Muon Collider Targetry Workshop
Princeton University, Feb. 27, 1998

Experience with High Flux Targets - Summary of presentation

Colin Johnson, CERN

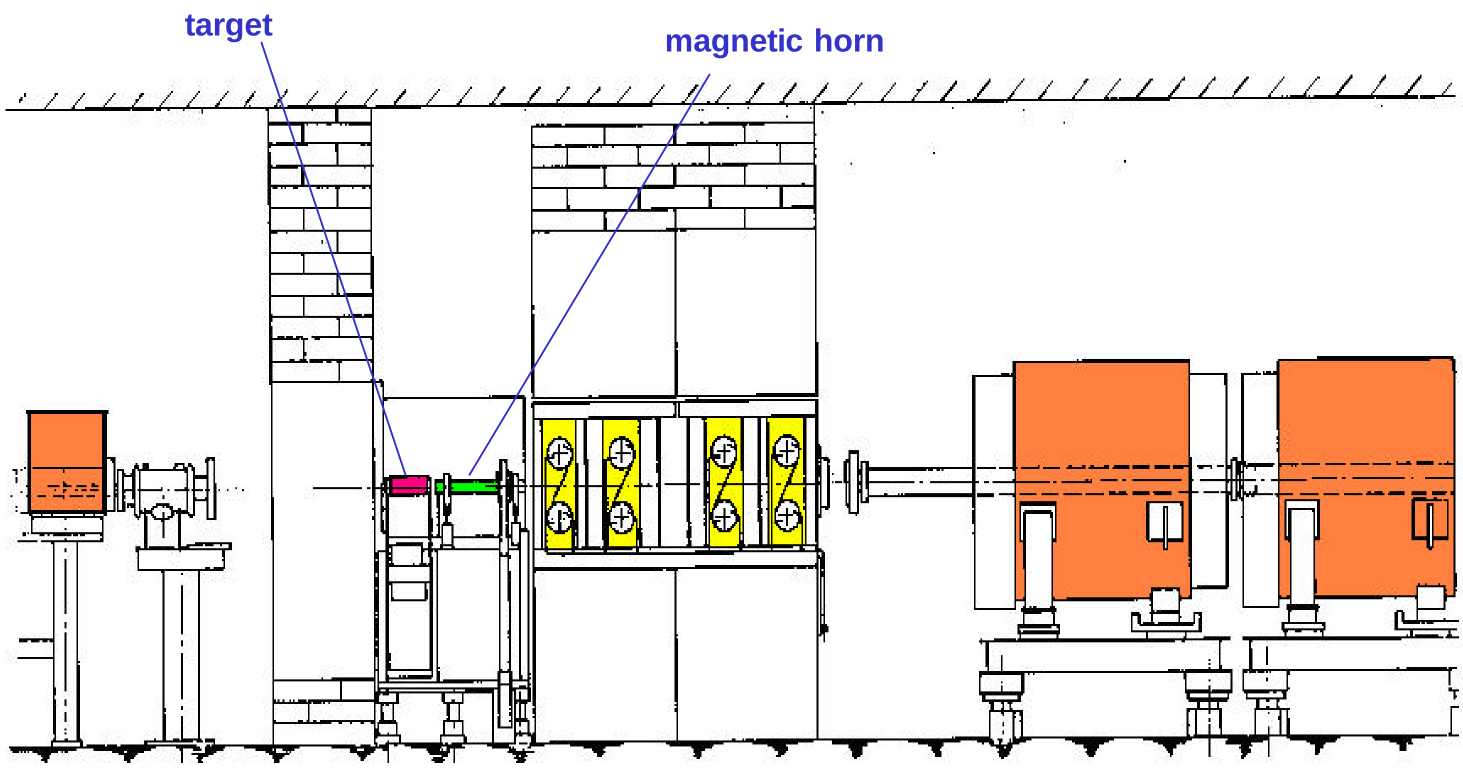
The AA/ACOL antiproton production target received 26 GeV proton beams of around 1 x 10^{13} protons per pulse at a repetition rate of 0.42 Hz (i.e. 1/200 of the mean power of the proton driver for the pion production target)

AA/ACOL production targets. The AA/ACOL target/Li-lens assemblies are shown in the first 4 transparencies. This ACOL target incorporated several years of R&D studies, some resulting in catastrophic damage. The target lifetime of this version (from 1988 onwards) was effectively unlimited.

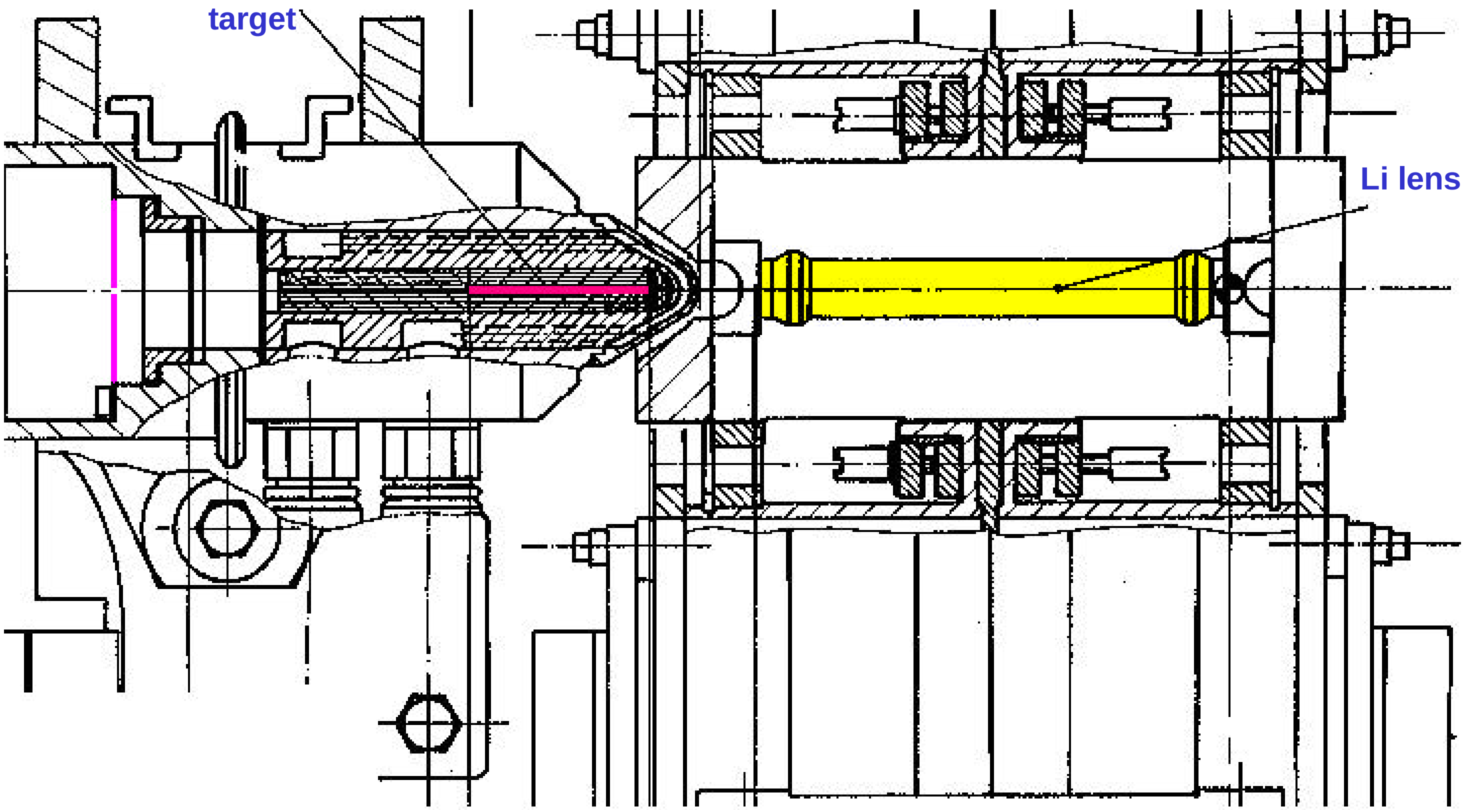
The Mercury Jet target. This was a laboratory experiment to test the feasibility of liquid jet targets. Some constructional details are presented together with computer enhanced photographs of the experiment - 4 transparencies. REXCO hydrodynamic shock simulations of a proton beam hitting a mercury target, i) contained within a stainless steel tube, and ii) in the form of a jet in vacuum, have been worked up from hitherto neglected runs by A. Poncet and are presented - 3 transparencies.

