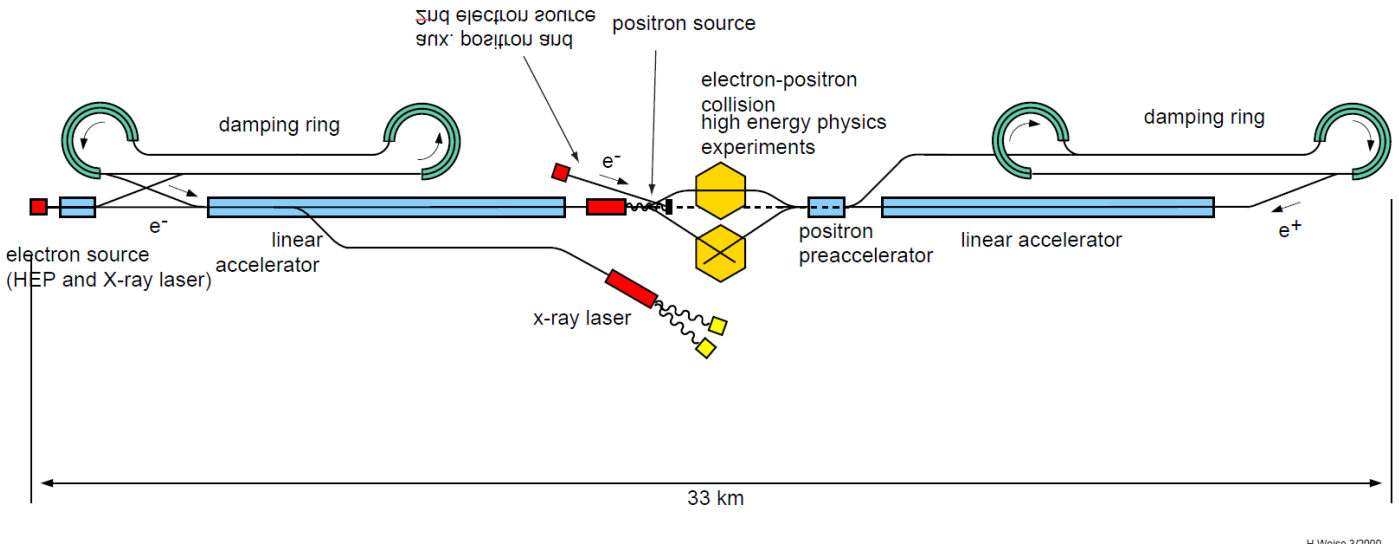
1990s

Linear Collider R&D at **SLAC** and **KEK** developed new generation of microwave power sources.

Pre-History before the ILC/GDE

TESLA Concept

1990s



- The TESLA proposal called for a 15-km-long **superconducting** radio-frequency linac to accelerate an electron beam to 250 GeV, and a second, almost identical linac for positrons. Each linac had 10K resonant RF cavities made of superconducting niobium operating at the 25-MV/m accelerating field for a 500-GeV collider.

