The story of SASE-FEL at DESY – politics, strategies etc. (1992-2001)

‘Political’ status in 1992:

no Berlin wall, Germany reunited, currency DM,
USSR collapsed, cold war ends,
UK still in EU - new eastern countries joining,

There still were: transparencies and overheads and

General feeling: the future is bright and peaceful

X-ray Science Status in 1992

- X-ray lasers → a dream

- Synchrotron X-radiation

  ESRF in commissioning mode

  APS and Spring-8 in discussion/planning

  Bypass at DORIS starting operation

  - DORIS III becomes dedicated SR source

The dream of an X-ray laser around 10keV

In the 1970th:

→ to pump inversion of inner electron shells would need GWs, (ca1W/atom)

→ FORGET IT

Or: use an atomic bomb explosion ?

In the 1980th :

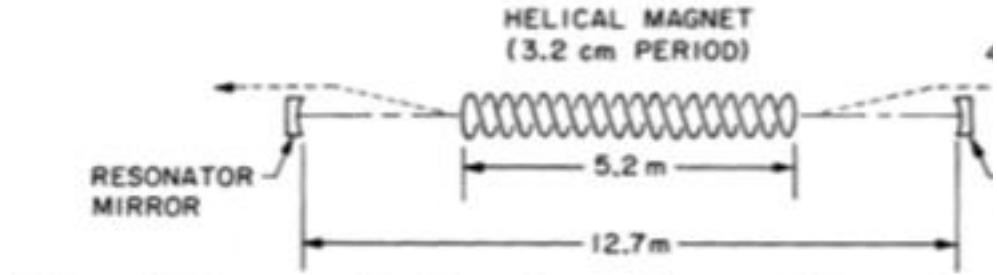
SDI- The strategic Defence Initiative: LA&LLNL did really try -
Underground at Nevada Test Site

But there was also a lot of accelerator based research following the experiment of Madey

First Operation of a F

D. A. G. Deacon, f L. R. Elias, J. M. J. Mac
and T. I. Smith
High Energy Physics Laboratory, Stanford University, S
(Received 17 February 1977)

A free-electron laser oscillator has been ope
of 3.4 micrometer.



Schematic diagram of the free-electron laser oscillator. (For

Can we use this for x-rays?

