



Industrial RF Linac Experiences and Laboratory Interactions

Michael Peiniger, ACCEL Instruments GmbH

- Introduction - Industrial Relations with Labs
- ACCEL as an Advanced Technology Equipment and Turn-Key System Supplier
- Examples of Interactions with Labs on RF Linac Components and Systems
- Conclusions and Future Prospects



Introduction - Industrial Relations with Labs

Ref. D. Krämer, BESSY, EPAC 2002 (Experience with Industry during the Construction of a large Accelerator)

„...since the early 80th...as a consequence of the new requirements (of modern accelerators)... e.g. for synchrotron light sources..., especially the big companies left the market segment of accelerators... nevertheless a number of highly specialized suppliers continued delivery of components and/or subsystems.“....

„People’s argument modern accelerators are too complex for a single company are not free from prejudice. The argument is true for most of recently built accelerators for the time being. Non of the active companies in the field of accelerators covers all aspects in their present production. Nevertheless it is interesting to realise that companies started to hire accelerator physicists to improve their capabilities. Thus present limitations of cooperation are not static but change with time.“

Introduction - Industrial Relations with Labs (ct'd)

e.g. ref. Bjarne Roger Nielsen, Danfysik A/S, EPAC 2002 (Relations between Accelerator Institutes and Industry):

Some Types of Relation

Accelerator Institute

Industrial Company

Expert & Designer	<>	General Contractor (job shop, build to print)
Customer	<>	Standart Equipment Supplier
Project Manager	<>	Special Equipment Supplier
End User	<>	Turn-Key System Supplier
Technology Provider	<>	Technology Receiver
Collaborator	<>	Collaborator

ACCEL Instruments GmbH

Advanced Technology Equipment and Turn-Key System Supplier for
Research, Industry and Medical worldwide



Business Units

RF Components and Systems
Linear Accelerators
Specialized Manufacturing Projects

Superconducting Magnet Systems
Circular Accelerators
Proton/Ion Therapy

Synchrotron-Beamlines
X-Ray Systems
Special UHV Equipment

ACCEL Instruments GmbH

1980 - 1993

Siemens AG/Interatom GmbH in
Bergisch Gladbach

„Accelerator and Magnet Technology“

1993/94

Foundation of ACCEL Instruments GmbH,
Management Buyout Contract with Siemens AG

Production Facilities, Rights, Documentation
Regulation Transfer, Guarantees, etc.
Transfer of about 30 existing Key People

End of 2003

Staff of 250 People
Physicists, Engineers, Manufacturing Specialists,
Commercial, Controlling, Administration

ACCEL Sites



[Bergisch Gladbach \(8000 m²\)](#)

Administration,
Marketing/Sales,
Management, Engineering,
Manufacturing, Assembly,
Testing,

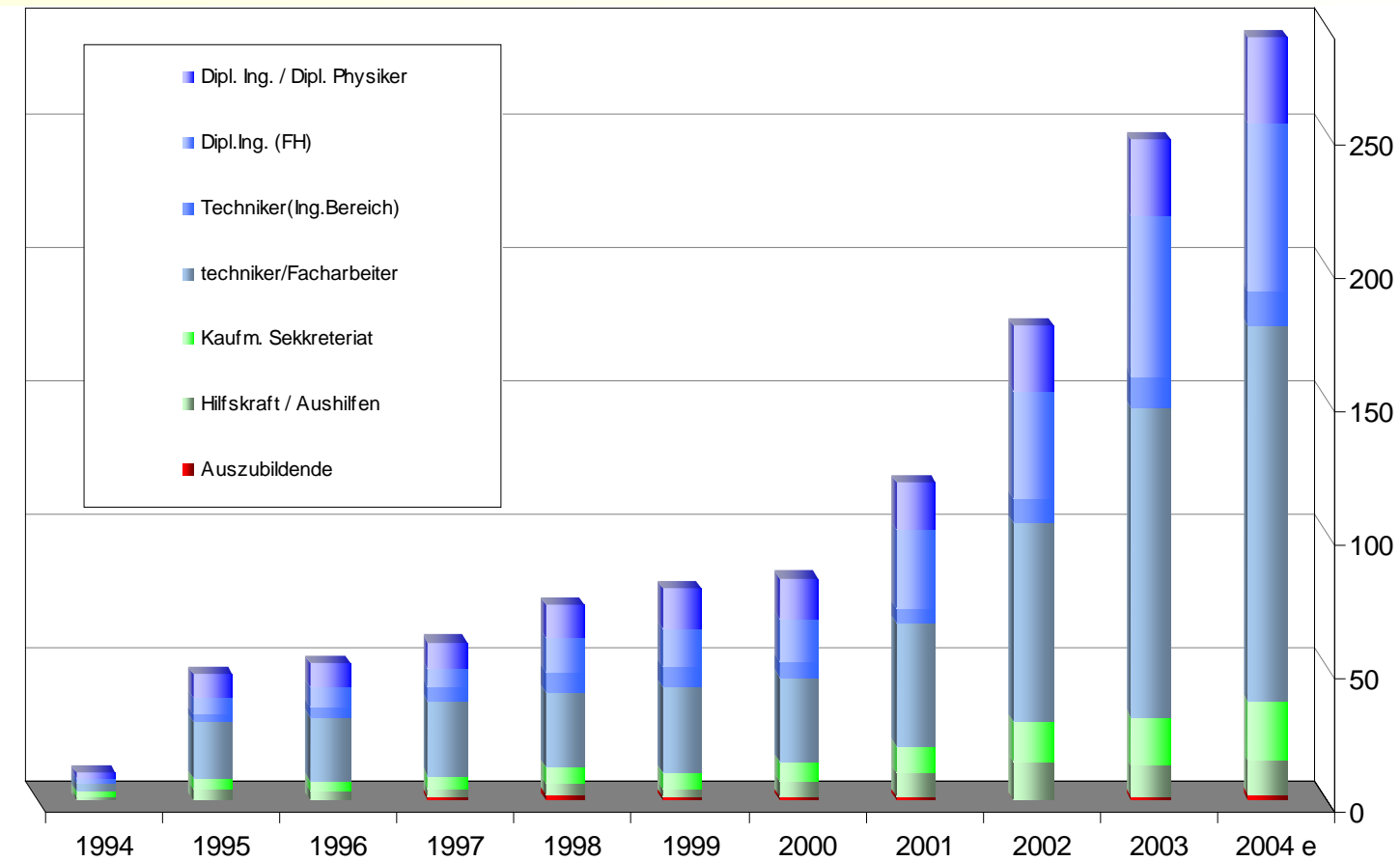
[Troisdorf \(5500 m²\)](#)