HEPAP SUBPANEL

U.S. Long Range Planning Committee

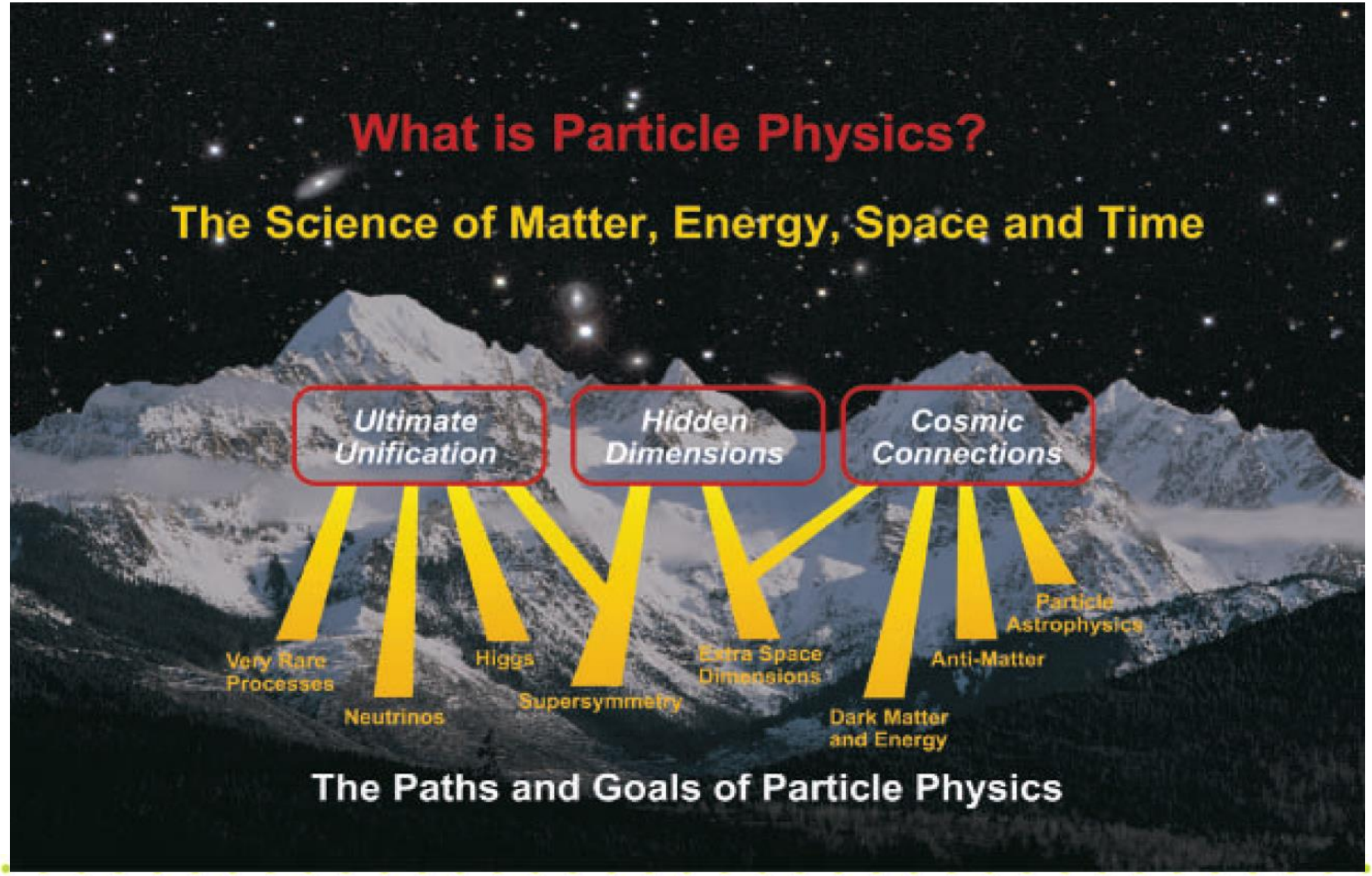
Questions for the Community

Jonathan Bagger & Barry Barish

Snowmass

July 1, 2001

2001 Bagger-Barish HEPAP Subpanel



HEPAP Subpanel Recommended reconvene Loew Panel to Make Technology Choice

SLAC-PUB-10024
July 2003

REPORT FROM THE INTERNATIONAL LINEAR COLLIDER TECHNICAL REVIEW COMMITTEE

G. A. Loew, SLAC, Menlo Park, CA 94025, USA

Produced beautiful 600 page report, but without technology choice.

ICFA/ILCSC Evaluation of the Technologies

International Linear Collider

Technical Review Committee

Second Report

2003

The Report Validates the Readiness of L-band and X-band Concepts

ITRP Arriving in Korea

Deliberating in Korea

Departing from Korea

International Technology Recommendation Panel Meeting
August 11 ~ 13, 2004. Republic of Korea

ITRP

Linear Collider Technology Recommendation

Barry Barish

ILCSC/ICFA Special Meeting

IHEP, Beijing

19-Aug-04

The Technology Recommendation

- The recommendation was presented to ILCSC & ICFA on August 19 in a joint meeting in Beijing.
- ICFA unanimously endorsed the ITRP's recommendation on August 20

The Recommendation

- **We recommend that the linear collider be based on superconducting rf technology**
  - This recommendation is made with the understanding that we are recommending a technology, not a design. We expect the final design to be developed by a team drawn from the combined warm and cold linear collider communities, taking full advantage of the experience and expertise of both (from the Executive Summary).
  - The superconducting technology has several very nice features for application to a linear collider. They follow in part from the low rf frequency.

What's Next?

- A new global design based on superconducting rf technology will be undertaken by the combined warm and cold experts.
- We need to fully capitalize on the experience from SLC, FFTB, ATF and TTF as we move forward. The range of systems from sources to beam delivery in a LC is so broad that an optimized design can only emerge by pooling the expertise of all participants.
- The R&D will be coordinated by an International Central Design Team, which the ITRP endorses.
- The first collaboration meeting at KEK in November.

Statement of Funding Agency (FALC)

17-Sept-04 @ CERN

Attendees: Son (Korea); Yamauchi (Japan); Koepke (Germany); Aymar (CERN); Iarocci (CERN Council); Ogawa (Japan); Kim (Korea); Turner (NSF - US); Trischuk (Canada); Halliday (PPARC); Staffin (DoE – US); Gurtu (India)

Guests: Barish (ITRP); Witherell (Fermilab Director,)

