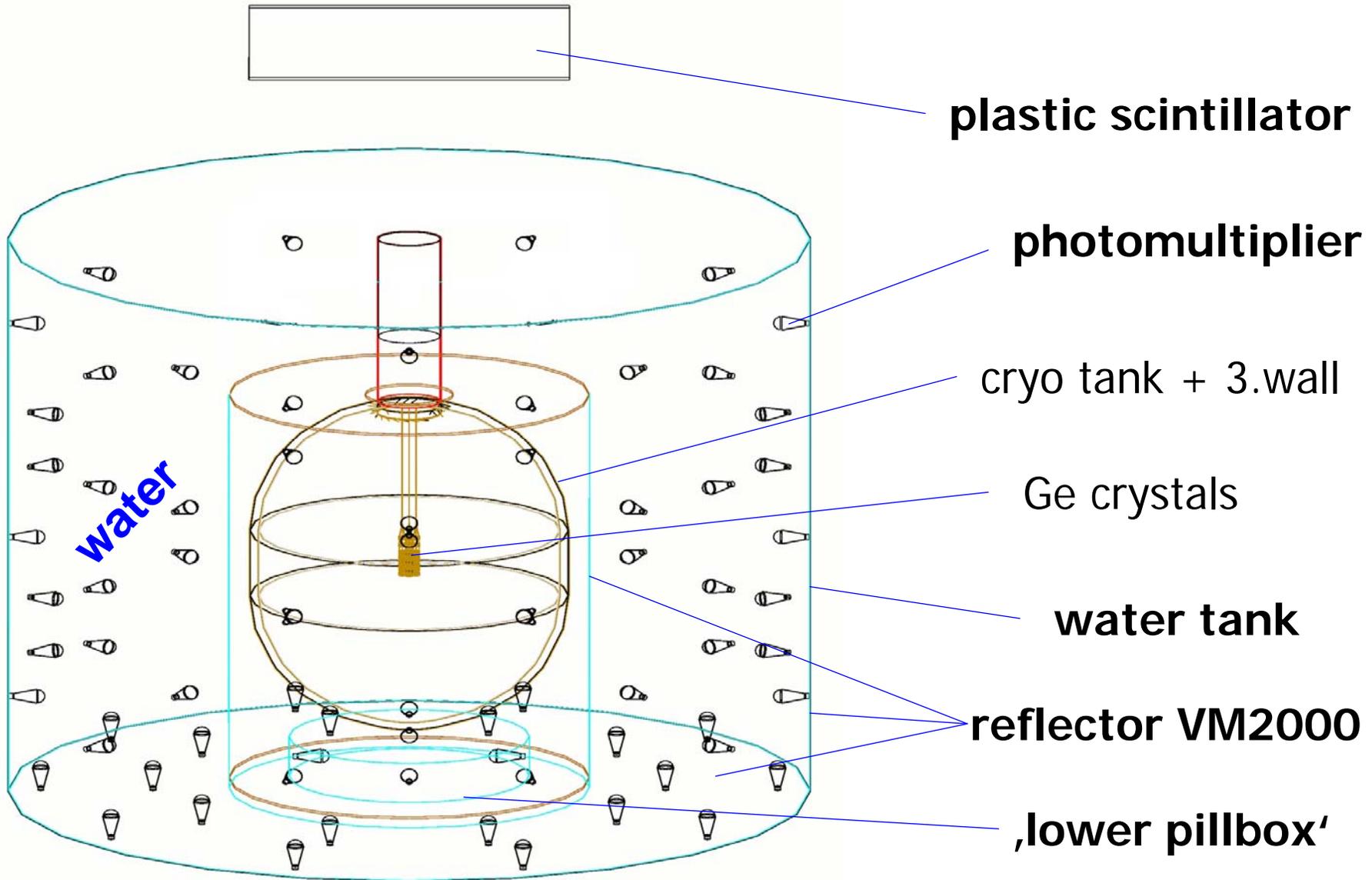