Series Production of the
Superconducting Main Quad
Magnets

[Glarus/Schweiz \(300 m²\)](#)

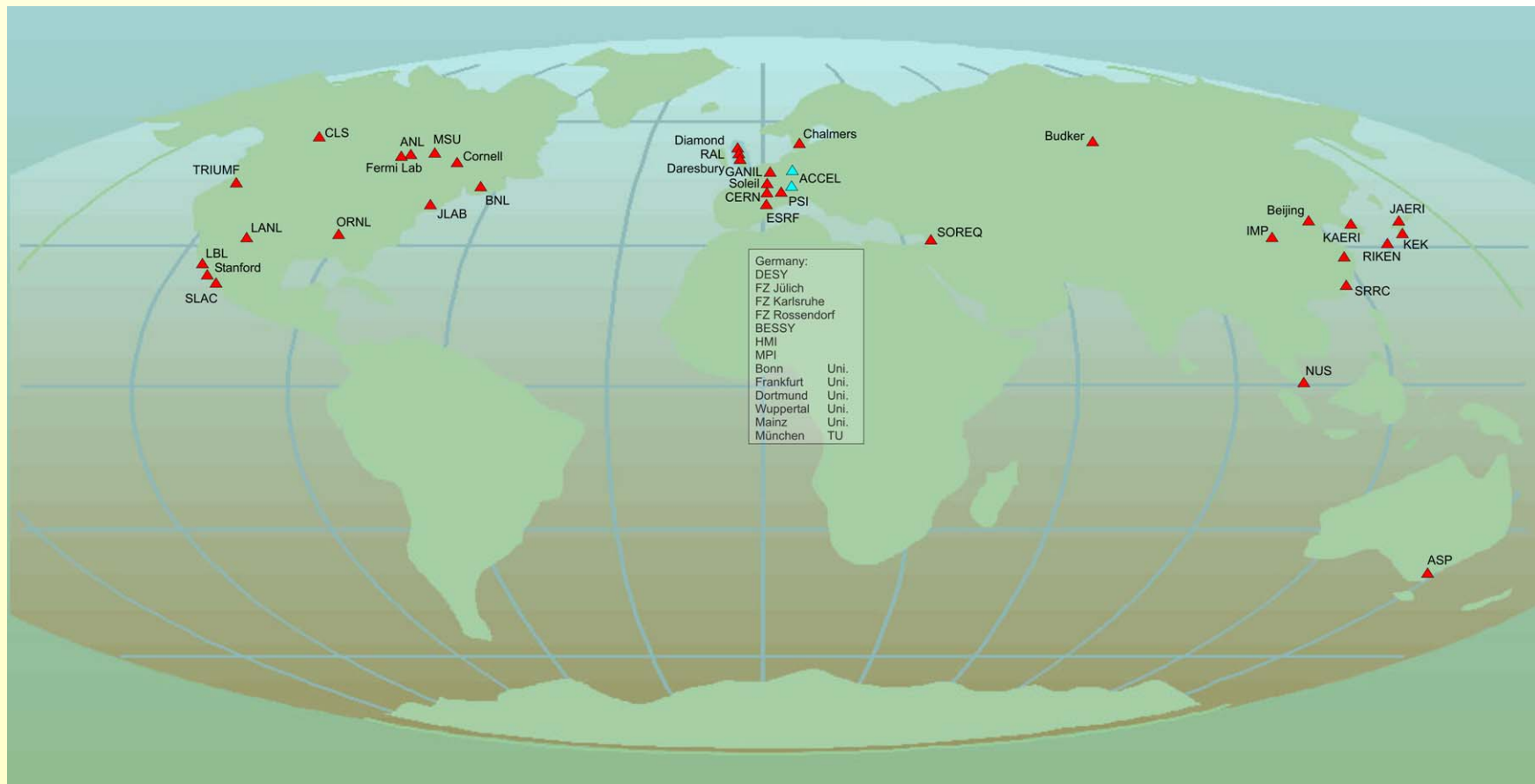
Mechanical Machining, Sales

ACCEL Personnel



ACCEL is an Engineering and Manufacturing Company

World Map of Customers and Partners in Fundamental and Applied Research (not complete)



Production of Superconducting Niobium Cavities

ACCEL manufactured e.g. 360 CEBAF, 109 SNS and about 50 TESLA Cavities as a Special Equipment Supplier ([Technology Transfer](#) DESY, JLAB, Cornell, Wpt. Univ.)

