



SAPIENZA  
UNIVERSITÀ DI ROMA



# **UHV chamber for tritium loading**

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**Ptolemy meeting Jun 2023**

# Goals

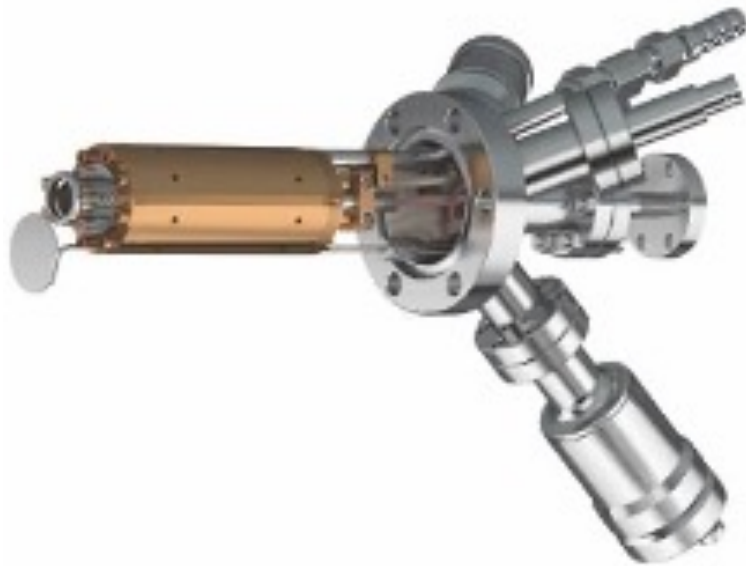
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- ▶ Have a **< 1 GBq solid atomic tritium** target
- ▶ Use carbon nanostructure as support
  - ▶ Well defined **position** in the apparatus, well defined **potential**
- ▶ Demonstrate the solid target is **stable** (i.e. no tritium release in air) at **room temperature**
  - ▶ To be certified according to radio-protection standards
- ▶ Measure **activity**
- ▶ First **beta spectrum** measurement
  - ▶ With solid state sensors,...

# Hydrogenation principle

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- ▶ Based on the work of C.Mariani et al. on NPG hydrogenation
  - ▶ Use **thermal cracking** (2400 K) of hydrogen molecule
    - ▶ Atomic thermal hydrogen flowing onto the sample