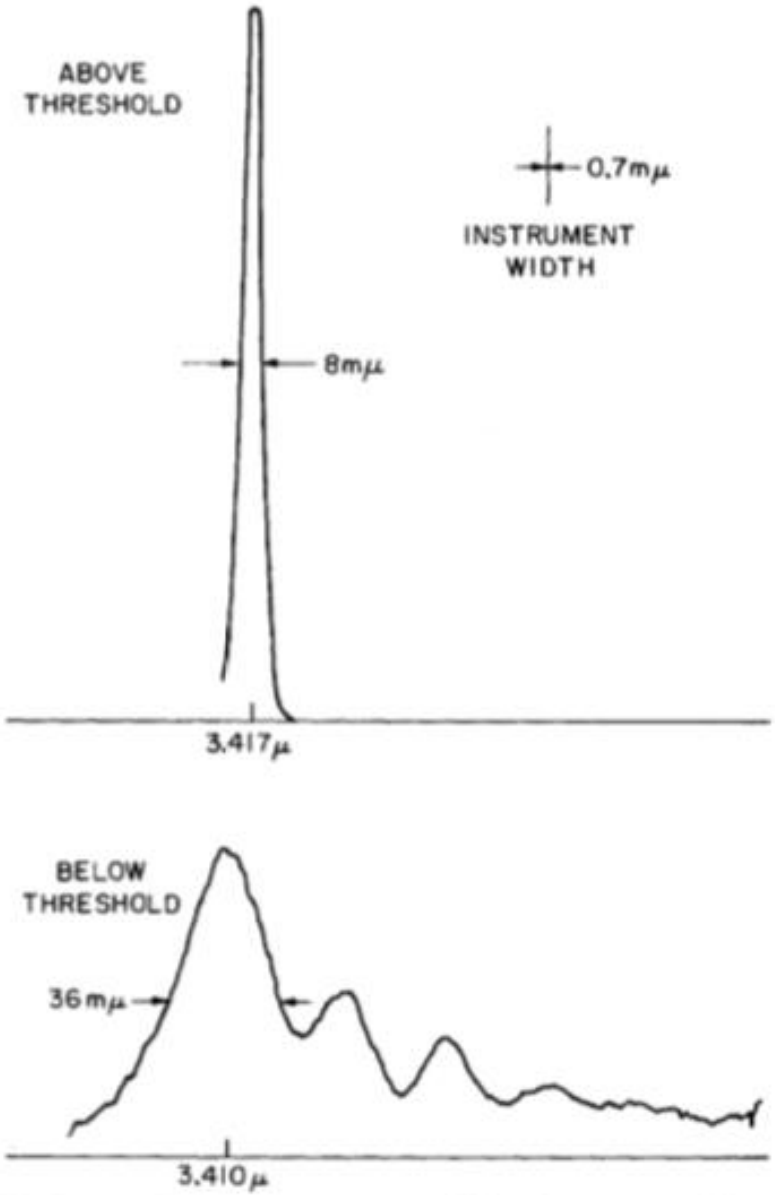


FIG. 2. Emission spectrum of the laser oscillator above threshold (top) and of the spontaneous radiation emitted by the electron beam (bottom).

X-ray FEL history

Talk sorted with input from a summary collected by:

- Jochen R. Schneider (6.1.2010)
- Petra Folkerts (11.1.2010)
- Thomas Tschentscher (13.1.2010)
- Joerg Rossbach (20.1.2010)
- Karl Witte (21.1.2010)
  Additions (Febr. 2010): R. Brinkmann, T. Tschentscher
  Addition of period 2010 until March 2013: Petra Folkerts pf_2013-04-08

1980: A.M. Kondratenko, E.L. Saldin:

"Generation of Coherent Radiation by a Relativistic Electron Beam in an Undulator" Part. Accelerators 10, 207 (1980)

1984: R. Bonifacio, C. Pellegrini, L.M. Narducci:

"Collective Instabilities and High-Gain Regime in a Free-Electron Laser"

1986 ICFA workshop on low emittance e- - e+ beams (BNL)

J.B. Murphy and C. Pellegrini

1988 The switched power workshop (design of a high-brightness electron gun) (BNL) R. Fernow

1990 Workshop on prospects for a 0.1 nm free-electron laser (BNL)
Robert Palmer, William Willis, Juan C. Gallardo

1991: Foundation of TESLA collaboration with the goal to push the gradient of the sc cavities to the ultimate value and to reduce the overall cost of the accelerator units

Björn Wiik on maximum gradient 

2/1992 Workshop on Fourth Generation Light Sources (SLAC) M. Cornacchia and H. Winick

- Examples of FELs operating from 100 nm to 0.1 nm producing peak power from 0.65 MW to 5 GW using linacs of 0.325 GeV to 50 GeV were developed by the working group and are listed in their summary. These include the use of the SLAC linac equipped with low emittance guns to drive 4 nm to 0.1 nm FELs.

Herman Winick in Hamburg at 15th HEACC → HW ?

11/1992 Workshop on scientific applications of short wavelength coherent light sources (SLAC) W. Spicer, J. Arthur and H. Winick

Being for short sabbatical at SLAC, B Wiik participates in the above

→ Result…

1993 B. Wiik becomes Director General of DESY, following V Soergel,

J. Schneider becomes Head of HASYLAB, following G Materlik

7/1993 – 6/1994 GM in Stanford joins HW's XFEL working group →

2/1994 Workshop on scientific applications of coherent X-rays (SLAC)

J. Arthur, G. Materlik and H. Winick

WORKSHOP ON
SCIENTIFIC APPLICATIONS OF COHERENT X-RAYS
February 12, 1994

Is there new science to be done?

Assume we have solution for optics and sample !

ORGANIZATION and PROGRAM

J. Arthur, G. Materlik*, H. Winick
Stanford Linear Accelerator Center
Stanford Synchrotron Radiation Laboratory
Stanford University, Stanford CA 94309

**permanent address*
HASYLAB/DESY
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D-22603 Hamburg, Germany

EXECUTIVE SUMMARY

R.J. Birgeneau**, C.S. Fadley,*** G. Materlik

***Massachusetts Institute of Technology*
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****Lawrence Berkeley Laboratory*
Materials Science Division MS 2-100
Berkeley CA 94720

WORKSHOP ON SCIENTIFIC APPLICATIONS OF COHERENT X-RAYS
Table of Contents

But what about Coulomb Explosion and radiation damage ?