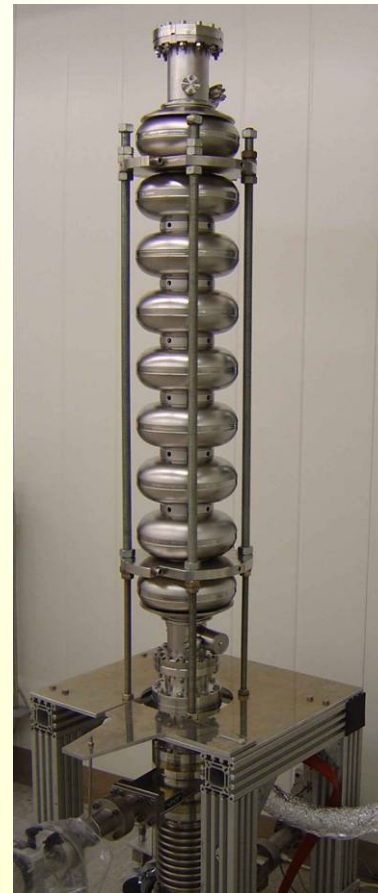


2 TESLA Cavities with guaranteed Performance for BESSY

Preparation steps	Done at
Manufacturing	ACCEL
100 μm BCP (closed loop)	ACCEL
Heat treatment 800 $^{\circ}\text{C}$	DESY
20 μm BCP (closed loop)	ACCEL
High pressure rinsing (HPR)	ACCEL
Assembly in cleanroom	ACCEL
Transport under vacuum	ACCEL
Vertical test	DESY

For Future Projects:

All steps under responsibility of ACCEL
with **using** existing DESY inspection,
furnace and test **infrastructure**

