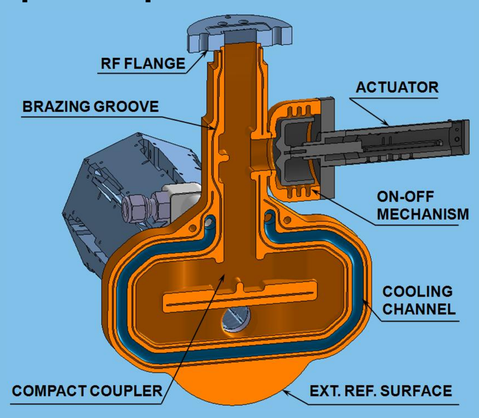
# INTEGRATION OF RF STRUCTURES IN THE TWO-BEAM MODULE DESIGN

G. Riddone, CERN, Geneva, Switzerland
A. Samoshkin, D. Gudkov, JINR, Dubna, Russia

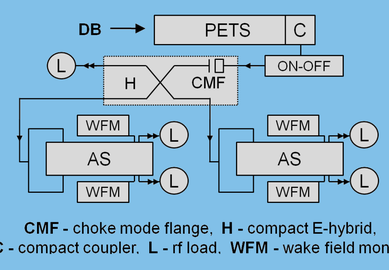
**Abstract**
The CLIC (Compact LInear Collider) design is based on two-beam acceleration concept currently developed at CERN. The RF power is generated by a high current electron-beam called Drive Beam (DB), running parallel to the Main Beam (MB). The DB is decelerated in dedicated power extraction structures (PETS) and the generated RF power is transferred via waveguides to the accelerating structures (AS). To facilitate the matching of the beams, components are assembled in 2-m long modules of few different types. Special modules are needed in damping regions or to contain dedicated instrumentation and vacuum equipment. The module design and integration has to cope with challenging requirements from the different technical systems. This paper reports the status of the engineering design and related technical issues.

## Compact Coupler with On-Off mechanism



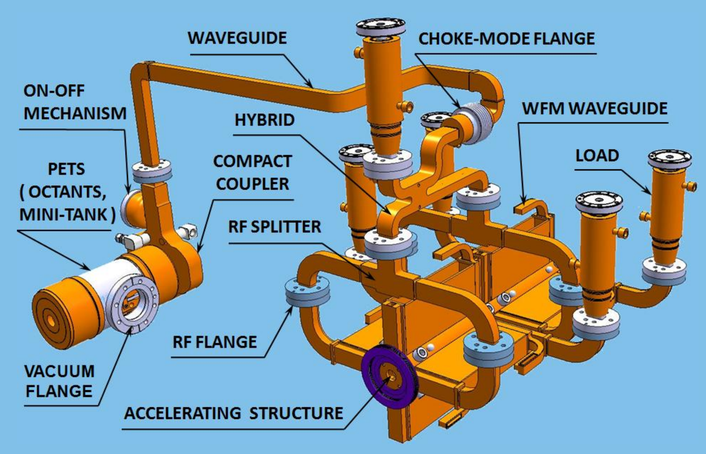

The compact couplers, collecting and guiding the RF power from PETS and transferring it to the AS, were designed to combine a few functions. The "On-Off" mechanism stands for momentary (< 20 ms) cut of the power produced by PETS.

## RF System

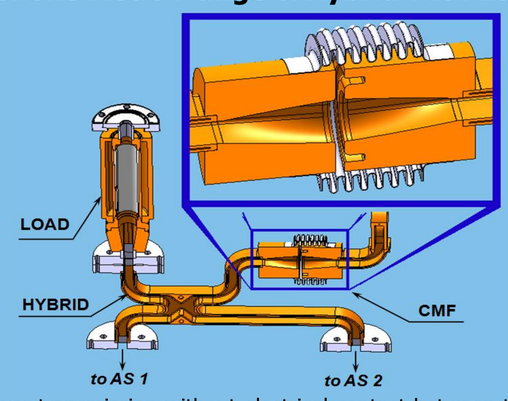



**CMF** - choke mode flange, **H** - compact E-hybrid,
**C** - compact coupler, **L** - rf load, **WFM** - wake field monitor

The CLIC two-beam RF network includes the standard X-band rectangular waveguides WR-90 connecting PETS, AS and other supplementary devices such as choke-mode flange (CMF), Hybrid, high power load, splitter and WFM.