Radioactivity and radiation issues. With high-flux targetry comes the problems of radiation damage and induced activity. A great deal of effort went into studying and documenting our experience - mainly the work of A. Sullivan. Our empirical formulae have been applied to the pion production target and capture solenoids - 3 transparencies.

Slurry jet targetry. This turns out to be more difficult than I had imagined. High-density slurries are very viscous due to effects at the microscopic level: irregular grain shapes and grain-to-grain bonding. A relatively low-viscosity slurry was achieved by mixing WSe_2 with water, but the density was no higher than 4 g cm^{-3} - 1 transparency.



AA target - horn assembly with water cooled collimators



ACOL target - lithium lens assembly

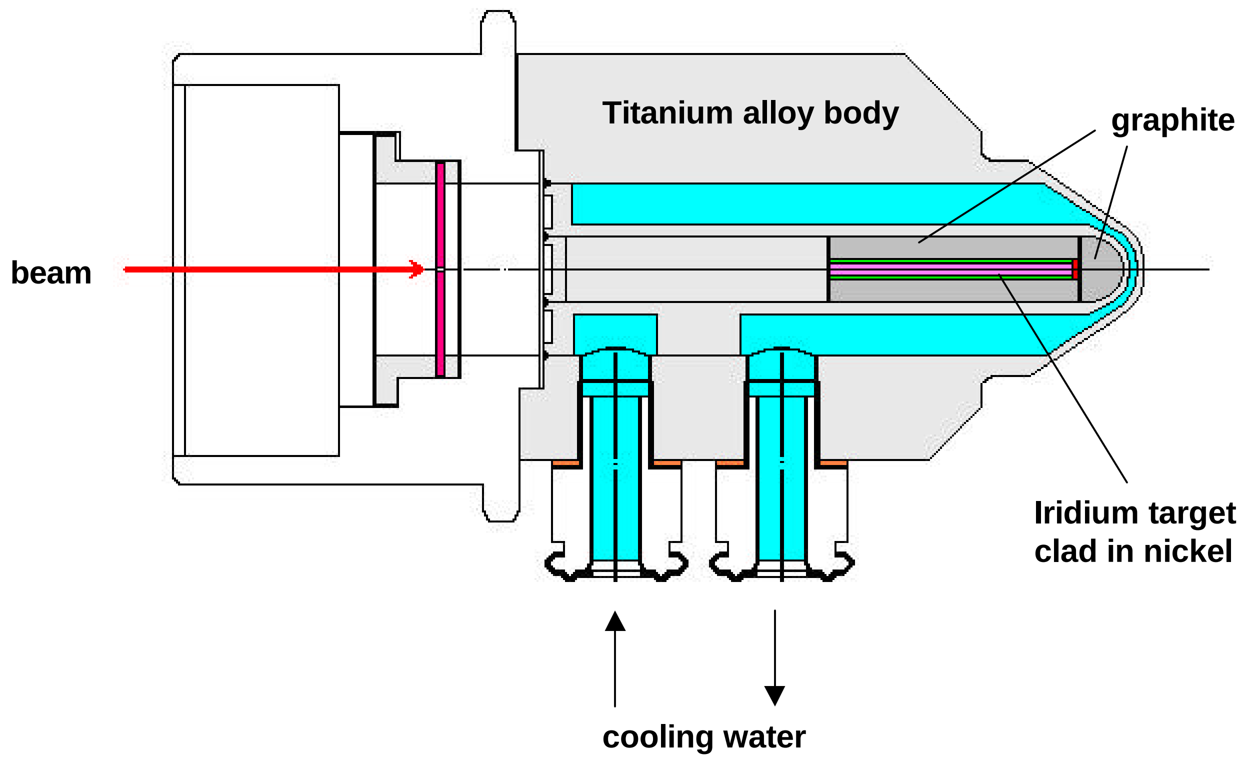
ACOL antiproton production target

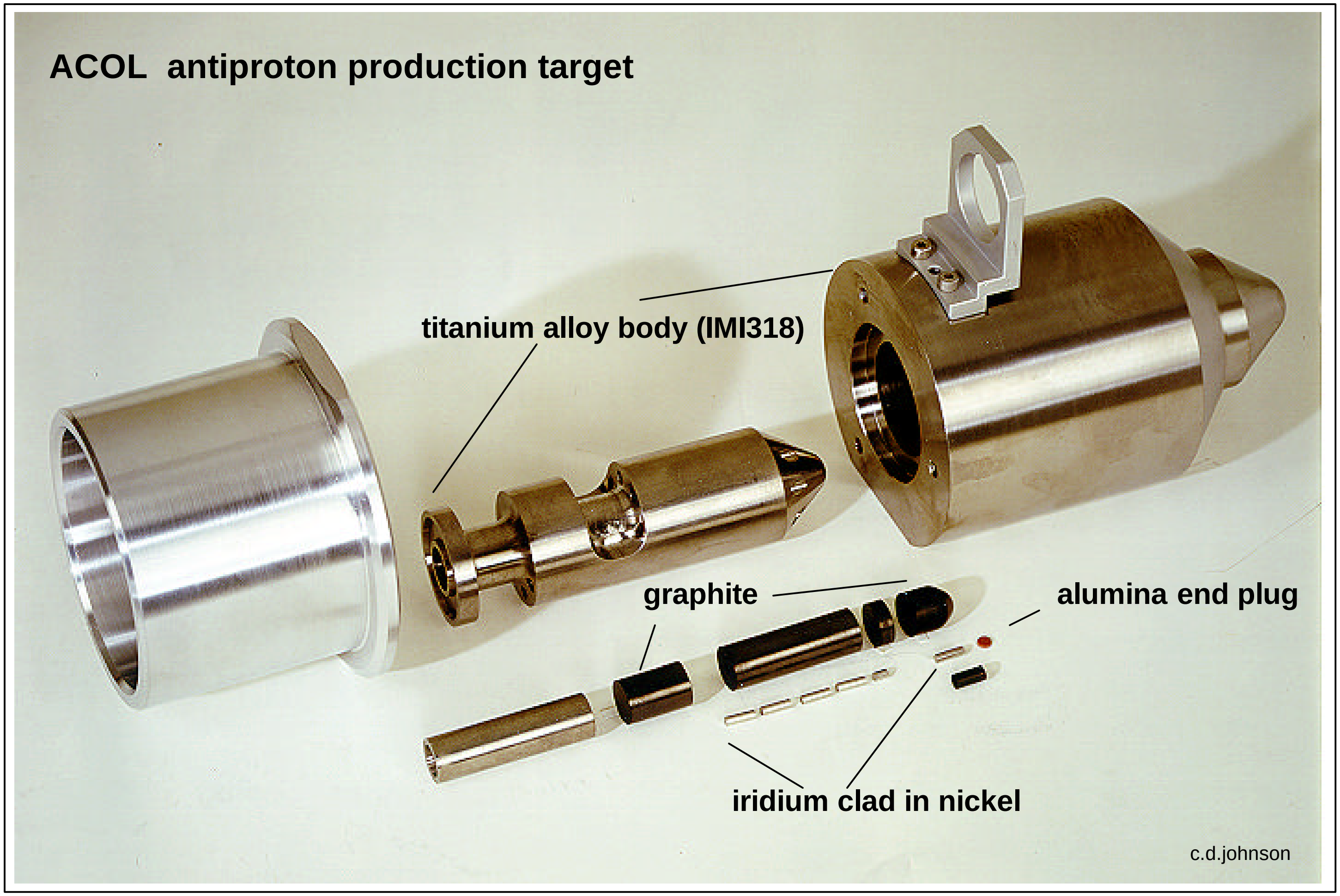
Design issues:

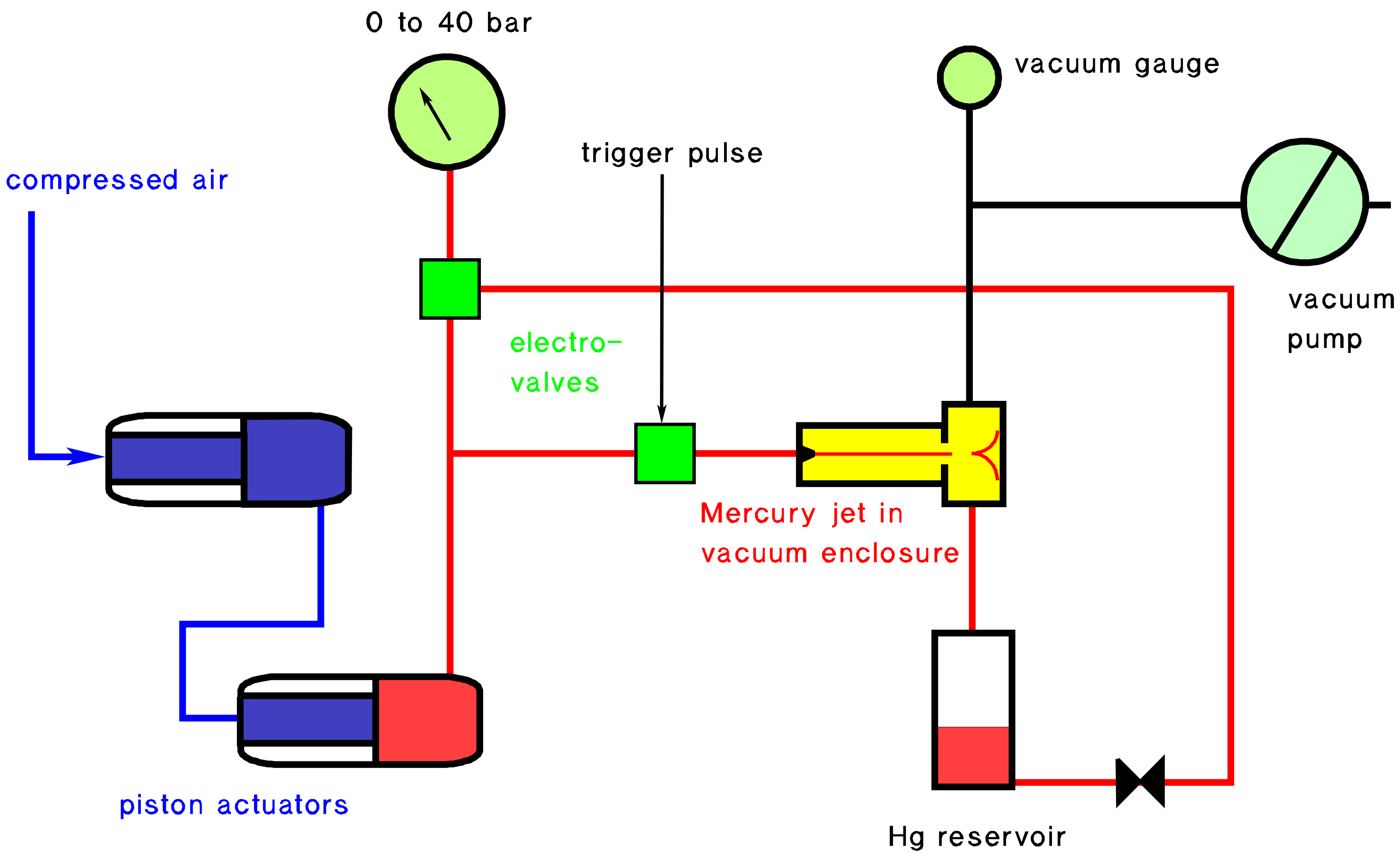
Shock wave damage - radial acoustic impedance matching