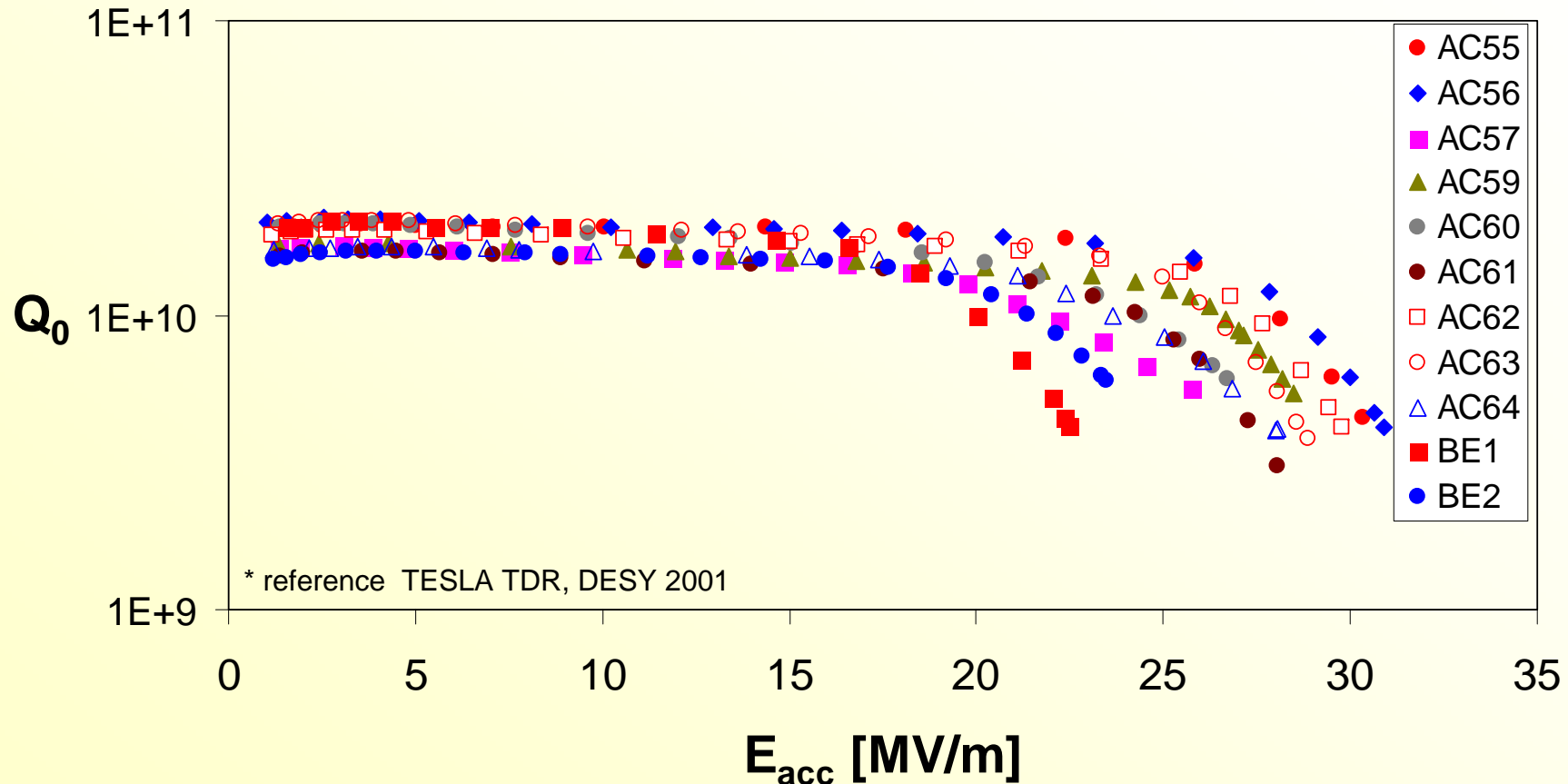


HPR at ACCEL



Test at DESY

TESLA Cavities for BESSY and DESY*

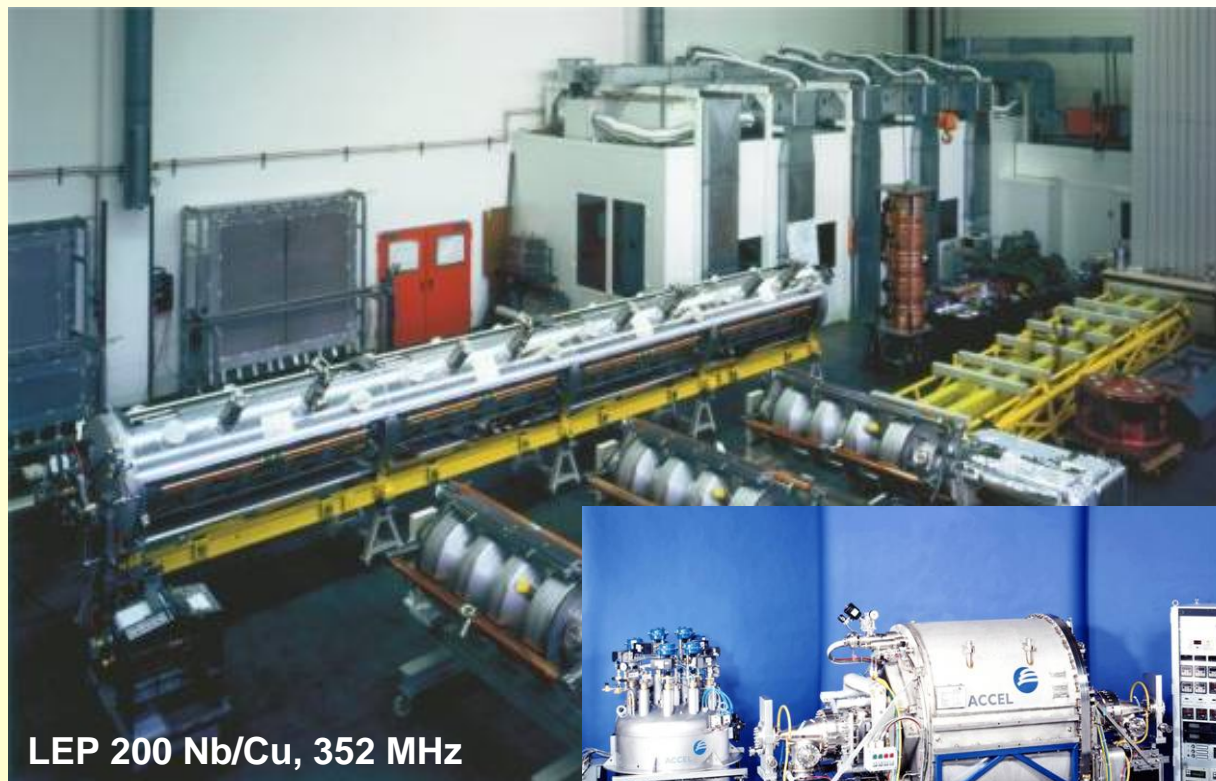


AC cavities for DESY (prepared by DESY): heat treated at 800 C and 1400 C
 BE cavities for BESSY (prepared by ACCEL): only heat treated at 800 C



ACCEL

Superconducting RF Accelerator Modules (Examples)



