Coatings for SEY reduction

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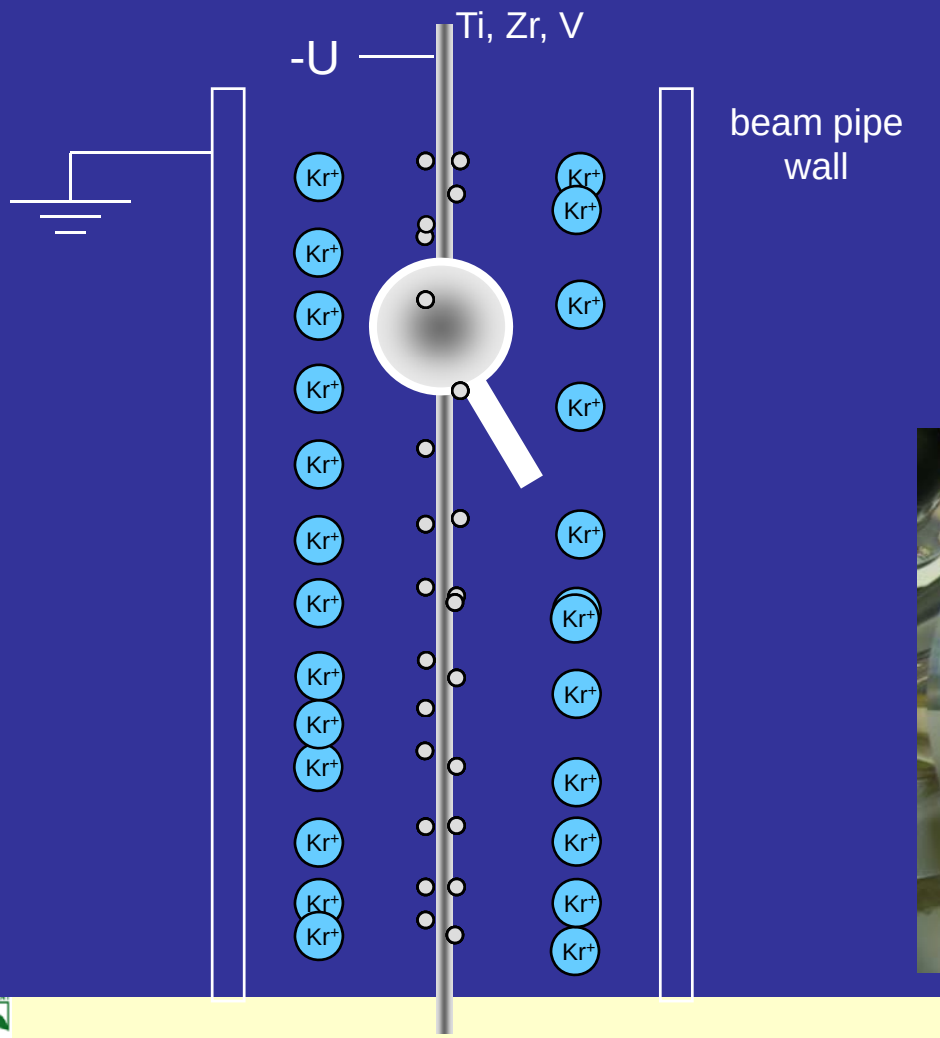
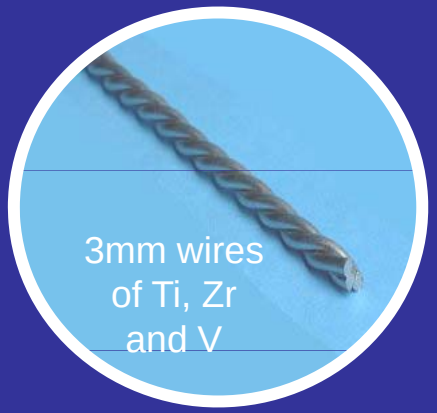
Metal sputtering of TiZrV, example from P. Costa Pinto

