supernemo collaboration

lapp
Laboratoire d'Annecy-le-Vieux de Physique des Particules

Source production at LAPP

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In2p3

For a good source, we need:

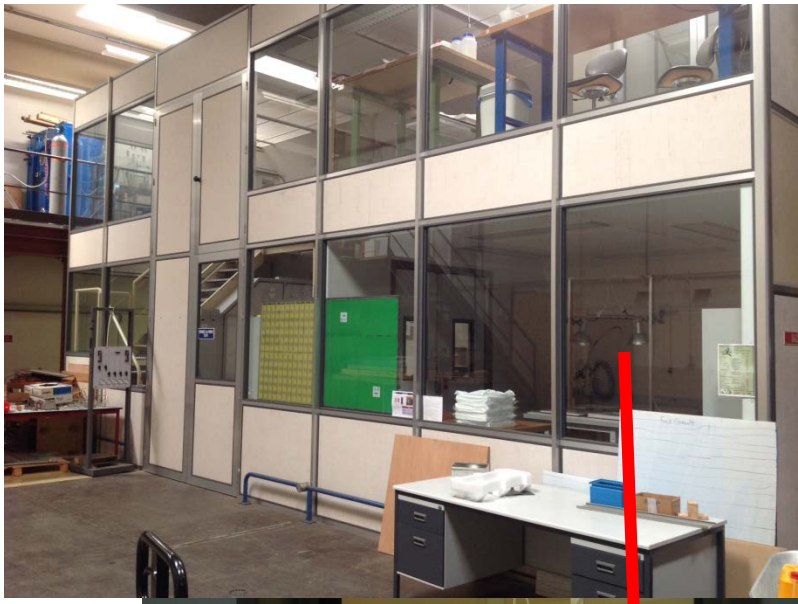
- Selenium
  - Grinding (U.Texas has shown it's difficult). This has not been pursued lately.
  - Produce powder directly after purification. This can be done in Idaho, Dubna or Modane : need to decide soon by taking into account time constraints and the geographic proximity between Modane and Annecy.
- Backing system
  - Baseline ITEP System looks good/practical , but radiopurity issue
  - U.Texas is testing some wire/mesh: interesting results
  - LAPP is testing Tulle: promising results
- Radiopurity
  - PVA (powder and film) has been measured
  - Tests for film/wire/Tulle will be done soon
  - Tests after Se purification still need to be programmed
- Frame (LAPP not involved)

Possible «alpine» scheme (to be discussed)

- Get Se isotope at Modane
- Purify Se at Modane
- Precipitate to powder at Modane
- Prepare dedicated 3m long support in Annecy
- Transport Isotope powder or liquid to Annecy (need special packaging?)
- Pour liquid mixture onto support (with Annecy Tulle or Texas mesh)
- Let dry for a day
- Peel of Source foil
- Put into transport box (probably 3m long, not as flexible as ITEP foil)
- Send to BiPo for Radiopurity measurements
- Transport to Modane & Install into demonstrator

Cleaning à la « Gerda »

- January, cleaning plant installation



Cleaning Procedure

- For stainless steel:
  - Wipe clean with acetone
  - Degrease in a biological bath (Bio-Circle™*L* at 41°C)
    - decomposition of incorporated oil by microorganisms
  - Rinse with tap water then distilled water
  - Ultrasonic bath in basic solution at 80°C
    - 5% highly concentrated grease-solving base (Tickopur R33)
  - Rinse with distilled water
  - Ultrasonic bath in distilled water
    - Removes the base residue
  - Drying in furnace at 100°C
    - Samples stay there until extraction and packaging
  - Package in food-grade cling film (wearing gloves)
- Entire procedure carried out in class-1000 clean room
  - Takes about 1.5 hours per batch of components.
- Procedure developed by GERDA (0νββ search at Gran Sasso)
  - See Maneschg et.al NIM A593 (2008) 448-453.