LEP 200 Nb/Cu, 352 MHz

Technology Transfer from
CERN and Cornell



3rd harmonic,
1500 MHz, for
BESSY

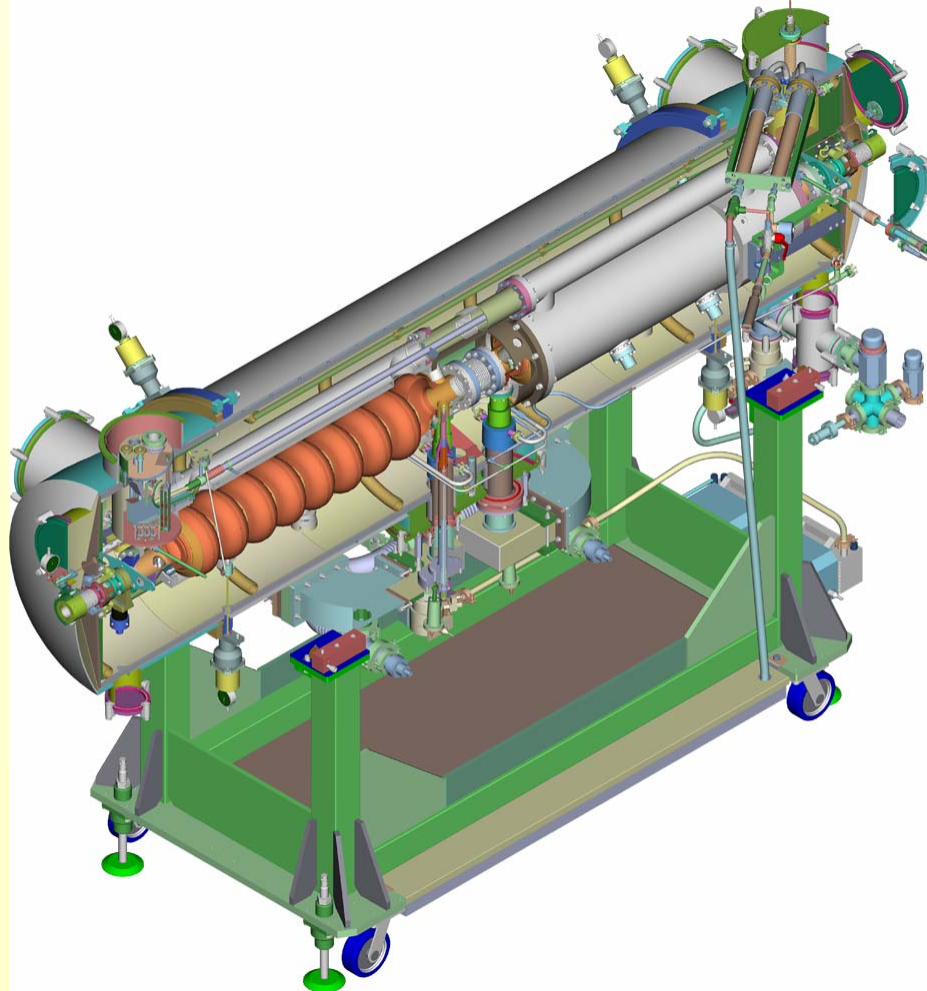


Cornell, 500 MHz, single cell module
for Cornell, NSRRC, CLS, DLS



ACCEL

Twin TESLA Cavity Accelerator Module as Turn-Key System for FEL and ERL Application



Target Values cw:

$E_{acc} > 15 \text{ MV/m}$
@ Cavity $Q > 1 \text{ E}10$

$P_{rf} > 8 \text{ kW}$ per Coupler

TESLA Technology Transfer from
DESY etc.

