

Some topics to discuss on DART

Why Aria?

<0.1 expected and 0 observed events for Ds-50 with AAr (1Bq/Kg) with an exposure of 1420 Kg d

(\rightarrow ^{39}Ar counts: $1.4e3 \cdot 3.6e3 \cdot 2.4e1 = 1.2e8$ \rightarrow suppression factor!)

Ds-20k is 100t yr so is $100/1.42 \cdot 365$ of times

so to have 0 background one needs to have an ^{39}Ar concentration of 26k times less.

UAr is $0.7e-3\text{Bq/Kg}$ \rightarrow factor 1500

Need another factor of 20 + get rid of ^{85}Kr

This of course does not exclude that we could have 0 background with more background but wiser cuts

Pile up

Max drift time 375us

Background rate with UAr in Ds-20k :

$0.7e-3 * 2e4 = 14\text{Hz} = 14/\text{sec} = 14e-6/\text{usec}$

$\langle \text{Pile up} \rangle = 14e-6 * 375 = 5.2e-3$

with Aria \rightarrow $\langle 0.1\%$

Already done

A Study of the Residual ^{39}Ar Content in Argon from Underground Sources

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Operated underground at 1400mwe (suppression ??)

(in Seruci we are at 700mwe → factor 30 wrt to surface)

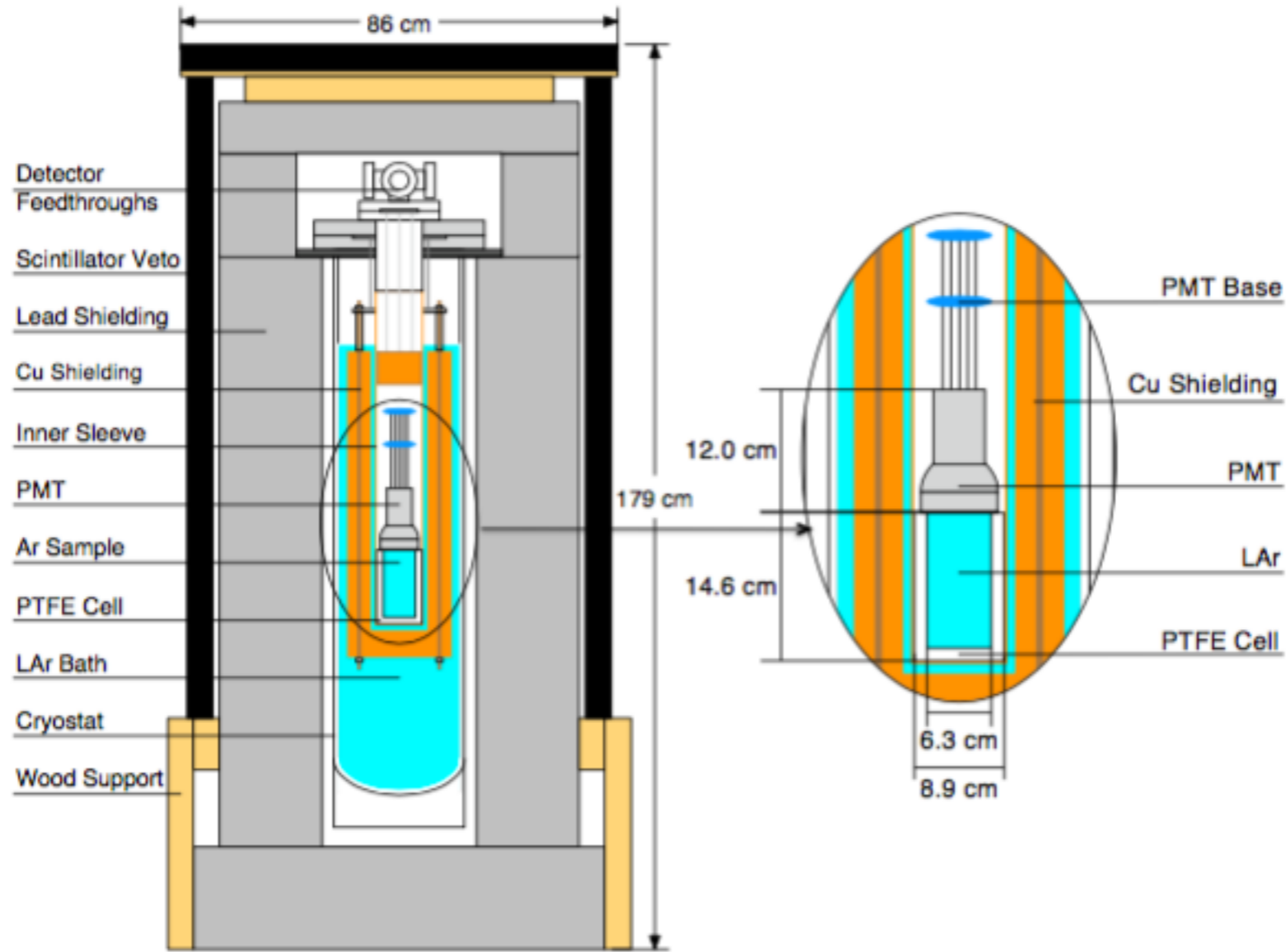


Figure 2: A schematic diagram of the low background detector.

