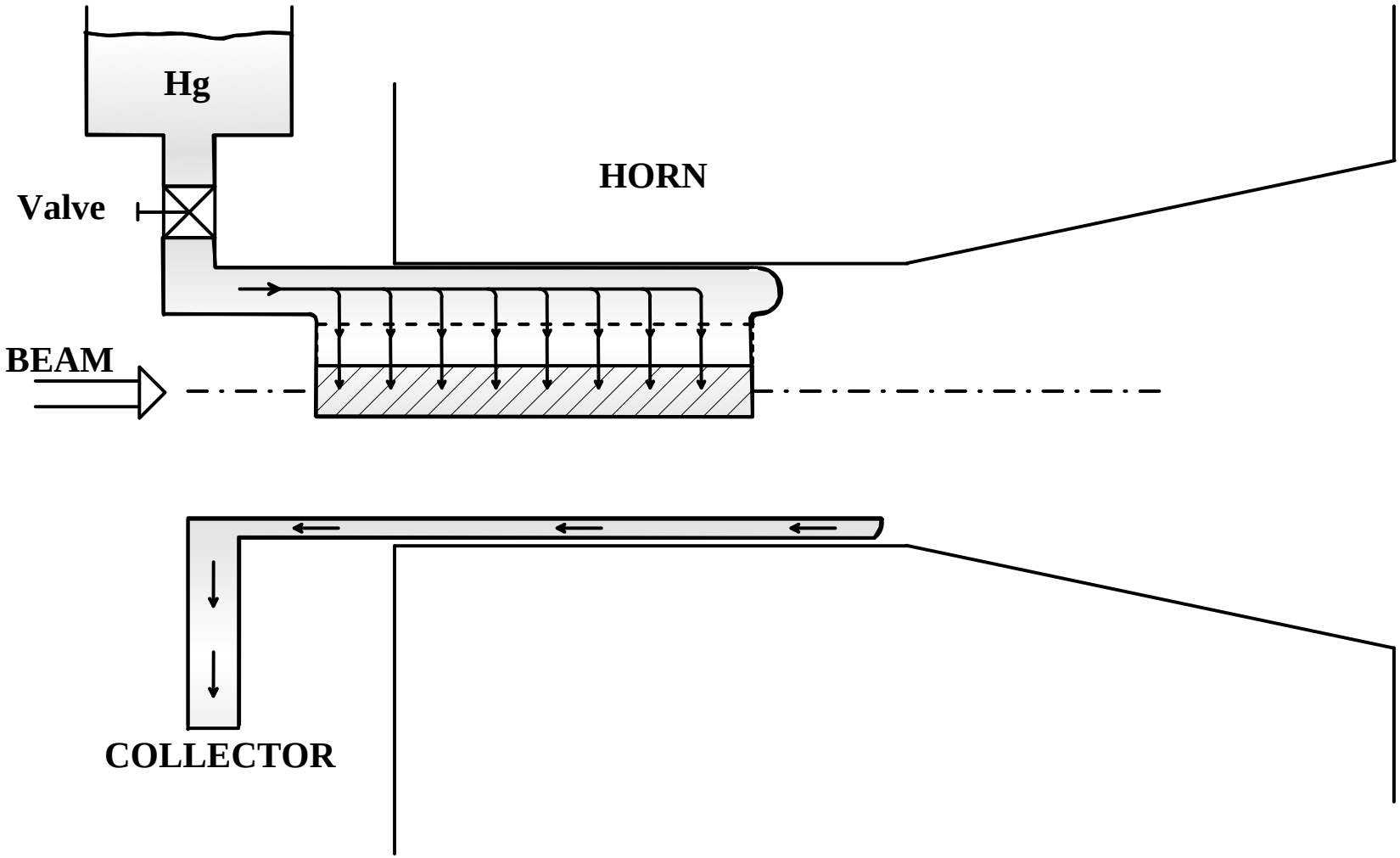
High-power Targetry for Future Accelerators
September 8-12, 2003
BNL