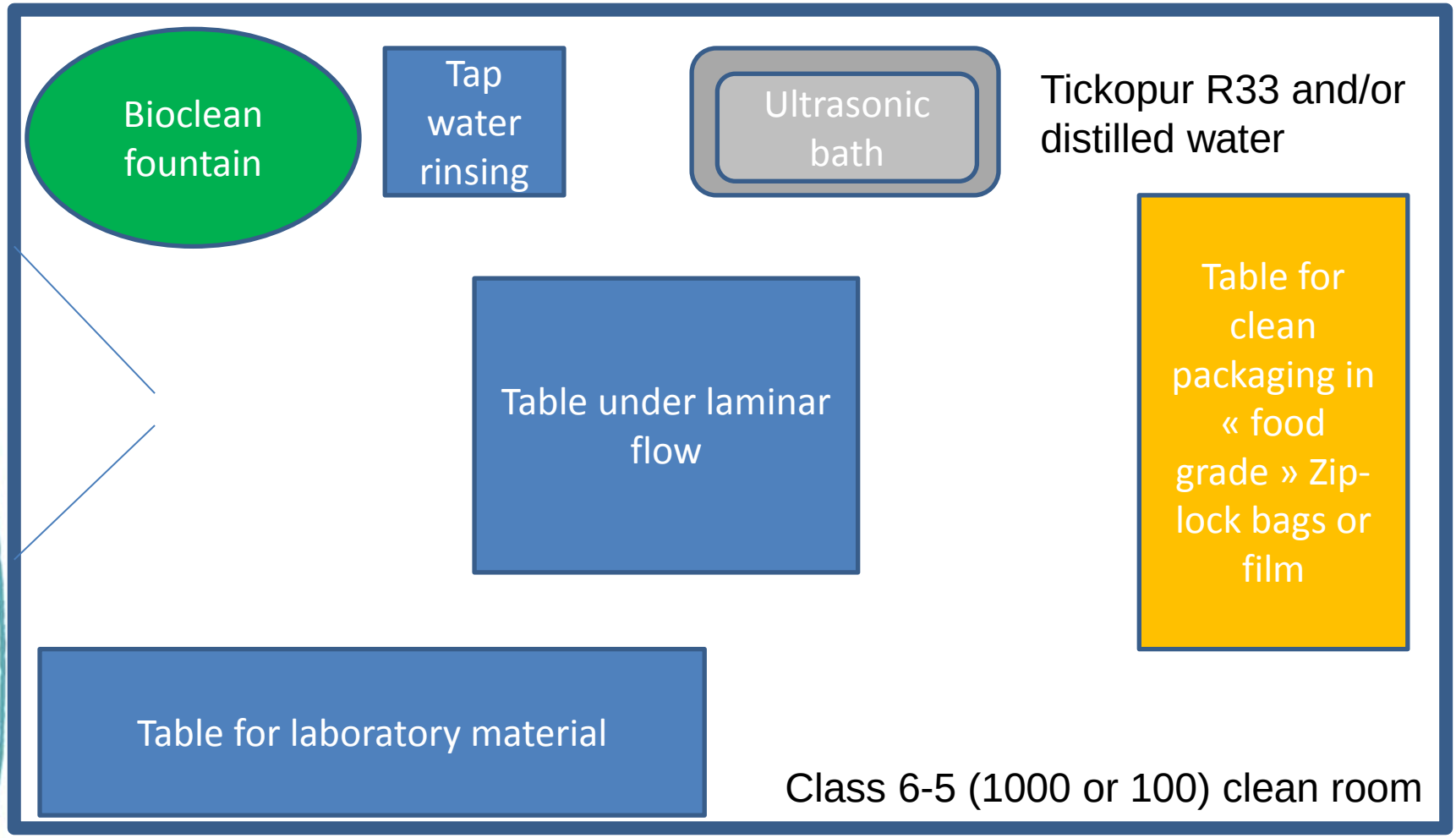
The University of Manchester

J.Pater - Tracker Component Cleaning

Caen - 26 October 2011

Implementation plan at LAPP

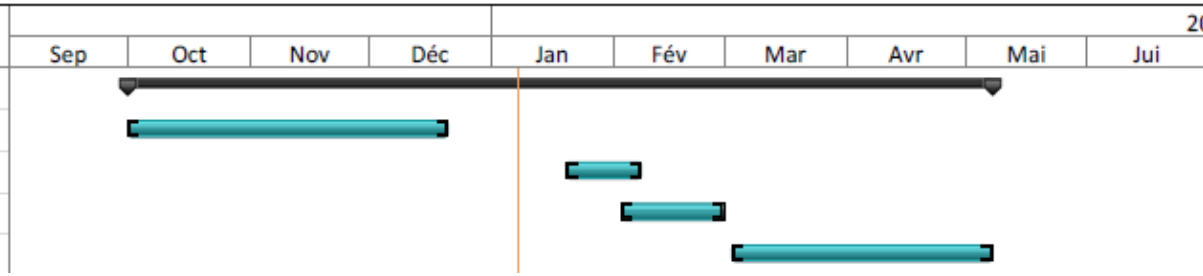
All items ordered, some have been delivered