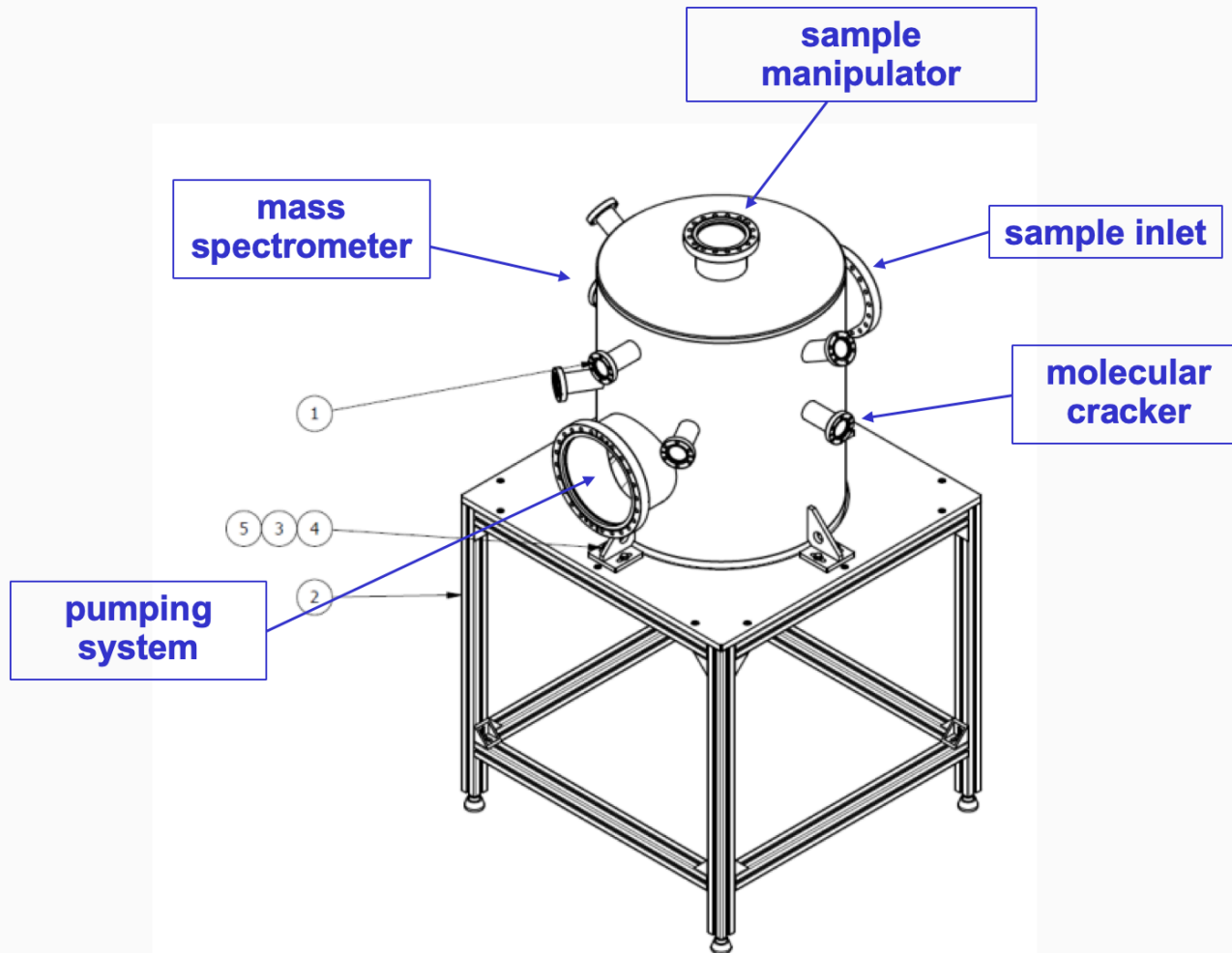
Using **commercial components**  
(validated in other experiments  
and more recently at RomaTre)

**Funded** by Princeton University

To be **commissioned** in Roma

Then shipped to US (Princeton and then  
SRNL)