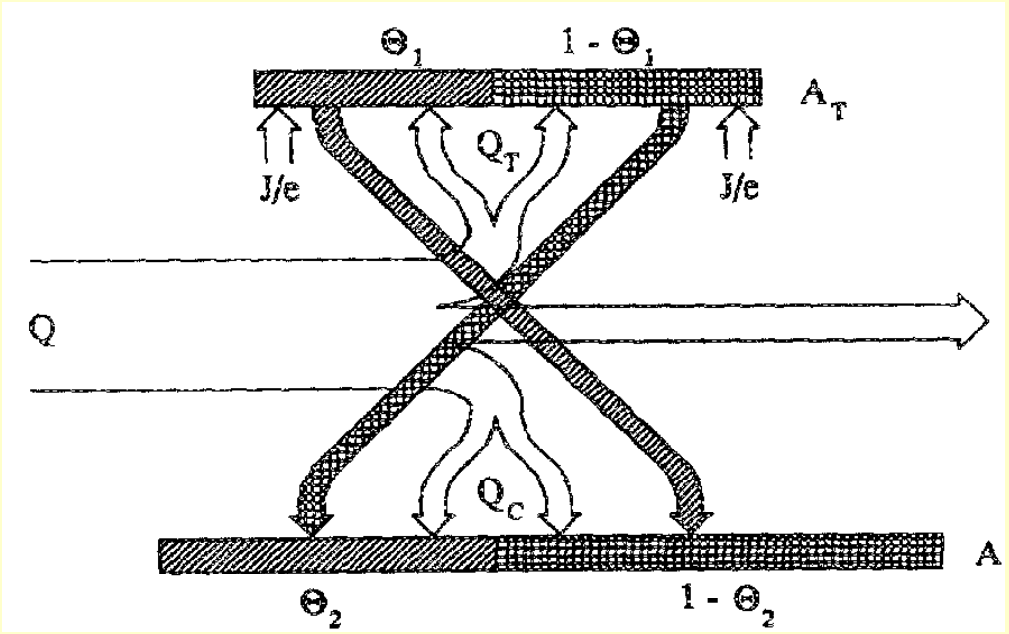
The NEG thin film is obtained by ion bombarding a target made of inter twisted wires of titanium, zirconium and vanadium. The atoms of the target are then sputtered and deposited on the beam pipe walls.

