



ISTITUTO NAZIONALE DI FISICA NUCLEARE
SEZIONE DI MILANO
LABORATORIO ACCELERATORI E SUPERCONDUTTIVITA' APPLICATA



DISCO_RAP (NTA)

DIpoli SuperCONDuttori RAPidamente Pulsati

dipole magnet test at LASA



the goals of the test at LASA



*To verify the **magnet's basic functionality**,
prior to its full characterization to be performed at
Darmstadt.*

*Minimum goal is therefore to **reach the magnet nominal field in static conditions** and to test the quench behaviour;
it is also desirable to test the operation in pulsed conditions,
with the measurement of the losses.*



test procedure



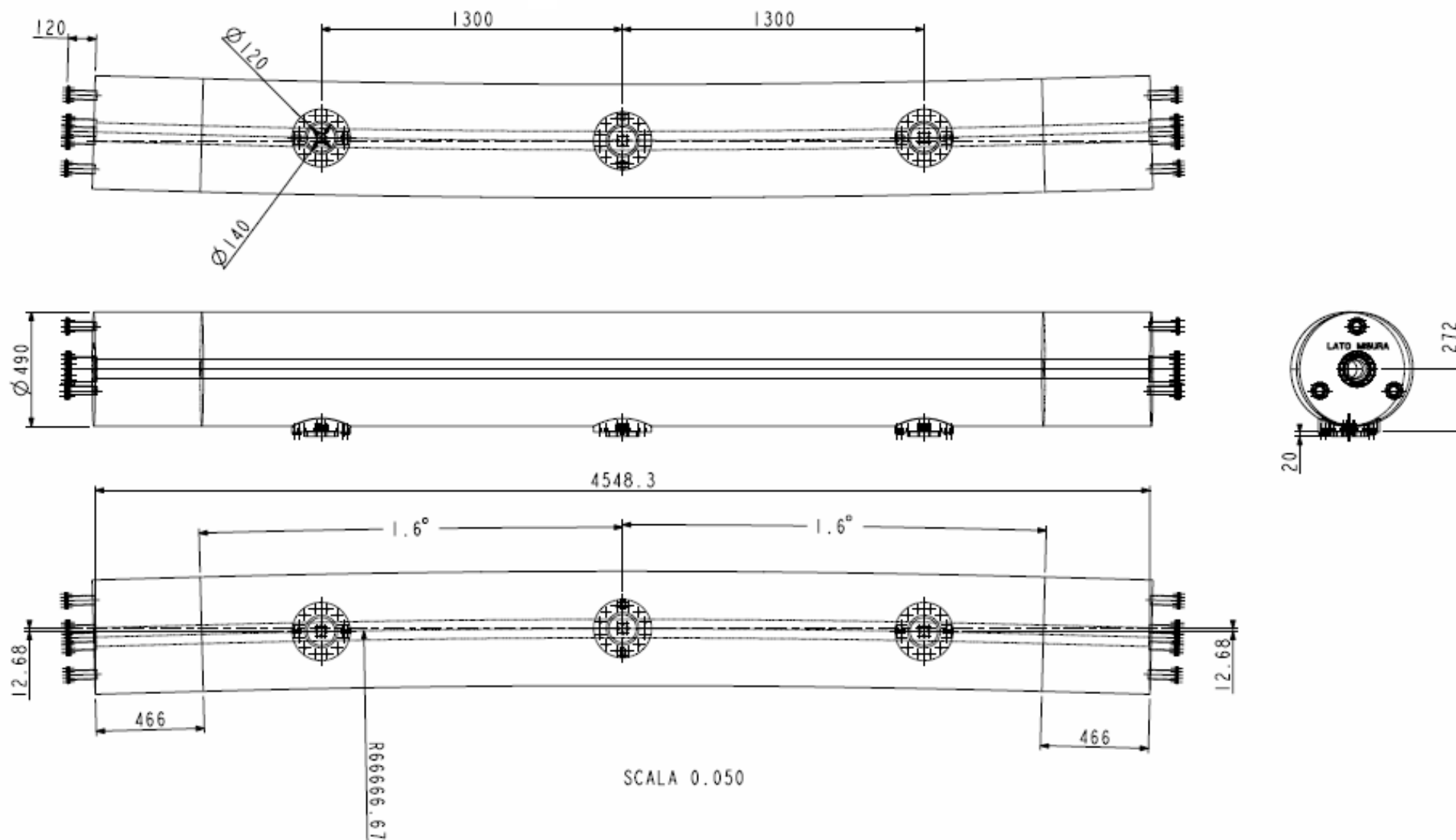
The magnet cold mass will be installed inside an ad-hoc vertical cryostat.

The test will be performed in atmospheric pressure boiling liquid helium; behaviour could differ from the supercritical conditions.

It will be fed with three 10 kA power supplies, connected in series, which can provide up to 18 V. An ad-hoc power electronic will allow the fast discharge. The magnet can be charged at about 0.5 T/s, and discharged at 1 T/s or more.

