Helsinki contribution 2012–16 to CLIC / X-band Technology area

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Department of Physics, Department of Physics,
University of Helsinki & Helsinki Institute of Physics

Contributions to

- **RF–R&D WP: Basic High Gradient R&D**
- **RF–XPROD WP: X-band RF structure Production**

NB! contributions mainly manpower

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Multiscale modeling of break-down in CLIC RF structures

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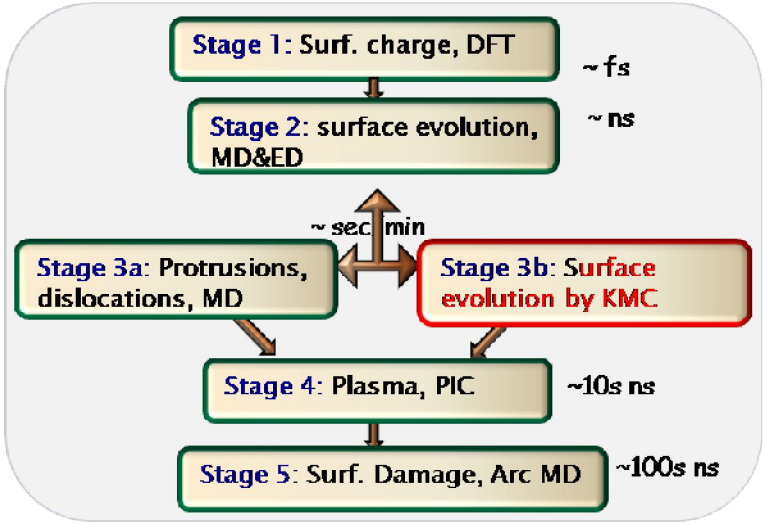
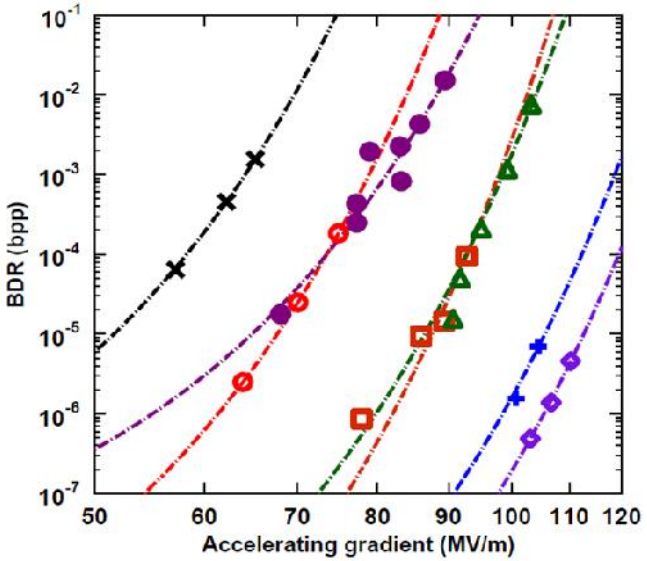
Basic high-gradient R&D / task2: theoretical & experimental studies





Currently pursuing parallel activities in all steps of the *multiscale* model:

- simulating plastic deformations of metal surfaces due to tensile stresses leading to tips on the surface
- combining electro-dynamic effects and atomistic simulations to predict behavior of surface atoms;
- simulation of created plasma and subsequent surface damage.

i.e. physics motivated scaling law for breakdown rate (BDR) vs E-field: Assumption: field emitters are formed via punching of dislocation loops. Result: fit to experiment (left) as BDR(E) ~ concentration of dislocations $=A\ exp(\varepsilon_0 E^2 \Delta V/kT))$ reveals a realistic size of loops (10's of nm).

NorduCLIC collaboration NorduCLIC

Multiscale modeling of breakdown in CLIC RF structures: resources

Seniors:
- *F. Djurabekova 70 %*
- *prof. K. Nordlund*

PhD students:
- *A. Pohjonen (-31.3.2013)*
- *S. Parviainen (-31.12.2013)*
- *A. Ruzibaev (-31.12.2013)*
- *L. Bukonte (1.1.2012 – 31.12.2014) (replacing H.Timko)*

In Helsinki:
0,7 senior + 2–3 PhD students

At CERN:
1 PhD student

large computing resources

Funding 2012–13 OK
Funding 2014–16 open

Currently funding from HIP, Department of Physics (UH), EU (EuCARD), Academy of Finland, ...

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Development of dynamic vacuum measurement method

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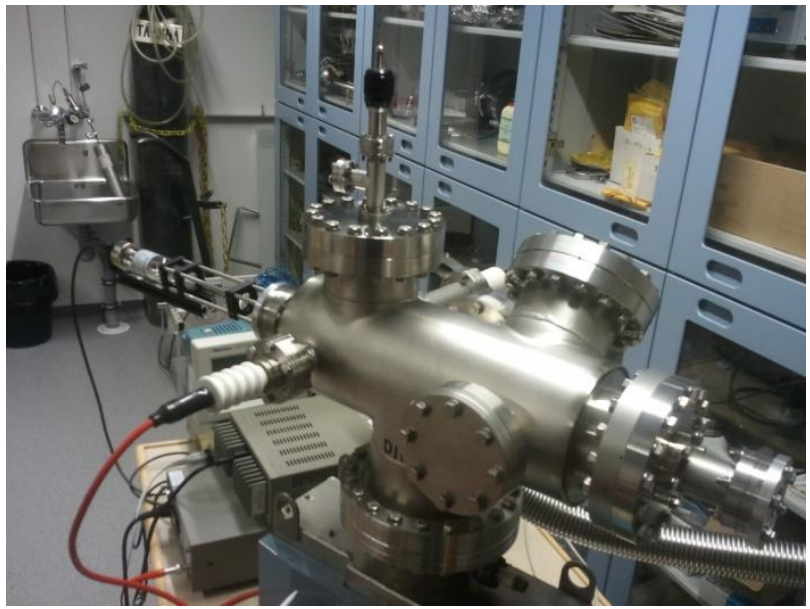
Basic high-gradient R&D / task2: theoretical & experimental studies