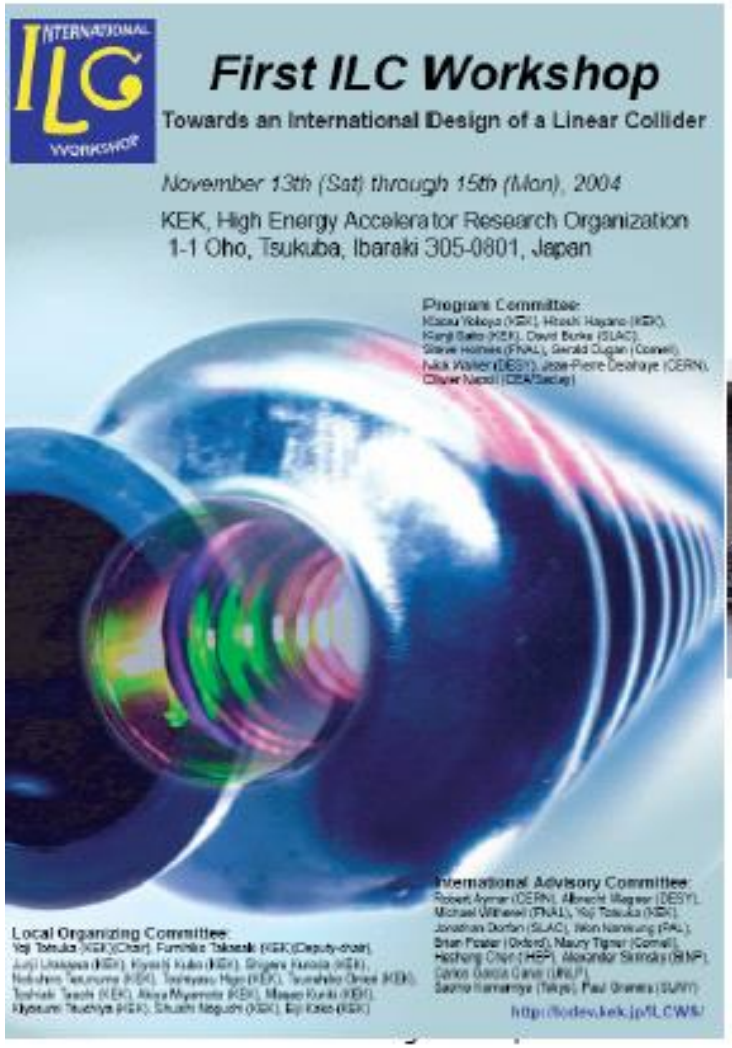
"The Funding Agencies praise the clear choice by ICFA. This recommendation will lead to focusing of the global R&D effort for the linear collider and the Funding Agencies look forward to assisting in this process.

The Funding Agencies see this recommendation to use superconducting rf technology as a critical step in moving forward to the design of a linear collider."

FALC is setting up a working group to keep a close liaison with the Global Design Initiative with regard to funding resources.

The cooperative engagement of the Funding Agencies on organization, technology choice, timetable is a very strong signal and encouragement.

The Community then Self-Organized



Nov 13-15, 2004

~ 220 participants from 3 regions, most of them accelerator experts

15

First ILC Meeting @ KEK

- There are 19/49/60 participants registered for Asia/Europe/North America and total number is 128 + ILCSC = 146. An additional 66 Japanese scientists are registered – attendance > 210 expected.
- There will be 5 working groups:
  WG1: Overall Design
  WG2: Main Linac
  WG3: Injector, including damping rings
  WG4: BDS, including collimator, final focus etc.
  WG5: Cavity design: higher gradients, etc.

  Each has 3 convenors, one from each region.
- There will be three plenary talks, one from each region, outlining activity; then almost all of the meeting will be in working parallel sessions.

Snowmass 2005

2005 International Linear Collider Physics and Detector Workshop
and Second ILC Accelerator Workshop
Snowmass, Colorado, August 14-27, 2005

Global Effort on Design / R&D

<u>Joint</u> Design, Implementation, Operations, Management
Host Country Provides Conventional Facilities