	Rate/mBq, (300, 400) keV
Natural Ar (NAr)	108.78 ± 0.39
Underground Ar (UAr)	1.87 ± 0.06
Estimated Background	1.54 ± 0.22
^{85}Kr Background	< 1.83
NAr, Background Subtracted	107.2 ± 1.9
UAr, Background Subtracted	0.32 ± 0.23

Table 3: A summary of the background subtraction analysis. The entire upper limit ^{85}Kr rate is taken as an uncertainty in the background subtracted NAr rate. To convert these rates into activities per unit mass, an argon active mass of 0.56 ± 0.03 kg can be used.

Source	^{252}Cf	PMT	Base	Copper
Rate (mBq)	0.82 ± 0.16	0.29 ± 0.08	0.07 ± 0.02	0.36 ± 0.11

Table 2: The expected background rate in 300 - 400 keV from different sources.

$^{39}\text{Ar}/^{40}\text{Ar} = 8 \times 10^{-16}$. In 0.5Kg rate due to NAr $\rightarrow 0.5\text{Bq}$ (1.4Bq/l); 100mBq in 300 to 400KeV

$\rightarrow 0.05\text{count/s}$;

overall 86400 counts/Kg/day; end point 565KeV \rightarrow if flat 170counts/Kg/day/keV; indeed at 200KeV is 300counts/Kg/day/keV

UAr =0.6mBq; in this volume 0.3×10^{-3} counts/sec; 1 counts/h ; at 200KeV ; 0.18counts/Kg/day/keV

DAr=0.06mBq; in this volume 0.1counts/h \rightarrow could become $\times 20$ 10Kg \rightarrow **2counts/h**; 0.018counts/Kg/day/keV

Possible dimensions

cylinder $d=20\text{cm}$ $h=30\text{cm}$

2 PM top 2 PM bottom

6. Future Work

The dominant backgrounds in this measurement were identified to be: 1) the unexpected ^{252}Cf source, 2) the radioactivity in the PMT and base, and 3) the cosmogenic activity in the copper shielding. By removing 1) and replacing the PMT with a new version with even lower background, we estimate that

the background event rate in the ^{39}Ar measurement can be reduced by at least a factor of two. A second measurement campaign, implementing these improvements and making use of a more recent batch of underground argon from the Cortez extraction facility, is planned for the early summer of 2012. In the longer term, a more significant upgrade in which the passive shielding of the current experiment is replaced by an active veto composed of organic liquid scintillator is being considered.

Major isotopes

Decay Chain	Measurement Point	PMT (mBq)	Base (mBq)	Cu (mBq/kg)
^{232}Th	^{228}Ra	6 ± 1	41 ± 2.8	-
	^{228}Th	6 ± 1	45 ± 4.7	-
^{238}U	^{234}Th	190 ± 40	25 ± 3.7	-
	^{234m}Pa	80 ± 40	< 149	-
	^{226}Ra	18 ± 1.2	32 ± 1.9	-
^{235}U	^{235}U	8 ± 2	1.4 ± 0.4	-
^{40}K	^{40}K	79 ± 10	65 ± 9.3	-
^{60}Co	^{60}Co	8.8 ± 0.8	< 1.2	2.1 ± 0.19
^{57}Co	^{57}Co	-	-	1.8 ± 0.4
^{58}Co	^{58}Co	-	-	1.7 ± 0.09
^{56}Co	^{56}Co	-	-	0.2 ± 0.03

Table 1: The major radioactive isotopes in detector components.

Calaprice's proposal

Use PMT off the shelf from Hamamatsu that have a reduced radioactivity (as in DS-10) and even better some new ones under development with even less radioactivity

Use Copper produced underground (contact Gerda?)

Use Roman Lead for the inside shielding (lead++ for shielding lead - -):is there any left?

**For cryostat also consider low background copper.
Feasible? (Marco, help...)**

Offer from Calaprice

Send us his device to play with
do we need it?

Urgent actions

Contact people doing simulations (GEANT?) of background in DS to replicate it with our setup

—> Alberto contacted Paris group

Understand if we need to go underground and if the mine is enough or we need LNGS

Understand if possible to use f90 to reject neutrons or use passive filter

—> ask Calaprice or do it in the bunker

Technical issue LAr

Discussion with Augusto

Dust in the underground cavern should be considerably reduced after refurbishing

Clean room is only for us

How to get LAr from Aria?

Aria-1 will produce gas argon stored in 200bar bottles

—> we need cryocooler OR LN (this may cause safety issues)

Aria-2 could yield LAr directly

Discussion with Galbiati/ Batignani /Fiorillo

Necessaria simulazione GEANT dei fondi → Luciano Pandola appena entrato espertissimo

inoltre viene da GERDA quindi sa del rame underground.