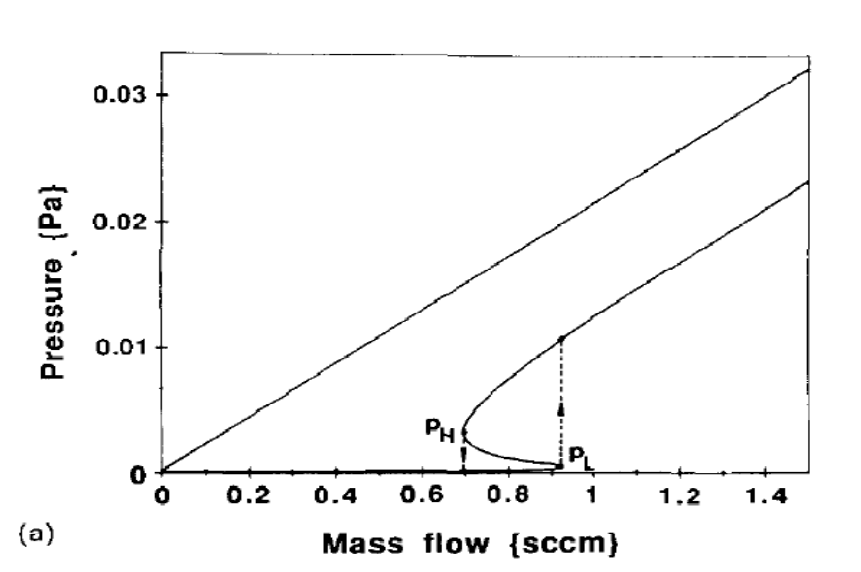


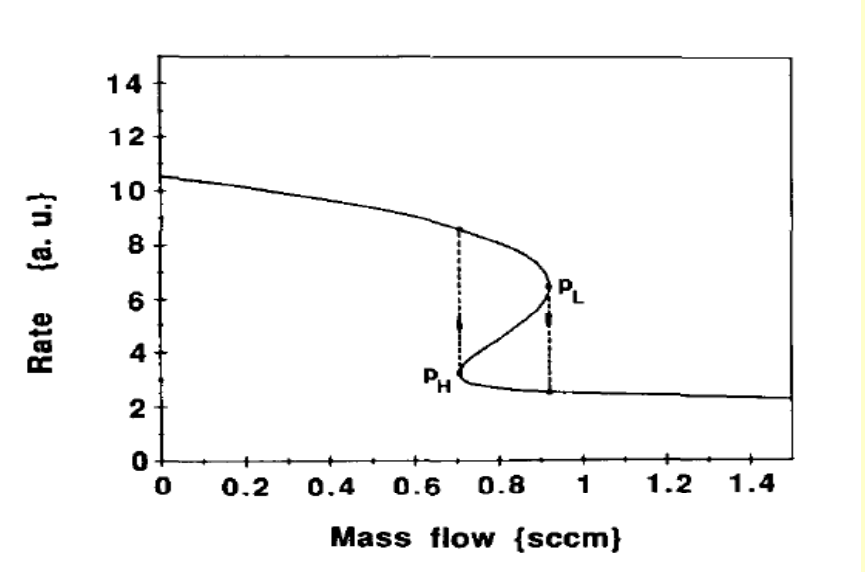


Reactive sputtering: example of TiN

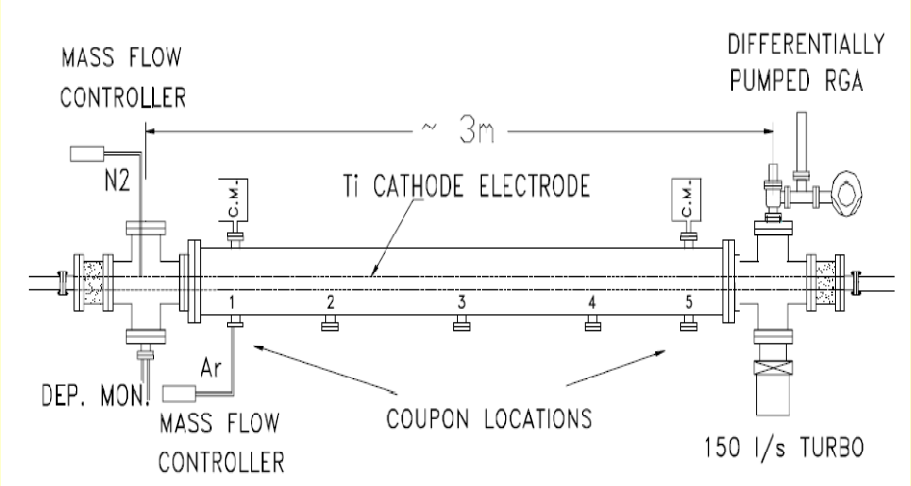
- A nitrogen flow Q is injected into the sputtering chamber
- The nitrogen reacts both at the target and at the substrate with the sputtered titanium
- Increasing the nitrogen flow increases the nitrogen content of the TiN film… really?