License Agreement on the Twin
Cavity Module with FZ Rossendorf

Supply of Turn-Key TESLA/XFEL –
Type Modules is Future Goal



ACCEL

CCL Modules for SNS in Oak Ridge/USA

Complete
CCL-Module
during RF
Test at
ACCEL

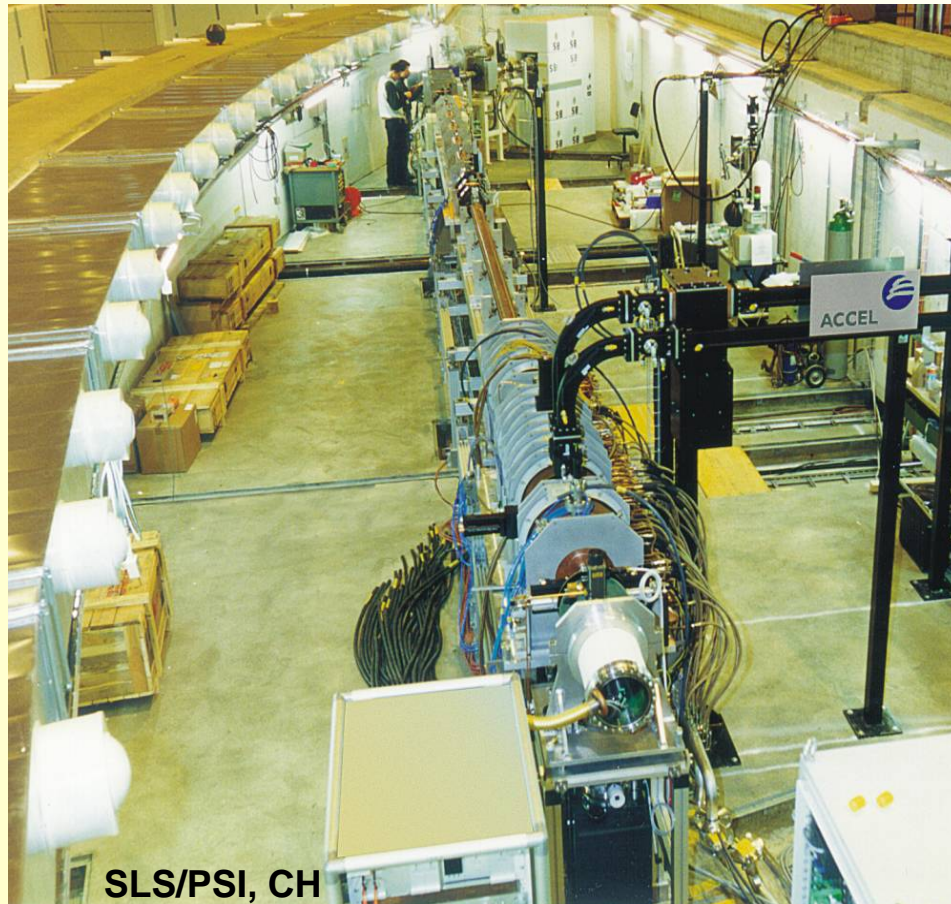


CCL Linac at SNS



ACCEL manufactured, assembled, aligned and rf tuned 4 CCL Modules as a Special Equipment Supplier ([Co-operation](#) with LANL)

Turn-Key S-Band Electron Linacs for Synchrotron Light Sources and Others



Energy:

Delivered:

SLS/PSI, CH 100 MeV

In Production:

DLS, UK 100 MeV

ASP, Australia 100 MeV

PTB, Germany 0,5-50MeV

Technology Transfer from DESY
(Dortmund Univ.)

License Agreement on S-Band Lin.