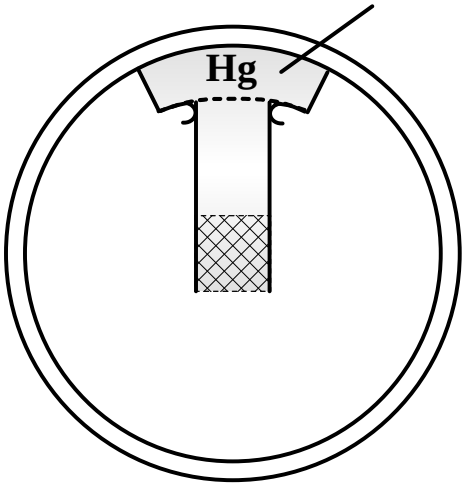
Freely Dropping Mercury Curtains

P. SIEVERS
CERN

FREE FLOWING CURTAIN TARGET

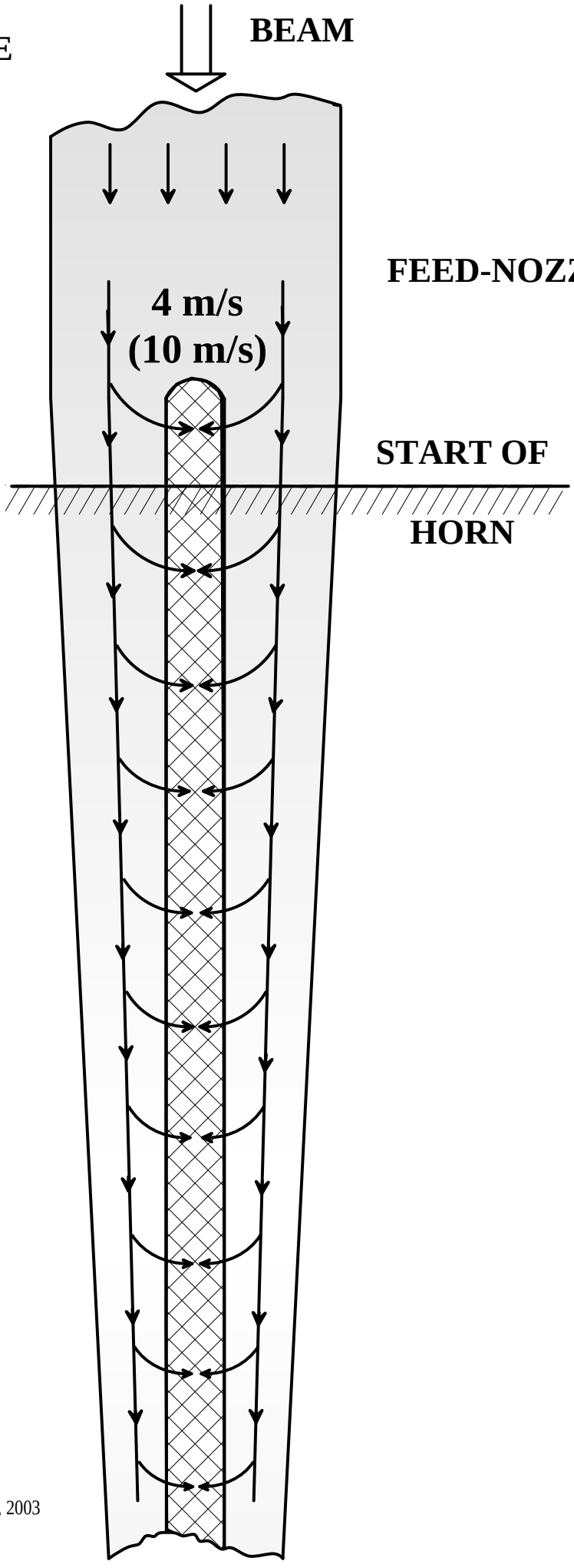


Front view



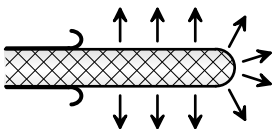
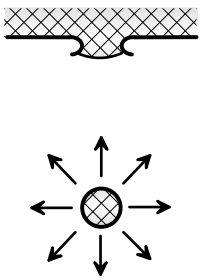
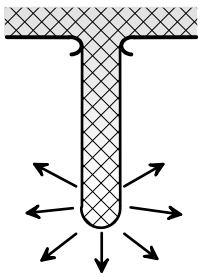
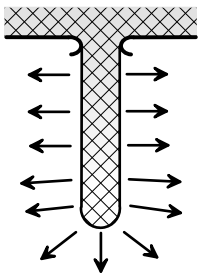
INNER CONDUCTOR OF HORN

Top view



Burst Frequency : 50 Hz

Target : 1cm x 1cm
L = 40cm

	Free Jet	Pulsed Curtain	Continuous Curtain Tip explodes	Curtain explodes
				
Volume Flow (cm^3/s)	2000.	2000.	2000.	5000.
Velocity at nozzle (m/s)	>20.	1.25	0.5	1.25
Pressure (kPa)	2700	10.5 Pulsed Pressure. Mech. or el. magn. valve	1.7	10.5

Conclusion

- Yield somewhat reduced by nozzle and curtain ?

- Very conservative pressures and velocities

- For lower burst frequencies even better

- How much of curtain explodes ?

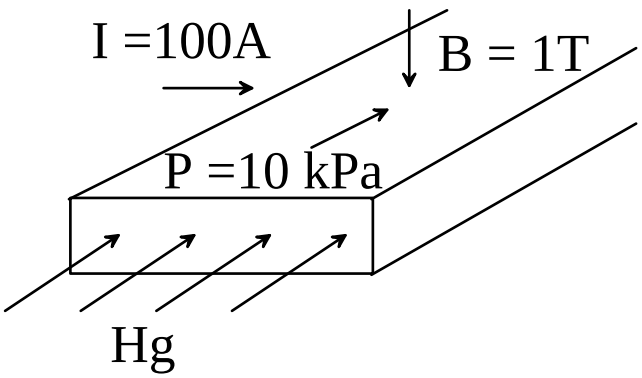
- Pulsed curtain

- Valve at 50 Hz

  Pulsed pressure

  Mechanical valve (rotating shutter)

  El. magn. valve :