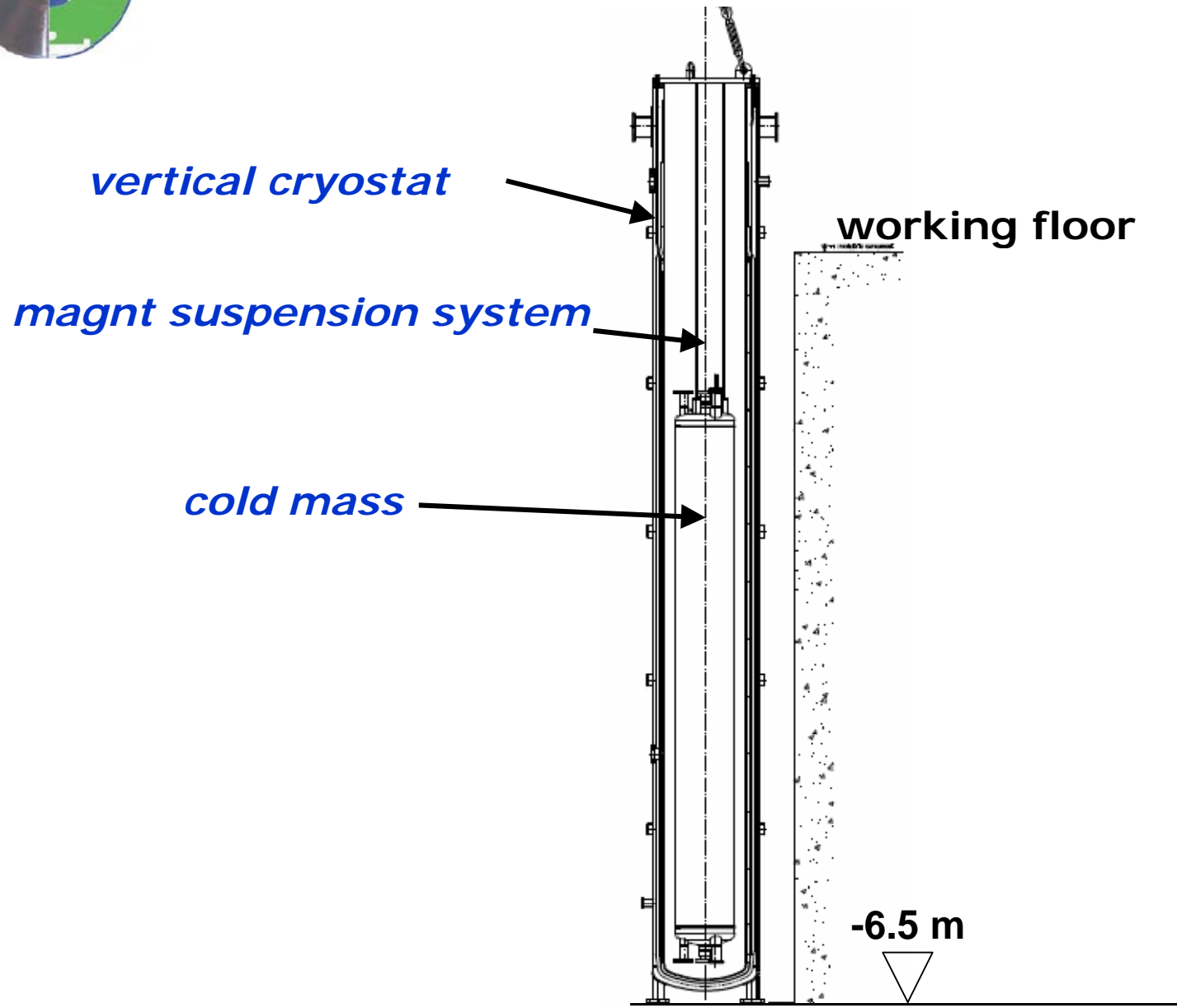


cold mass



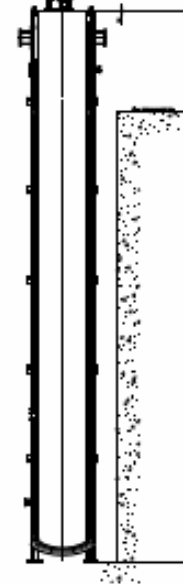
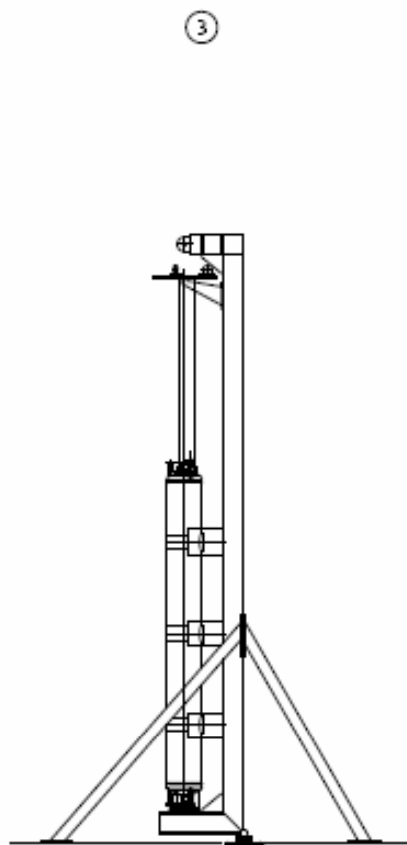
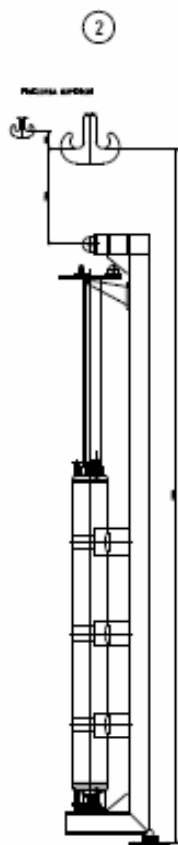


vertical cryostat





cold mass assembly and ① insertion





magnet powering principle