Timeline

- Time is short! => radiopurity measurement availability critical!
- If we measure Tulle in HPGe and BiPo at the same time, we can have an answer about the Tulle Radiopurity by the end of April.
- Then a test with Natural purified Se on Tulle should be done in BiPo before final Demonstrator foil production

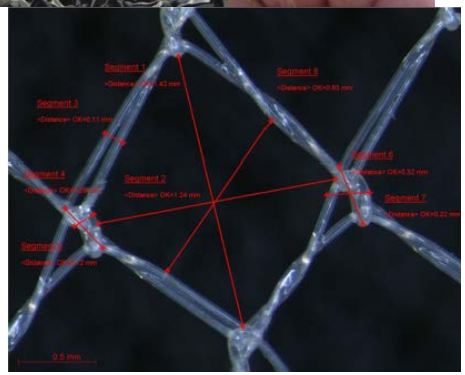
N°	Nom de la tâche
12	**Cleaning**
13	Definition of cleaning procedure
14	Cleaning installation
15	Tulle cleaning
16	Tulle radiopurity measurements



What we tested so far

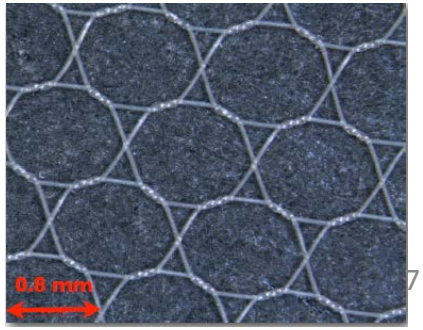
- Fishing wire with PVA
  - Not pursued at LAPP

- Florist Tulle (for free)
  - Used for preliminary tests
  - Similar to the baseline Tulle (except for quality and price)



- Bobbinet Tulle (not for free!)
  - Just set to dry, no chemicals nor glues

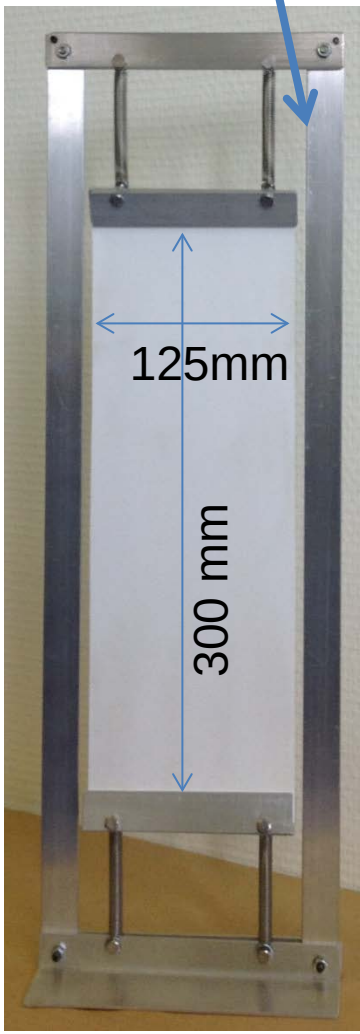
=>More expandable: issue under study



Source foil preparation procedure

- We used Al_2O_3 powder with 15 micron grains.
- Prefer Teflon, Delrin… : closest to final production protocol
- Procedure
  - Heat water to about 80°C
  - Mix with PVA powder for a few minutes until no flakes seen, let cool
  - Add powder. Keep stirring to avoid powder settlement
  - Pour on Tulle in dedicated support: no bubbles or very few
  - Let dry for a night until water has evaporated with heating lamp (lamp will not be used for Se)
  - Peel foil with embedded Tulle
- Result with Florist Tulle
  - Doesn't "twirl"
  - Powder distribution visually OK
  - Easy handling with Tulle
  - Thickness 120-150 microns with 10% homogeneity (with caliper)