symmetry
dimensions of particle physics

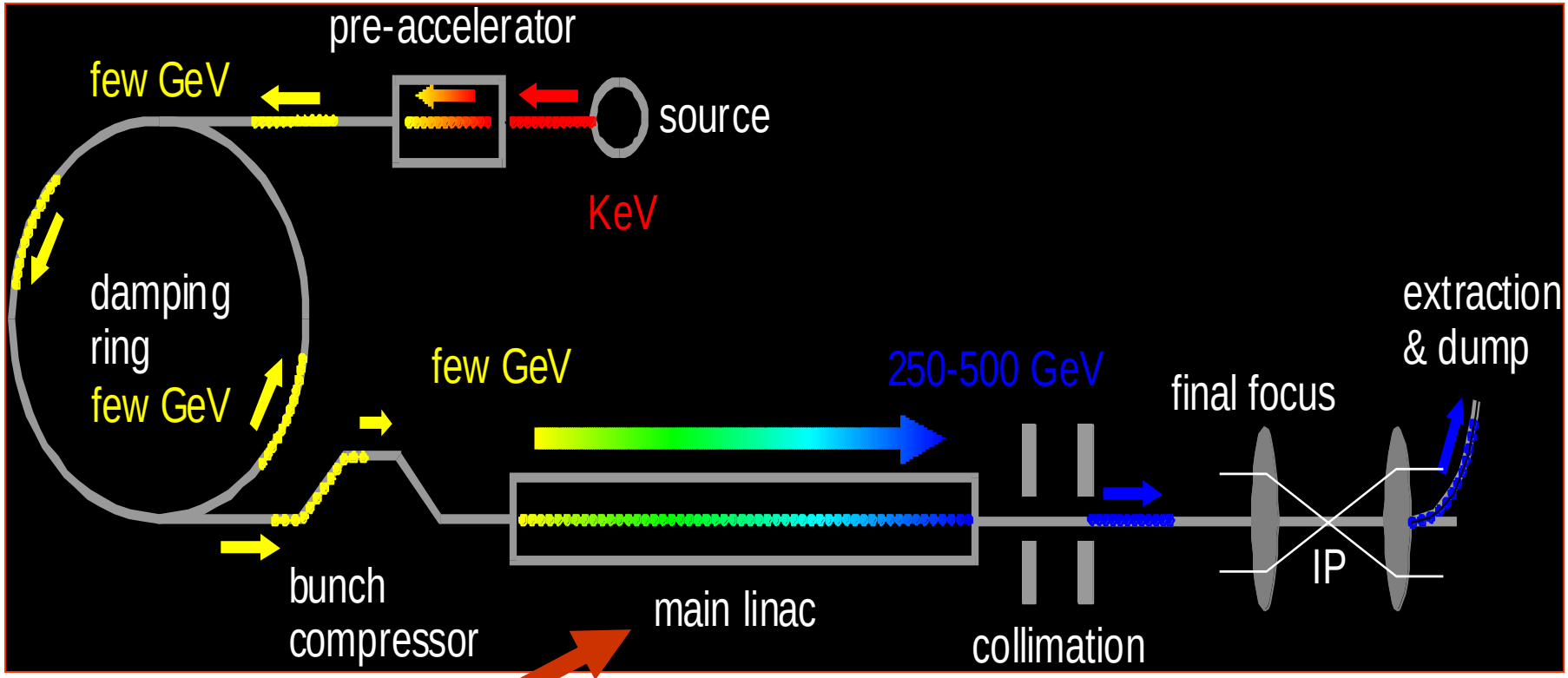
Snowmass 2005: Toward an International Linear Collider

Brian Foster, GDE Regional Director, ILC Europe

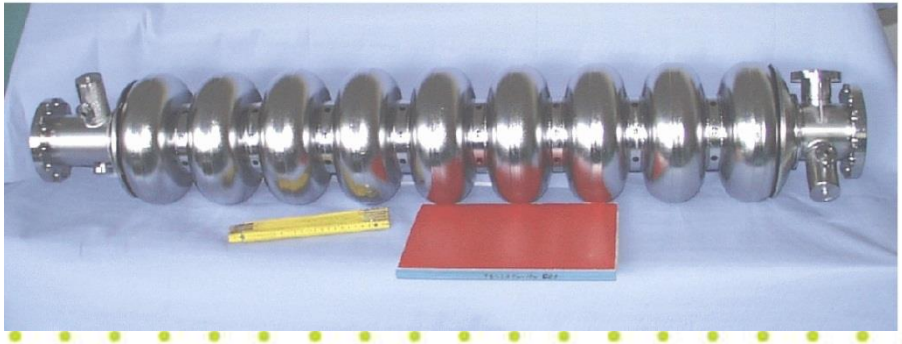
"Challenges attract smart people."

Following the world particle physics community's decision, announced a year ago in Beijing, to adopt superconducting technology for the proposed new collider, "about two-thirds of the community had to switch from one technology to the other, which is not an easy thing," said Brian Foster, regional GDE director for Europe. "Now this process is essentially completed and our community is much more focused. Our big objective at Snowmass is to converge to a consensus [on the machine's baseline design]. But it will take time. We will need it by the end of the year."

