TIARA PP

TIARA Kick-Off Meeting
23-24th February 2011 - CERN

TIARA-PP WP 9 : TIHPAC

Test Infrastructure for High Power Accelerator Components

Test Infrastructure for High Power Accelerators Components
TIHPAC

Sébastien Bousson
On behalf of the WP9 participants

Outlook

- A brief history of WP9
- The two main objectives
  - Infrastructure for testing Multi MegaWatt target station
  - Infrastructures for testing low beta superconducting cavities
- Description and organisation of Work
- Participants & Ressources
- Conclusion

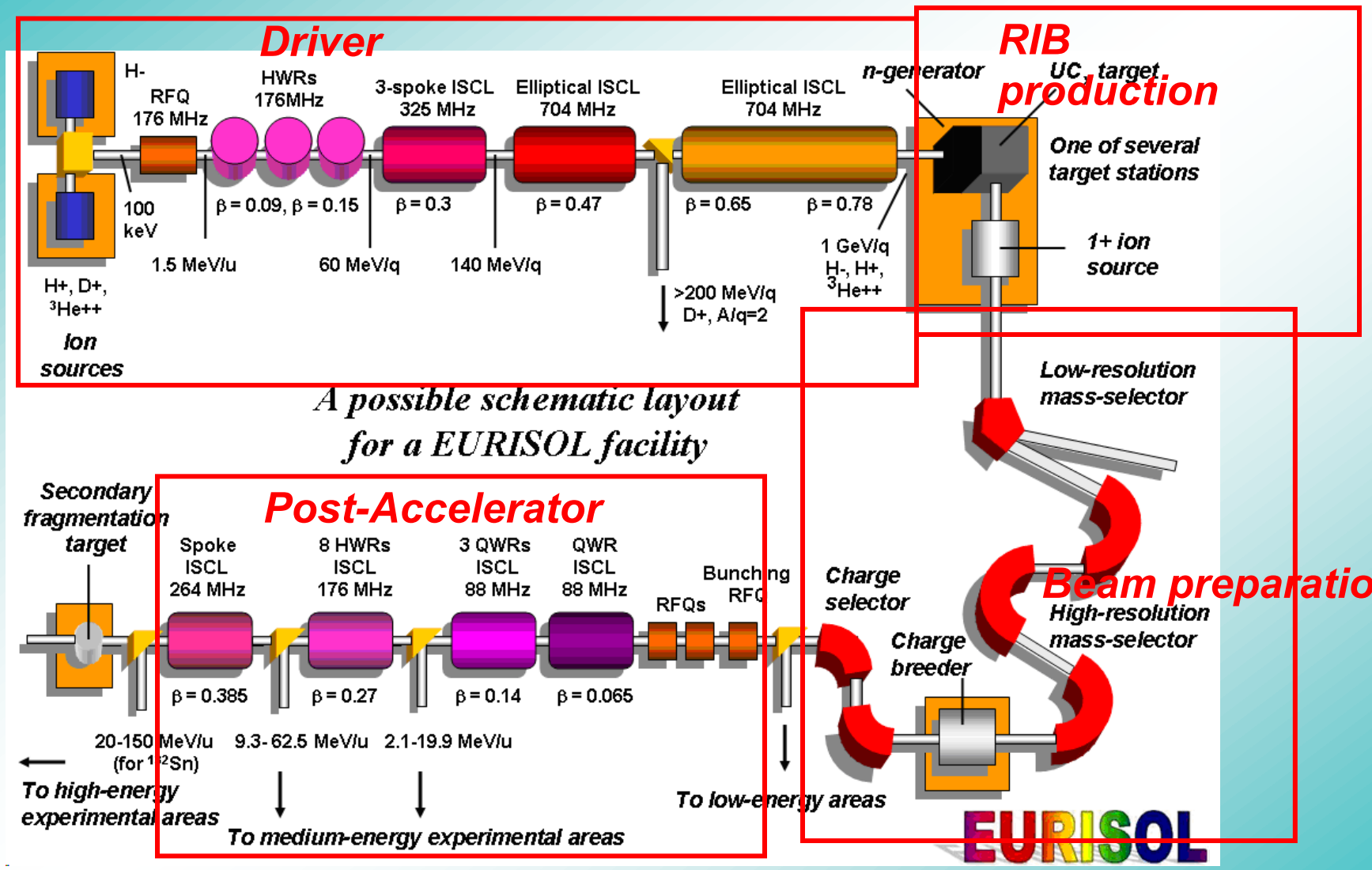
WP9 : A brief history

WP9 is coming from the following consideration:

What would be the necessary test infrastructures for developing the key elements of the EURISOL project ?