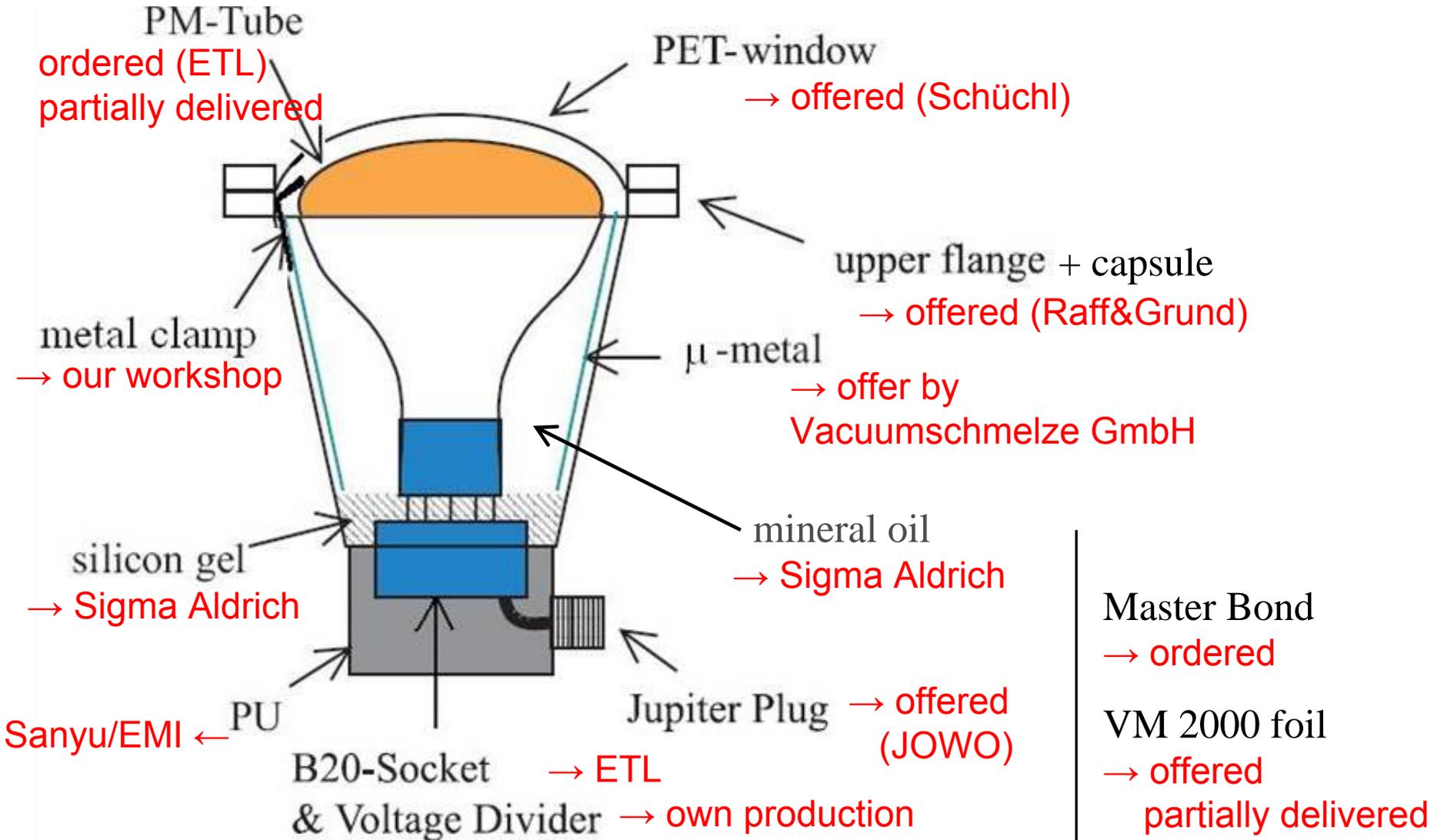