High-power Targetry for Future Accelerators September 8-12, 2003 BNL

Stationary High-power Target for a Neutrino Factory

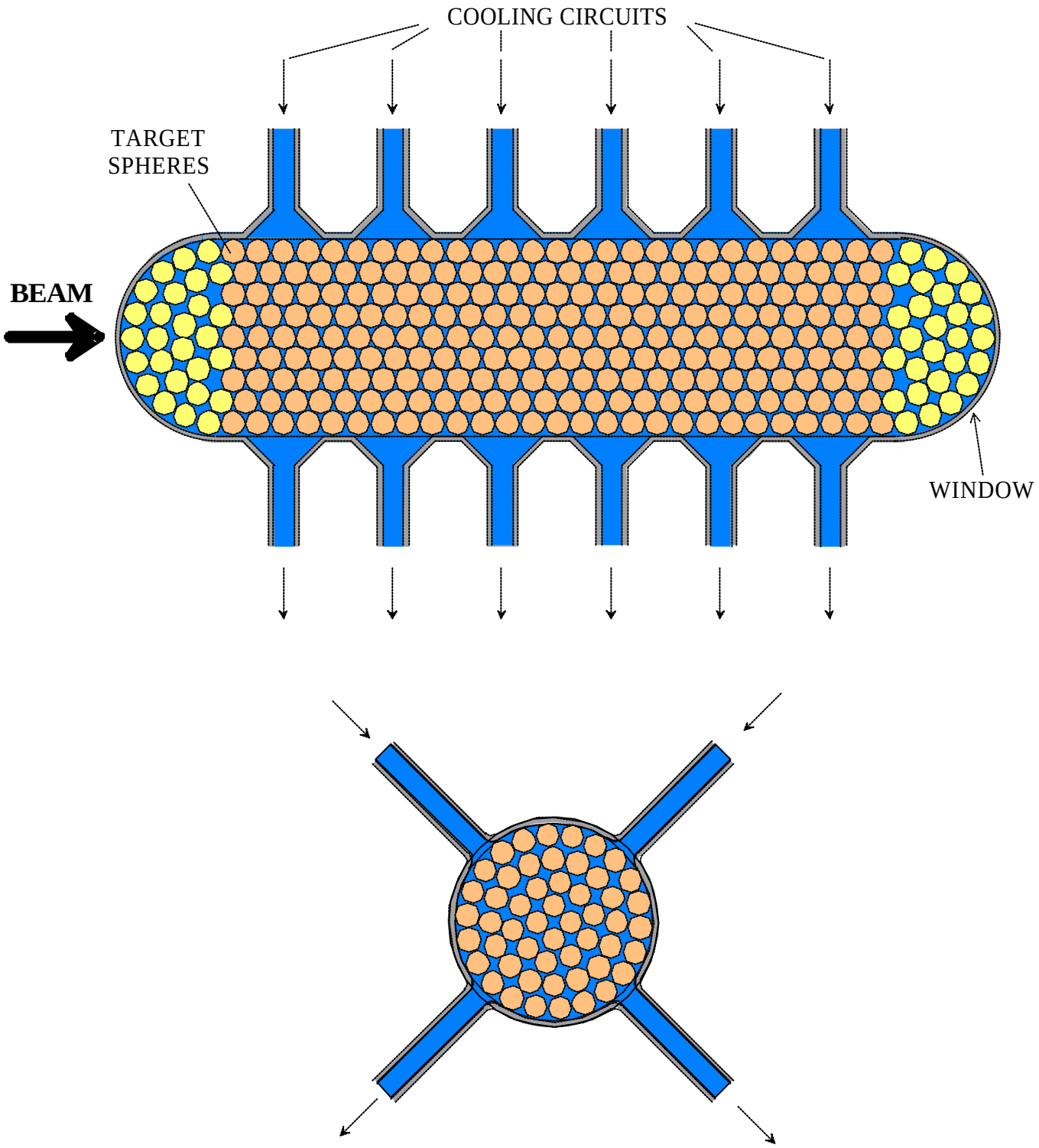
P. SIEVERS
CERN

Proton Energy : 2.2 Gev
Burst Duration : 3.3 μs
Burst Frequency : 50 Hz
Beam Power : 4 MW

STATUS OF STATIONARY GRANULAR TARGET AND PERSPECTIVES
PETER SIEVERS – CERN

- **Tantalum (or WC, Pt) Spheres :** ∅ = 2 mm, ρ = 0.6 x 16.8 ≈ 10 g / cm^3
- **Small static thermal stress:** Each sphere heated uniformly.
- **Small thermal shock waves:** Resonance period of a sphere is (0.26 μs) small relative to the heating time (3.3 μs).
- **Large Surface / Volume:** F/V~5000 cm^2/250 cm^3.Heat removed where deposited.
- **Heat Transfer Coefficients:** 20 kW / m^2 K for water,
  10 kW / m^2 K for He-gas, within reach.
- **Time constant of temperature decrease between pulses (20 ms):** ~ 40...80 ms
- **Set-up to measure heat evacuation from Granular "Wire Bunch" Target was under Construction, stopped due to lack of funding !**
- **Fatigue of Spheres:** 130 Mio. thermal cycles / month.
- **Integration of Target into Horn.**
- **Radiation damage of spheres, container and windows:** n x10 dpa's per n weeks. (see also SNS-Target)
- **Moving Window.**
- **Lifetime of Target > Horn to be expected ?**