The controlled discharge of a “pure” inductance requires a power supply capable to provide a negative output while feeding current, absorbing the magnet stored energy.

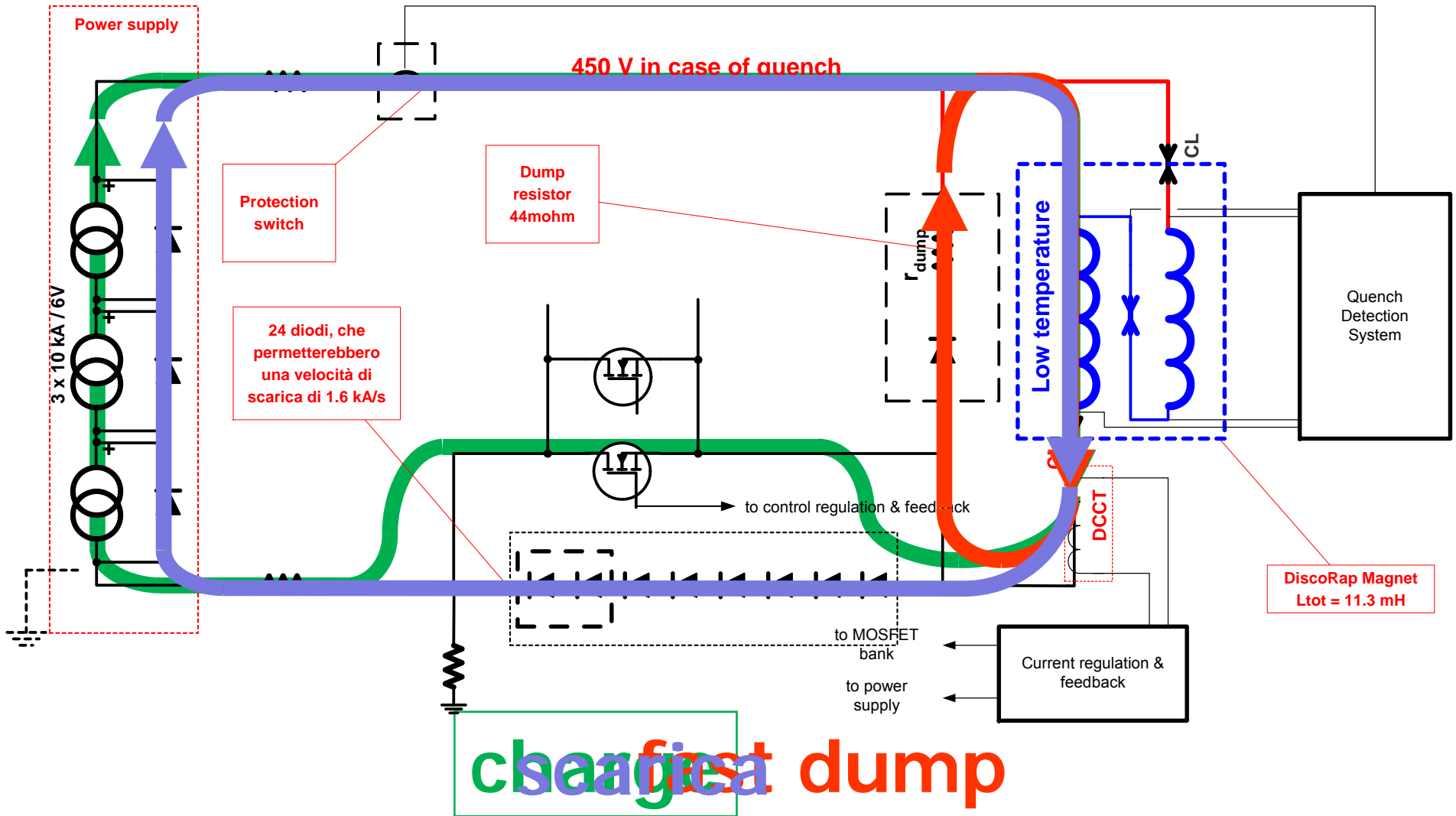
In our case, the price tag for a 10 kA \pm 40 V power supply is around 180k€. To limit the overall costs we have decided to develop a system based on:

- 1) three 10 kA x 6 V power supplies, already installed at LASA,*
- 2) a discharge system based on a 24 diode stack in parallel to a MosFet bank which short-circuits the diodes during the magnet ramp-up.*

Keeping into account all the voltage drops along the current circuit, the voltage at the magnet exit probably does not exceed 15 V, so that the maximum ramp rate could be 0.6 T/s at most, instead of the nominal value, 1 T/s.

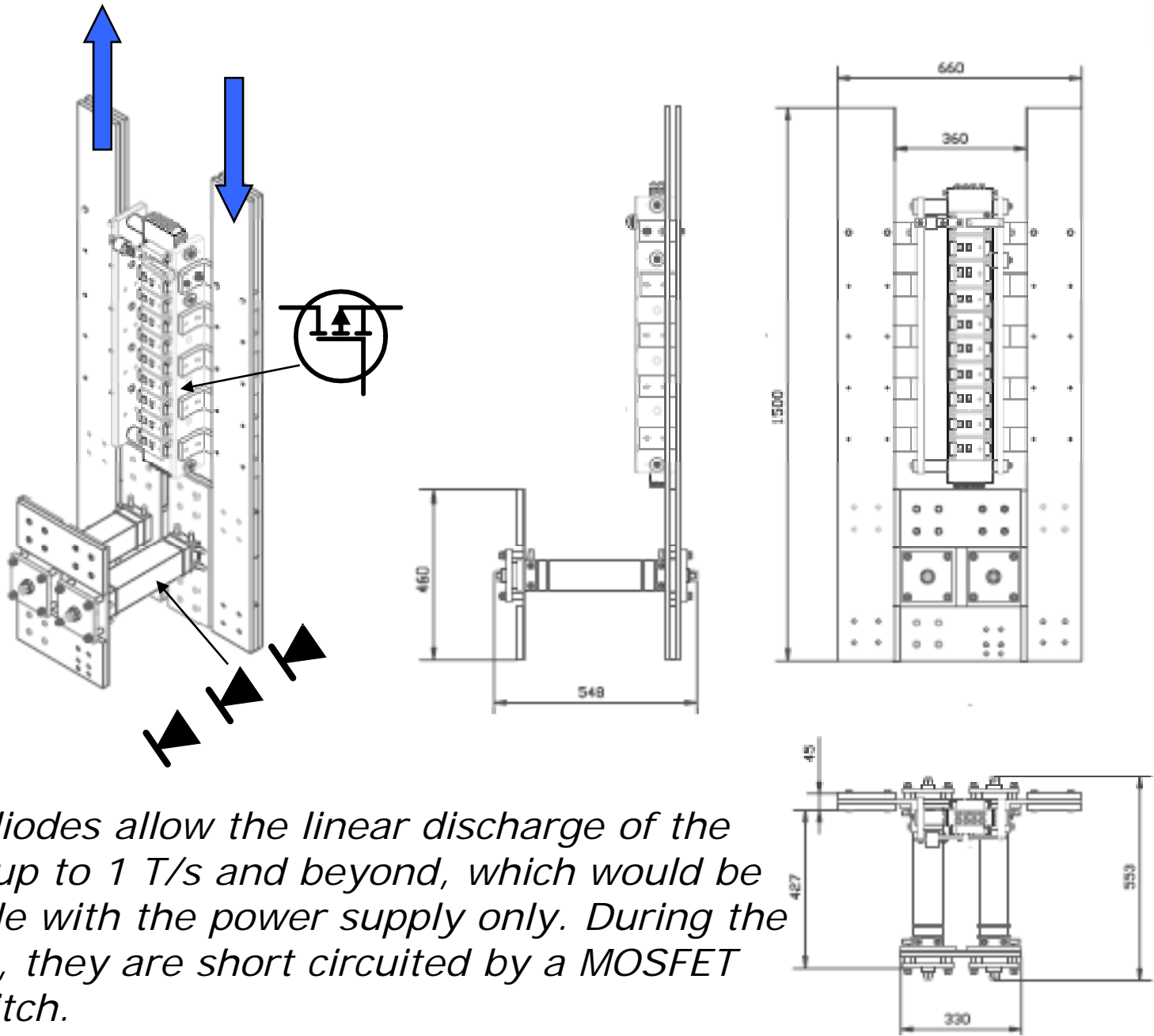


powering scheme





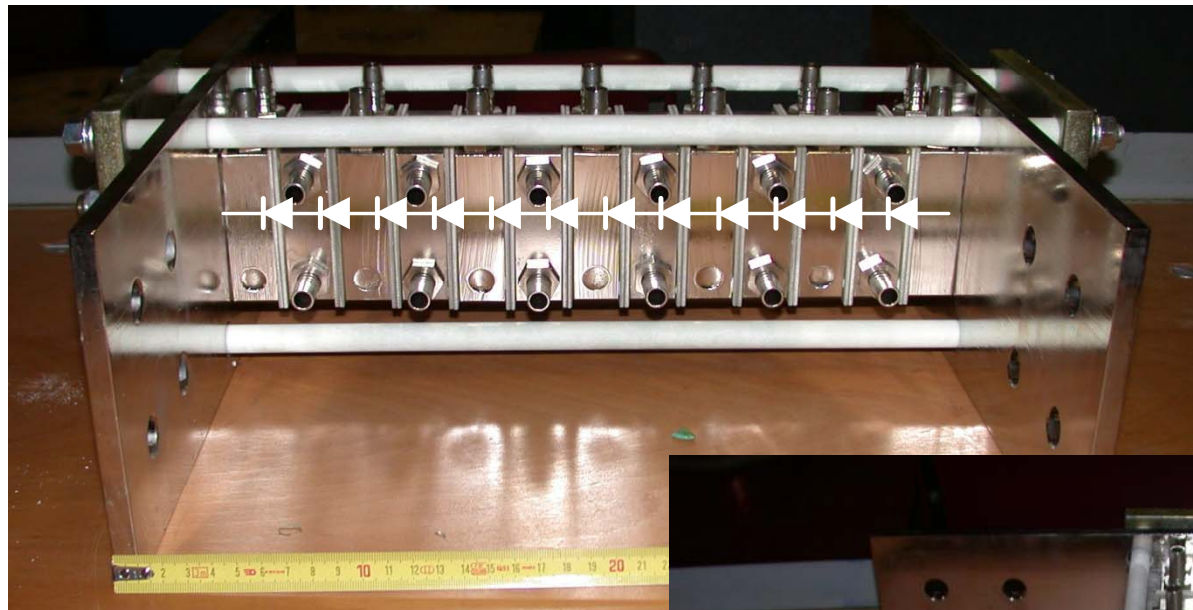
discharge unit



The 24 diodes allow the linear discharge of the magnet up to 1 T/s and beyond, which would be unfeasible with the power supply only. During the ramp-up, they are short circuited by a MOSFET bank switch.