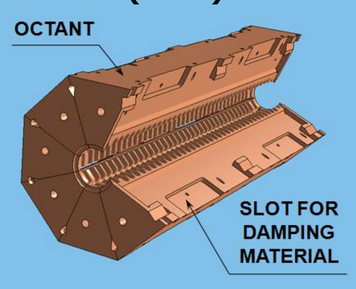



## Choke Mode Flange & Hybrid with Load

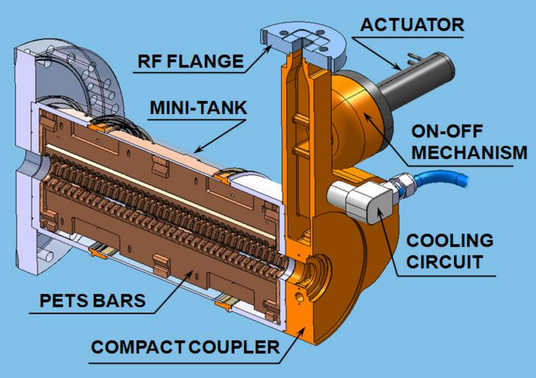



The power transmission without electrical contact between two beams, and MB and DB independent alignment is getting possible with CMF. The Hybrid provides the power to two adjacent AS. The RF load is attached to one of the hybrid ports to avoid the RF reflection to the corresponding PETS. The RF splitters are used to equally feed the AS.

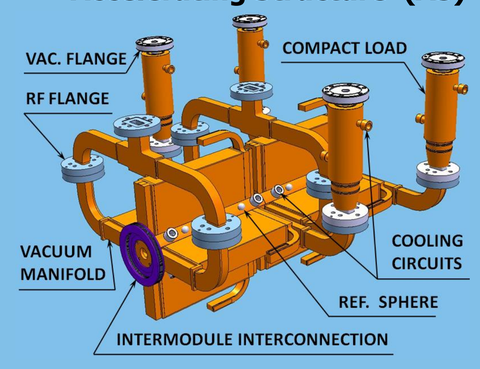
## Power Extraction and Transfer Structure (PETS)



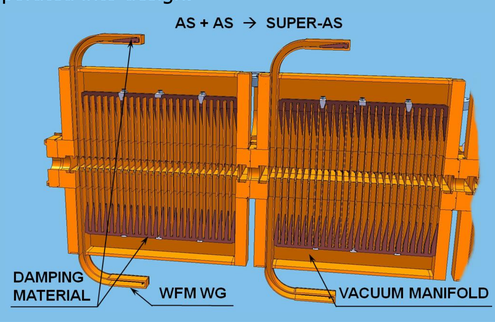

The PETS are composed of eight bars milled with 0.015 mm shape accuracy. The octants assembly, mini-tank, "On-Off" mechanism [3] combined with compact coupler, vacuum system, cooling circuits and interconnection are the subject for integration study.