GRANULAR TARGET COOLED BY LIQUID OR GAS



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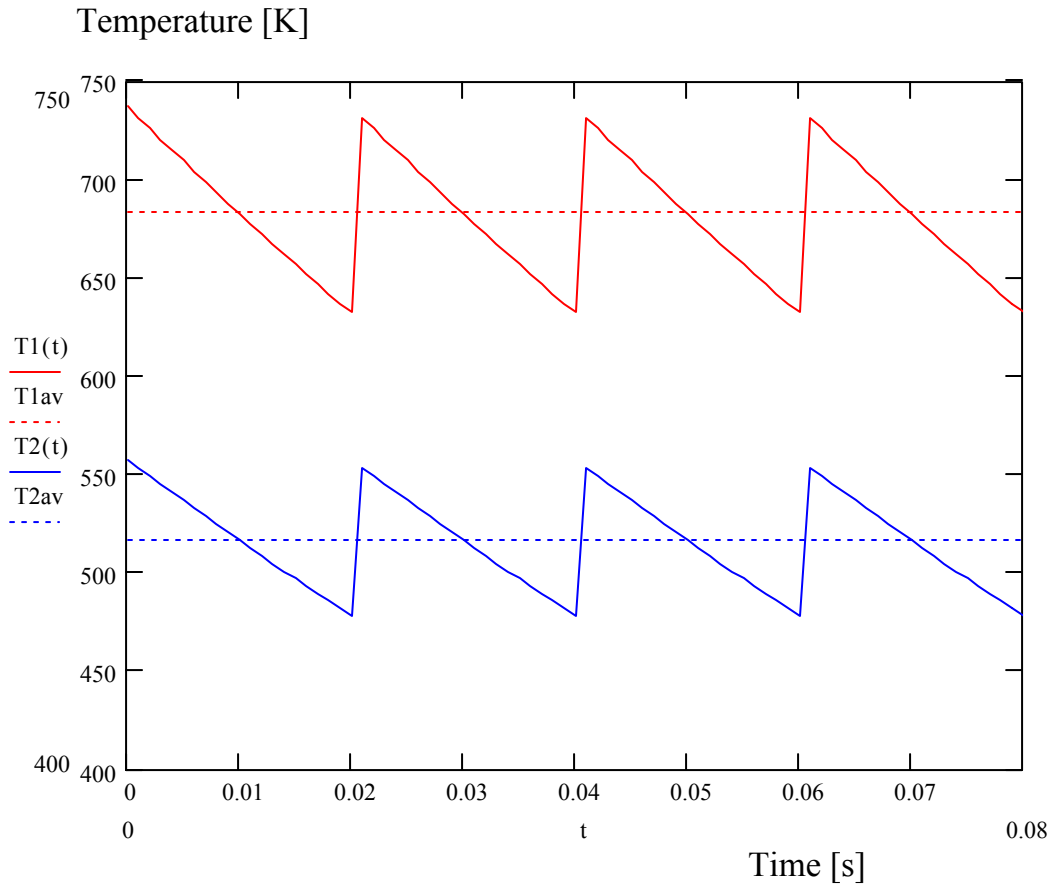
20/11/2000