Radiation induced voids - reduces density

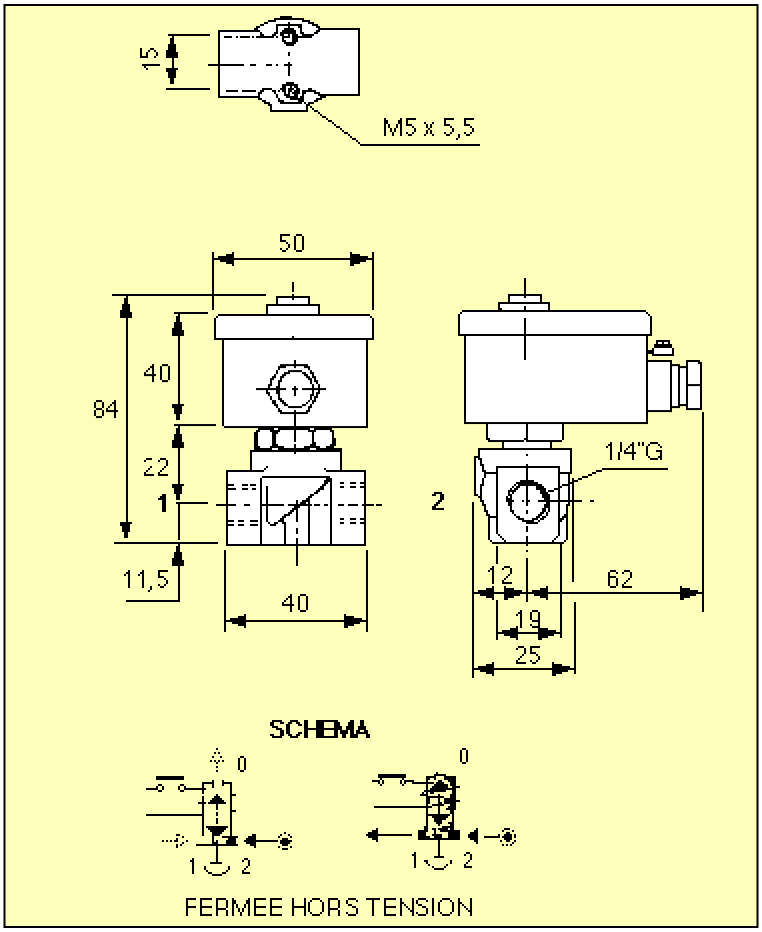
Fatigue -container exit window at risk




ACOL antiproton production target
titanium alloy body (IMI318)
graphite
alumina end plug
iridium clad in nickel
c.d.johnson



Schematic diagram of the mercury jet target – laboratory test



18.60.80.I   ELECTRO-VALVES "LUCIFER" FOR AIR,INERT GASES,NON-CORROSIVE FLUIDS

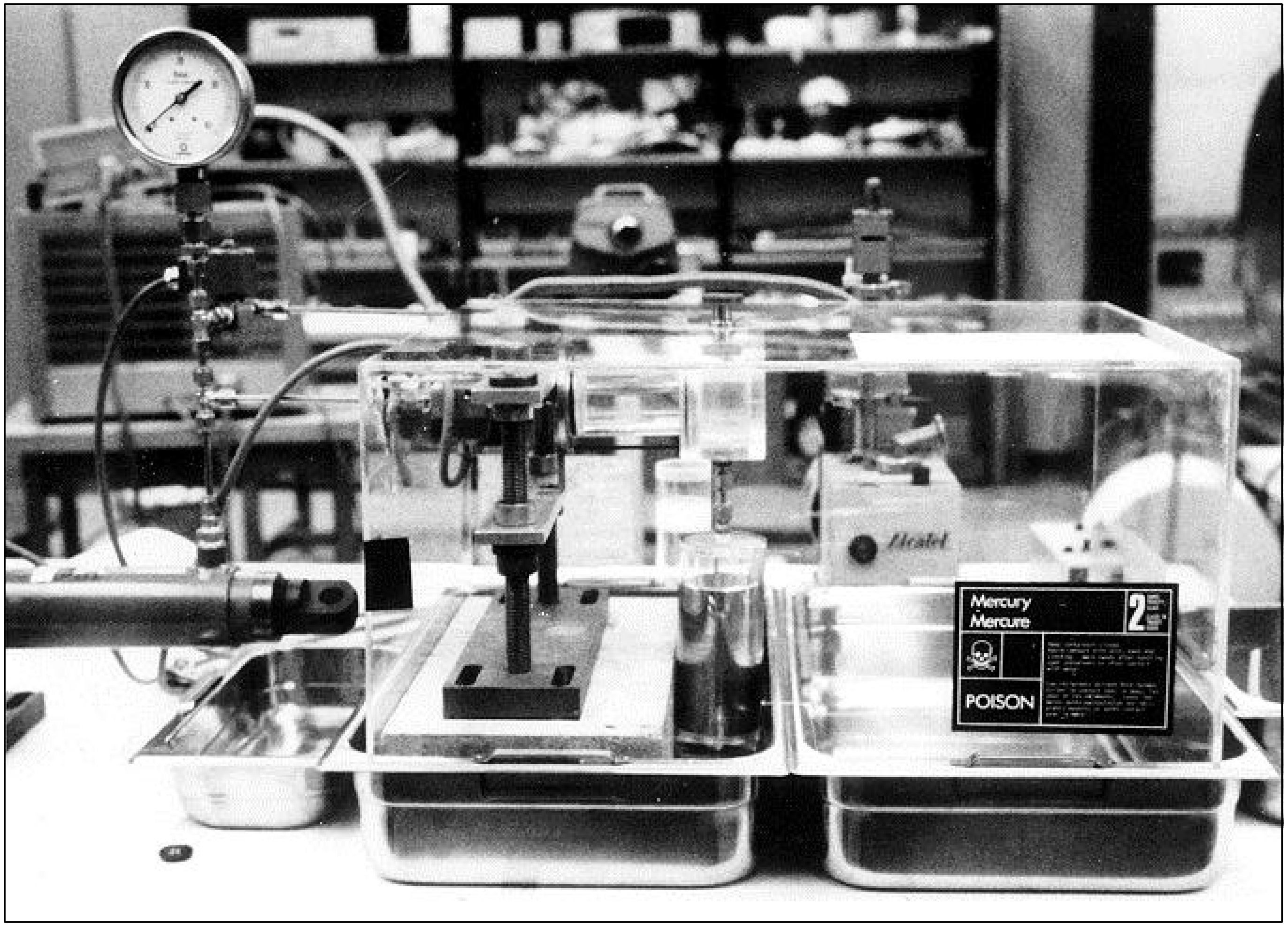
- Images
- Keywords

FRENCH: Air, Corrosifs, Electro, Fluide, Gaz, Inertes, Valve
ENGLISH: Air, Corrosive, Electro, Gas, Inert, Valve
GERMAN: Elektro, Gas, Luft, Ventil, Zerfressend
SUPPL.MANUF.: Lucifer
DUTCH: Lucht