About 60 Participants, some could not fly in because of a blizzard at the east coast

Connection between US-SR community and SLAC was not smooth sailing: PEP closure

Burt Richter: great! You will find out how it is to have 100 co-authors

Message to BW: yes, there is a very strong science case

Technically important: BNL had built a copper gun with required emittance

BW sent J Roßbach to SLAC to establish machine physics link to the ongoing US work

BW decided to go ahead with TTF-FEL
Funding? (done in the DESY way)
He even brought 3 FEL theoreticians very fast to DESY

Facing a political mine field:

relatively easy for stage 1 the TTF-FEL part, but very difficult for stage 2 the XFEL part:

Finally want to operate two user facilities

Priority: avoid site discussion - both should be in HH

Funder BMFT: great idea! But include Europe for funding

Europe: what is the right way? Like ESRF project?

via EU?

Get science collegues onboard.

Round Table of SR and FEL Facilities

7/1994 Colloquium “30 Years of Synchrotron Radiation at DESY”:

- B.H. Wiik reports on a 500 MeV superconducting accelerator under construction at DESY which after a test period will be used as injector for a free-electron laser for photon energies up to 200 eV (DESY)

11/1994 Discussion of the scientific case for a VUV-FEL (DESY)

4/1995 Discussion of the scientific case for a VUV-FEL (DESY)

6/1995 Conceptual Design Report on a VUV Free-Electron Laser at the TESLA Test Facility at DESY

1995 Approval for construction of the VUV-FEL at the TESLA Test Facility (TTF1) by DESY Council

9/1996 International Workshop on X-ray Free-Electron Laser Applications (DESY)

11/1996 Workshop on the characterization of FEL radiation (DESY)

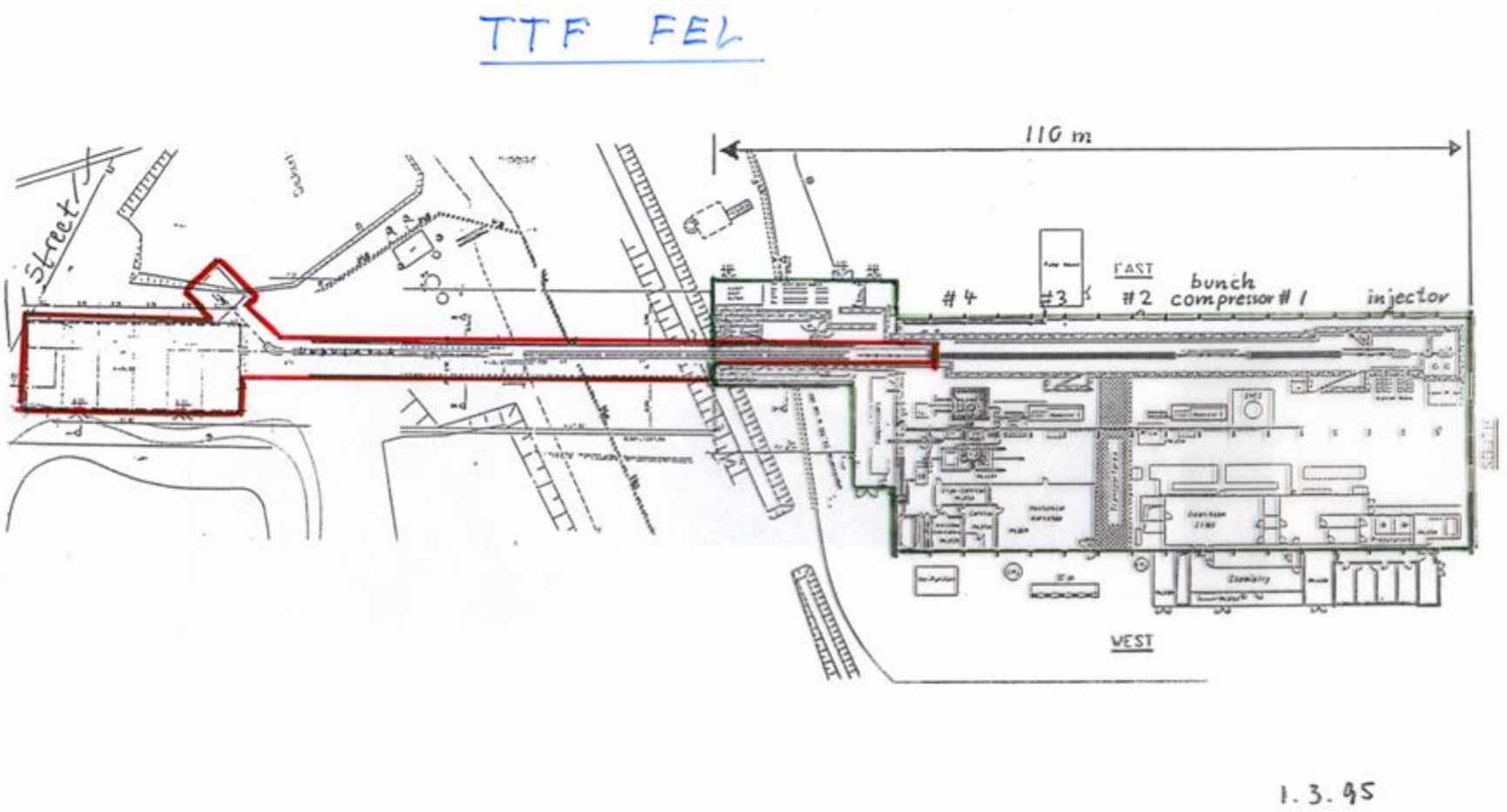
1/1997 SLAC/DESY International Workshop on Interactions of Intense Sub-picosecond X-rays with Matter (SLAC)