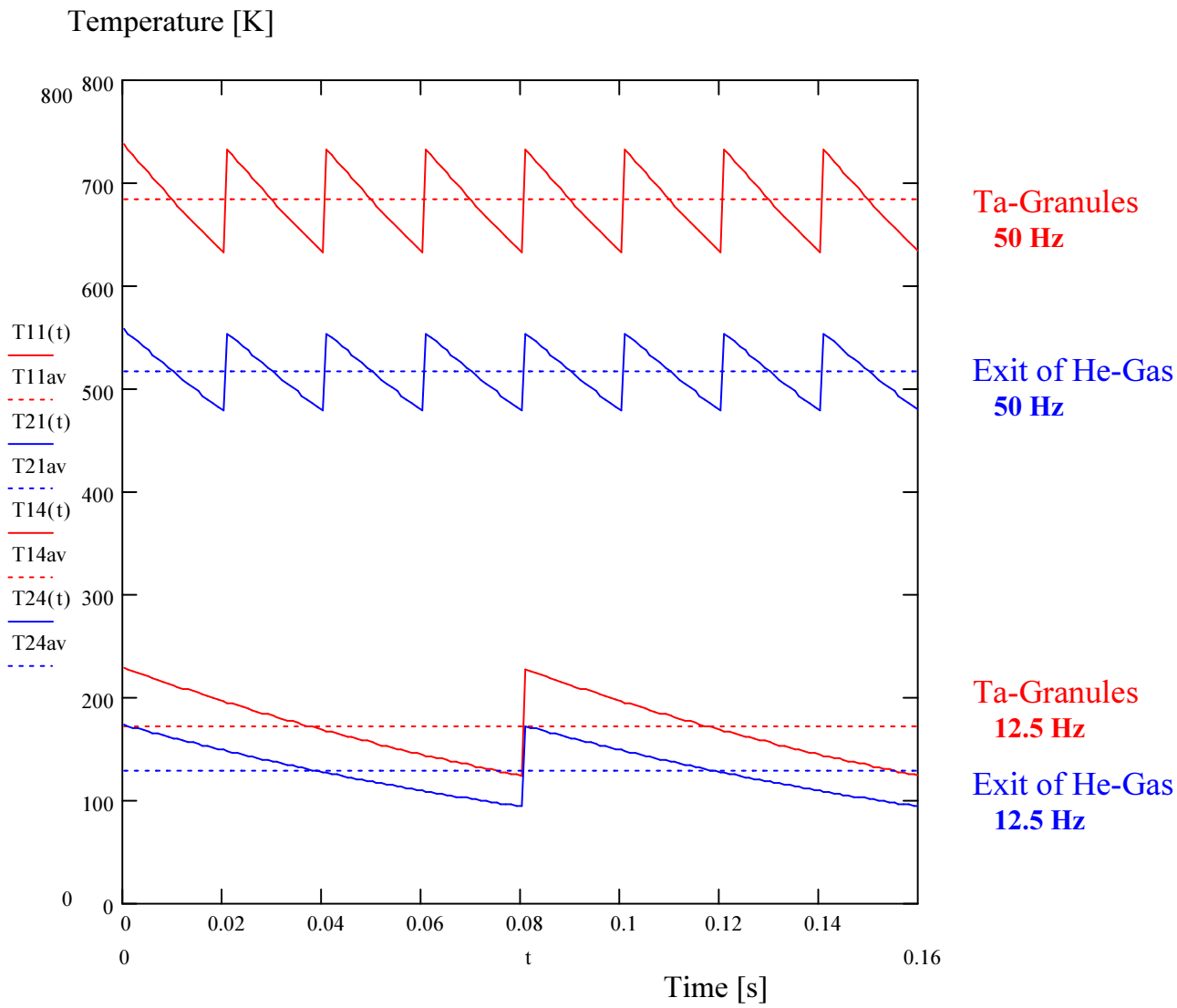
He-Gas COOLED GRANULAR TARGET
4 MW-BEAM



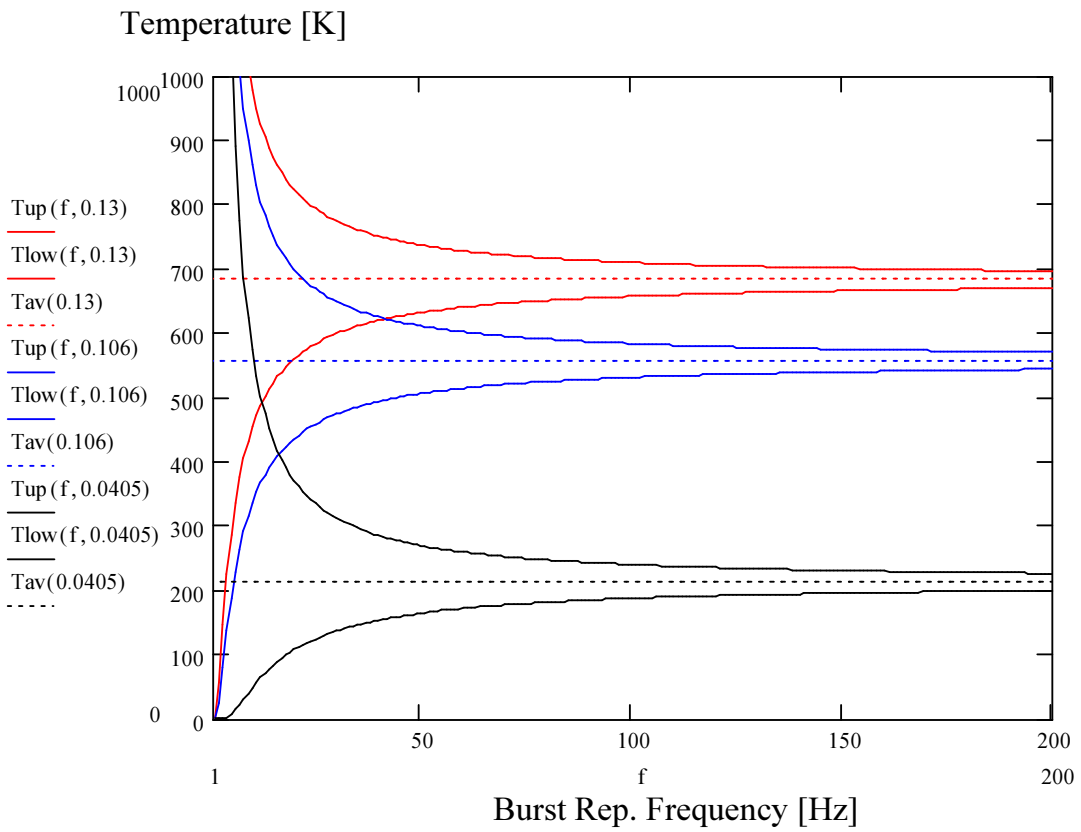
Ta-Granules

Exit of He-Gas

He-Gas COOLED GRANULAR Single (50Hz) and Quadruple (12.5Hz) TARGET