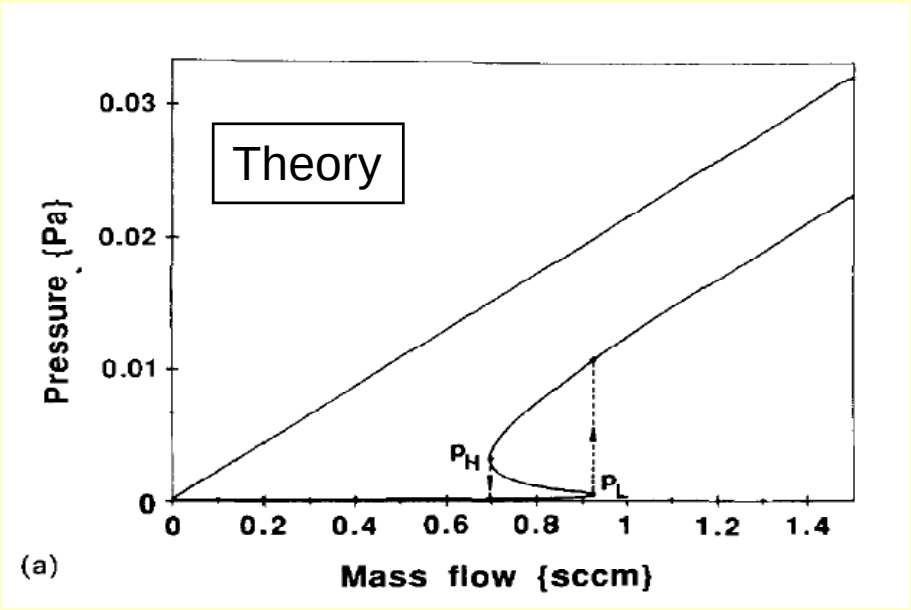


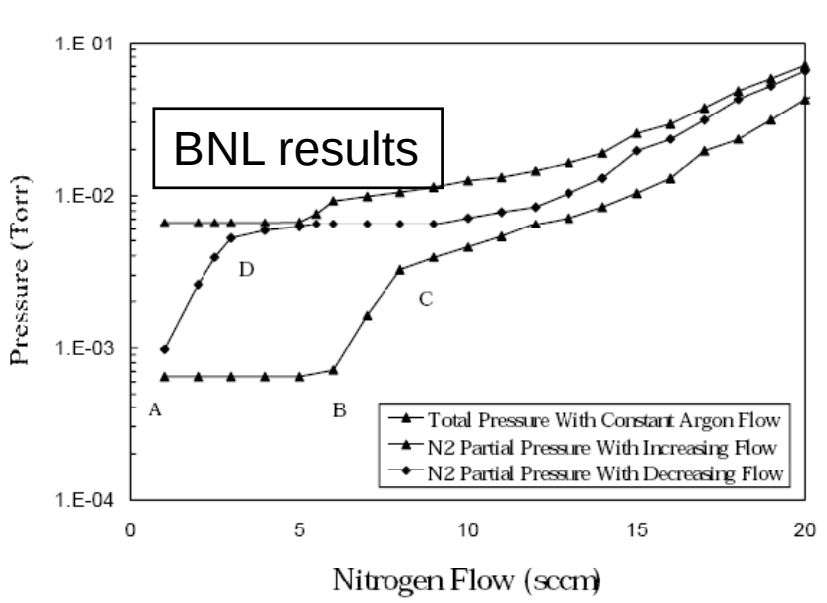


Composition control: experience from BNL

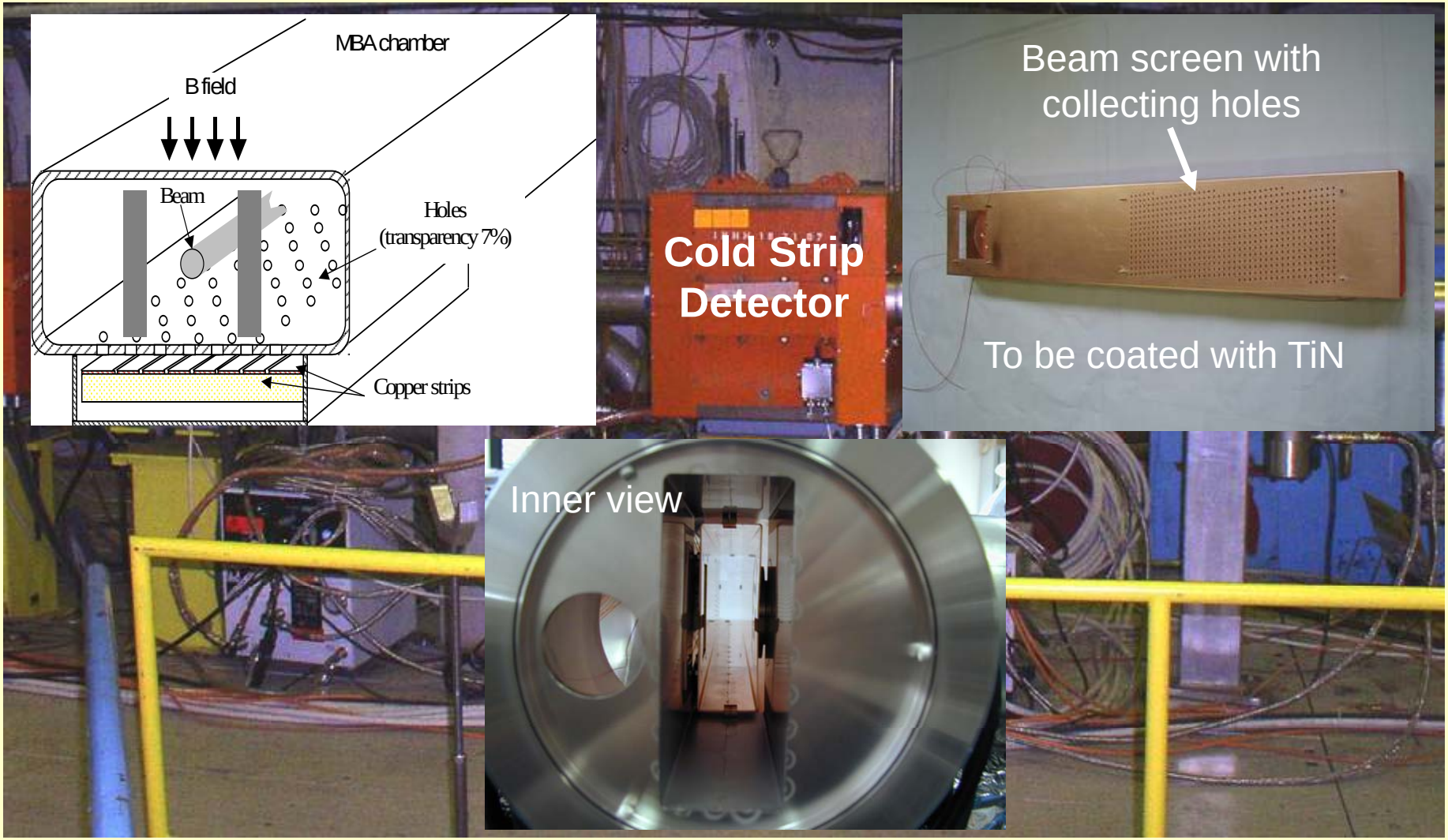


- Ti_1N_1 considered as best choice
- "Gold" colour (smooth surface, "D" operating point) provides higher SEY/lower outgassing than "brown" colour (rougher surface, "D" operating point)
- Composition control along length and cross section has been seen as the most difficult practical aspect