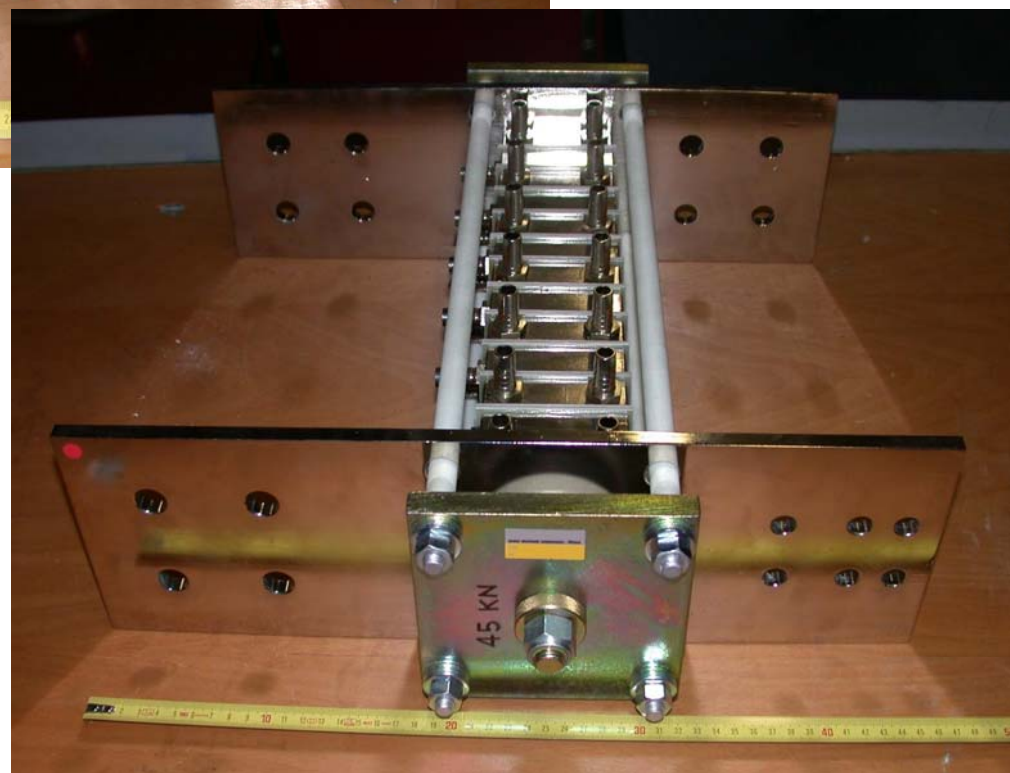


diode bank



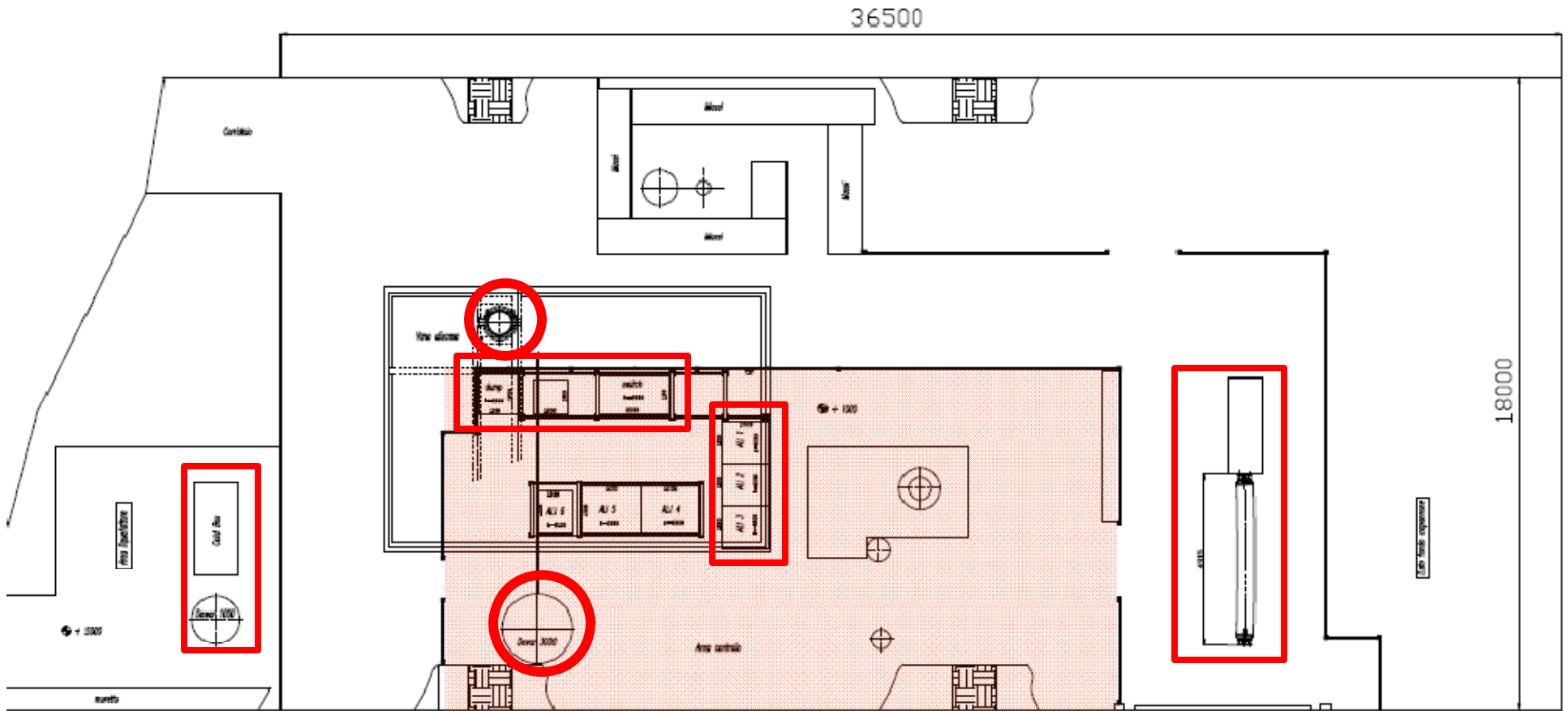
One of the two 12-diode stack, with their water-cooled heat exchanger.

The two stack together will provide a discharge voltage of $24 * 0.9 \sim 22$ V, which amounts to a -1.8 kA/s ramp rate.





experimental hall @ LASA





experimental hall @ LASA



Giovanni Volpini, INFN-GSI meeting 4 November 2009



cryogenics



Two methods can be adopted for the magnet cooling:

*direct connection to the TCF-100 LASA helium liquifier
(30 l LHe/h or 80 W @ 4 K) used as a cooler, with cold gas recovery:*