# UHV chamber



*Other parts being procured separately*

**Custom chamber**

**Designed** in collaboration to with SAER\_RIAL (Parma, IT)

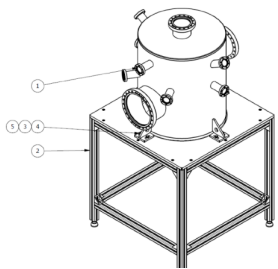
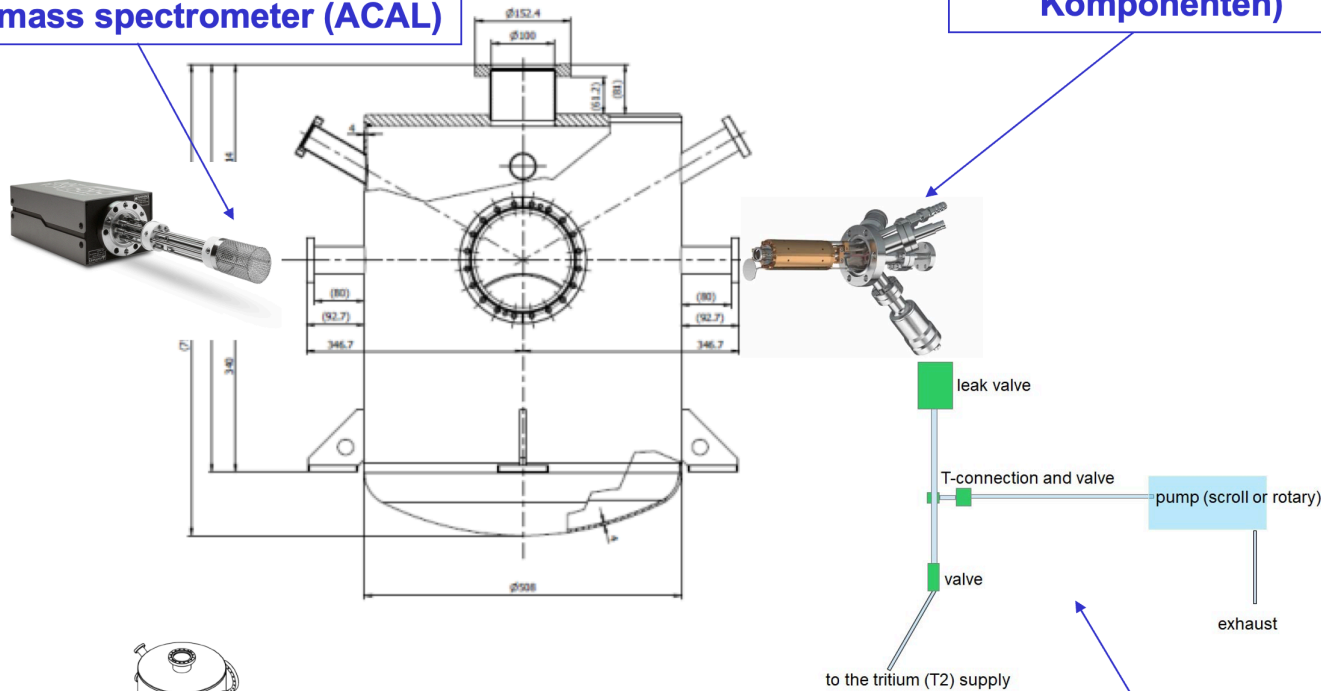
Currently in **production** by SAES\_RIAL

To be **shipped** to Roma in Sep

# Components of the chamber

0-100 a.m.u. quadrupole mass spectrometer (ACAL)

thermal (up to 2400 K) molecular cracker (MBE Komponenten)



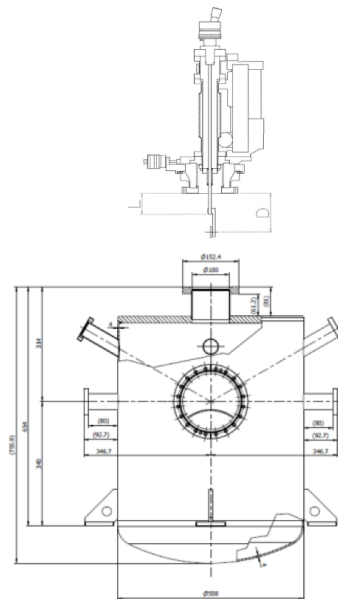
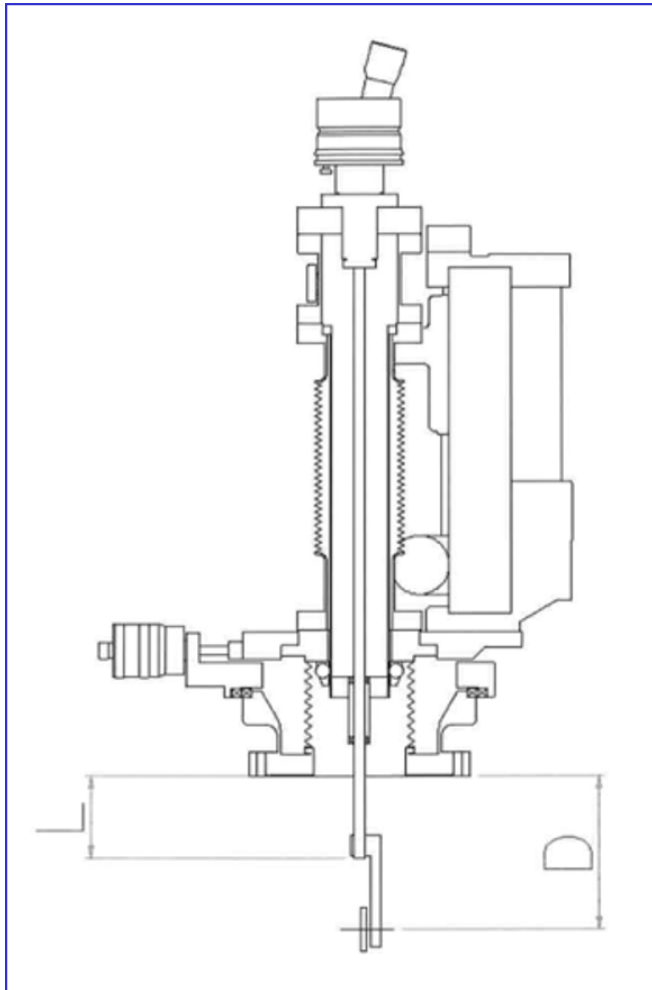
- ▶ All in procurement phase
- ▶ Pump system at LNGS



