



Uwe Filges

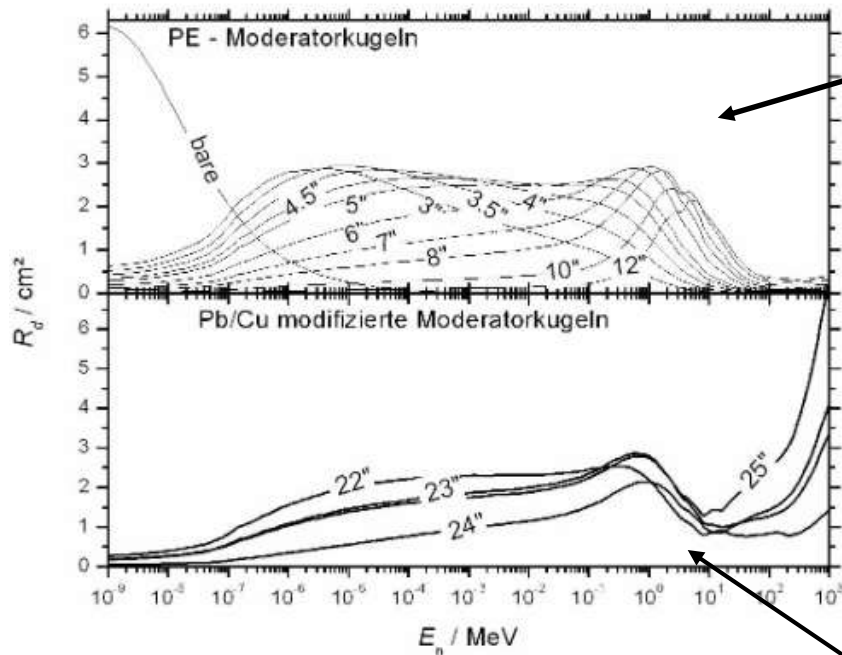
Laboratory for scientific Developments and novel Materials (LDM)

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Extending the BSS system - Manufacturing of Lead Spheres

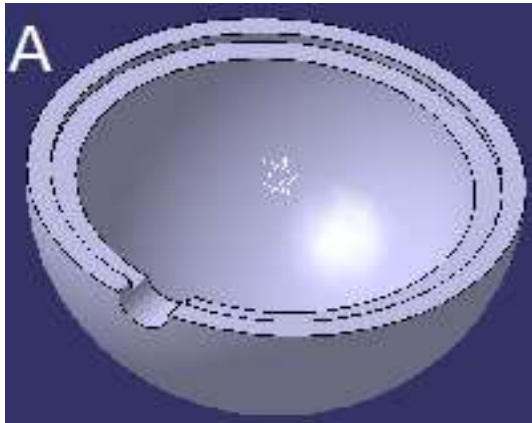
Motivation

Standard BSS – System is limited to measure neutrons up to 20 MeV



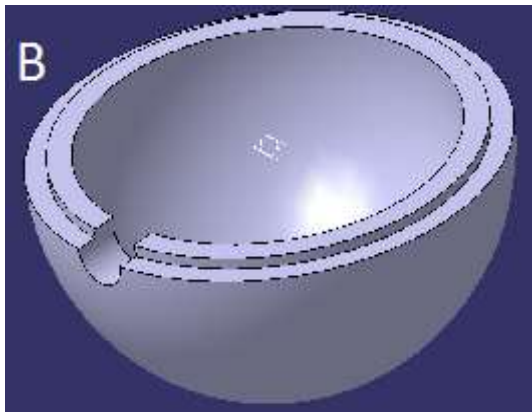
Index (i)	$d_{\text{PE,inside}}$	Material	d_{Inlay}	$d_{\text{PE,outside}}$
22"	3"	Pb	5"	7"
23"	4"	Cu	5"	7"
24"	4"	Pb	5"	7"
25"	4"	Pb	6"	8"

Task: Manufacturing of 3 lead spheres



Practically: manufacturing of 6 half-spheres perfectly shaped with best homogeneity !!