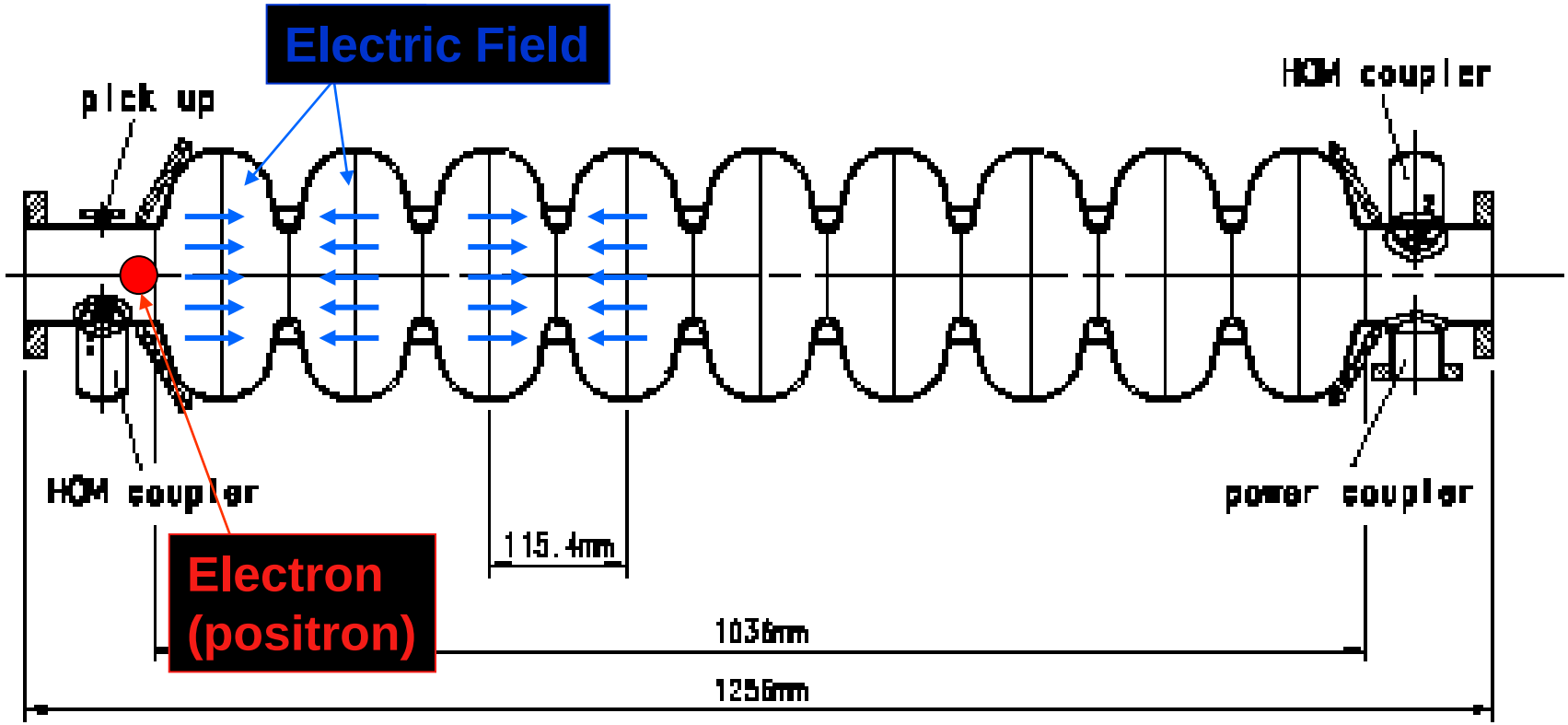
Designing a Linear Collider



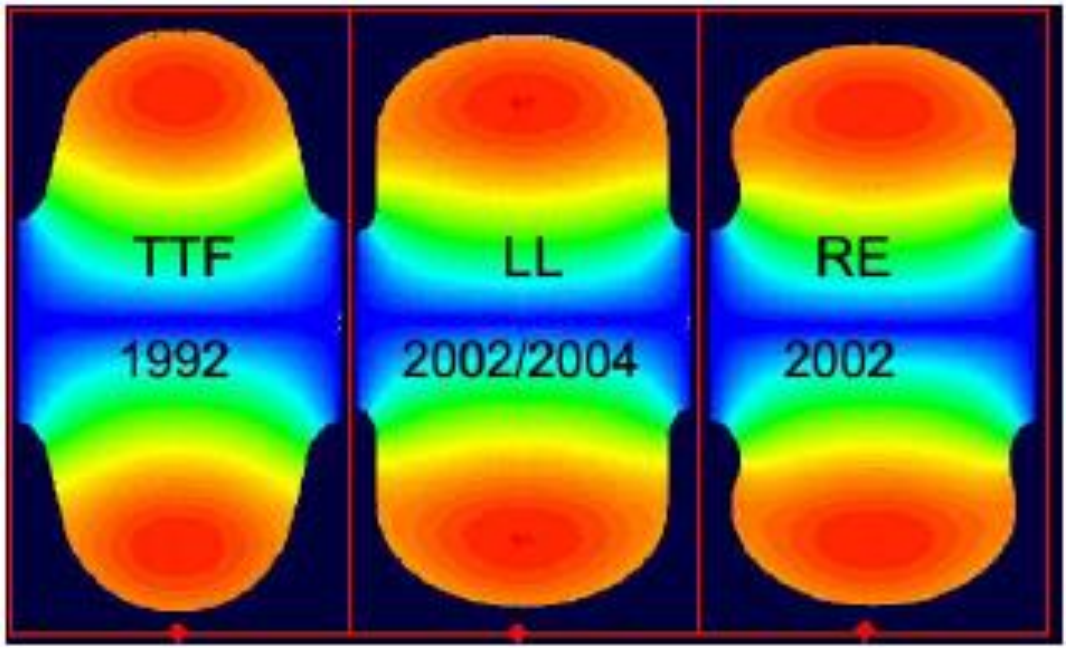
Superconducting RF Main Linac



Technical Challenges: High Grad SCRF

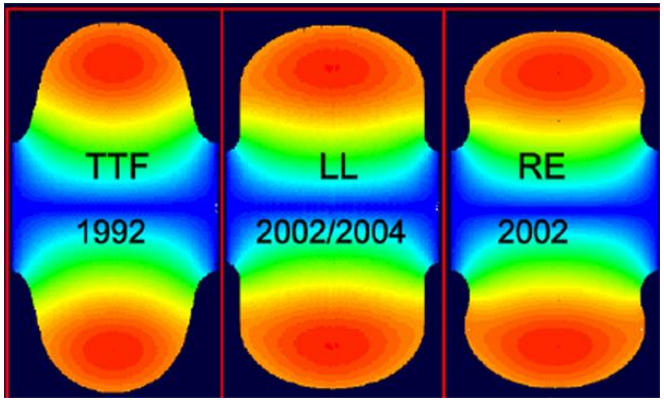


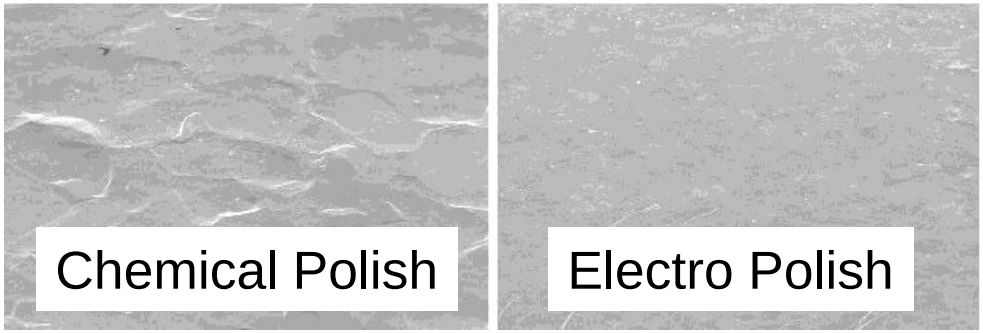
Cavity Shape Optimization



	TESLA	LL	RE
Aperture, mm	70	60	70
k_c,%	1.9	1.52	2.38
K_e = E/Eacc	1.98	2.36	2.39
k_m, mT/(MeV/m)	4.15	3.61	3.78
(r/Q), Ω	113.8	133.7	120.6
G, Ohm	271	284	280

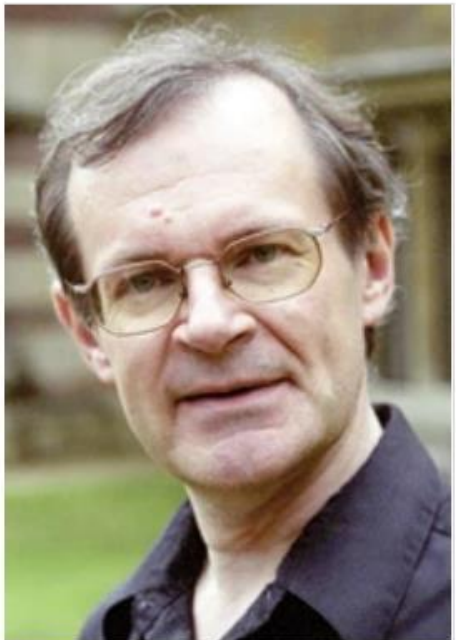
Superconducting RF Cavities





Movers | Published: 07 September 2005

Brian Foster, European regional director, International Linear Collider's Global Design Effort, Oxford, UK