- List of Items

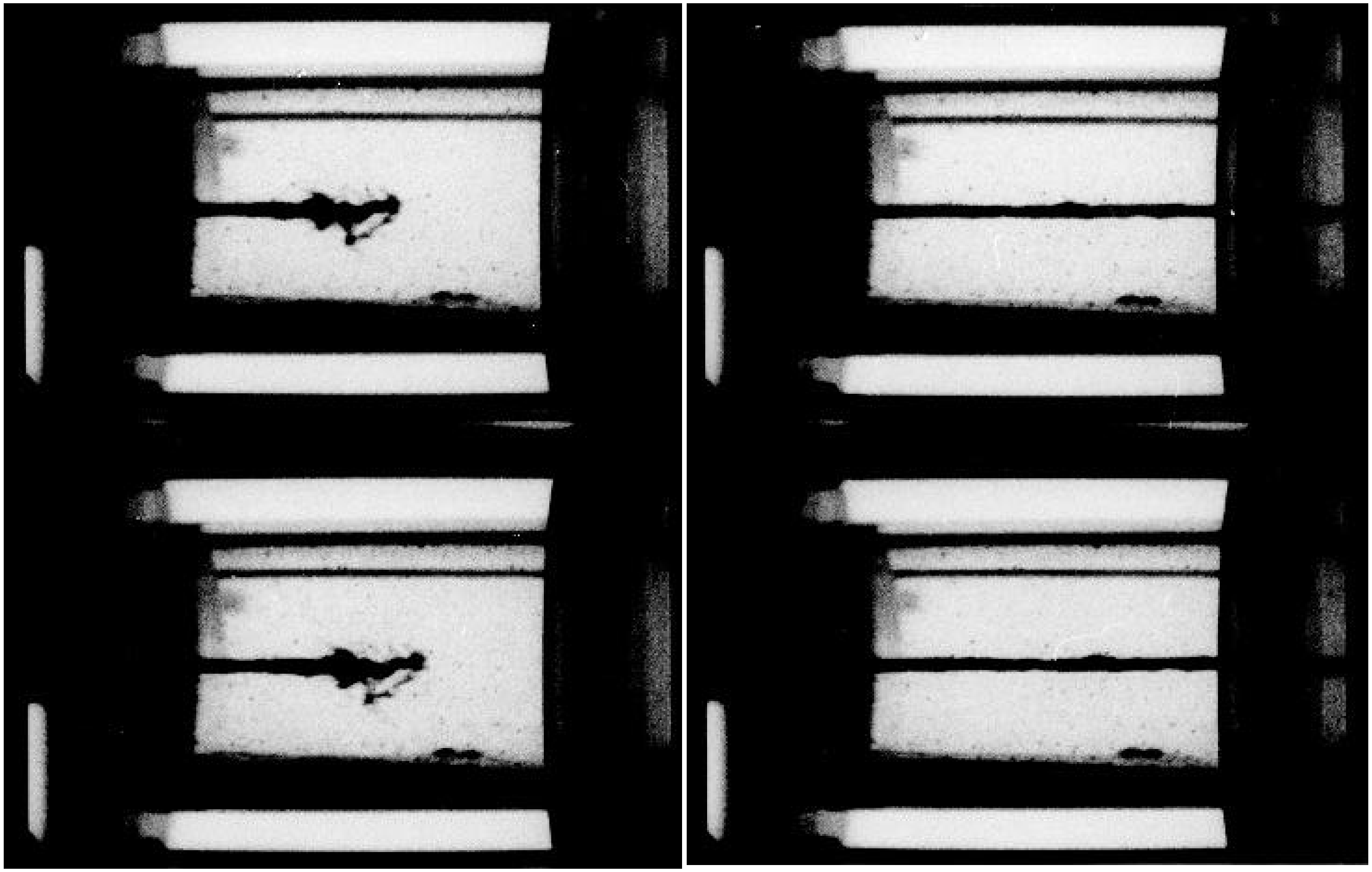
SCEM	DESIGNATION
18.60.80.905.3	VALVE 3/2 (3 voies) type 131 K 04

Valve used for laboratory test of mercury jet target



Mercury jet target - laboratory installation CERN-PS-AA

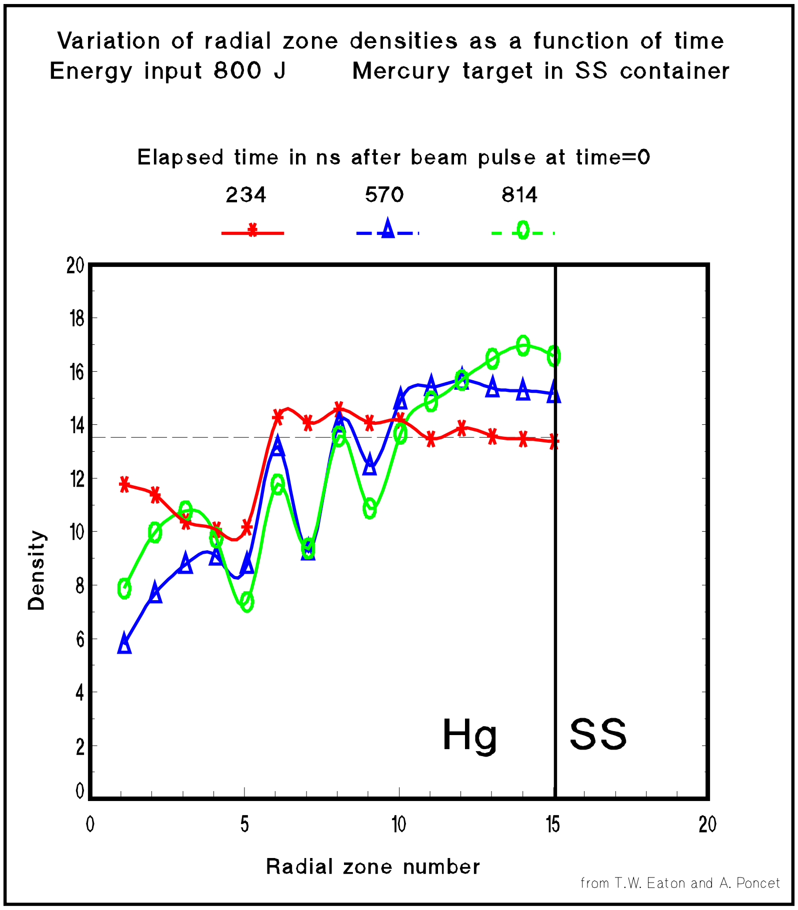
A. Poncet



High-speed photographs of mercury jet target for CERN-PS-AA (laboratory tests)

4,000 frames per second, Jet speed: 20 ms-1, diameter: 3 mm, Reynold’s Number:>100,000