gas-line (in preparation)

- ▶ Pump-to-chamber interface being prepared

# Manipulator for the samples



## ▶ VG HPT

- ▶ X - Y range  $\pm 1.25$  cm
- ▶ Z range  $\pm 5.0$  cm
- ▶ Heating system with e-bombardment (1300 K for sample annealing)
- ▶ Standard sample holder

- ▶ Long procurement time (6 months)
- ▶ Currently a **static holder** has been designed and being build in Roma INFN (with a heating system)

# Schedule

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- ▶ We have a brand new lab equipped for flammable gases, available for testing the chamber (Sep 2023)
- ▶ Without waiting the manipulator, we will do a commissioning using NPG substrates
  - ▶ Some standard test (XPS) in our lab's in Roma
- ▶ Ship everything by end of 2023 to Princeton.

# ENEA INMRI collaboration

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- ▶ Recent visit, very enthusiastic to collaborate
  - ▶ Sapienza-ENEA **framework agreement** already in place, easy to approve a specific memorandum
- ▶ Next year (mid 2024) they can
  - ▶ measure the **activity**
    - ▶ Very standard techniques, important for us to understand the **actual deposited mass of tritium**
  - ▶ demonstrate the tritiated graphene is not releasing tritium
- ▶ Very interested in the use of **TES** for **metrology** of beta spectra



# Conclusion

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- ▶ A general goal for the collaboration is to have a **tritium sample** at our disposal
  - ▶ This would lead us to do **measurement of the beta spectrum** in different forms
- ▶ Goal is to have a sample that can be easily handled
- ▶ Project of having a UHV chamber is **progressing**
  - ▶ Slow, due to difficulties in parts procurement
- ▶ We will start with **NPG as a first substrate** but we will also do planar graphene and CNT

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<b><i>Chamber</i></b>	<b><i>In production</i></b>	<b><i>Sep 2023</i></b>
<b><i>Manipulator</i></b>	<b><i>Ordered ?</i></b>	<b><i>3 months since</i></b>
<b><i>H-cracker</i></b>	<b><i>Ordered ?</i></b>	<b><i>3 months since</i></b>
<b><i>Mass spectrometer</i></b>	<b><i>To be ordered</i></b>	
<b><i>Chiller</i></b>	<b><i>To be ordered</i></b>	
<b><i>Gas lines</i></b>	<b><i>Shipped to Italy</i></b>	
<b><i>Pumping system</i></b>	<b><i>To be shipped to Roma</i></b>	
<b><i>Static holding support</i></b>	<b><i>July 2023</i></b>	