Support frame just for demonstration



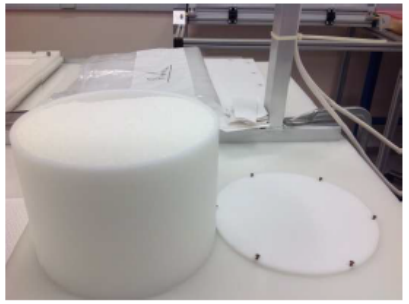
Results give us confidence in technique chosen

Parameters used in tests

PVA: low ash Mowiol 4-88 by Kuraray
H_2O: distilled water for tests
Al_2O_3: 15 micron size grains, density 3,95g/cm^3

Component	Value	Comment
Powder mass	50mg/cm^2	SuperNEMO design
PVA	2g	
H_2O	30g	Not much influence on final foil mass
Al_2O_3	18g	
PVA/powder	10/90	Powder stays in place
Surface	300x125mm^2	

PVA powder for source foil



- sample prepared by A. Jérémie (LAPP) in big Marinelli n°2
- Final measurement performed at LSM during 26 days

Sample	Mass (g)	Time (h)	HPGe Detector	^{40}K (mBq/kg)	^{214}Bi (mBq/kg)	^{208}Tl (mBq/kg)
Marinelli n°2 only (Delrin)	1039	211	Jasmin	30±9	2.0±0.8 (609 keV)	1.2±0.7
PVA powder with substraction of the Marinelli2 activity	1485	626	Jasmin	<5.3	<0.35	<0.12

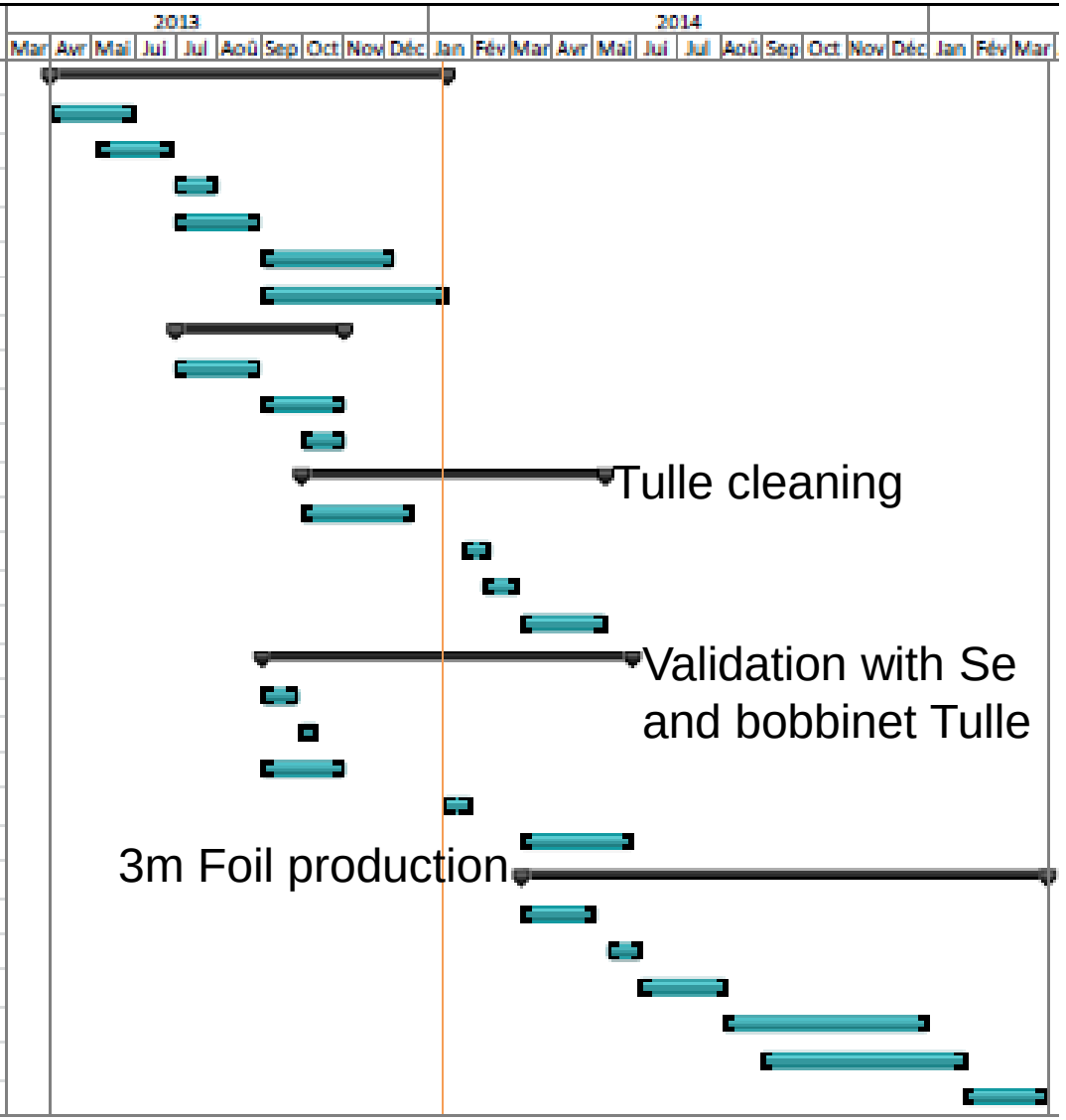
- Preliminary contamination in ^{214}Bi reported at Bratislava colllaboration meeting was coming from the Marinelli itself .