EURISOL is the next generation of a facility aiming at the production of radioactive ion beams (RIB) using the ISOL technique.

The Eurisol Facility Layout



WP9 : A brief history

WP9 is coming from the following consideration:

What would be the necessary test infrastructures for developing the key elements of the EURISOL project ?

EURISOL is the next generation of a facility aiming at the production of radioactive ion beams (RIB) using the ISOL technique.

A Design Study within FP6 has just finished, and among all the technical challenges raised by this project, 2 key components have been identified which will require an important R&D program and an intense experimental program to fulfill the Eurisol requirements:

- ***The multi-MW target complex***
- ***The low beta superconducting (SC) cavities (for driver and post-accelerator)***

WP9 : The main objectives

Full scale test of the MMW target available only in the final facility !

Achieving the design of the full scale target (ex. 4 MW for Eurisol) will require several partial tests: sub-components, irradiation at lower power, instrumentation tests…

N°	Research Items	Application
1	Test coaxial guided stream (CGS) Window cooling with laser heating	Performance
2	Test windowless transverse film (WTF) stability with high speed camera	Performance
3	Sub-scale Target irradiation	Performance
4	Ultra-sound sensors	Instrumentation
5	Pressure sensor capillaries	Instrumentation
6	Heat Transfer Coefficient (HTC) method improvements with laser	Instrumentation
7	Primary/Secondary fluid interaction study	Safety
8	Investigation of the pressure wave from a pulse	Science
9	Investigation of on-line isotopic separation	Science
10	Fatigue under Liquid Metal (LM) corrosion and irradiation study	Science
11	Influence of wall conditions on LM Heat transfer	Science
12	Long-duration test facility	Engineering
13	Dedicated LM Component development	Engineering

All these research items will require experimental studies.

The main idea:

Develop a versatile target concept to be tested with beams at all possible locations, meaning over a wide range of beam power (several kW to MW).

The target itself should be adaptable, but keeping all services (heat exchanger, loop…) externalized (i.e. common for all target geometries).

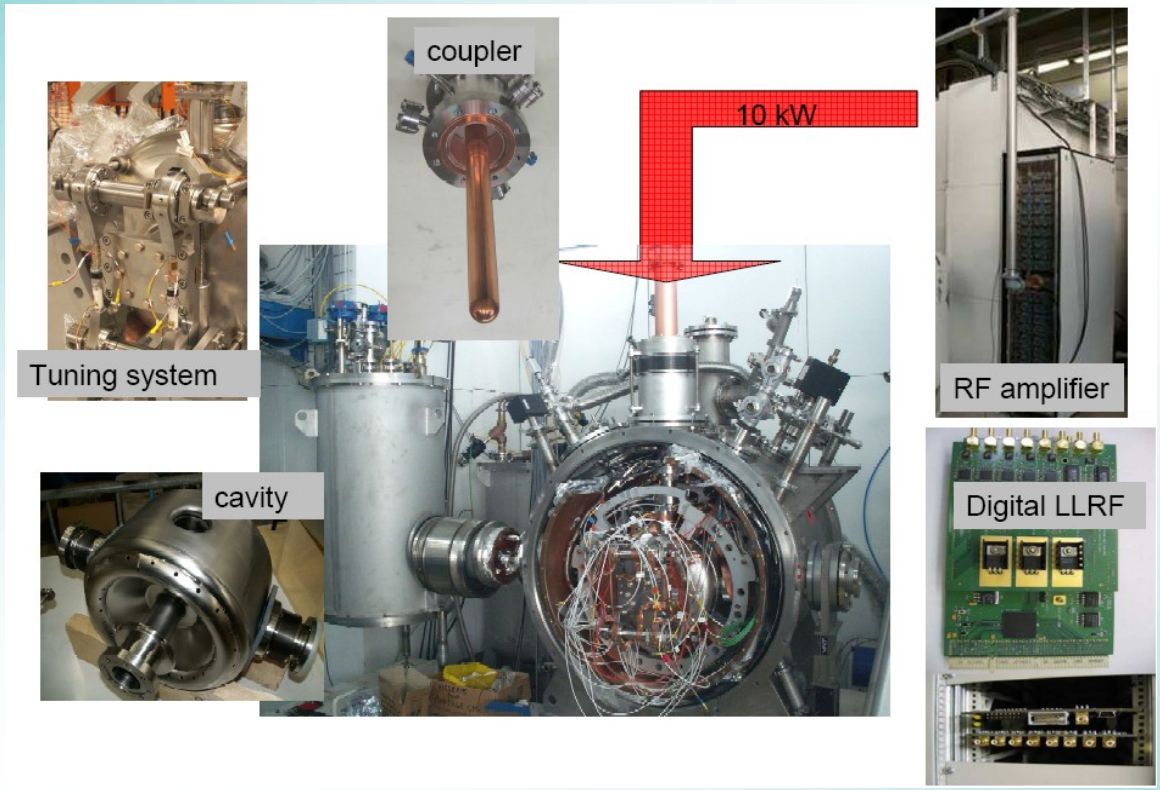
Adapted for studies for:

- ESS (pulsed)
- EURISOL (CW)
- MYRRHA (CW)
- IFMIF (CW)

WP9 : The main objectives

Before assessing that a SC cavity is validated for an operational use in an accelerator, the final experiment is a cryogenic test at nominal RF power of the fully equipped cavity (power couplers, cold tuning systems…)

Very few "accelerator configuration" test cryostat are existing in Europe and they are only designed for elliptical cavity testing.



Such a cryostat, specific and devoted to low beta SC cavities will be a useful complementary equipment.

WP9 : The main objectives

The objective of this WP is to coordinate the definition and the engeenering design of two test benches:

- an irradiation test facility for the high power target developments
- a cryogenic test cryostat for testing fully equipped low beta superconducting cavities.

➡ These two infrastructures are relevant and important for many European projects, in particular ESS, MYRRHA, HIE-ISOLDE, EURISOL, IFMIF…

WP 9 : Deliverables and Milestones

Milestones				
Num	Nat[40]	Short name	Description	Month
M9.1	R	DSIF	Report on the Definition and Specifications of the Irradiation test Facilities	**12**
M9.2	R	PDIF	Preliminary Design report of the high power Irradiation test Facility	**16**
M9.3	R	URCS	Report on the User Requirements and setting up of the test Cryostat Specifications	**13**
M9.4	R	PDCC	Report on the Preliminary Design study of the low beta SC Cavity test Cryostat	**18**

Deliverables					
Num	Nat[1]	Short name	Description	month	P*M
D9.1	R	TDIF	Technical Design Report of the Multi-MW test Irradiation Facility	**36**	19
D9.2	R	TDCC	Technical Design Report on the SC Cavity test Cryostat	**36**	30

WP 9 : Ressources and key persons

WP9	TIHPAC			
Participant	CERN	CNRS	UU	**TOTAL**
Human Resources (p*m)	**16**	**27**	**6**	**49**
Personnel Direct Costs	150,4	135	38,64	324,0
Direct travel cost	**7,5**	**9,4**	**5**	**21,9**
Total direct cost	157,9	144,4	43,64	345,94
Total indirect cost	94,74	86,64	26,184	207,6
Total cost (k€)	**252,6**	**231,0**	**69,8**	**553,5**

➢ **The key persons:**

- **CERN : Yacine Kadi**
- **University of Uppsala (-> ESS) : Håkan Danared, Mats Lindroos**
- **CNRS (IPNO) : Sébastien Bousson**

WP 9 : Start of Work

For both sub-task, work is starting by defining exactly what these two test infrastructures will be:

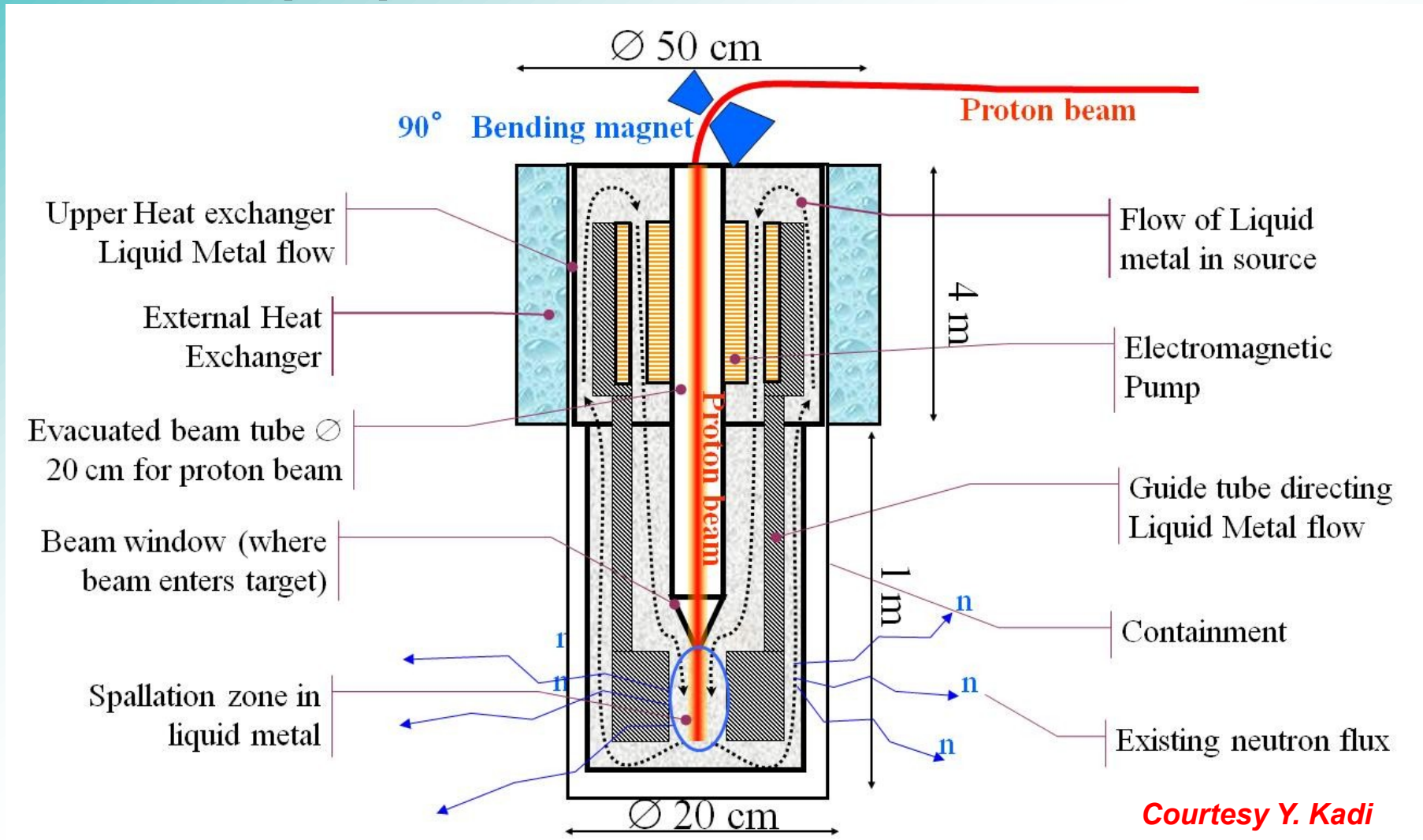
* Definition and Specification of the Irradiation test Facility