Development of method & device for direct measurement of vacuum inside accelerating structures during the 200 ns RF pulse. This to verify estimated change of vacuum due to dark currents from simulations – *NorduCLIC* **collaboration**

Senior support
- *P. Tikkanen (vacuum)*
- *H. Räikkönen (laser)*
- *I. Kassamakov (laser)*
- *prof. E.Haeggström*

PhD student:
- *A. Meriläinen (-31.3.2013)*

In Helsinki:

1 PhD student + vacuum & laser support (0,1 senior)

~50–60 kCHF available for hardware 2011–13 (Academy of Finland)

Funding 2012–13 OK
Funding 2014–16 open

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RF structure production

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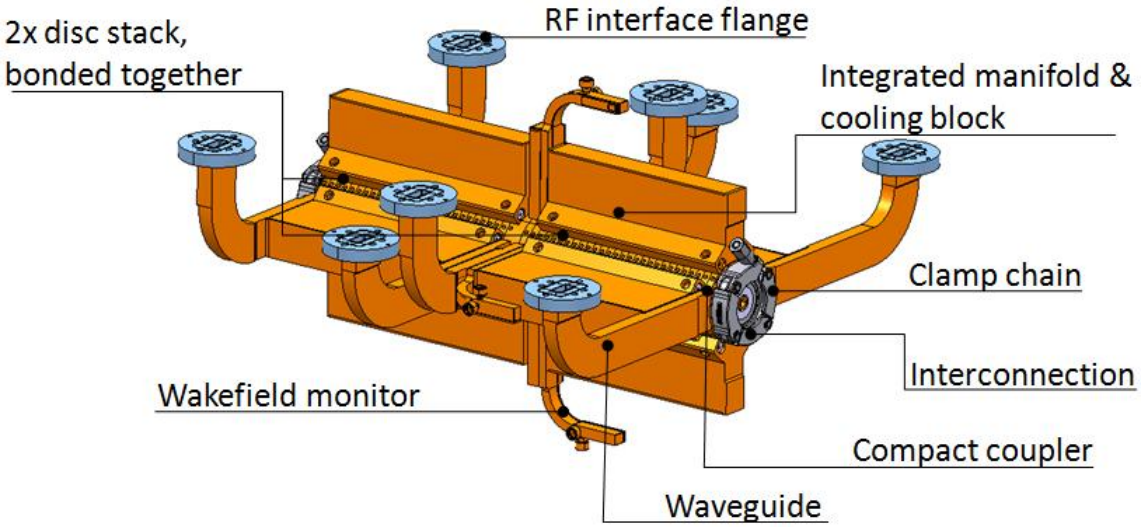
X-band RF structure / task 1: Construction of baseline AS and task 6: Baseline to pre-series development (industrialisation)

(also touching Task 5: Alternative fabrication methods)

Subjects: Brazing of RF structures, machining of tooling for RF structure assembly, alternative fabrication methods e.g. HIPing, industrialisation, FEA studies of assembly process, ultra-precise machining tests & metrology



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CLIC RF structure production: resources

Senior

- K. Österberg 20 %

- J. Väinölä 50 %

Engineers:

- post-doc to be recruited

- J. Nurminen (1.2.-31.7.2012)

- F. Smeds (1.1-31.12.2013)

- M. Rissanen (1.7.2013-31.6.2014)

- N. N. from Tarkmet Oy

+ F. Rossi (1.4.2011-31.3.2013)

In Helsinki: 0,2 senior

At CERN:

0,5 senior + 0,5 post-doc (2 years)

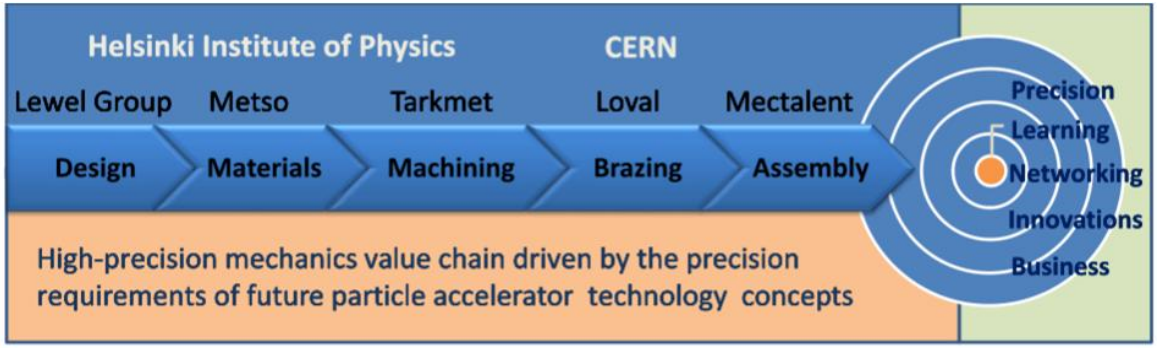
2 engineers/year (6–12 months) from Finnish industry upto 6/2014

15 kCHF/year to cover some production in Finnish industry

Funding 2012–13 OK

Funding 2014–16 open

FP7/IAPP project MeChanICs: industry–CERN person exchange



In addition funding from HIP, Department of Physics (UH)...