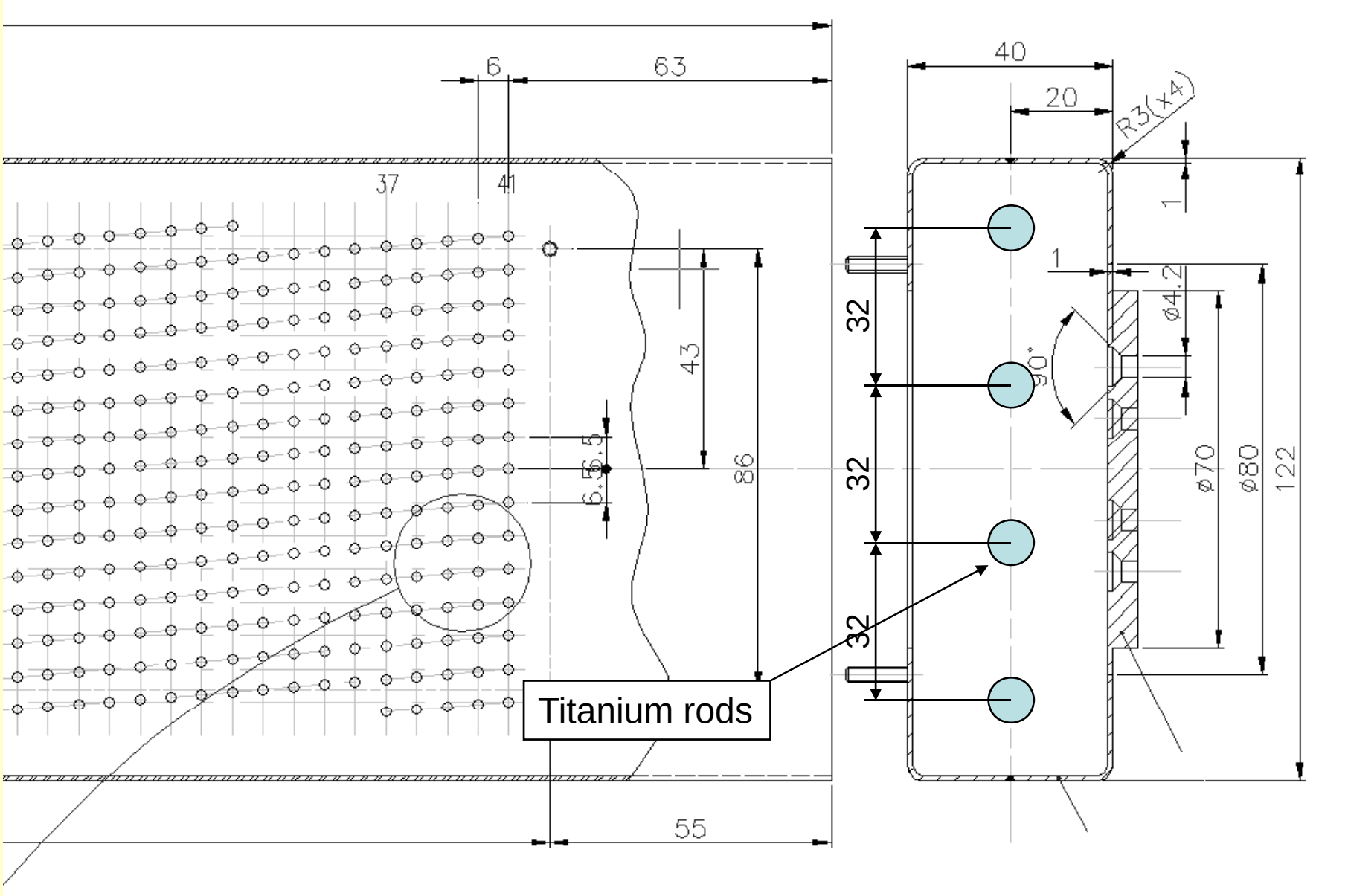


Proposed test at CERN SPS: The CSD detector

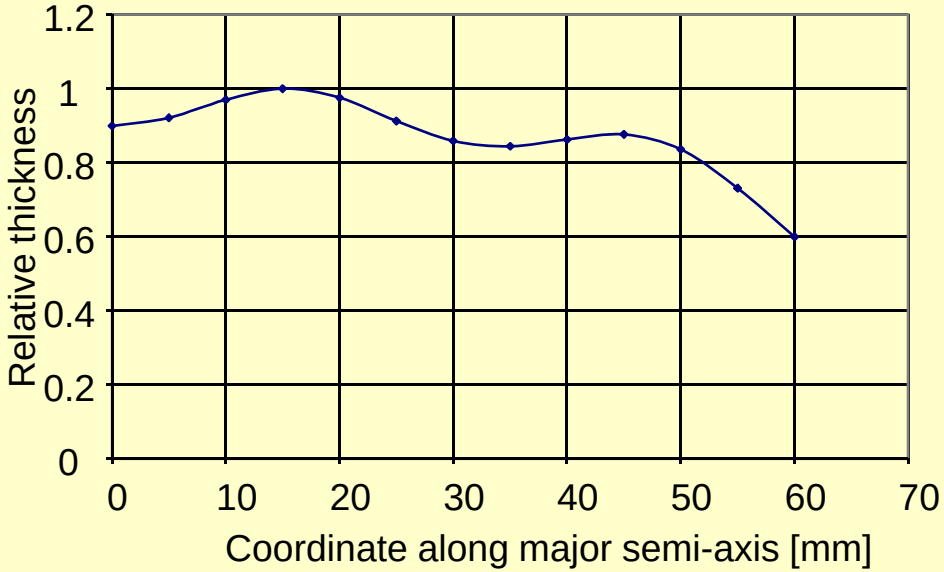


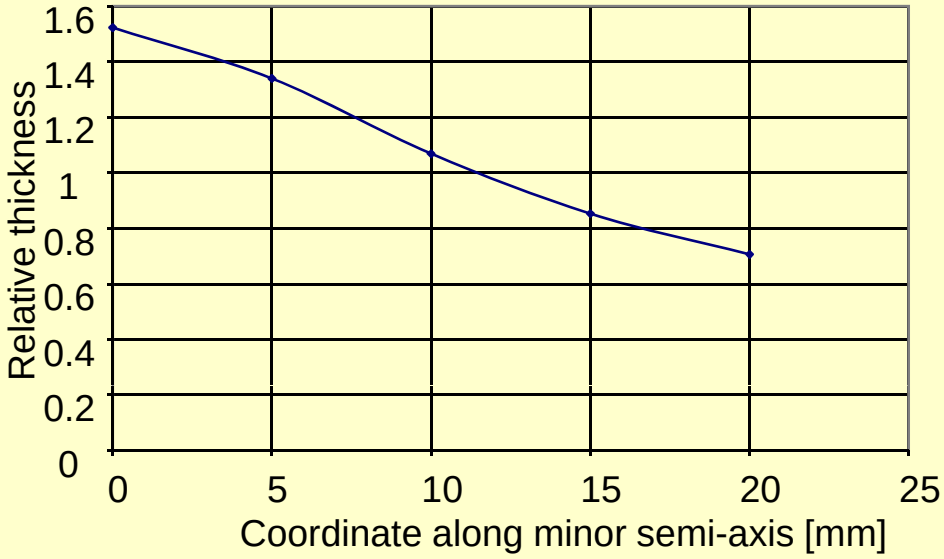
From: J. M. Jimenez

Beam screen geometry



Calculated thickness profile over the beam screen (titanium only)