5/1997 Conceptual Design Report for a Linear Collider with an Integrated X-ray Laser Facility

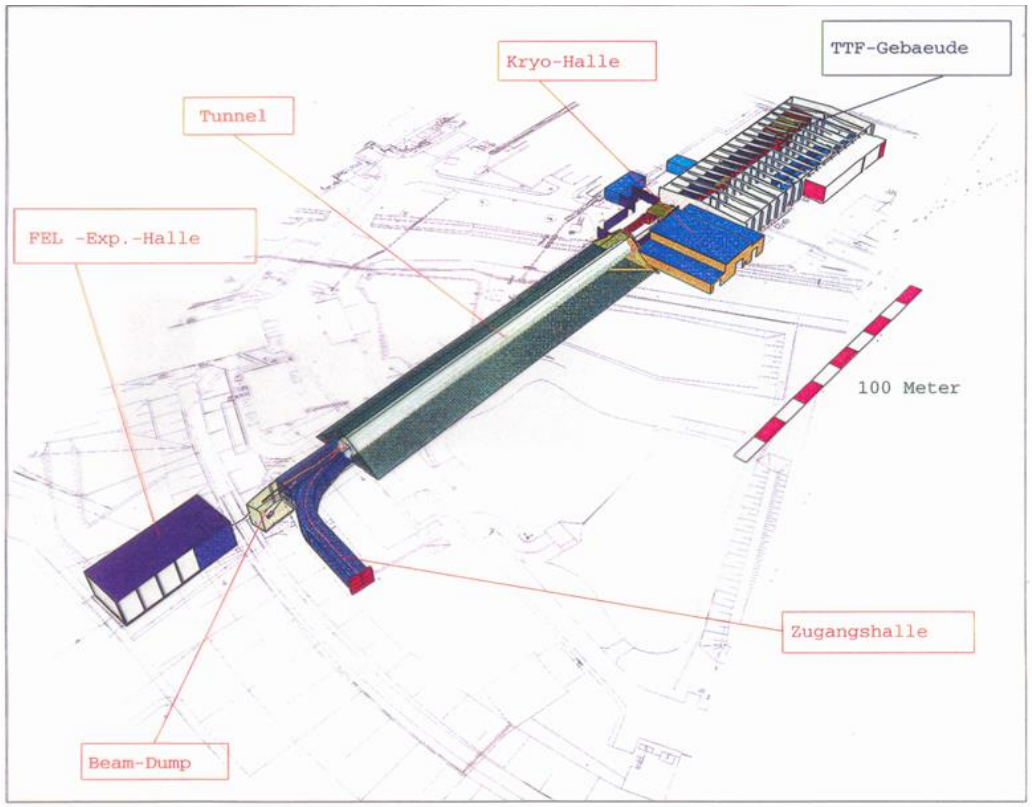
BW kept very close to the technical problems and progress

Eg: shall we have the experimental hall inside or outside the PETRA tunnel?