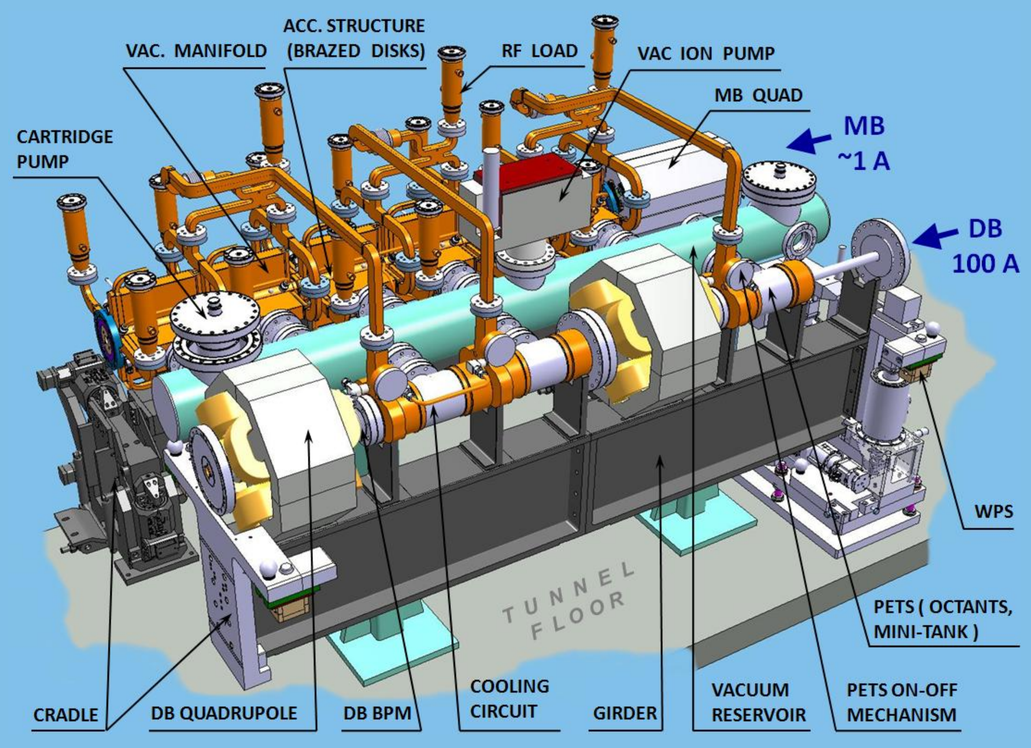

## Accelerating Structure (AS)




The AS design [4] is based on experience of an international collaboration. The AS with damping features is made of disks Ø80 mm joined by diffusion bonding at 1040 C. The shape accuracy is relatively high (0.005 mm). Many features of different systems, such as vacuum, cooling, wake field monitor as well as damping waveguide absorbers are incorporated into design.

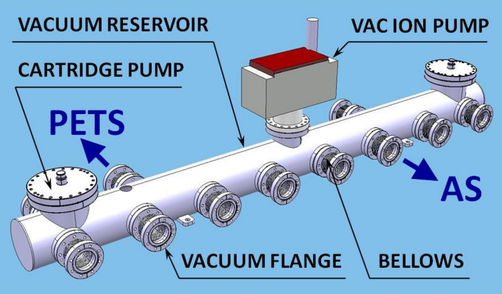



## CLIC Module (Type 1) integration layout

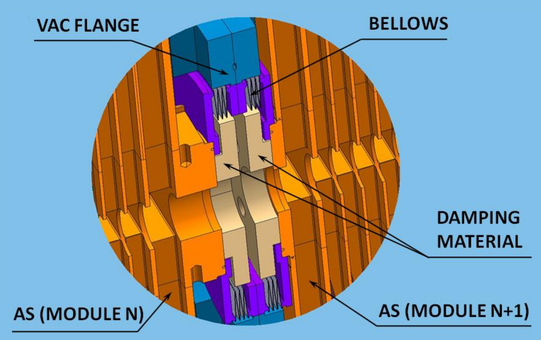



The design of a typical CLIC Module Type 1 incorporates all main components, including the MB Quad, replacing two AS, and technical systems, such as supporting, stabilisation, vacuum, alignment and BPM.