Using pure lead (> 99.9%)– very low Antimony content
-> avoid activation



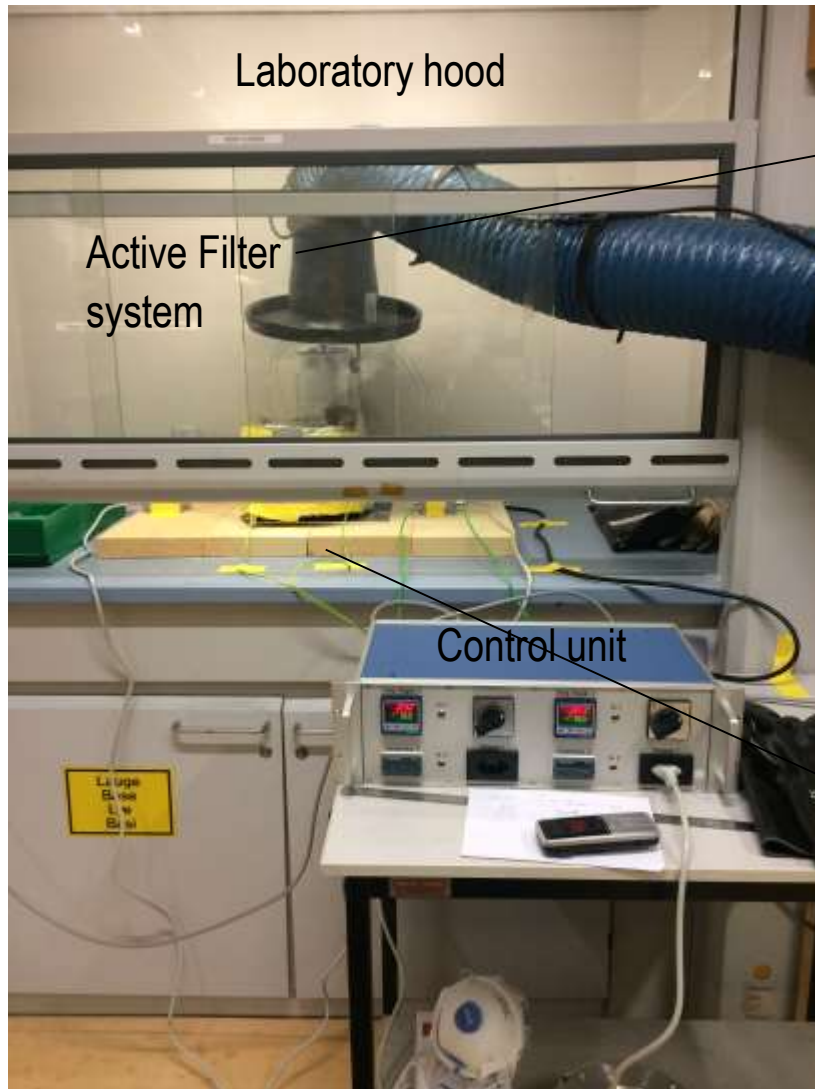
Pure lead is a very soft material - > can't be machined

Technical solution: melting the lead and cast it into
“coquilles”

Bad: Lead is very toxic !! -> especially inhalation of
vapours must be avoided

CADIA - Drawing

General Casting Setup



casting mold covered with insulating material and oven

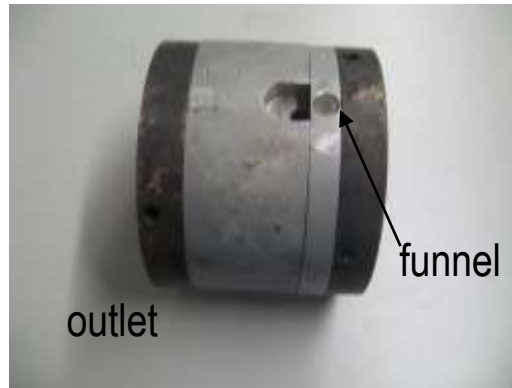
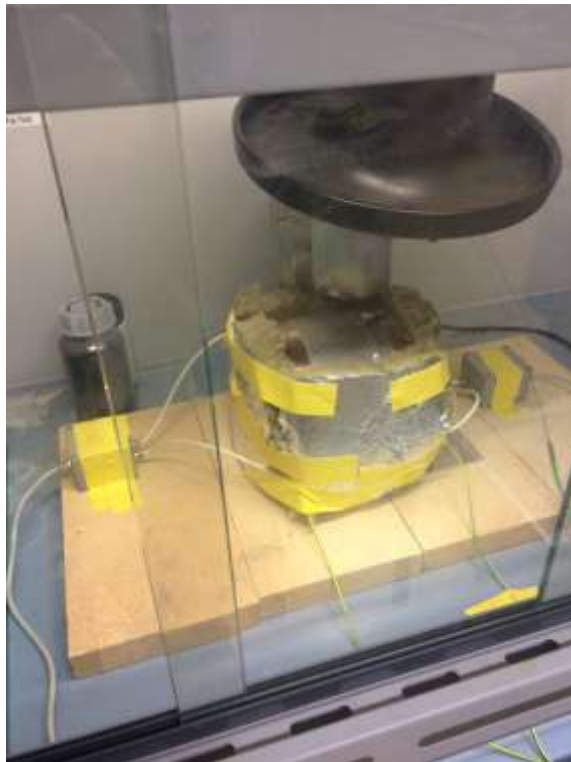