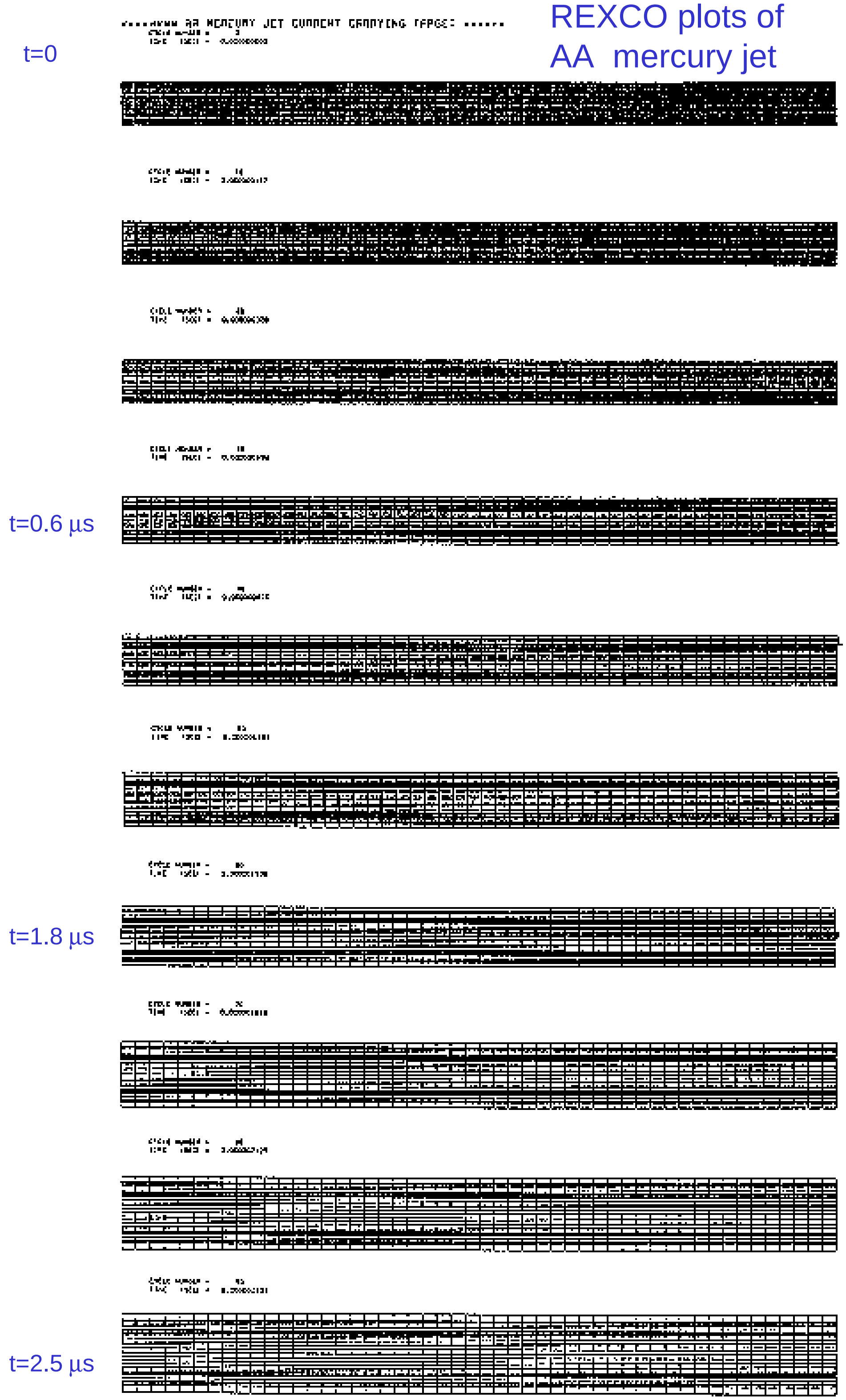
A. Poncet



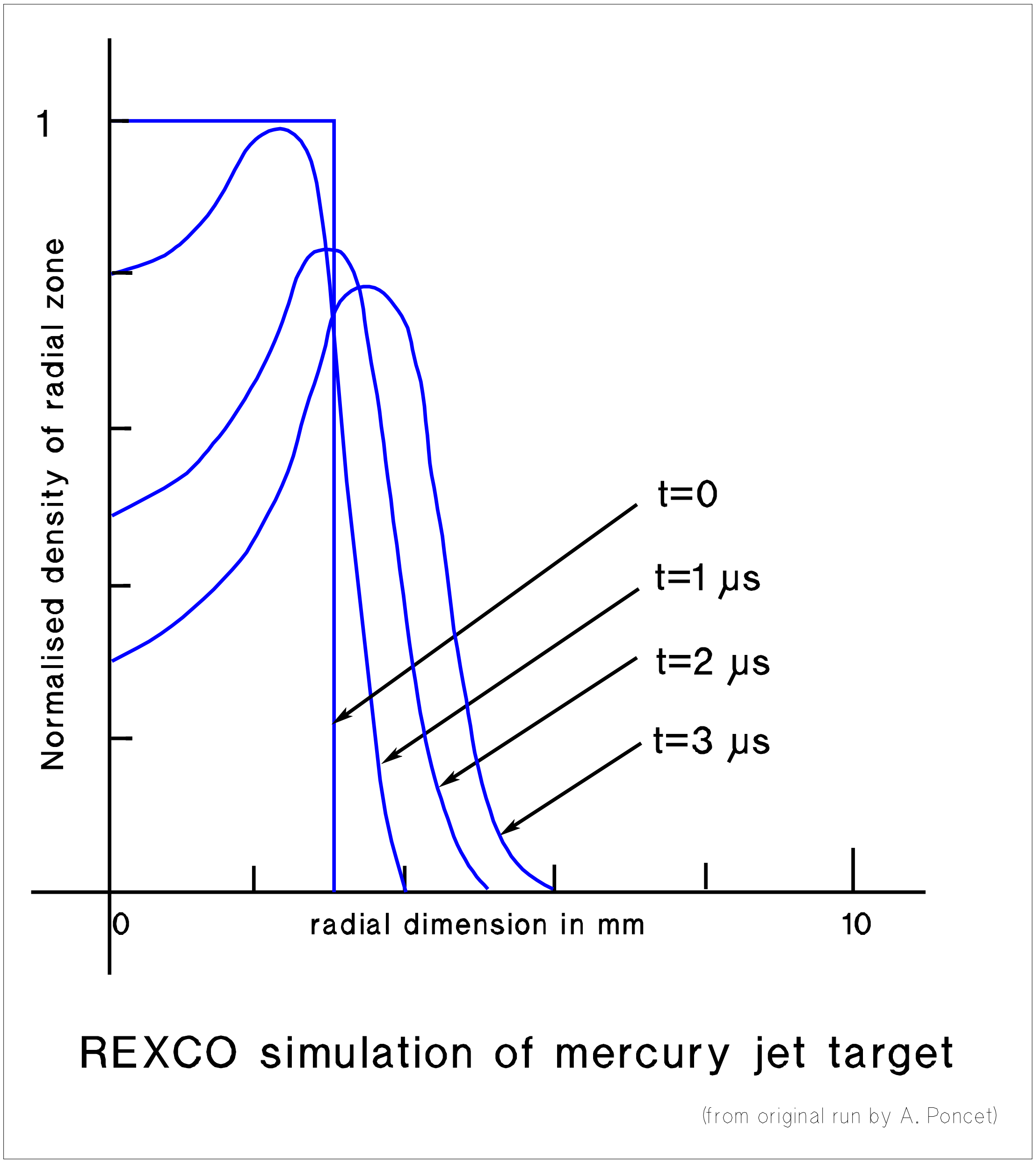
Hydrodynamic calculations of shock waves in a cylindrical mercury target encased in a stainless steel tube using the REXCO code