→ PVA powder has a very good radiopurity from HPGe point of view.

→ To be compared with the BiPo results

Timeline

N°	Nom de la tâche
1	**PVA activities**
2	Firsts preliminary tests with old PVA
3	Inquiries for new product
4	Order material, clean room setup
5	Setup PVA radiopurity measurements
6	PVA radiopurity measurements in Ge
7	PVA radiopurity measurements in BiPo
8	**Mechanical support (short)**
9	Inquiries for new internal mechanical support
10	Mechanical support testing
11	Material order
12	**Cleaning**
13	Definition of cleaning procedure
14	Cleaning installation
15	Tulle cleaning
16	Tulle radiopurity measurements
17	**Preparation with powder**
18	First test with Al2O3 powder
19	First test with Se powder
20	Defining security protocol for Se
21	Validate technique with bobbinet Tulle
22	Extended test with Se powder
23	**3m prototype**
24	Defining protocol for 3 m long foil production
25	Pure natural Se foil production
26	Natural Se foil BiPo measurement
27	Full demonstrator foil production
28	Foil radiopurity measurement
29	Foil installation at LSM



Collaborative Source Production

F.Piquemal Bratislava October 2013

To succeed:

- No compromise with radiopurity of materials
- No impasse
- Discussion with experts at any moment in case of doubt
- Exchanges with the collaboration when a problem appears
- Role of the collaboration is to find solution all together, we are in the same boat

=> A collaborative organisation suggested by Alberto Remoto (LAPP) and Federico Nova (U.Texas) and concrete actions have been taken :

- December 6 2013 :telephone meeting between Texas and LAPP on backing solutions tested and exchange of results
- December 18/20 1013: meeting with Se purification experts from Modane and Dubna
- January 17 2014: show and tell meeting in Annecy between Texas and LAPP (you are all invited).
- Regular phone meetings will be organised.
- Mailing list dedicated to Foil Production should be set up including Texas, LAPP, ITEP and radio-purity experts

Conclusion

- Time and resources are scarce! => need to work in a collaborative and efficient manner if we want data next year
- At LAPP, in the past 3 months, we succeeded in producing good source foil samples (with Al_2O_3 and test Tulle)=> promising
- LAPP program for the coming months:
  - Continue tests with Tulle/Mesh and Se
  - Cleaning plant will be ready in a few weeks
  - Tulle radiopurity to be validated: need to measure at the same time in HPGe and BiPo!
  - If pure Se powder can be produced « chemically » directly without grinding: great time saving! No more grinding R&D needed.
  - Decide soon on the Se Isotope flow path
  - As foreseen today, the Source Foil installation can be done early Spring 2015 (difficult before…).