4 MW-BEAM



COOLED GRANULAR TARGET
4 MW-BEAM



Normal He-Gas Cooling

High He-Gas Cooling

Water Cooling

COOLED GRANULAR TARGET
4 MW-BEAM

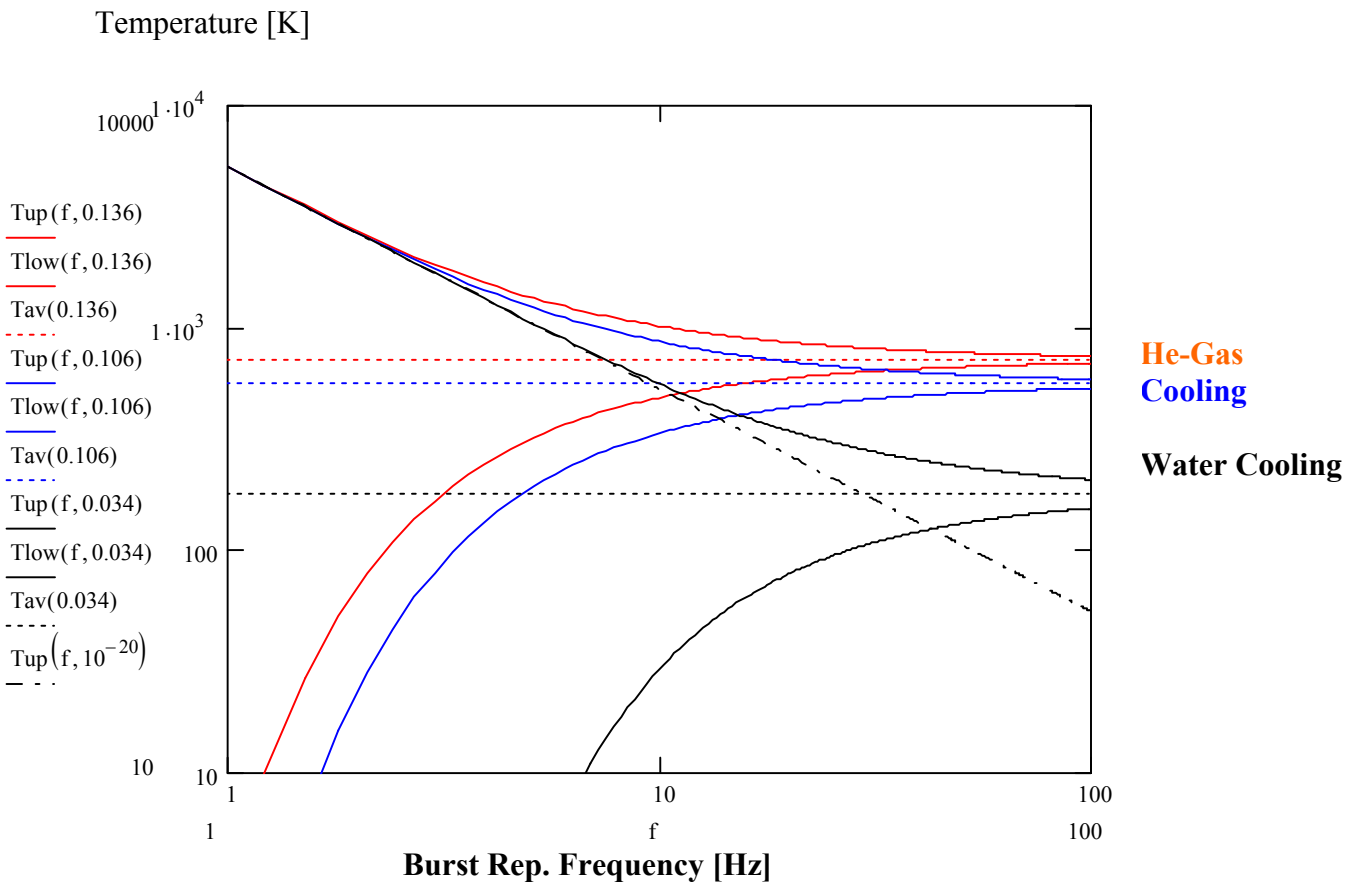
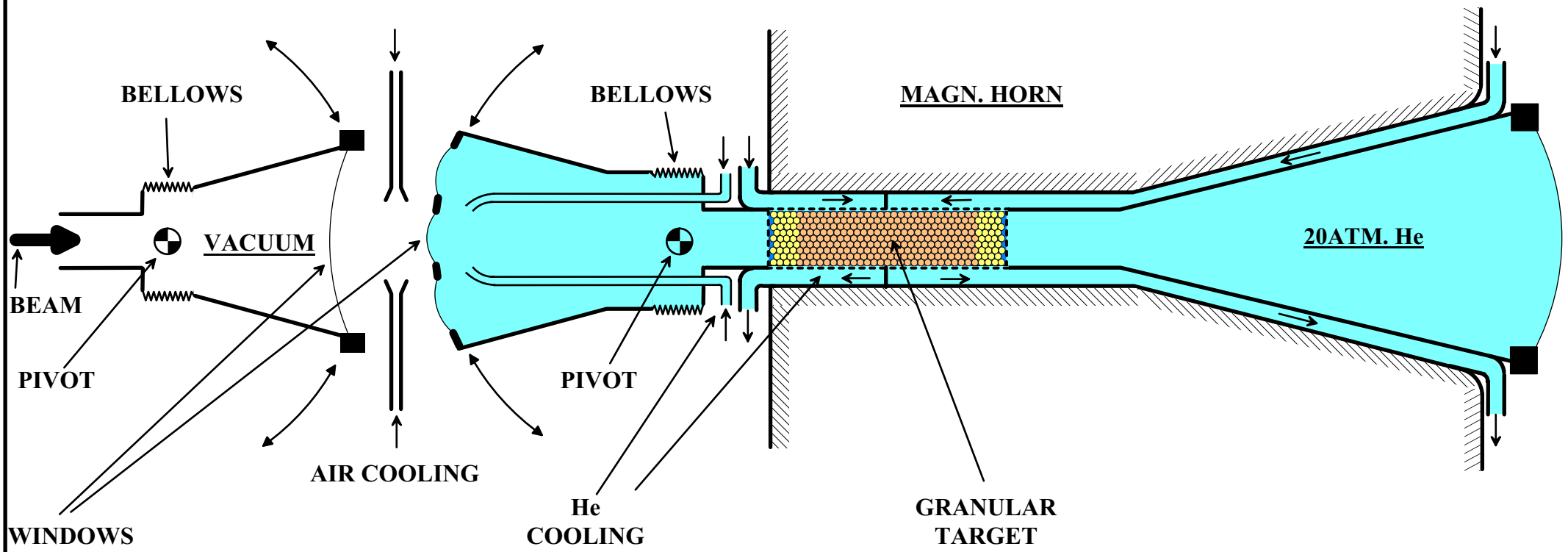