The mercury column is 50 mm long and 1.5 mm radius. It is divided into 20 equal axial zones and 15 equal radial zones of width 0.1 mm. 800 J of energy was deposited uniformly in the inner 5 radial zones at time zero

REXCO plots of AA mercury jet

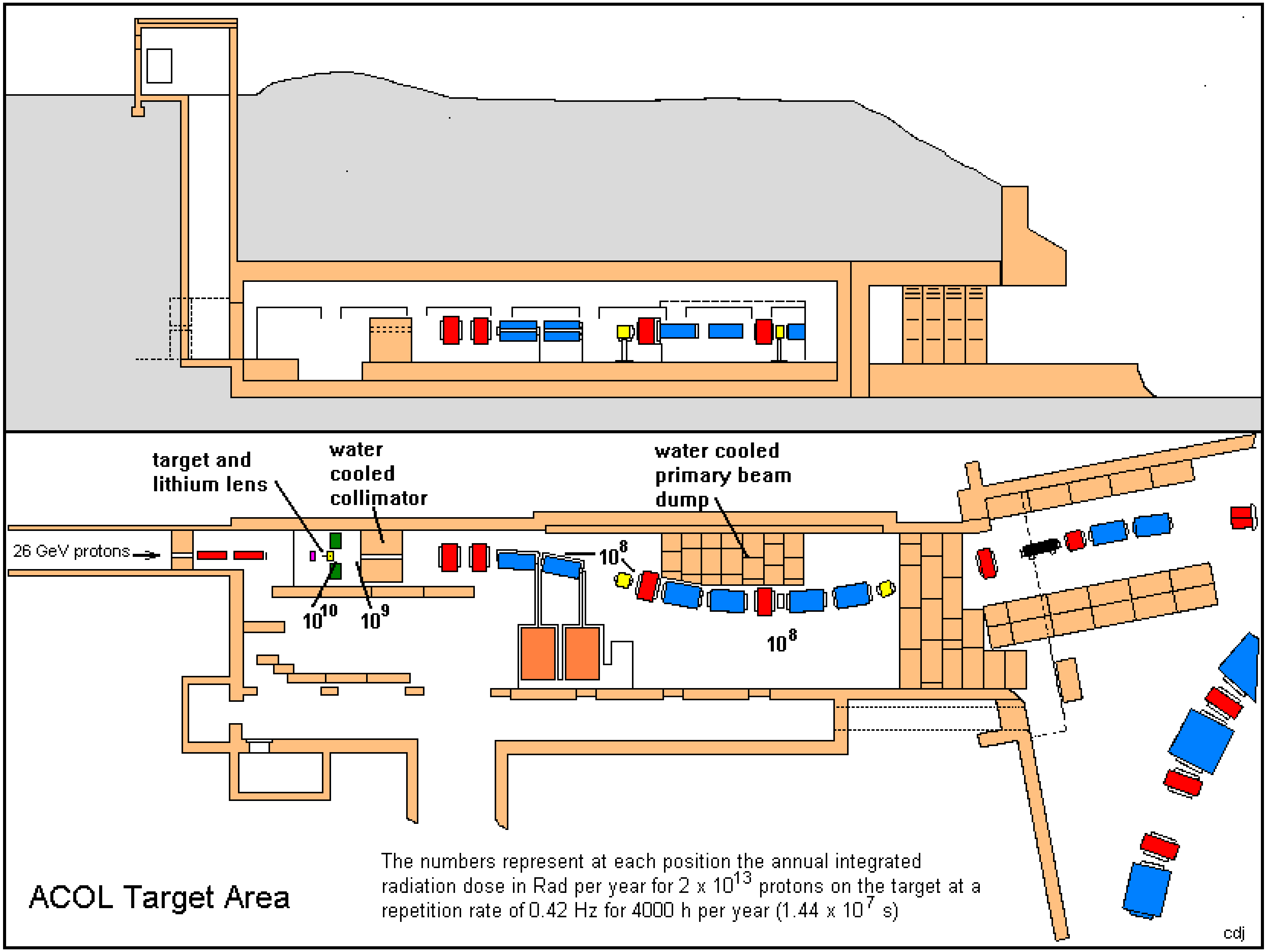


A. Poncet



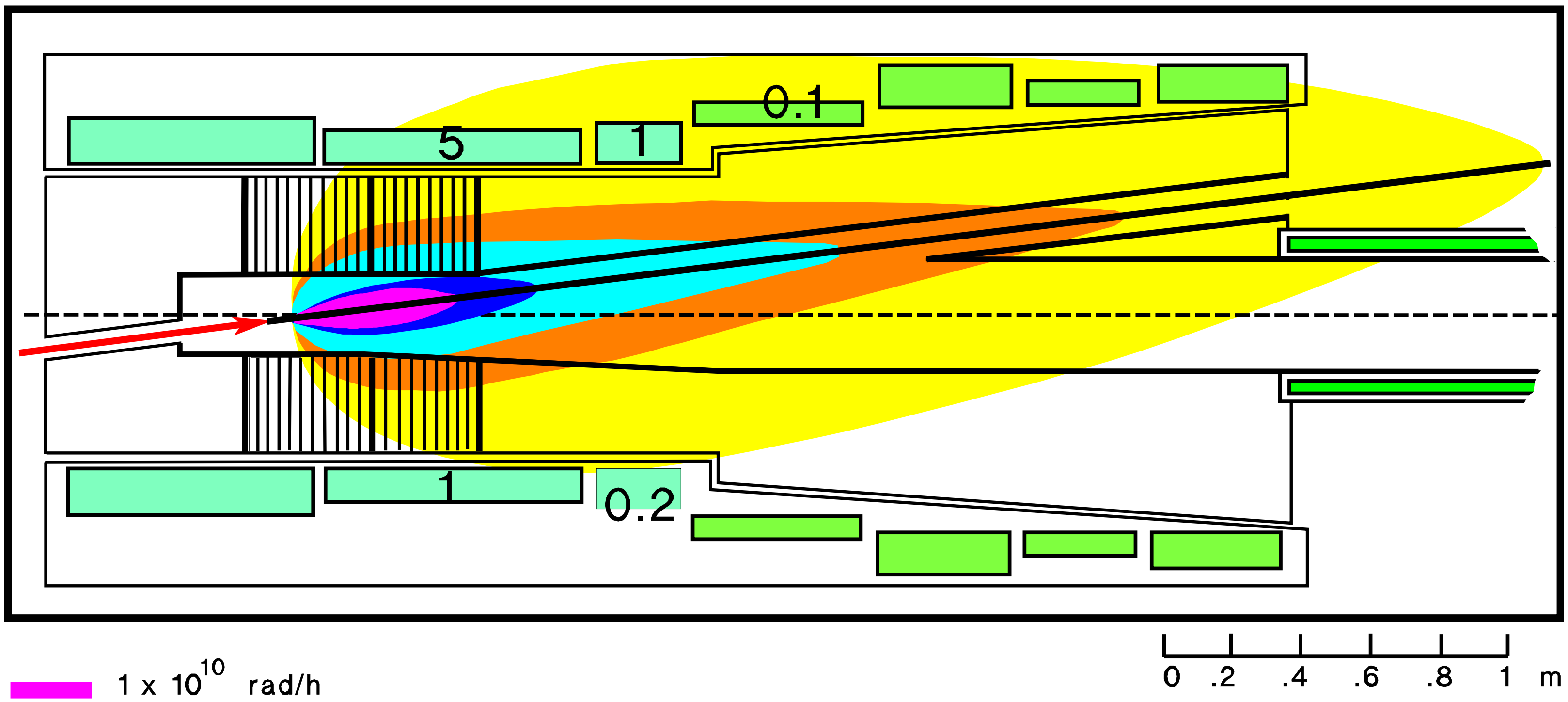
Early simulation of the radial zone density variation in a mercury jet target in which 1 kJ of beam energy is deposited at time zero. The target radius is 3 mm, the length 50 mm and the beam radius (uniform density) is 0.5 mm.