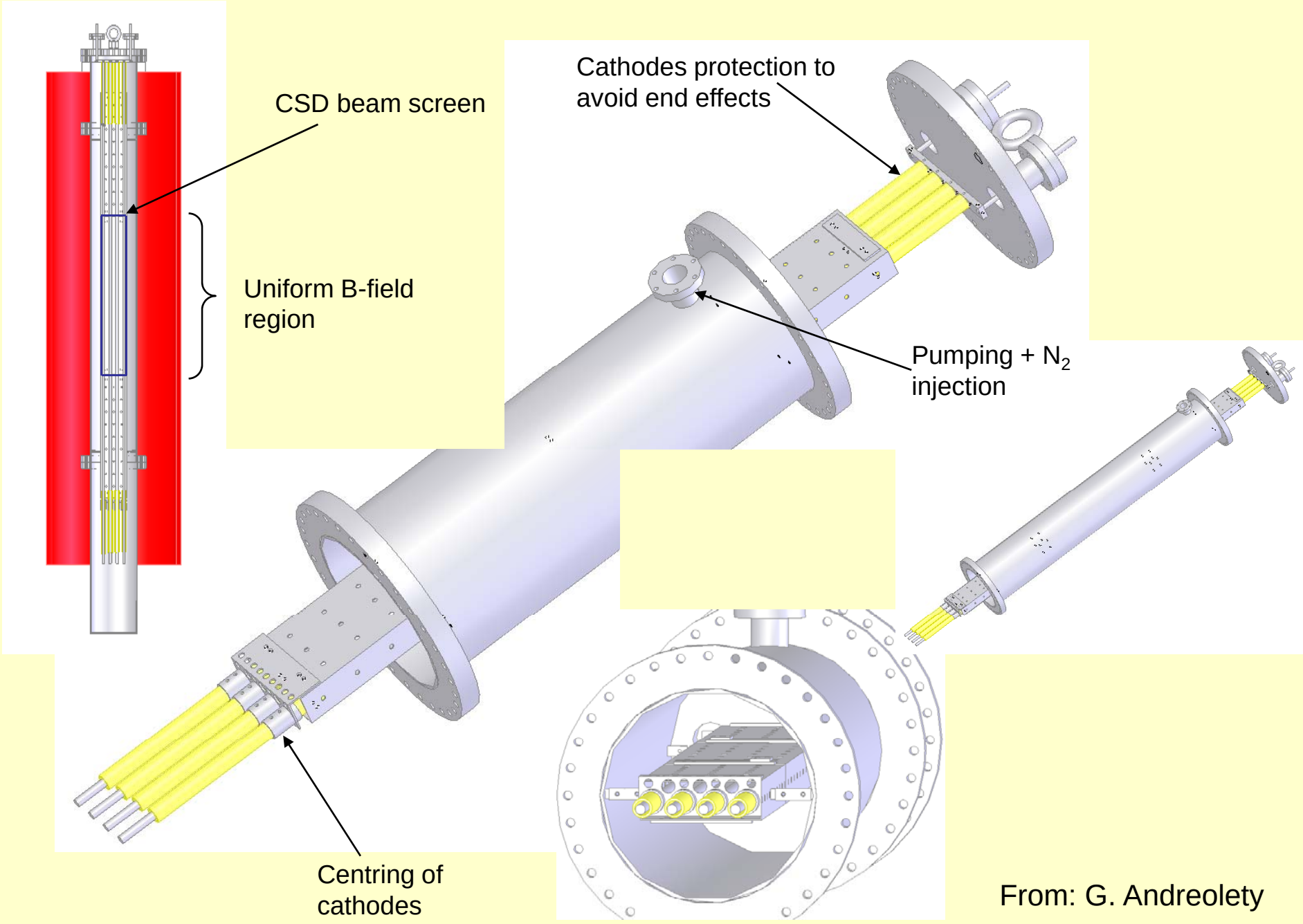




- Cathode spacing 32 mm
- Thickness uniformity along the major semi-axis is within ± 10% over > 50 mm and ± 20% along the full width, which is in the order of the accuracy of controlling the coating process
- Thickness uniformity along the minor semi-axis considered of lesser importance