smaller helium request
technically more complex
high reliability required

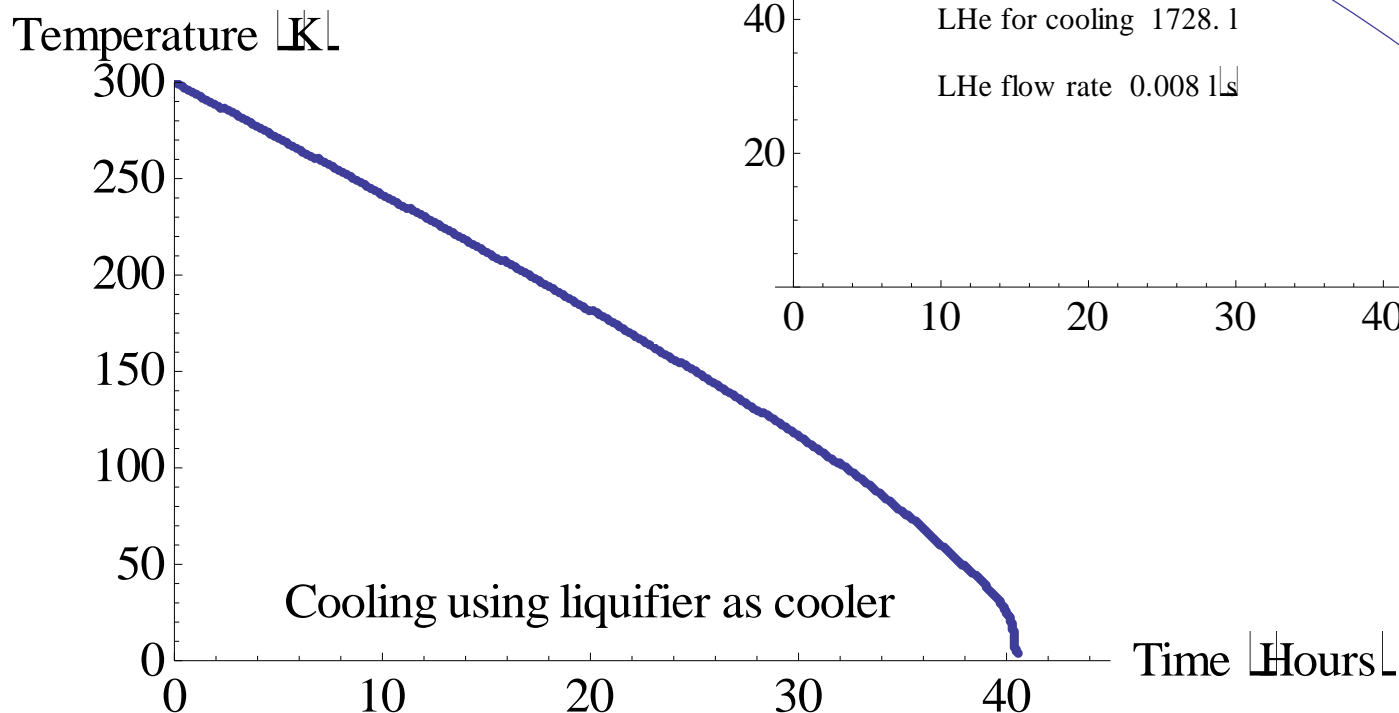
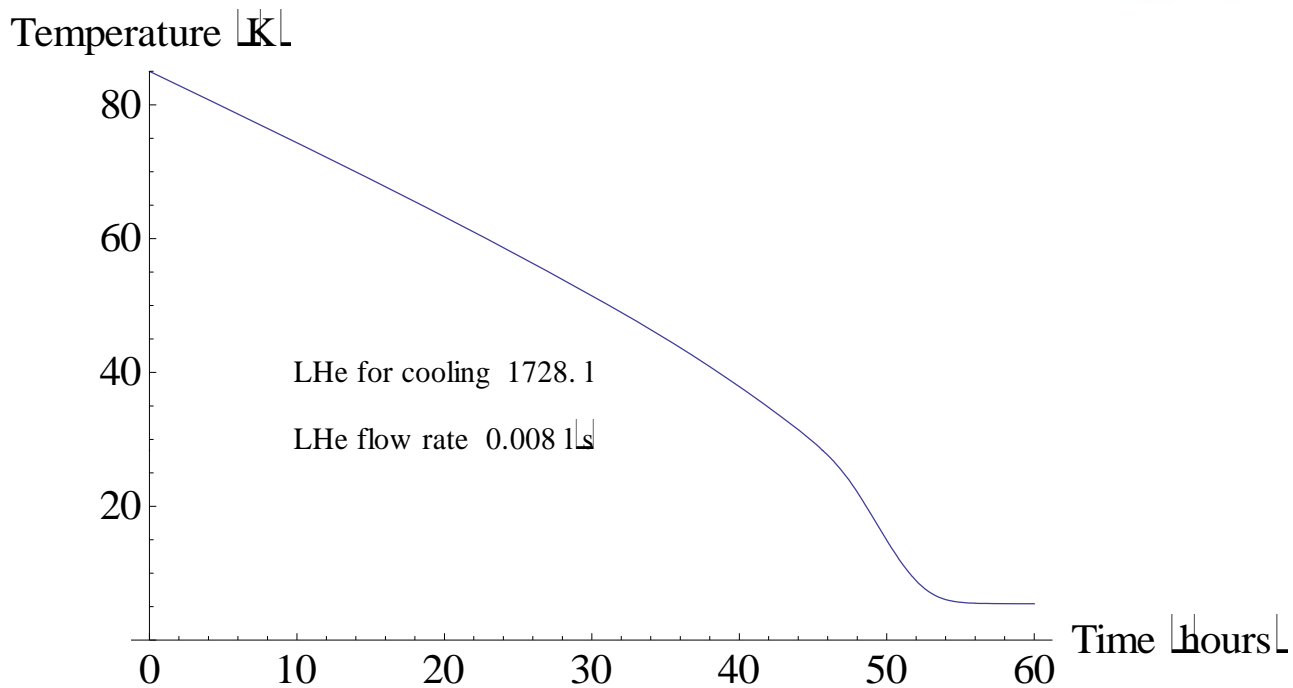
*by means of cryogenic fluids, LN2 down to 80 K and then about 2,000 liters
of LHe*