Temperature controlled lead casting !!!

Lead melting temperature: around 328 – 336 °C

Casting Setup (detailed)

Casting mold with add. Cu plates



Oven – especially made for small lead spheres (old guns)



4 heading cartridges are used to hold the coquille on lead melting temperature (entered in the Cu plates)

- Oven had not enough power
- Isolation of heading cartridges breaks after few hours operation
- Openings of casting mold to small



Two high power heading plates (up to 450 C)



Use of bunsen burner

Different Lead Material

Lead cylinders

tiny Lead spheres



Lead bares

Lead bares: a lot of cinder – two processes are needed for reduction of cinder

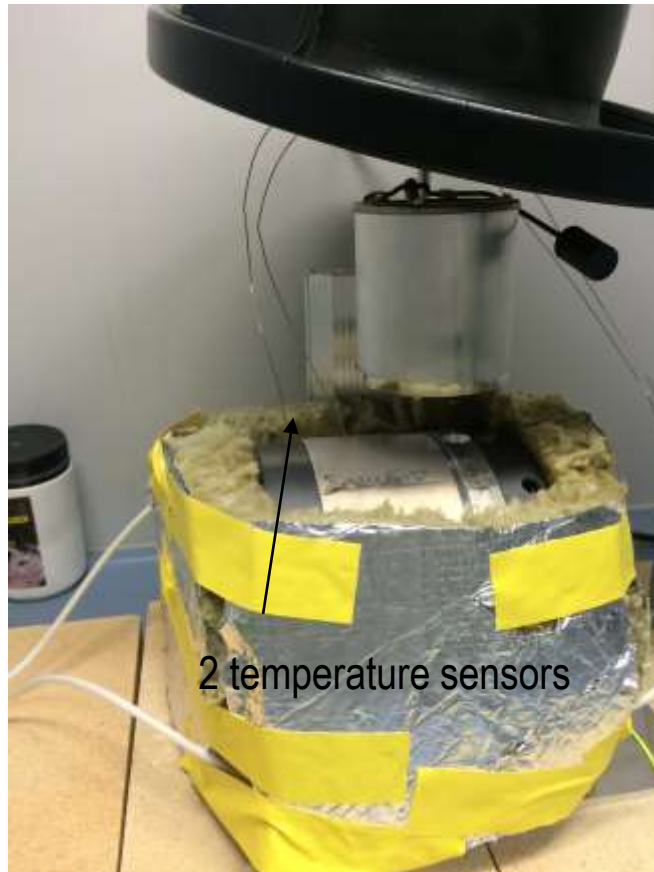
tiny Lead spheres: material was to old – already strongly oxidate (melting point goes up)



Lead cylinders finally used

Homogeneity of the lead spheres

Problem: air can not release completely the casting mold during filling



Temperature controlled heading and cooling
(at least 3-4 times per sphere)



At the outlet the sphere are structured
and not perfectly filled (void fractions).

Weight comparison of the different lead spheres

Sphere-Size (Outer to Inner Diameter, inch)	Mass/kg	Theoretical Mass/kg	Measured Total Mass/kg	Theoretical Total Mass/kg	Difference/kg	Difference/%
5"-4"	2.85	2.88				
5"-4"	2.99	3.029	5.84	5.909	0.069	1.17%
5"-3"	4.57	4.627				
5"-3"	4.78	4.856	9.35	9.483	0.133	1.40%
6"-4"	7.25	7.22				
6"-4"	7.52	7.518	14.77	14.739	-0.031	0.21%



Lead spheres before deburring and polishing