Believing in things of a size most people can't imagine is part of a physicist's everyday life. In his work towards the proposed International Linear Collider (ILC), Brian Foster has gone from subatomic quarks and leptons to the largest linear collider ever built. (See CV)

For Foster, this is the biggest step in a career that has seen him building new equipment to take discovery further and influencing

nature 7 Sept 2005

Brian tells ‘nature’ …

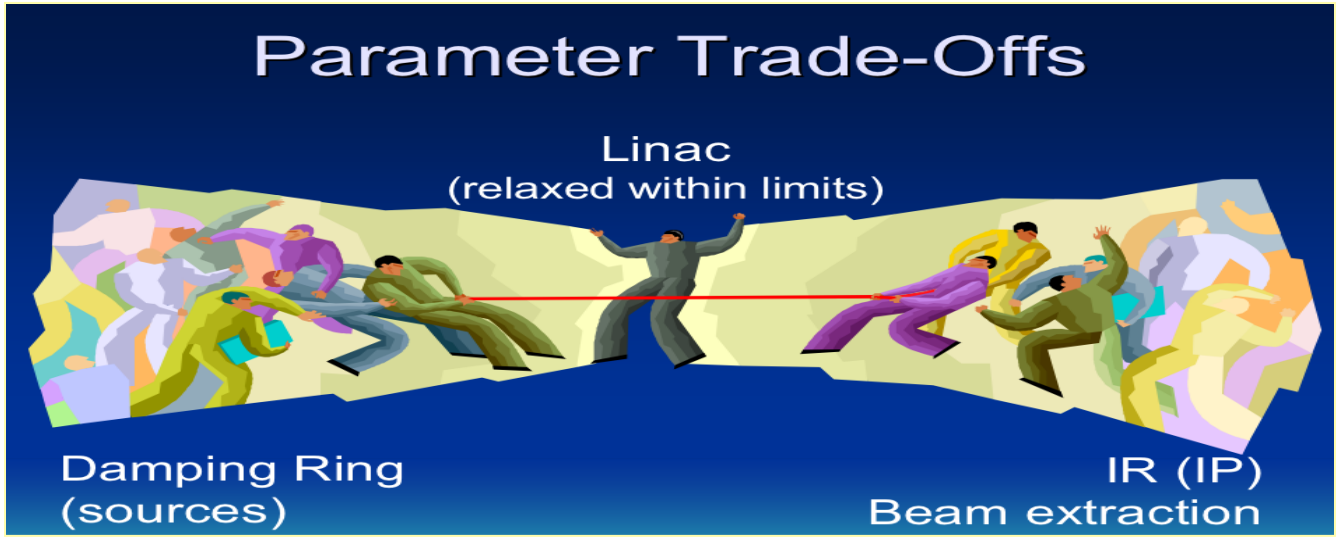
“Never get depressed when you think that your career isn't developing or advancing,” he advises. “This happened to me several times. What is actually happening is that the pressure is gradually building up, more and more people are noticing you, there will be a sudden 'dam-break' and your career will move to another level.”