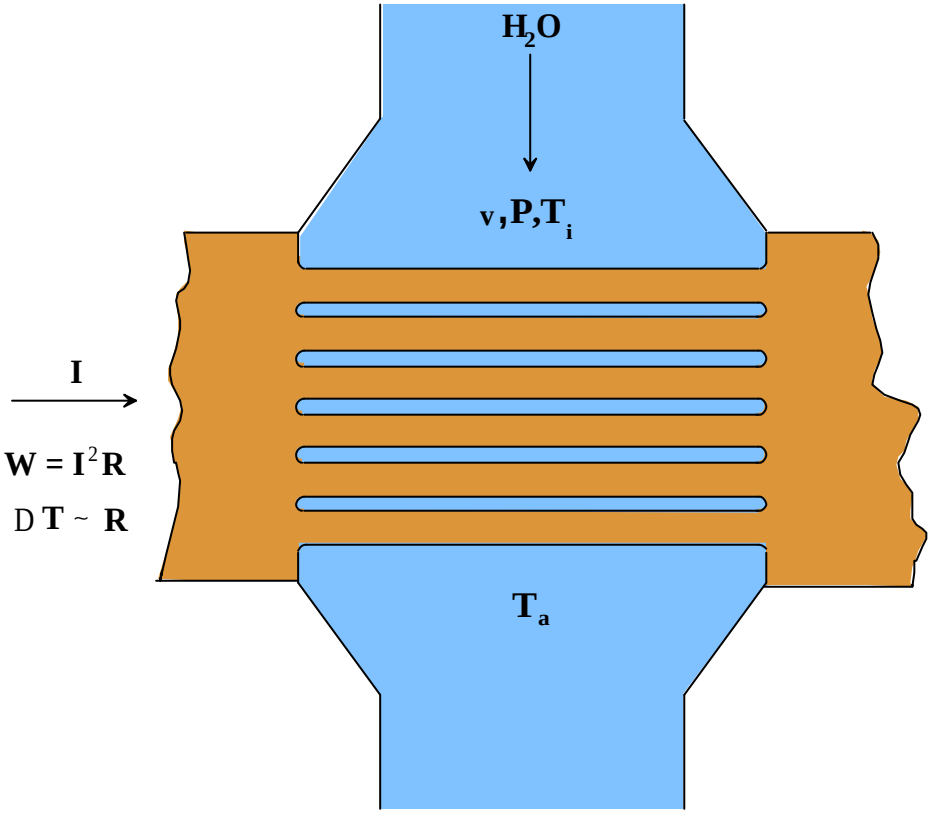
Table 1: Minimum and maximum temperature inside spheres and He-gas during the 50 Hz pulsed beam. The time average temperatures refer to a 4 MW continuous beam.