1st layout (everything inside PETRA)



Experimental Hall outside Petra



But how do we pay for the Hall?

Expo 2000

1997 First beam acceleration (10 MV/m) in a 12-m-long superconducting module of the TESLA Test Facility

1998 Hamburg and Schleswig-Holstein signed an agreement to build the 33- km-long TESLA linear collider combined with an XFEL in Hamburg and in the district of Pinneberg

1/1999 Start of commissioning of the VUV-FEL at DESY

2/1999 Björn Wiik tragically dies in an accident

7/1999 Albrecht Wagner starts as DESY Chairman

1/2000 Jochen Schneider starts as Research Director of Photon Science

1999 BES Panel on novel coherent light sources (Leone-panel) (DOE)
Gaithersburg, Maryland, USA

- *The panel found that the most exciting potential advance in the area of in- novative science is most likely in the hard X-ray region, in the range of 8- 20 keV, and even higher.*
  The panel unanimously recommends that the case for the science still must be improved.

8/1999 Observation of first spontaneous radiation at the VUV-FEL at DESY

8/1999 21st International Free-Electron Laser Conference at DESY

9/1999 DESY decides to build and operate the photo-injector test facility (PITZ) at its institute in Zeuthen near Berlin

1999 The Low-Energy Undulator Test Line (LEUTL) at the APS at Argonne National Laboratory demonstrates SASE gain at 530 nm wavelength

2/2000 TESLA Test Facility (TTF) demonstrates SASE gain at 108 nm wavelength

This success of the whole TTF-FEL team is essential to move on with the TESLA XFEL project. It is 2 - 3 orders of photon energy to reach 10 keV…

2000 German Science Council receives mandate from the Federal Government of Germany to evaluate 8 large scale research facilities proposed by German institutions or research centers

4/2000 First meeting of the Fine Analysis of Matter Expert Group FAM-EG in London including representatives from France, Germany, Italy, Spain, and UK.

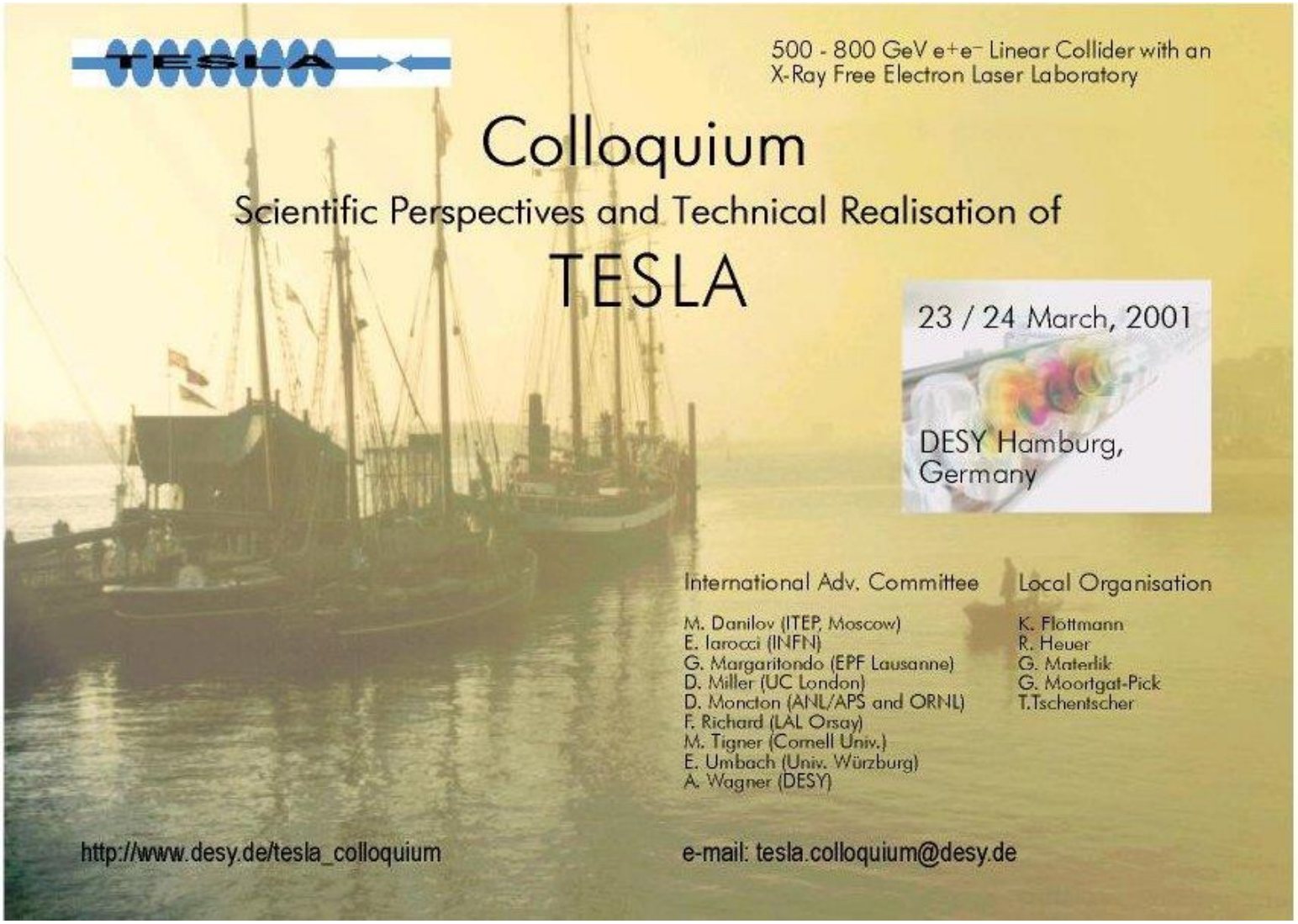
2000 EXPO 2000 exhibition “Light for the next millennium” at DESY attracts 106 000 visitors.