Accettata l'idea di portare qui il trabiccolo di Calaprice : prima fase test di Aria con NAr → riduzione $1e-2$ → va benissimo

Per ragioni politiche Galbiati vorrebbe usare i SiPM ma: saranno radiopuri???

Galbiati → considerare la possibilità' di fare lo schermo attivo con NAr con fototubi

Si e' anche discusso di usare Ds-50 per questo test ma ci sono problemi di vario genere.

Su chi lo paga non si e' deciso nulla e dipendera' anche dal costo

Obsolete proposal

Measurement of Ar-39 in Argon

Andrew Sonnenschein, David Finley, Stephen Pordes, Richard Schmitt,
C. J. Martoff

with gas argon;

for 700cm2**

lead: low 210Pb Doe Run

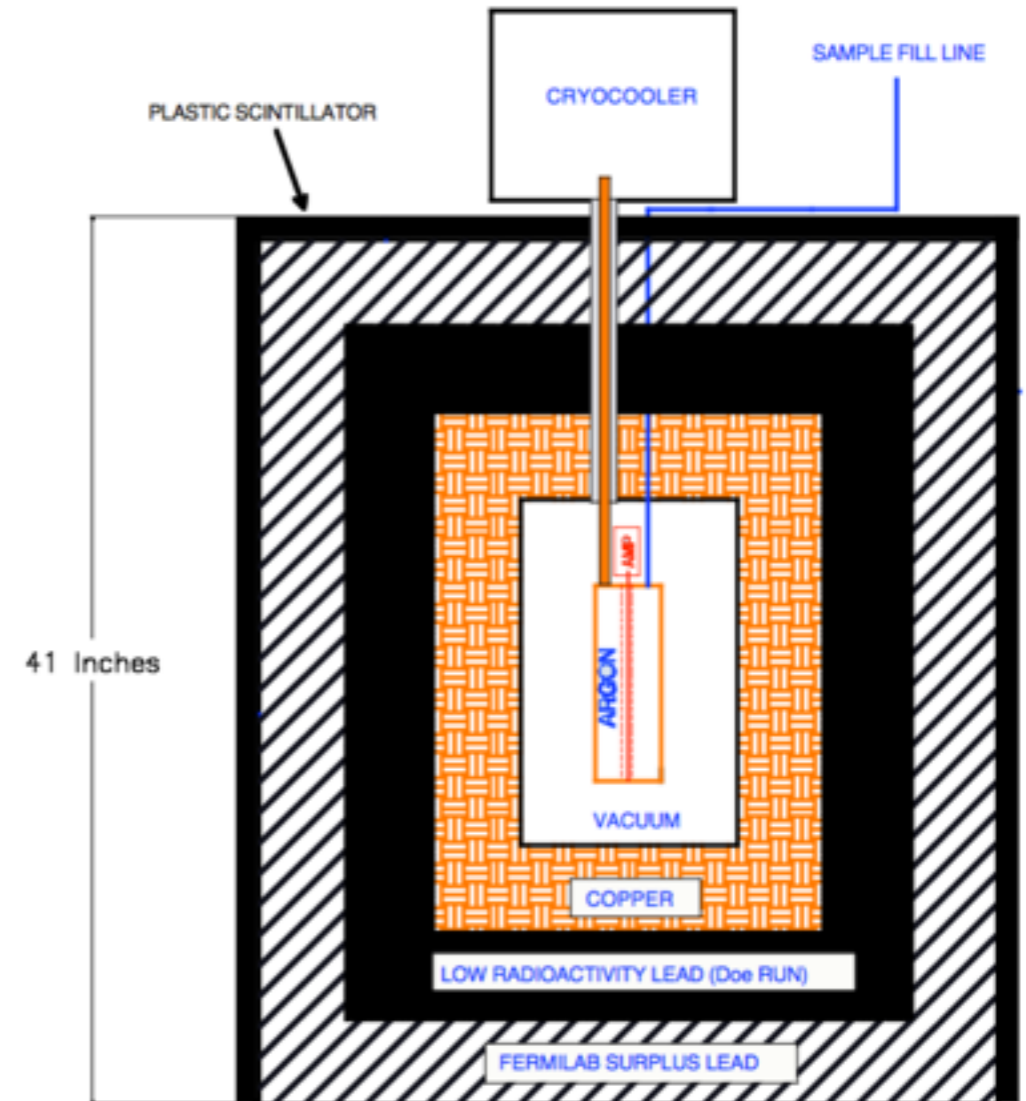
~7 counts/keV-kg-day

copper : 1cm MPI high purity

intrinsic:~0.07 counts/keV-kg-day at 200 keV

reduces the 210Pb background (210Bi) to 0.01 events/keV-kg-day

surface contamination: 0.01 events/keV-kg-day



Meeting of the 14

define starting time

define schedule

Ready talk done