# Status of Muon Veto

# Muon Detector - Overview

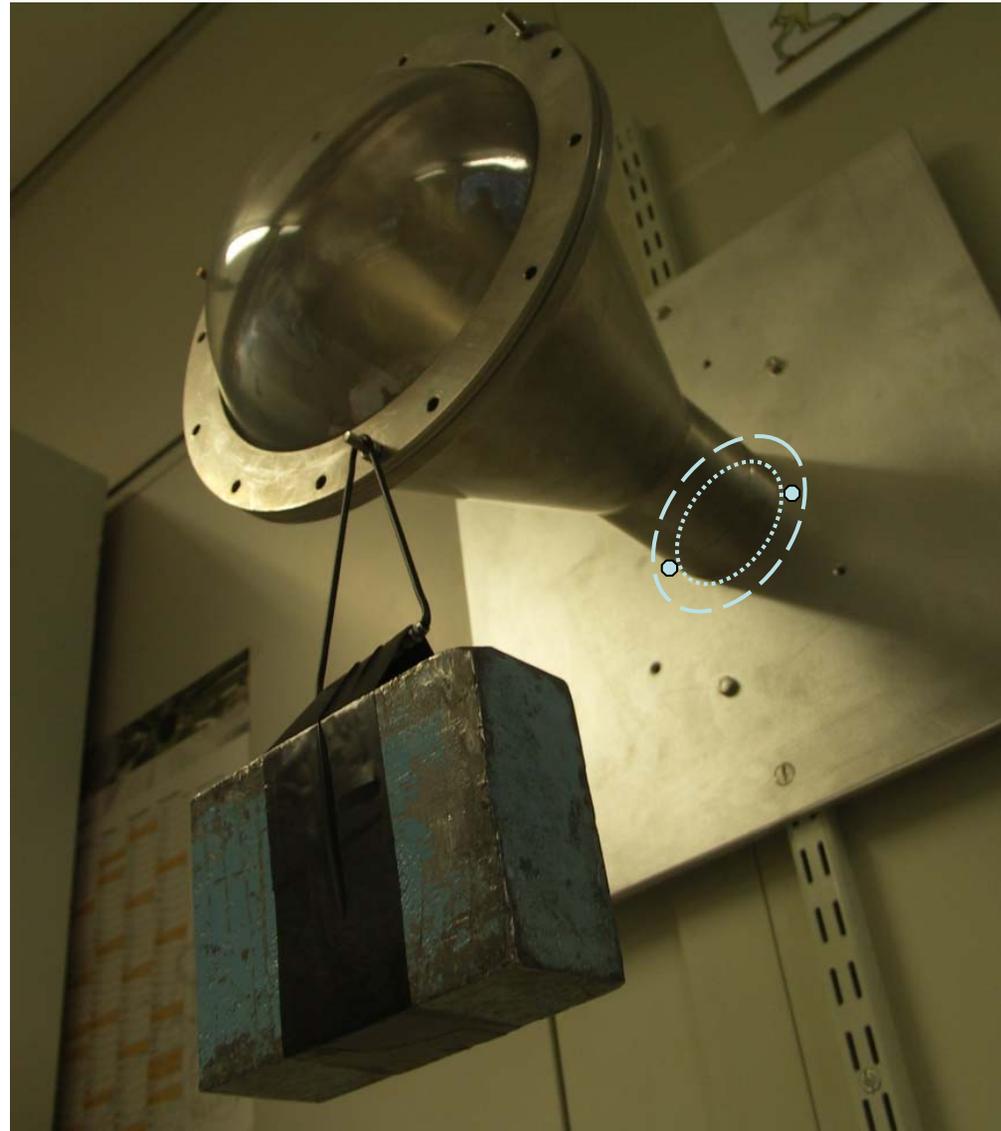


# PMT - Encapsulation Design & Status



# PMT's - Attachment to Tank

- Based on steel studs, welded in tank
- Tested: 1 screw (8mm) on the back center  
Picture: Encapsulation plus weight of 5kg
- Intended: Attachment by 2 studs (8mm)  
PMT not rotatable  
Cable always upwards  
No additional parts  
Important: Welding of 2 related studs