9/2000 The Low-Energy Undulator Test Line (LEUTL) at the APS at Argonne National Laboratory reaches lasing at saturation at 530 nm wavelength.

→ Was LEUTL an attempt to get LCLS to Argonne or just competition???

3/2001 TESLA Colloquium at DESY on Scientific Perspectives and Technical Realization of TESLA attracted around 1000 participants, 40% of them from abroad

3/2001 Presentation of the TESLA Technical Design Report on a Linear Collider with an integrated X-ray Free-Electron Laser Facility (More than 1100 scientists from 36 countries contributed on 1424 pages)


TESLA
500 - 800 GeV e+e- Linear Collider with an
X-Ray Free Electron Laser Laboratory
Colloquium
Scientific Perspectives and Technical Realisation of
TESLA
23 / 24 March, 2001
DESY Hamburg,
Germany
International Adv. Committee
M. Danilov (ITEP, Moscow)
E. Iarocci (INFN)
G. Margaritondo (EPF Lausanne)
D. Miller (UC London)
D. Moncton (ANL/APS and ORNL)
F. Richard (LAL Orsay)
M. Tigner (Cornell Univ.)
E. Umbach (Univ. Würzburg)
A. Wagner (DESY)
Local Organisation
K. Flöttmann
R. Heuer
G. Materlik
G. Moortgat-Pick
T.Tschentscher
http://www.desy.de/tesla_colloquium
e-mail: tesla.colloquium@desy.de

TESLA Colloquium on Scientific Perspectives and Technical Realization of TESLA

All Photon talks in ppt !!!