technically simpler
definitely more expensive

*Once cooled at 5 K, the magnet cryostat will be filled with some 1,200 l of
LHe, by means of a transfer line from the 3,000 liter dewar to the
vertical cryostat.*



cryogenics





data acquisition



*Loss measurements will be performed by integration of $V \cdot I$ signal.
Calorimetric measurements will complement this.*

Quench study will be based on a fast (1 kHz) acquisition system, triggered by the QDS signal and able to monitor and record 32 channels.



horizontal cryostat integration

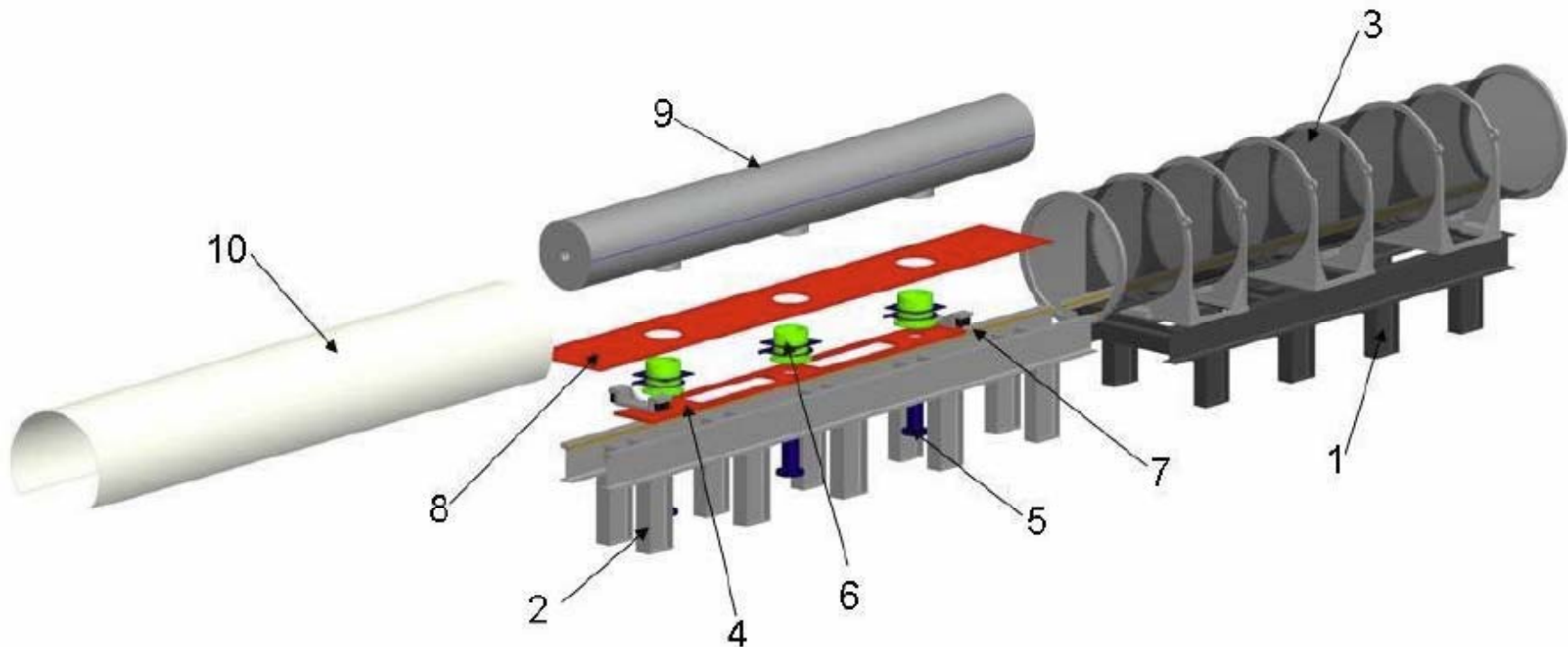


Fig. 2 – Schema di integrazione massa fredda e criostato: 1) 2) supporti per montaggio; 3) contenitore esterno; 4) piastra centrale; 5) supporti di rinforzo per trasporto e montaggio; 6) supporti in vetroresina (POST); 7) carrello di inserimento; 8) *bottom tray* schermo di radiazione; 9) *cold mass* con culle di ancoraggio; 10) semiguscio schermo di radiazione.



the end