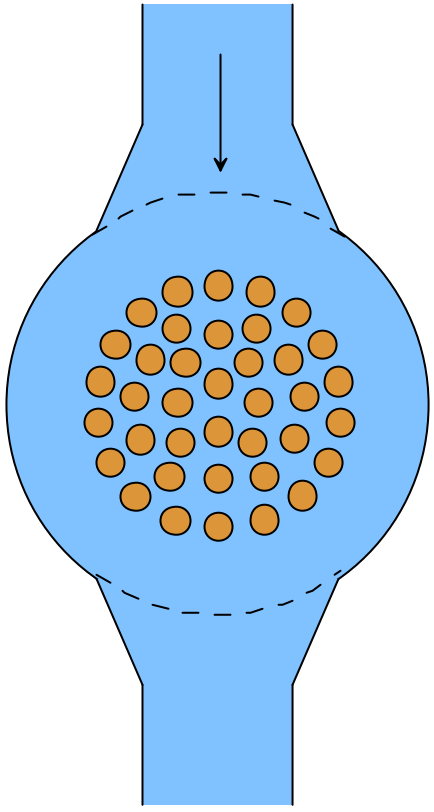
	$T_{S,}$ min.	$T_{S,}$ Max.	$T_{S,}$ average	$T_{He,}$ min.	T_{He} Max.	T_{He} average
Single target, $\dot{m}_{He} = 0.36$ kg/s	631	731	680	505	585	544
Single target, $\dot{m}_{He} = 0.72$ kg/s	387	487	435	240	302	270
Quadruple target, $\dot{m}_{He} = 0.36$ kg/s	125	225	170	100	180	136

GRANULAR TARGET WITH He-GAS COOLING AND WITH WINDOWS OF EXTENDED LIFETIME

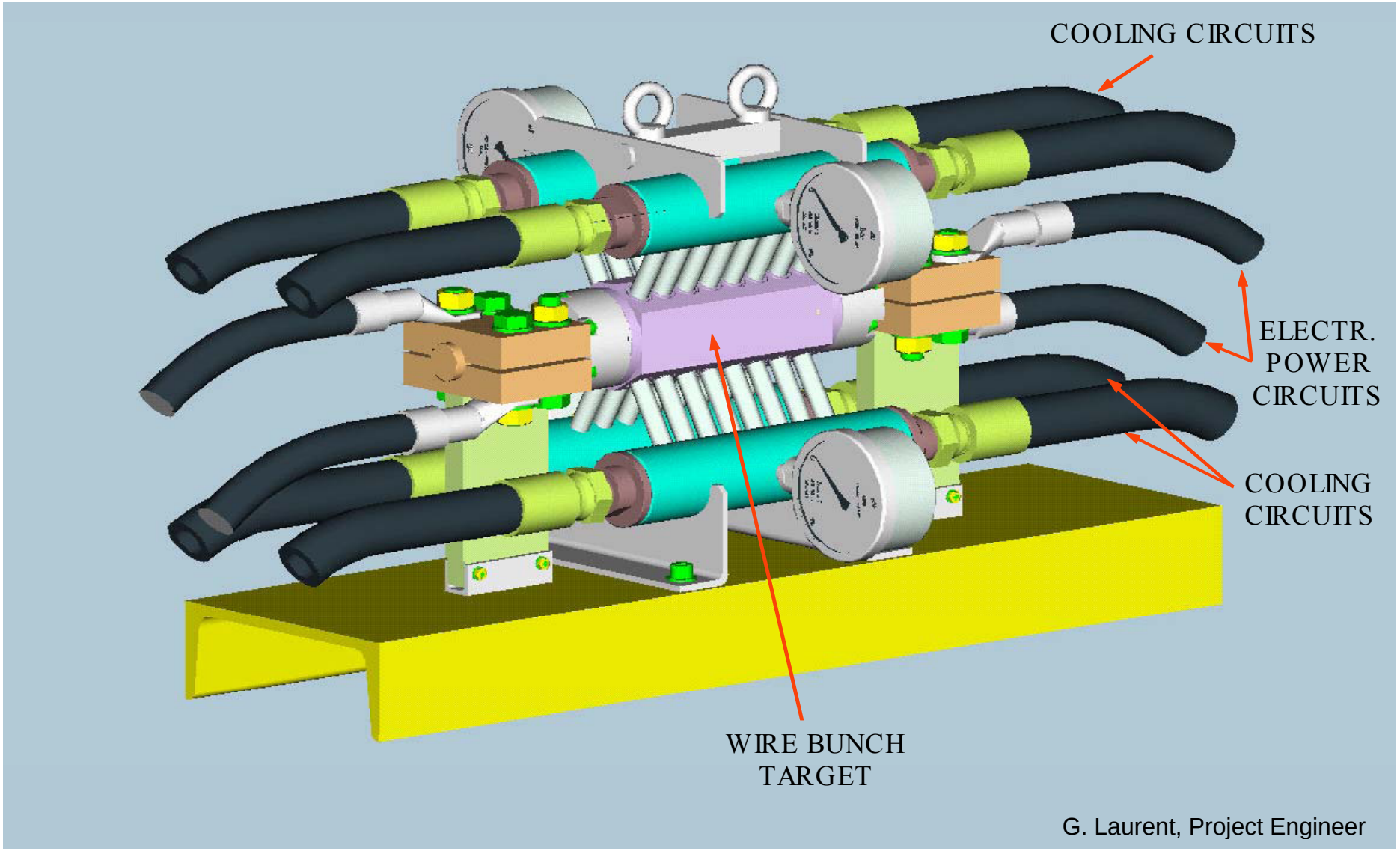


TEST SET-UP TO MEASURE HEAT TRANSFER COEFFICIENT





Test Circuit for High Power Heat Removal From Granular "Wire Bunch" Target



G. Laurent, Project Engineer