# PMT Encapsulation - Purity

			$^{238}\text{U}$ $\begin{matrix} [\text{g} / \text{g}] \\ [\text{g}] \end{matrix}$	$^{232}\text{Th}$ $\begin{matrix} [\text{g} / \text{g}] \\ [\text{g}] \end{matrix}$	$\text{K}$ $\begin{matrix} [\text{g} / \text{g}] \\ [\text{g}] \end{matrix}$
PMT Glass from ETL (400g)	low backgr. (70 PMTs)	MPIK	$(161\pm 15)10^{-9}$ <b><math>(64000\pm 6000)10^{-9}</math></b>	$(328\pm 26)10^{-9}$ <b><math>(130000\pm 10000)10^{-9}</math></b>	$(383\pm 77)10^{-6}$ <b><math>(153000\pm 31000)10^{-6}</math></b>
	ultra low bgr. (30 PMTs)		$(163\pm 16)10^{-9}$ <b><math>(65000\pm 6400)10^{-9}</math></b>	$(52\pm 15)10^{-9}$ <b><math>(21000\pm 6000)10^{-9}</math></b>	$(57\pm 14)10^{-6}$ <b><math>(23000\pm 5600)10^{-6}</math></b>
Steel capsule (2000g)		Diverse samples Gerda proposal	$\sim 0.5 \cdot 10^{-9}$ <b><math>\sim 1000 \cdot 10^{-9}</math></b>	$\sim 3 \cdot 10^{-9}$ <b><math>\sim 6000 \cdot 10^{-9}</math></b>	$\sim 0.5 \cdot 10^{-6}$ <b><math>\sim 1000 \cdot 10^{-6}</math></b>
$\mu$ metal (150g)		Borexino	$(4.6\pm 1.7)10^{-9}$ <b><math>(690\pm 255)10^{-9}</math></b>	$< 6.6 \cdot 10^{-9}$ <b><math>&lt; 1000 \cdot 10^{-9}</math></b>	$< 5.8 \cdot 10^{-6}$ <b><math>&lt; 870 \cdot 10^{-6}</math></b>
Voltage divider (25g)		Borexino	$(55\pm 3)10^{-9}$ <b><math>(1400\pm 75)10^{-9}</math></b>	$(79\pm 6)10^{-9}$ <b><math>(2000\pm 150)10^{-9}</math></b>	$(100\pm 10)10^{-6}$ <b><math>(2500\pm 250)10^{-6}</math></b>
Jupiter connector female (50g)		Borexino	$(4.5\pm 1.2)10^{-9}$ <b><math>(225\pm 60)10^{-9}</math></b>	$(6\pm 3)10^{-9}$ <b><math>(300\pm 150)10^{-9}</math></b>	$< 10 \cdot 10^{-6}$ <b><math>&lt; 500 \cdot 10^{-6}</math></b>
Cable (15m, 2300g)		Borexino	$(1.8\pm 0.5)10^{-9}$ <b><math>(4100\pm 1100)10^{-9}</math></b>	$< 0.48 \cdot 10^{-9}$ <b><math>&lt; 1100 \cdot 10^{-9}</math></b>	$< 4.74 \cdot 10^{-6}$ <b><math>&lt; 11000 \cdot 10^{-9}</math></b>
Master bond (<1g)		Borexino	$< 3 \cdot 10^{-9}$ <b><math>&lt; 3 \cdot 10^{-9}</math></b>	$< 6 \cdot 10^{-9}$ <b><math>&lt; 6 \cdot 10^{-9}</math></b>	$< 10 \cdot 10^{-6}$ <b><math>&lt; 10 \cdot 10^{-6}</math></b>
Urethane (200g)	Sanyu	Borexino	$(2.6\pm 0.3)10^{-9}$ <b><math>(520\pm 60)10^{-9}</math></b>	$< 1.2 \cdot 10^{-9}$ <b><math>&lt; 240 \cdot 10^{-9}</math></b>	$< 2 \cdot 10^{-6}$ <b><math>&lt; 400 \cdot 10^{-6}</math></b>
	EMI		$< 29 \cdot 10^{-9}$ <b><math>&lt; 5800 \cdot 10^{-9}</math></b>	$< 5 \cdot 10^{-9}$ <b><math>&lt; 1000 \cdot 10^{-9}</math></b>	$< 15 \cdot 10^{-6}$ <b><math>&lt; 3000 \cdot 10^{-6}</math></b>
Silicone gel (100g)		Borexino	$(3.9\pm 0.7)10^{-9}$ <b><math>(390\pm 70)10^{-9}</math></b>	$< 3.7 \cdot 10^{-9}$ <b><math>&lt; 370 \cdot 10^{-9}</math></b>	$< 3.9 \cdot 10^{-6}$ <b><math>&lt; 390 \cdot 10^{-6}</math></b>
Mineral oil (1000g)		not yet measured			
VM 2000 foil (470m <sup>2</sup> )		Gerda proposal	$< 0.7 \cdot 10^{-9}$ <b><math>&lt; 30 \cdot 10^{-9}</math></b>	$< 3 \cdot 10^{-9}$ <b><math>&lt; 130 \cdot 10^{-9}</math></b>	$(2.5\pm 1)10^{-6}$ <b><math>(110\pm 40)10^{-6}</math></b>