He is always learning from colleagues: veteran physicist George Kalmus, for example, a colleague on many Particle Physics and Astronomy Research Council committees, taught him “how to keep calm and extract the best from what seemed like awful dilemmas”.

He is learning from interests outside science, too — touring the globe with his violin teacher Jack Liebeck, giving a World Year of Physics lecture that celebrates Einstein (another passionate violinist) through a mixture of music and science. “Playing the violin seriously again has shown me that you are never too old to get better at something, if you want it badly enough, are lucky enough to find a superb teacher and can put in the work,” he says.

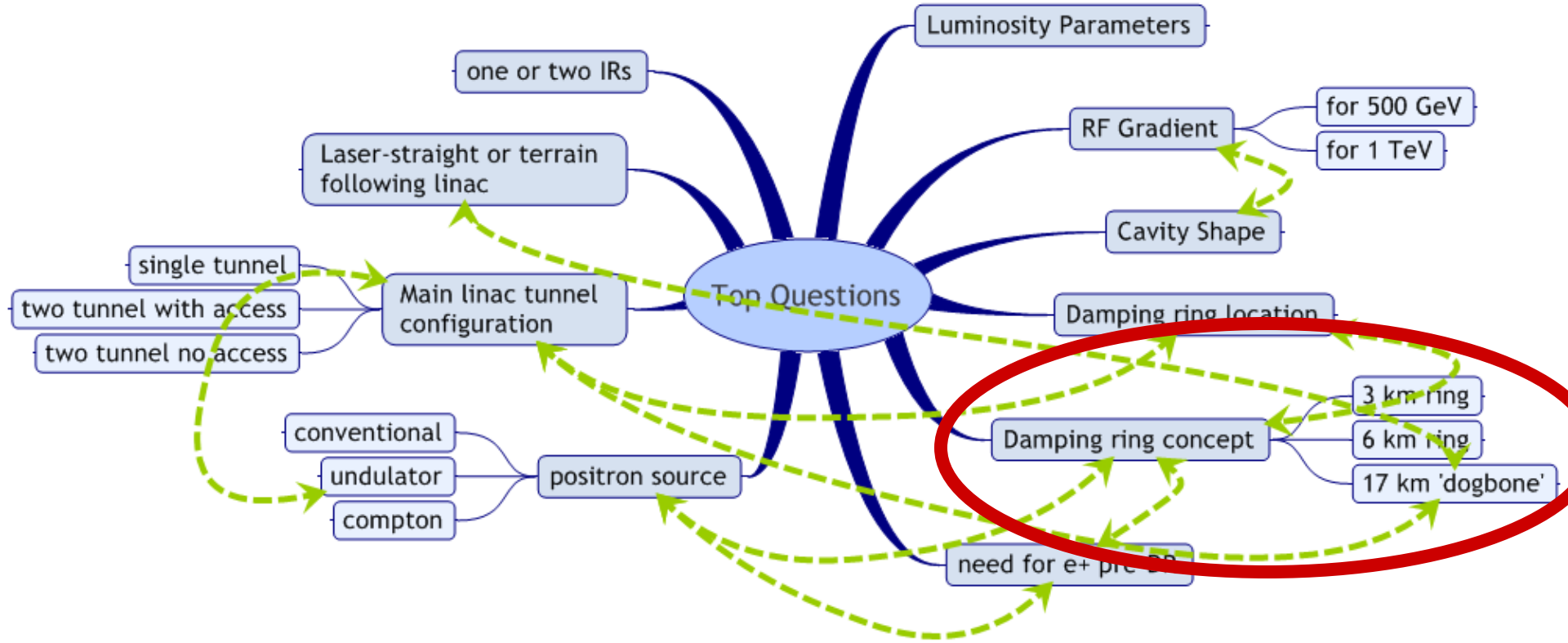
Parametric Approach

- A working space - optimize machine for cost/performance



		min		nominal		max	
Bunch charge	N	1	-	2	-	2	$\times 10^{10}$
Number of bunches	n_b	1330	-	2820	-	**5640**	
Linac bunch interval	t_b	**154**	-	308	-	461	ns
Bunch length	σ_z	**150**	-	300	-	500	μm
Vert.emit.	$\gamma\epsilon_y^*$	**0.03**	-	0.04	-	0.08	mm·mrad
IP beta (500GeV)	β_x^*	**10**	-	21	-	21	mm
	β_y^*	**0.2**	-	0.4	-	0.4	mm
IP beta (1TeV)	β_x^*	**10**	-	30	-	30	mm
	β_y^*	**0.2**	-	0.3	-	0.6	mm

Making Choices – The Tradeoffs



Many decisions are interrelated and require input from several WG/GG groups

Brian always watching over ‘Us’.