Collider Components with DESY

Turn-Key 40 MeV Proton/Deuteron SRF Linac for SARAF/Israel

Parameter for p / d	Value	Unit
Energy maximal	40	MeV
Energy minimal	5	MeV
Energy adjustment accuracy	200	keV/step
Current maximal (cw)	2 (4)	mA
Current minimal (cw)	40	μ A
Transv. emittance (norm. rms)	< 1	π^* mm*mrad
Longit. emittance (rms)	< 4	π^* nsec*keV/n
Operation	6000	hours/year
Reliability	90	%

3 Phases:

Assessment and Design Study (incl. Beam Dynamics Simul. and Error Analysis)

Design-Build-Install. Linac Injector with Prototype SRF-HWR Module (incl. Infrastructure Requirements)

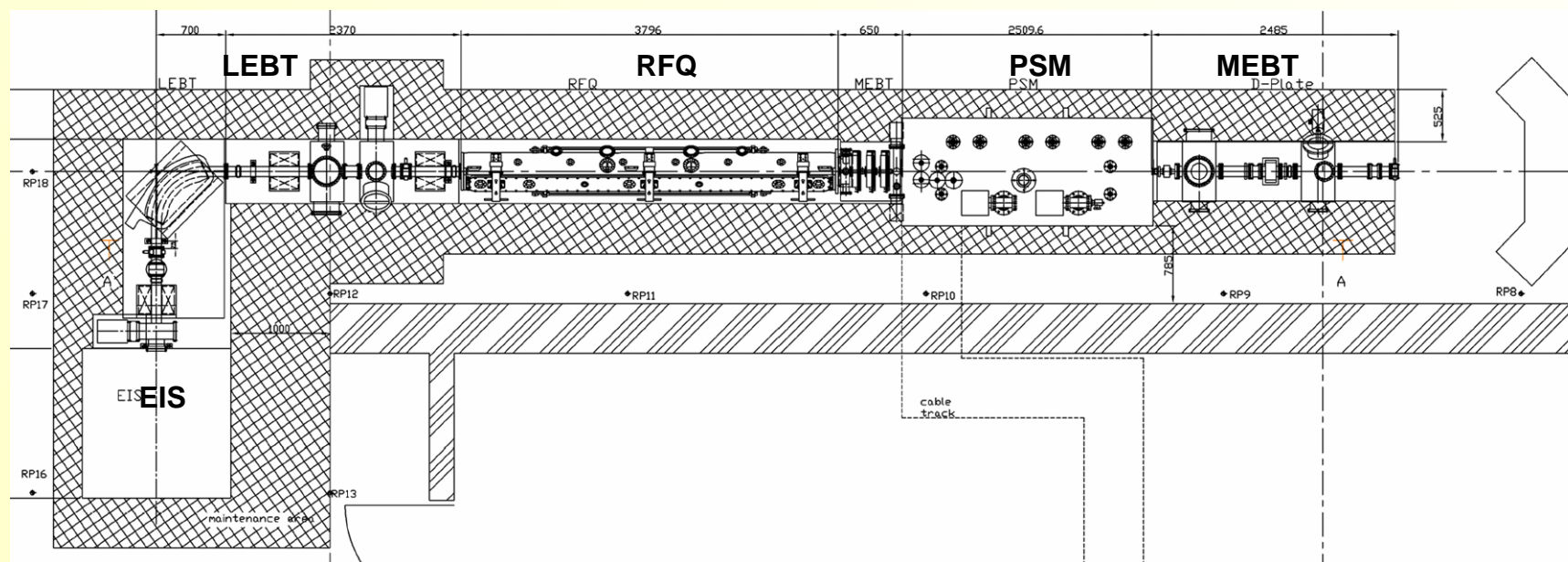
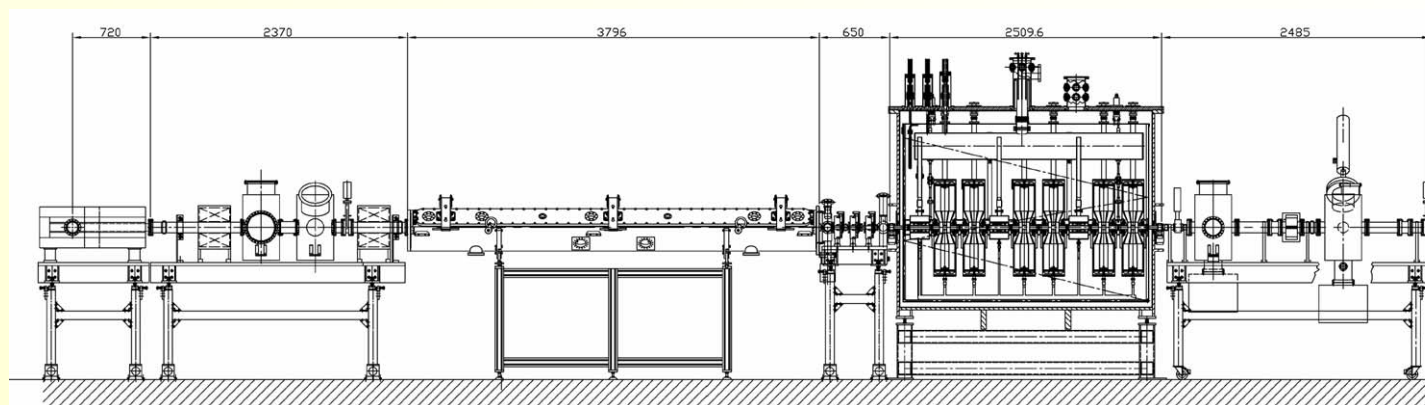
Upgrade to 40 MeV