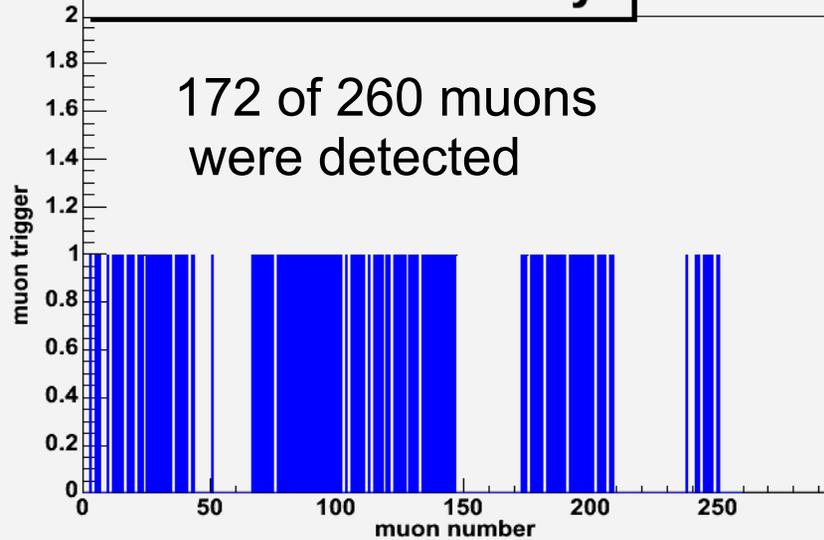
# VM 2000 Reflector Foil

- Attachment to tank:  
Steel ropes or rods fixed to tank  
Thread eyes in foil
- Safety Issues:  
If  $1000\text{m}^3$  tank empties with  $10\text{m}^3/\text{h}$   
→ Water level drops by 1cm in 6min  
No danger of ‚water column‘ behind foil  
Metal grid at drain to prevent a blockage by the foil