Identification of the User Requirements

* Definition and Specification of the low beta SC Test Cryostat

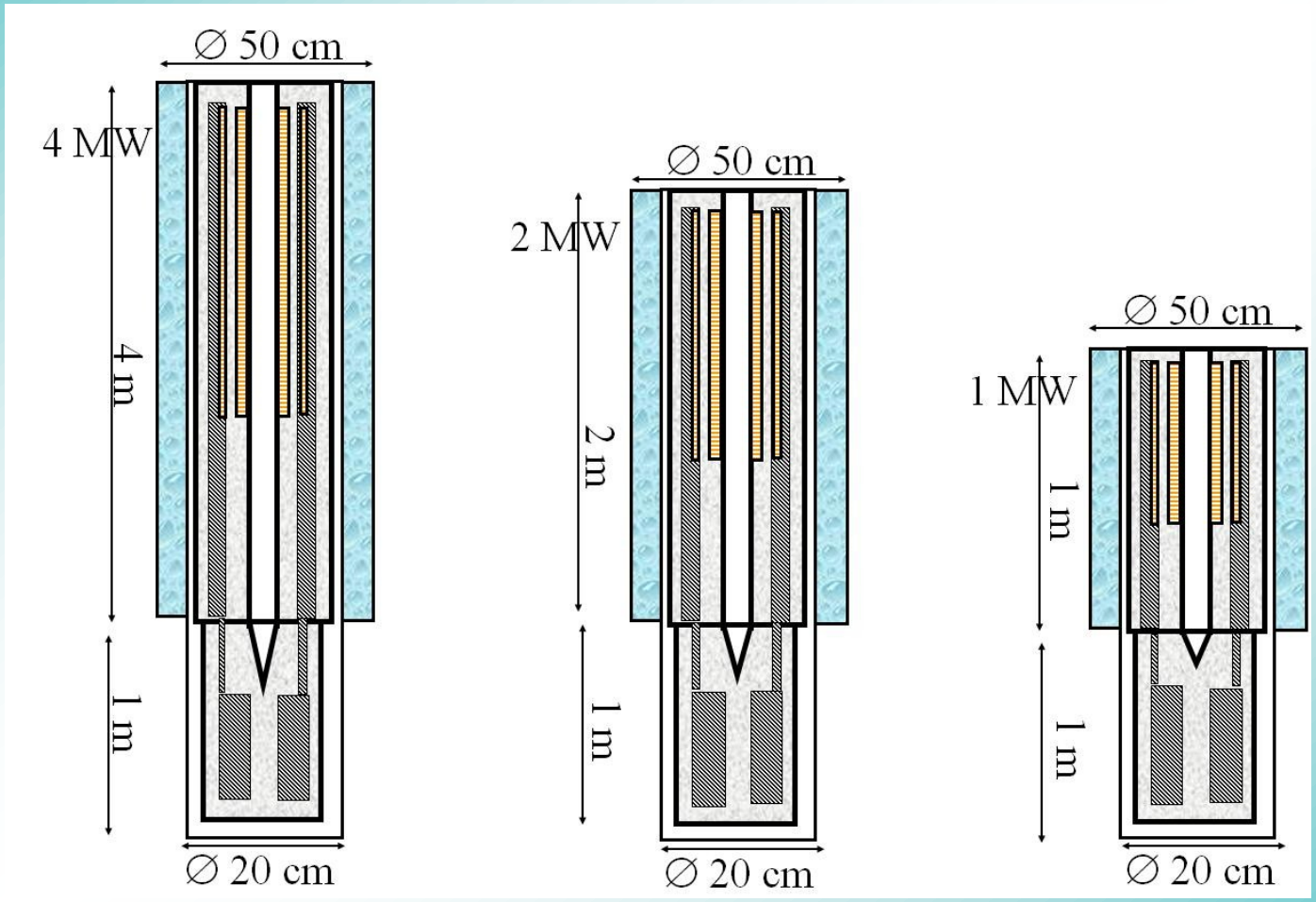
Identification of the User Requirements

The CORE proposal:



Courtesy Y. Kadi

Modularity: adaptable to several beam energies



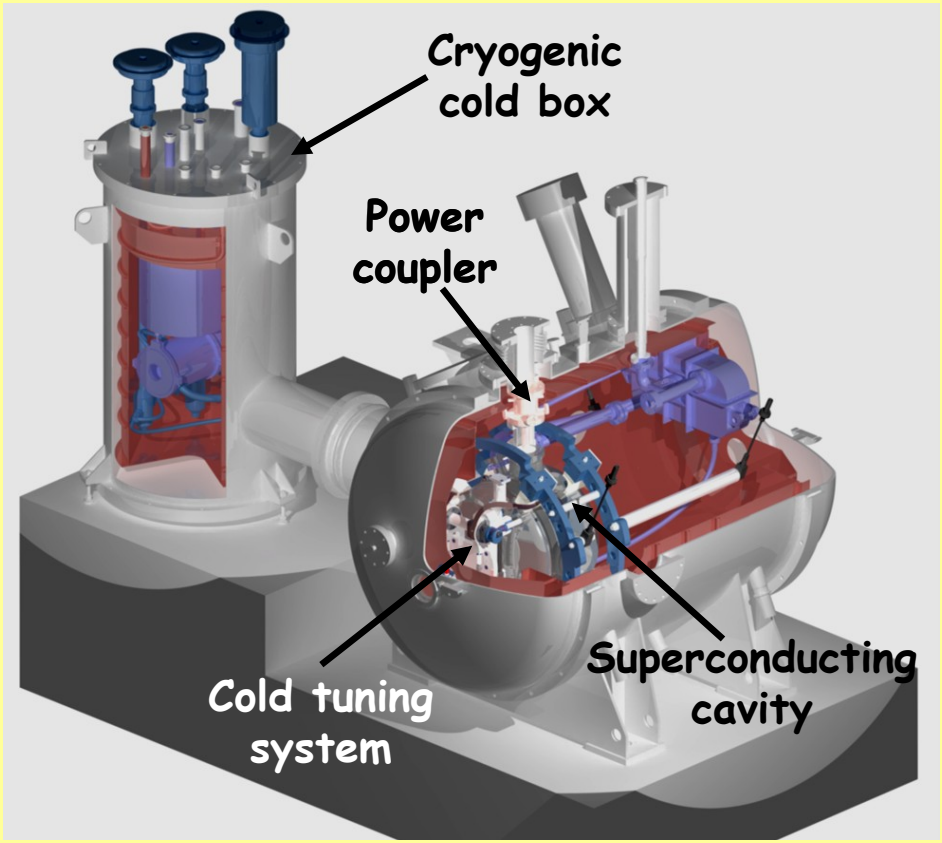
Courtesy Y. Kadi

WP 9.1 : Versatile MMW target development

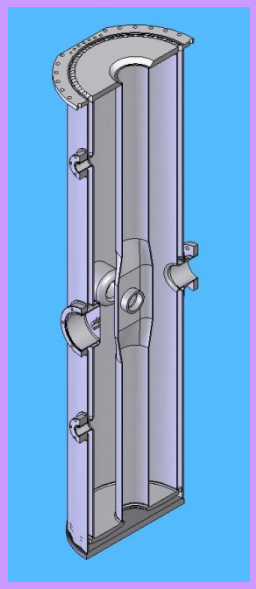
- **Builds on existing experimental basis**:
  - Neutron performance and structural materials validated in Megapie
  - Advanced hydraulics for high power validated in Eurisol
- **Combines the two experiences for :**
  - Higher performance at up to 10 MW
  - Superior safety: beam does not penetrate containment
  - Modular design wide range of power: 10 kW – 10 MW

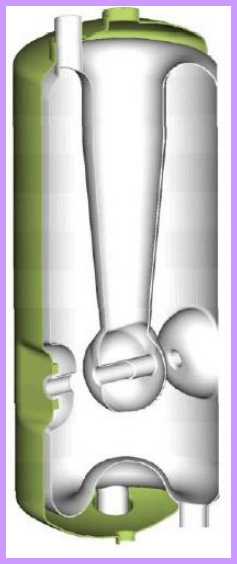
Key goals :	Output:
- Demonstrate capability 10 kW - 10 MW	(analysis)
- Demonstrate neutronic performance	(analysis)
- Design test under irradiation	(drawings)

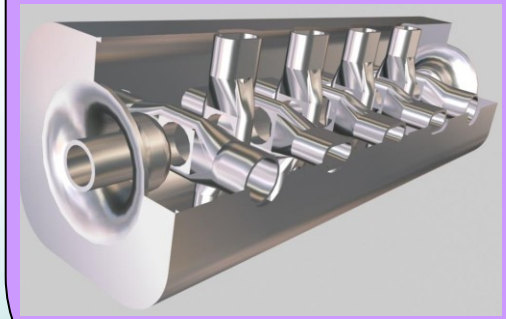
The Test Module

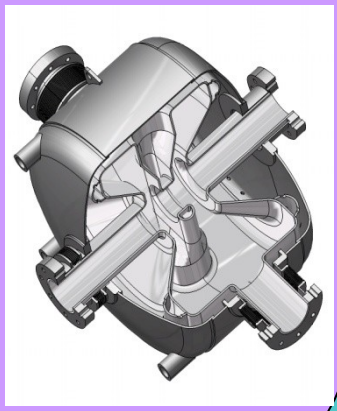


The Cavities









WP 9.2 : Designing a low beta cavity test cryostat

- **Specifications**
  - Adapted for various geometries; QWR, HWR, Spoke (single gap, multigap)…
  - Various configuration of power couplers and cold tuning systems
  - Could integrate a SC solenoid to test influence on the cavity performances
  - Operation at 4K and 2K

- **Interested projects**
  - ESS
  - MYRRHA
  - HIE ISOLDE
  - IFMIF
  - …