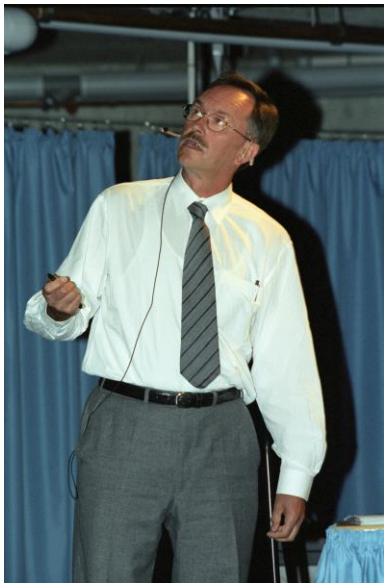
Helmut Dosch

Robert Feidenhans'l

Simone Techert

Richard Lee

Janos Hajdu



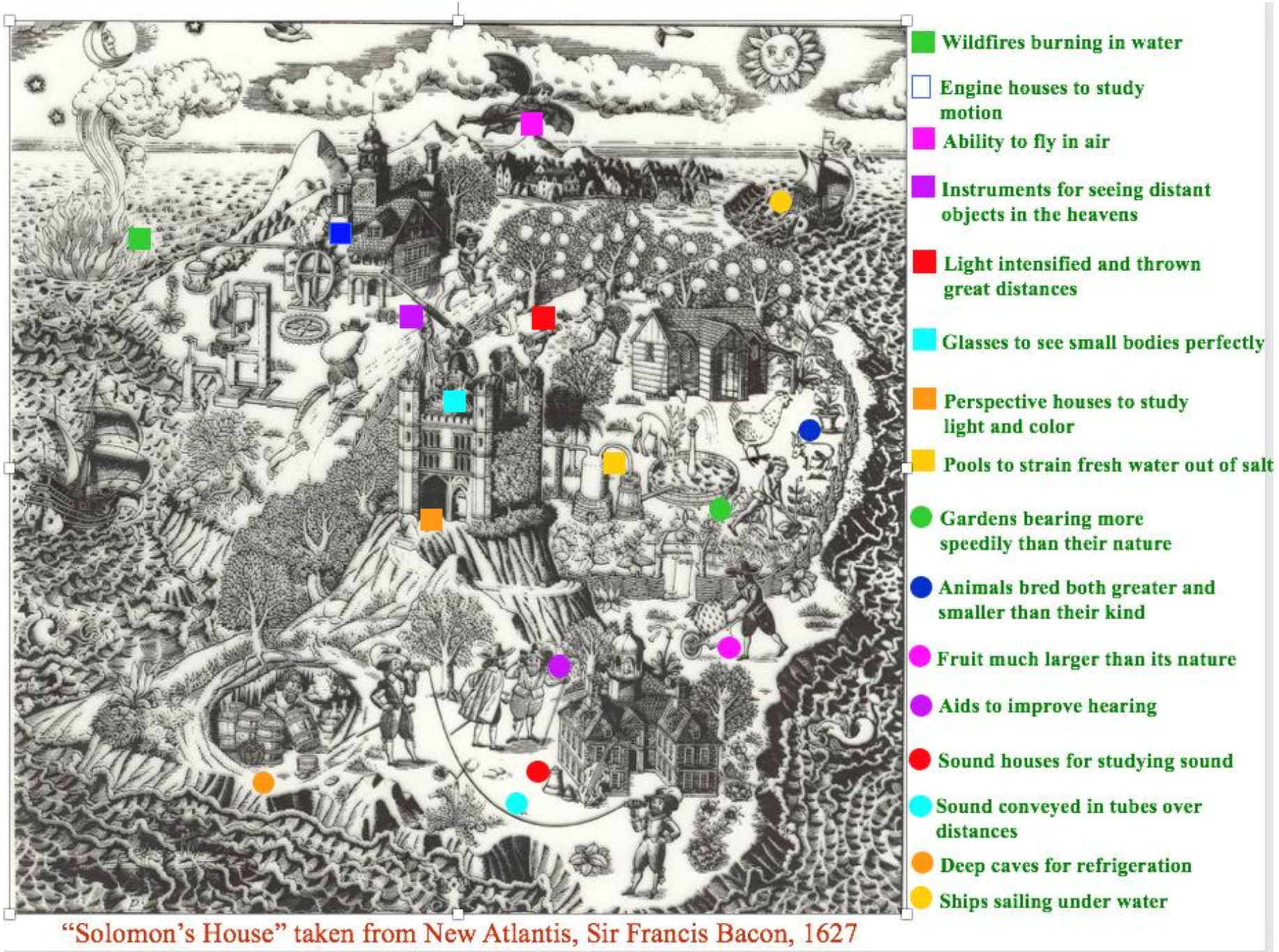
4/2001 Report of the FAM-EG on the potential for further European collaboration in determining requirements for large scale experimental facilities for the fine analysis of matter → Europe

10/2001 TESLA Test Facility (TTF1) reaches SASE in saturation at 98 nm wavelength

11/2001 First successful cluster experiments at TTF1 by the group of Thomas Möller

10/2001 DESY site visit of the German Science Council working group for the evaluation of TESLA XFEL and the BESSY FEL projects

We were not the first in human history to dream of a laser…



"Solomon's House" taken from New Atlantis, Sir Francis Bacon, 1627

My first thanks go to the members of the

TTF-FEL team !

You have all done a great job to make the DREAM reality here at DESY in Hamburg.

Just wonderful !

My second thanks go to all of you here for having listened to my first HISTORY talk.