Technology Transfer to Industry at PSI's SwissFEL Project and a Joint PSI/Industry Initiative beyond

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Advanced Accelerator Technologies AG
PARK InnovAARE, CH-5234 Villigen
is a Joint PSI/Industry Business Development Initiative
• Technology Transfer (TT) is one of the 3 pillars of PSI’s mission
  – Cutting edge Research
  – Education
  – Technology Transfer

• Inducing innovation and job creation, return on tax payer‘s money for society, economics and industry also short term

• PSI undertakes TT activities in many ways
  – transfer of specialists, technologies, processes, know-how and licensing of IP
  – support of or joint research & development projects with industry
  – development of demonstration and pilot projects, shared laboratories
  – fostering entrepreneurship among its scientists for implementing and exploiting their inventions which may lead to spin-off companies

• Intensified TT efforts during the ongoing SwissFEL project, examples…

• Additional, enforced TT approach developed → 2nd part of talk
The SwissFEL Project

<table>
<thead>
<tr>
<th>Key parameters of the SwissFEL</th>
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<tbody>
<tr>
<td>Overall length (incl. experimental hall)</td>
<td>740 m</td>
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<tr>
<td>Total electric power consumption</td>
<td>3.8 MW</td>
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<tr>
<td>Electron beam energy</td>
<td>5.8 GeV</td>
</tr>
<tr>
<td>Technology of linear accelerator</td>
<td>Normal-conducting copper cavities at 6 GHz</td>
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<tr>
<td>Charge per electron pulse</td>
<td>0.2 nC</td>
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<tr>
<td>Normalized beam emittance</td>
<td>0.4 mm•mmad</td>
</tr>
<tr>
<td>Number of X-ray pulses per second</td>
<td>200 (100 at each photon beamline)</td>
</tr>
<tr>
<td>X-ray pulse duration</td>
<td>24 fs</td>
</tr>
<tr>
<td>X-ray brilliance</td>
<td>1.3\times10^{33} \text{ photons/(s\cdot\text{flux}\cdot\text{bw}\cdot\text{mm}^2\cdot\text{mmad})}</td>
</tr>
<tr>
<td>Shortest lasing wavelength</td>
<td>0.1 nm</td>
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PSI initiated cooperation with industry wherever feasible, e.g. for delicate, high precision parts and devices like accelerating structures, pulse compressors, and insertion devices.
C-Band structure production in cooperation PSI/industry

- PSI designed & developed C-Band accelerating structure, 2m long; 104 pcs for SwissFEL
- Technology/production process development at PSI’s central technical unit
- Diamond machining, robotic stacking, cleaning/heating/multiple brazing procedures, extended survey, vacuum and RF testing...

Storage and transport under N2

1. Cup washing
2. Vacuum dryer
3. Transport
4. Cooling channels pressure test (with 9 bar nitrogen)
5. Heat treatment in vacuum oven
6. Disk stacking
7. Vacuum brazing
8. Wire insertion for the bead pulling
9. Leak test for vacuum part and cooling channels
10. Structure reversed to horizontal position on a temporary girder
11. Bead pulling

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C-Band structure production in cooperation PSI/industry

- Transfer of certain steps to industry (VDL/NL, TEL-VDL CH, especially UP machining)
- Training & supervision by PSI
- Other steps in house PSI
- RF manifold by MHI/JP
- Series production launched at the end of 2014
- Industry now at ~80% delivery level
- All structures completed, tested and installed into SwissFEL by Q4/2016
Novel Undulators in Cooperation PSI/industry

- Modular support suitable for in-vacuum, APPLE II or standard applications
- Design and technology development at PSI, close collaboration with industry
- Critical: Precision machining of large pieces and assembly in temperature controlled area
- Split of tasks
  - Support structure/drive systems (Daetwyler/CH)
  - UHV comp. (VDL/Comvat/CH)
  - magnets (Hitachi JP)
  - magnet assy (Daetwyler/CH, Bruker ASC-RI/D)
- Final assembly and field optim. PSI
- Series production launched end ‘14
- Industry now at >90% delivery level
- All 13 undulators completed, tested and installed into SwissFEL by 10’16
Novel undulators in cooperation PSI/industry

Key feature: automated field optimization

< 2h for 1060 individual corrections with μm accuracy
A Challenge beyond „Standard“ TT process

- Design and integration of subsystems and systems
- beyond transfer of single technologies
- overcome time/resources/budget constraints
- integrate industrial know how

→ PSI Directorate/PSI Stakeholders:
Create new opportunities!