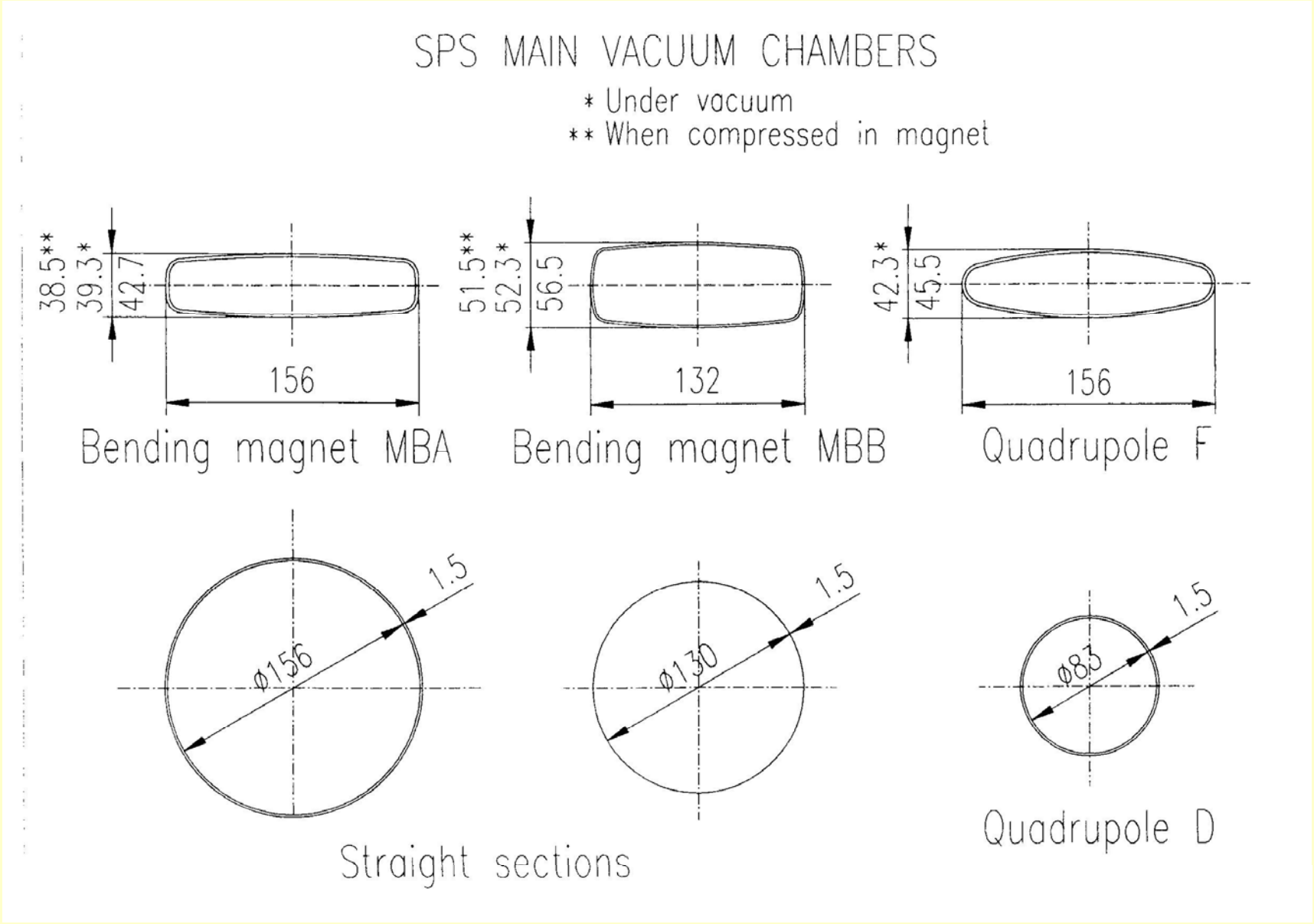
LSS facility

- Chambers of diameter up to 600 mm and length up to ~ 8 m could be coated in the LSS facility
- Modifications of the coating system for performing reactive sputtering are well understood (most hardware already designed and fabricated)
- Cathode, liner and nitrogen distribution line are already procured
- Assembly and setup of coating parameters for operation at the chosen working point could be achieved in 2 months/FTE



From: G. Andreolety

A view to the future: coating the full SPS?



Some references

- Some references on TiN sputtering models
  - Berg et al. J. Appl. Phys. 63 (1988) 887
  - Larsson Vacuum 39 (1989) 949

- Some references on TiN sputtering for vacuum chambers by SLAC, BNL (also for KEKB)
  - Kennedy et al. Proc of PAC1997
  - He et al, Proc. of PAC2001
  - Todd et al, Proc. of PAC2005

- Reference on properties of BNL coatings
  - He et al. Proc. of PAC2003

- INSPEC:
  - 309386 documents with the keywords: Titanium Nitride AND (Coating OR Deposition OR Sputtering)…