Brian Created the ILC Governance Plan

Conference Papers Year : 2010

Governance of the international linear collider project

B. Foster , B. Barish , J.-P. Delahaye (1) , U. Dosselli , E. Elsen (2) , M. Harrison , J. Mnich (2) , J.M. Paterson (3) , F. Richard (4) , S. Stapnes (1) , A. Suzuki (5) , G. Wormser (4) , S. Yamada (5)

Show details

Revised ILC Project Implementation Planning

B. Foster

July 2015
Revision C

Foster et al 2019 - ILC Global Project

March 2019

The International Linear Collider
A Global Project

Prepared by: Philip Bambade[1], Tim Barklow[2], Ties Behnke[3], Mikael Berggren[3], James Brau[4], Philip Burrows[5], Dmitri Denisov[6,7], Angeles Faus-Golfe[1], Brian Foster[3,5], Keisuke Fujii[8], Juan Fuster[9], Frank Gaede[3], Paul Grannis[10], Christophe Grojean[3], Andrew Hutton[11], Benno List[3], Jenny List[3], Shinichiro Michizono[8], Akiya Miyamoto[8], Olivier Napoly[12], Michael Peskin[2], Roman Pöschl[1], Frank Simon[13], Jan Strube[4,14], Junping Tian[15], Maksym Titov[12], Marcel Vos[8], Andrew White[16], Graham Wilson[17], Akira Yamamoto[8], Hitoshi Yamamoto[18], Kaoru Yokoya[8]

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[12] *IRFU, CEA Saclay,* [13] *Max Planck Inst., Munich,* [14] *PNNL,* [15] *U. Tokyo,*
[16] *U. Texas, Arlington,* [17] *U. Kansas,* [18] *U. Tohoku*

(Representing the Linear Collider Collaboration and the global ILC community.)

The International Linear Collider (ILC) is now under consideration as the next global project in particle physics. In this report, we review of all aspects of the ILC program: the physics motivation, the accelerator design, the run plan, the proposed detectors, the experimental measurements on the Higgs boson, the top quark, the couplings of the W and Z bosons, and searches for new particles. We review the important role that polarized beams play in the ILC program. The first stage of the ILC is planned to be a Higgs factory at 250 GeV in the centre of mass. Energy upgrades can naturally be implemented based on the concept of a linear collider. We discuss in detail the ILC program of Higgs boson measurements and the expected precision in the determination of Higgs couplings. We compare the ILC capabilities to those of the HL-LHC and to those of other proposed e^+e^- Higgs factories. We emphasize throughout that the readiness of the accelerator and the estimates of ILC performance are based on detailed simulations backed by extensive R&D and, for the accelerator technology, operational experience.

A New Day; A New Idea

New Journal of Physics
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2023

PAPER • OPEN ACCESS

A hybrid, asymmetric, linear Higgs factory based on plasma-wakefield and radio-frequency acceleration

B Foster[4,1,2], R D'Arcy[1,2] and C A Lindstrøm[3]

Published 21 September 2023 • © 2023 The Author(s). Published by IOP Publishing Ltd on behalf of the Institute of Physics and Deutsche Physikalische Gesellschaft

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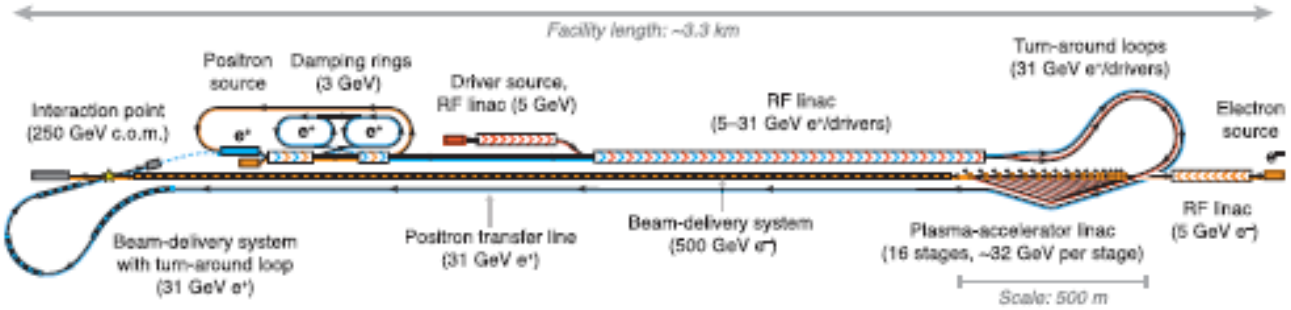
DOI 10.1088/1367-2630/acf395



Brian – Congrats & Happy Fosterfest !!