The velocity of the outer zone is approximately: 1,000 ms^{-1}



ACOL Target Area

The numbers represent at each position the annual integrated radiation dose in Rad per year for 2×10^{13} protons on the target at a repetition rate of 0.42 Hz for 4000 h per year (1.44×10^{7} s)



1×10^{10} rad/h

5×10^{9} rad/h

1×10^{9} rad/h

5×10^{8} rad/h

1×10^{8} rad/h

5×10^{19} hadrons/cm²/year

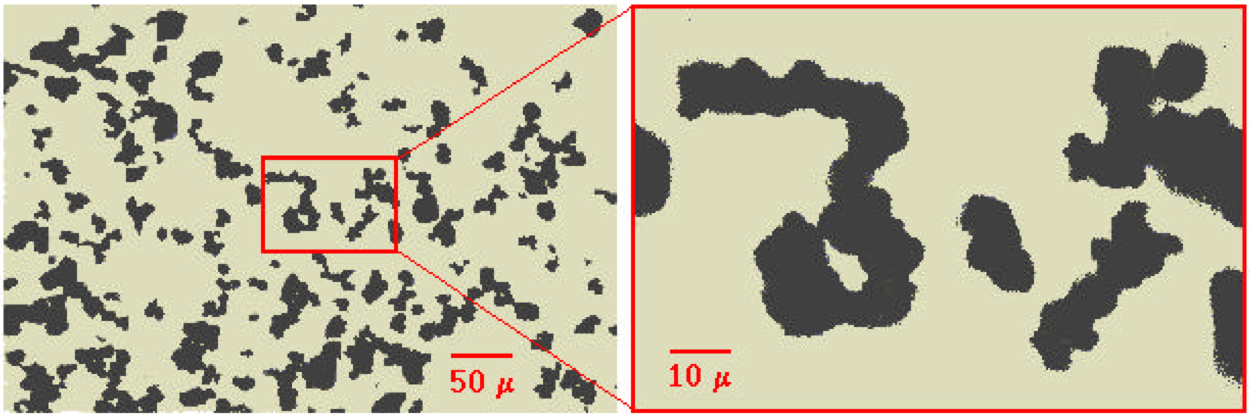
Isodose contours show radiation dose in rad/h for 1.5×10^{15} protons/s on target (from A.H. Sullivan) based on measurements in AA and ACOL target areas

Neglecting the water cooling spaces in the heavy metal absorber, the mean power deposited in the region of the solenoids is shown approximately in W/kg of absorber.

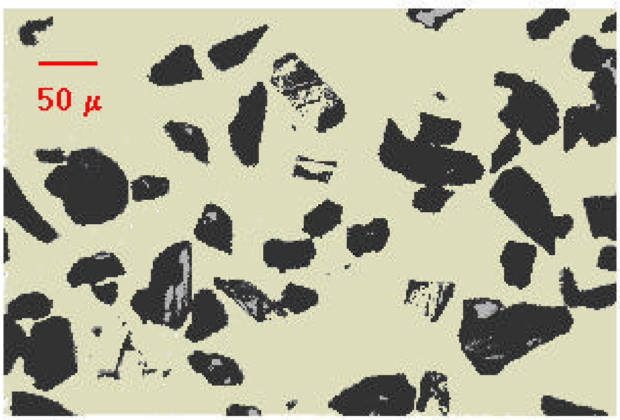
Pion production target and capture solenoids

The 4 MW cooling tower for AA

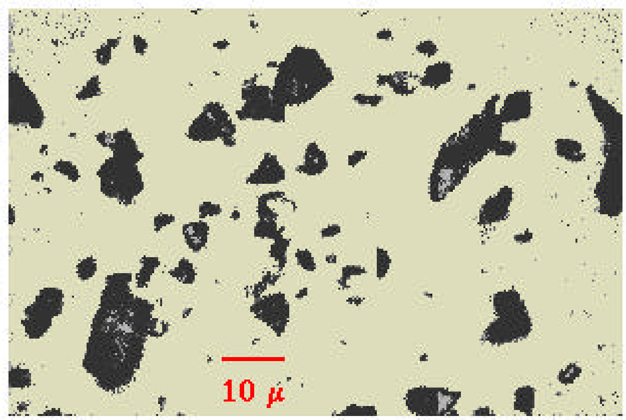
For the pion production target the water will be radioactive.
Maybe a liquid metal (e.g. lead) primary cooling circuit will be preferred.



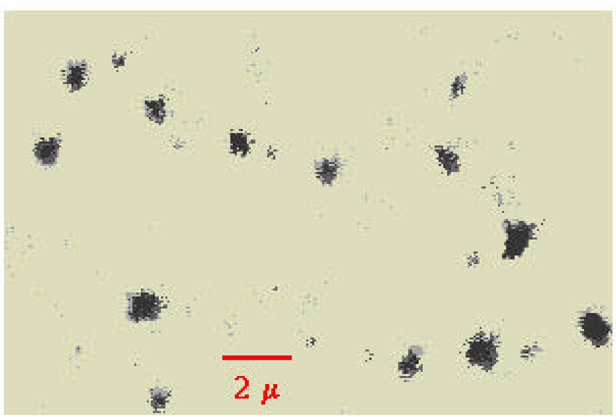
99,95% pure Tungsten Powder from Goodfellow Metals, U.K. - (100 micron max particle size)



Silicon Carbide 350 grain



600 grain



Tungsten Biselenide 0.75 μ from GREPSI, France

Micrographs of various powders used to make slurries.

	Bulk density	Slurry density
W	19.25	7 to 10
SiC	3.22	2.5
WSe_2	?	3 to 4