# Muon Veto - Simulations

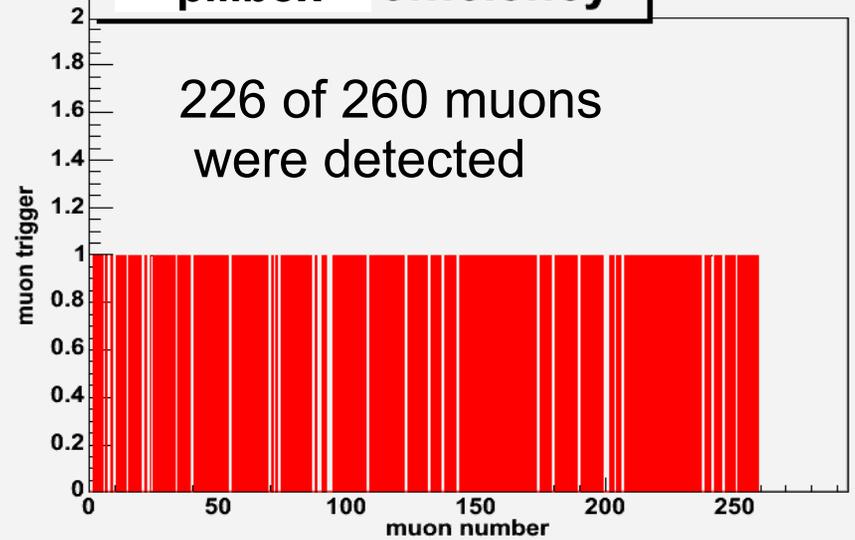
## outer veto efficiency

172 of 260 muons  
were detected



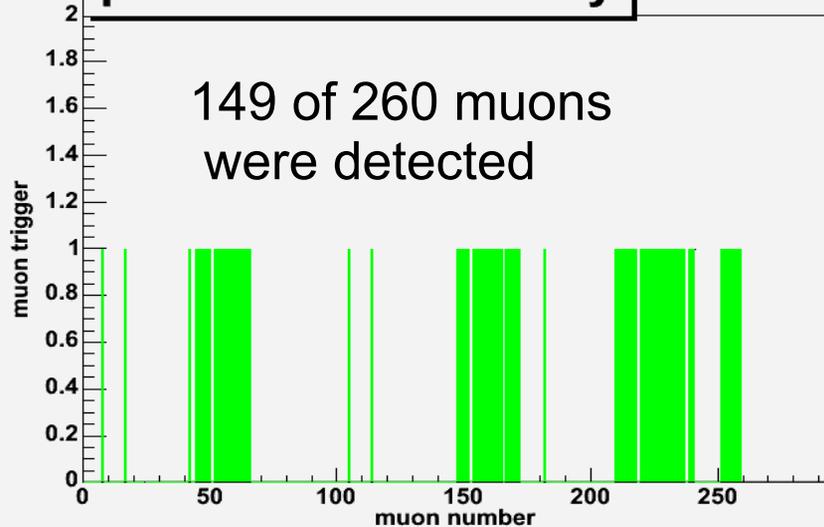
## pillbox efficiency

226 of 260 muons  
were detected



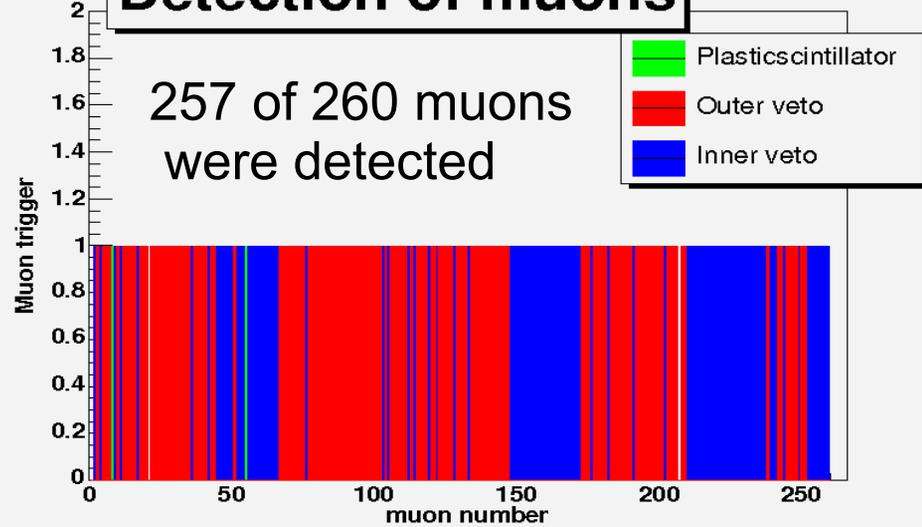
## plastic veto efficiency

149 of 260 muons  
were detected



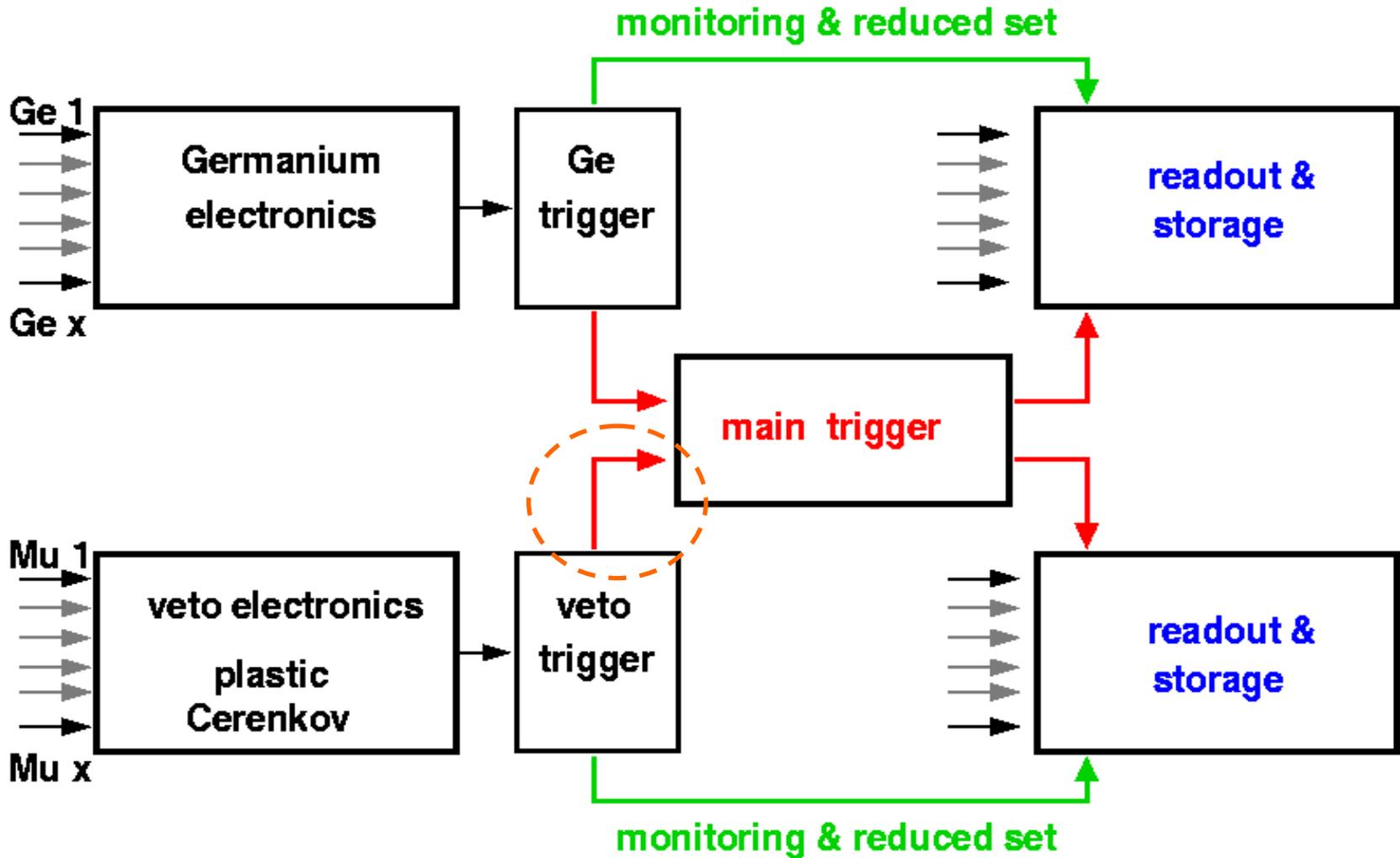
## Detection of muons

257 of 260 muons  
were detected



# Muon Veto - Data Acquisition

**schematics for data handling**



# Schedule

- May 2006: Encapsulation of one PMT in Tübingen  
(all parts delivered)
- June 2006: Tightness test of encapsulation (2 bar)
- Sep 2006: Encapsulation of all PMT's  
Tightness tests with more PMT's
- Summer/Autumn: Test of all PMT's + electronics
- Winter: Welding of attachment points in steel tank, for  
PMT's and VM2000 (prior to steel tank test)
- Spring 2007: PMT's and VM2000 installation  
Electronics set-up