Intense Inhouse R&D, [strong Interaction with World's leading Accelerator Labs](#) (e.g., INFN LNL, ANL, MSU, Frankfurt Univ., LANL, ORNL, PSI, AECL)



ACCEL

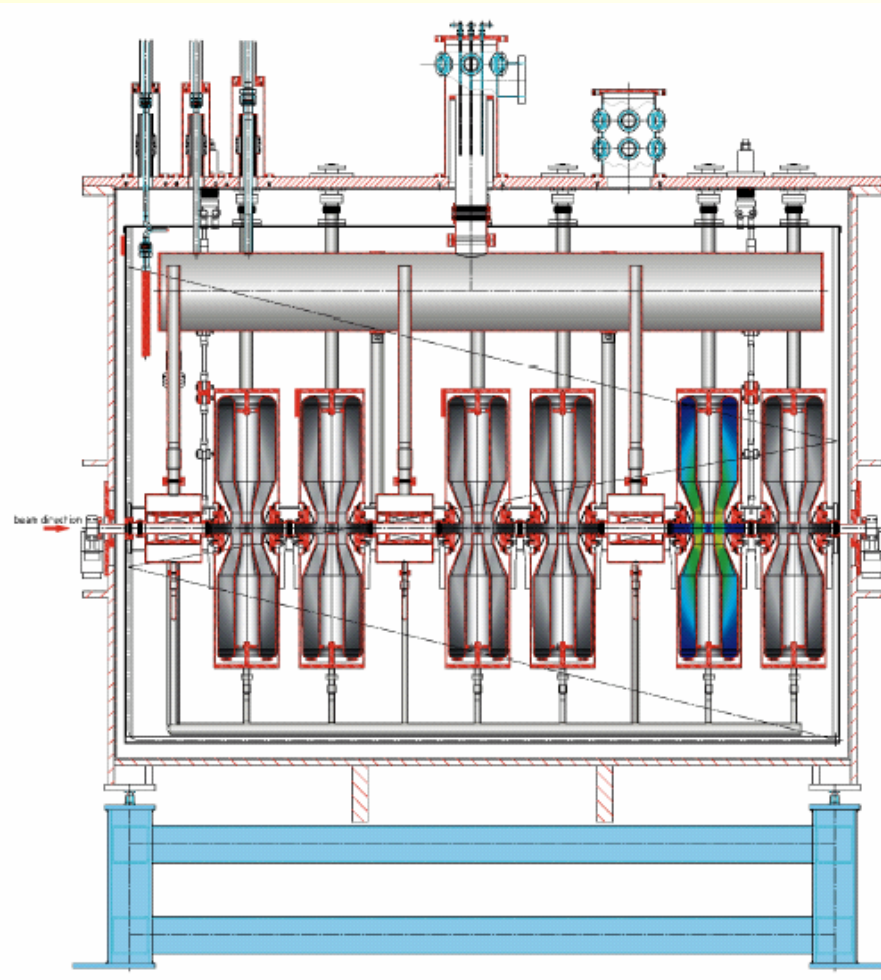
SARAF p/d Injection Linac





ACCEL

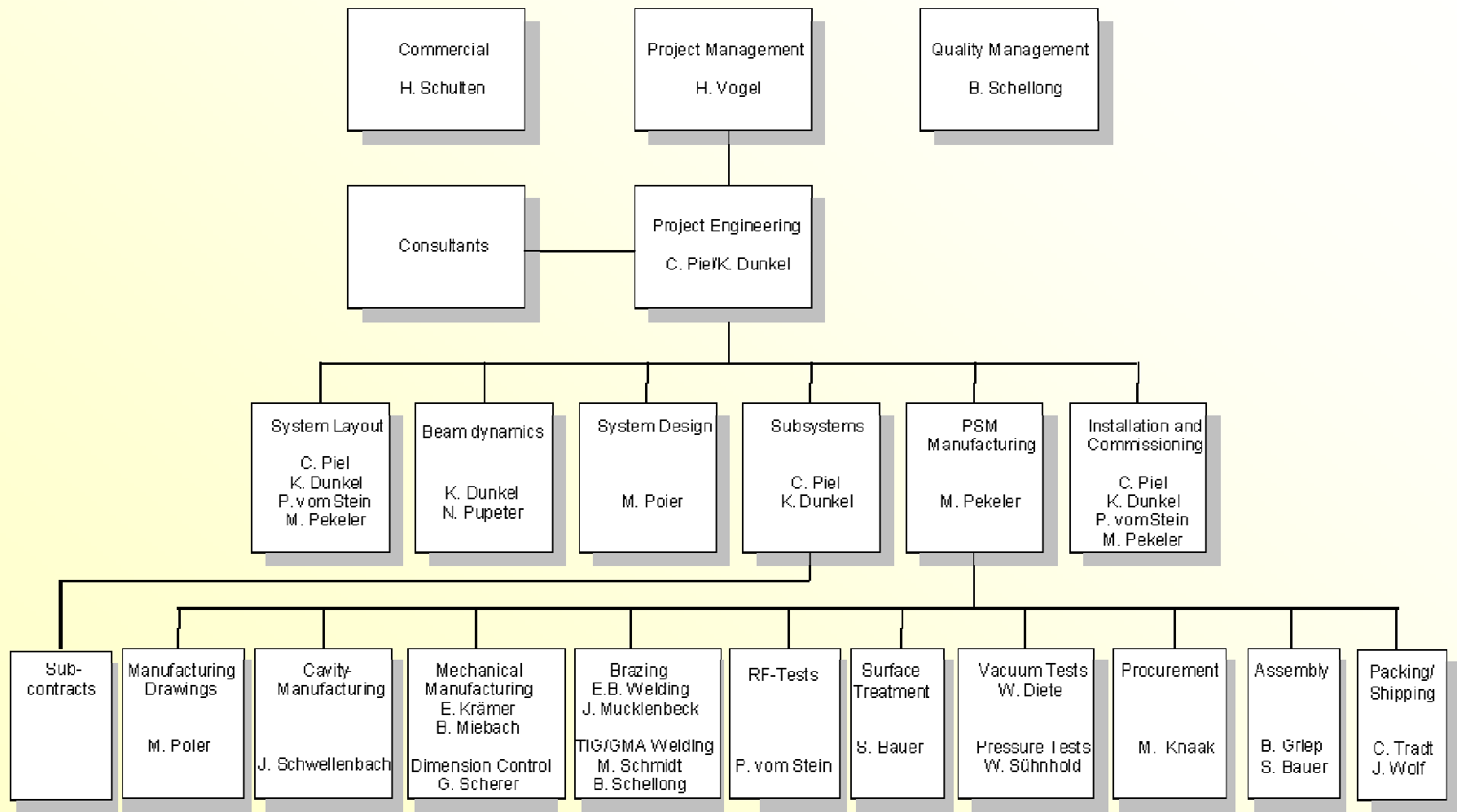
Prototype Superconducting HWR Module for SARAF



- Acceleration of protons and deuterons from 1.5 MeV/u on
- Cavity vacuum and insulation vacuum separated



ACCEL Project Team for SARAF



Conclusions and Future Prospects

ACCEL's mission is to serve as an industrial partner for the worldwide labs on

- supplying advanced technology equipment and turn-key systems, and
- co-operating on rf accelerators and its technologies.

For this ACCEL is investing substantially in specialized production capabilities and human resources.

An increasing number of young and motivated lab physicists and engineers are deciding to join ACCEL for working as accelerator specialists or project managers, thus combining their individual knowhow with the company's experience and capabilities.

Conclusions and Future Prospects (ct'd)

Baseline of our technological development is an intense co-operation with the world's leading labs in the respective fields. This allows us to evaluate and compare the different experiences of those labs for gaining best solutions on running and future projects.

It is our impression, that an increasing number of labs and people accept the role of the specialized industry and take advantage of a partnership under flexible but well defined conditions. This gives us (the industry) a basis to stabilize and continuously expand our activities.

Conclusions and Future Prospects (ct'd)

Successful partnership can only be accomplished by people on both sides with mutual respect and understanding.

Growing acceptance on a dependence on each other can create more in the future.

Thank You for your Attention