## Vacuum

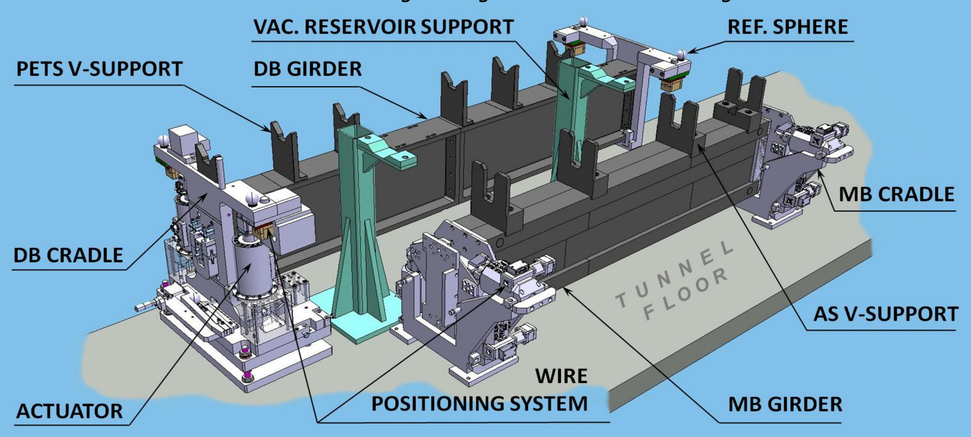



A low pressure level ($10^{-9}$ mbar), needed for keeping the good beam quality and a number of components in a very limited space (i.e. with very low vacuum conductance) makes the design of the vacuum system very challenging. The interconnections between main components should sustain the vacuum forces, provide an adequate electrical continuity with low impedance and remain flexible not to restrict the alignment.



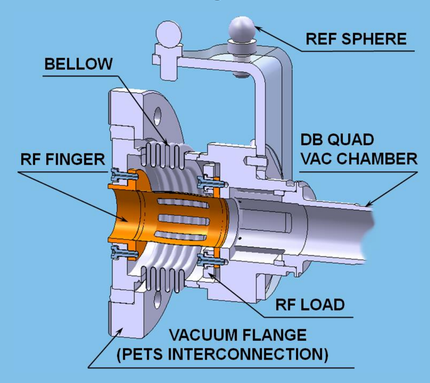

## Supporting and alignment systems

The main components of both beams are supported on rectangular shaped girders linked to one chain all along the linac. The MB focusing magnet is an exception due to stringent position requirements. It has its own support and stabilization unit, which will be integrated in a later phase.
The sensors of Wire Positioning System (WPS) are reading the transversal and vertical distances to one of the wires stretched between two beams for forming a straight reference line all along the linac..

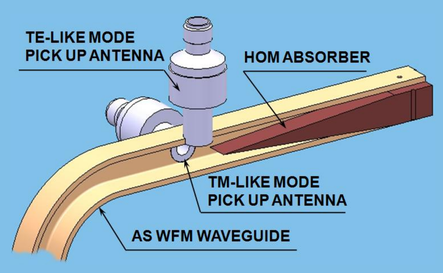



## Instrumentation

**Beam position monitor (BPM)**
The DB BPM is developed and mechanical design is done.
The MB BPM is still under design




**Wake field monitor (WFM)**
Mechanical design under way in collaboration with CEA-Saclay. AS with WFM → in 2010




## CONCLUSION

More than 10,000 modules, housing micro-precision components with stringent requirements, are needed in the CLIC main linac. The module design and integration also aims at maximising the filling factor by optimization of the layout and better functioning of the related technical systems. Possible configurations are being implemented and compared in order to identify critical zones requiring a particular attention for further simulations and design. The manufacturing methods and their influence on the product cost are also addressed in the design phase. The CLIC Conceptual Design Report will be issued by mid of 2011. Therefore the baseline module configuration has been defined. For this, the thermo-mechanical behaviour has been simulated [5], and the necessary changes were introduced into the module design.

## ACKNOWLEDGMENT

Authors sincerely thank all members of the "CLIC Module Working Group" for their valuable contribution.

## REFERENCES

[1] H. Braun et al., "CLIC 2008 Parameters", CERN-OPEN-2008-021; CLIC-Note-764.
[2] G. Riddone et al.: "Technical Specification for the CLIC Two-Beam Module", MOPP028, EPAC'08, Genoa, Italy, 23-27 June 2008.
[3] I. Syratchev, A. Cappelletti, "A new High-Power RF device to vary the output power of CLIC Power Extraction and Transfer Structure (PETS)", WEPE026, IPAC'10, Kyoto, Japan, May 2010.
[4] A. Grudiev, W. Wuensch, "Design of the CLIC Main Linac Accelerating Structure for CLIC Conceptual Design Report", LINAC'10, Tsukuba, Japan.
[5] R. Nousiainen et al: "Studies on the Thermo-Mechanical behaviour of the CLIC Two-Beam Module", LINAC'10, Tsukuba, Japan.