Search for alternate concept

→ New format, external to institute
→ Additional budget
→ Involve industry from start
New platform for
  • evaluation of PSI Know How for economic potential
  • identifying prospects, search for applications
  • more systematic business development, market studies
  • and for emerging business

Form a company
  • shareholders are companies with complementary activities/fields
  • ... and willingness to invest together into Business Development
  • i.e. to take considerable risk

Partner up with PSI
  • broad collaboration and license agreement

Phase 1 evaluation, business development, prepare business cases

Phase 2 business operation
Partners of Advanced Accelerator Technologies

<table>
<thead>
<tr>
<th>Collaboration and License Partner</th>
<th>Shareholders (Status May 2016)</th>
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</thead>
<tbody>
<tr>
<td>Paul Scherrer Institut</td>
<td>Ampagon</td>
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<td>Axilon AG</td>
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<td>Heinz Baumgartner AG</td>
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<td>VDL Enabling Technologies Group</td>
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<td>COSYLAB</td>
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Enhance economic impact of combined PSI and AAT Know How
Create value beyond individual expertises
AAT is embedded into federal initiative Swiss Innovation Funds/PARK innovAARE

Accelerator technologies

Human Health

Materials & processes

Energy

Materials & processes

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PARK innovAARE
How we work
Generic Stage Gate Process for BD

<table>
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<tr>
<th>Ideas Proposals</th>
<th>Feasibility, „Prospect“</th>
<th>Market Analysis Validation</th>
<th>Structuring LOIs, B-Plan</th>
<th>Business Operation</th>
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<tbody>
<tr>
<td>• Concretion of ideas and proposals</td>
<td>Technical concept, Feasibility Study</td>
<td>Detailed Analysis</td>
<td>• Pilot partner, customer identification</td>
<td>• Customer Contracts</td>
</tr>
<tr>
<td>• Rough outline, applications, demand</td>
<td>Schedule outline • Product Development • Manufacturing • Costs/price „Prospect“</td>
<td>• Applications • Market • Competitive solutions • Business model</td>
<td>• Realisation Plan, Cooperations</td>
<td>• Business Operation</td>
</tr>
<tr>
<td>• Budgeting/financing of subsequent investigations</td>
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<td></td>
<td>• Financing</td>
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Milestones/Gates

Final Critical review

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• Evaluation of PSI Know How/IP regarding potential for commercialisation & good fit to our aim to create value on the AAT level, i.e. beyond the individual partner‘s expertise

• **System level, integrated devices**
  → take longer development time, larger budget…

• **Specific „unique“ capabilities, instruments, applications…**
  → shorter time to market

• Few examples…
• In the course of the development and realisation of the SwissFEL many technologies, components, and systems have been developed, thoroughly tested, and brought to maturity; enormous Know How

• RF components, structures, modules, controls, timing systems, subassemblies or complete systems - based on SwissFEL technology

• Look out, identify, develop who could efficiently use this for upcoming projects, applications or products!
Diagnostics

- PSI is already now realising a wide range of diverse diagnostic components and complete systems including electronics, firmware and software.

- There is extended demand in other laboratories for PSI technologies.

→ Investigation in broader, systematic commercialisation.
EUV-Lithography (13.5 nm) is eventually being broadly introduced in Semi-HVM. PSI is developing unique metrology methods in this regime at the SLS. We are designing a specialised compact synchrotron as stand alone EUV-source.
AAT is a PSI/industry initiative, investing into enhanced transfer of PSI's large know how in accelerator technologies and applications.

AAT undertakes business development through evaluating and combining Know How, investigating demand and establishing cooperations.

If we can identify business cases, get the right team together, and secure financing, we go into operations.

Hence AAT is a new approach – beyond the classical tools - to enhance TT from science into economics, based on private investment and intense collaboration with PSI and the whole scientific community.

YES, WE ARE OPEN!
... for more ideas, discussion, cooperation, applications
Thank You