

# Positions of studs for the muon veto

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## 1 Studs for photomultiplier tubes

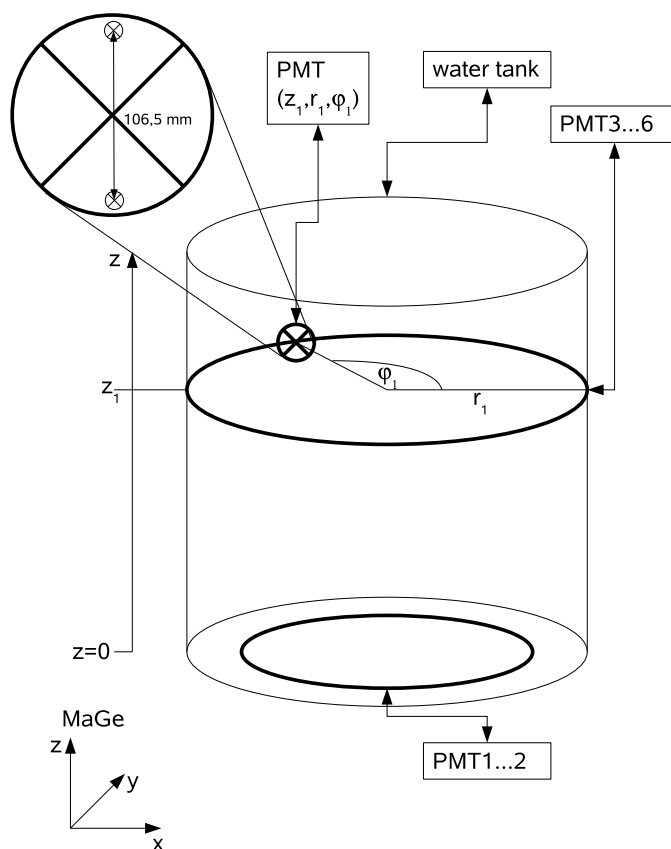


Figure 1: Coordinates  $(z, r, \varphi)$  for the distribution of photomultiplier tubes.

We will need two M8 studs for each photomultiplier tube (shown in the upper left of Figure 1). For each pair of studs, the central height  $z$ , the radius  $r$  and the angle  $\varphi$  are given (see Figure 1). We will need four rings on the wall of the water tank (PMT3, ..., PMT6) with 10 photomultiplier tubes (i.e. 20 studs) each.

Two more rings will be placed on the bottom of the water tank (PMT1, PMT2), the outer consisting of 12, and the inner of 8 PMTs. In total, 60 PMTs (i.e. 120 studs) will be mounted on the water tank. The pillbox PMTs will not be mounted on the water tank, but directly on the feet of the cryostat.

The positions of all PMTs are given in Table 1.

Table 1: Distribution of studs for PMTs (pillbox PMTs not mounted on water tank).

name	number of PMTs	z [mm]	r [mm]	$\varphi$ [°]
pillbox	6	500	2000	0,60,120,180,...
PMT1	8	0	2750	0,45,90,125,...
PMT2	12	0	4250	0,30,60,90,...
PMT3	10	2000	5000	18,54,90,126,...
PMT4	10	3500	5000	0,36,72,108,...
PMT5	10	5000	5000	18,54,90,126,...
PMT6	10	6500	5000	0,36,72,108,...

## 2 Studs for cables and VM2000 foil

We need one M8 stud per cable holder. These studs will also serve as fixation points for the VM2000 foil. In total, there will be 120 studs for the cables and the reflector foil. The distribution is given in Table 2, and a sketch for the coordinates is given in Figure 2.

Table 2: Distribution of studs for vertical cable holders.

name	number of attachments	z [mm]	r [mm]	$\varphi$ [°]
foil0	20	100	5000	9,27,45,63,81,99,...
cable1	20	2500	5000	9,27,45,63,81,99,...
cable2	20	4000	5000	9,27,45,63,81,99,...
cable3	20	5500	5000	9,27,45,63,81,99,...
cable4	20	7000	5000	9,27,45,63,81,99,...
cable5	20	8000	5000	9,27,45,63,81,99,...

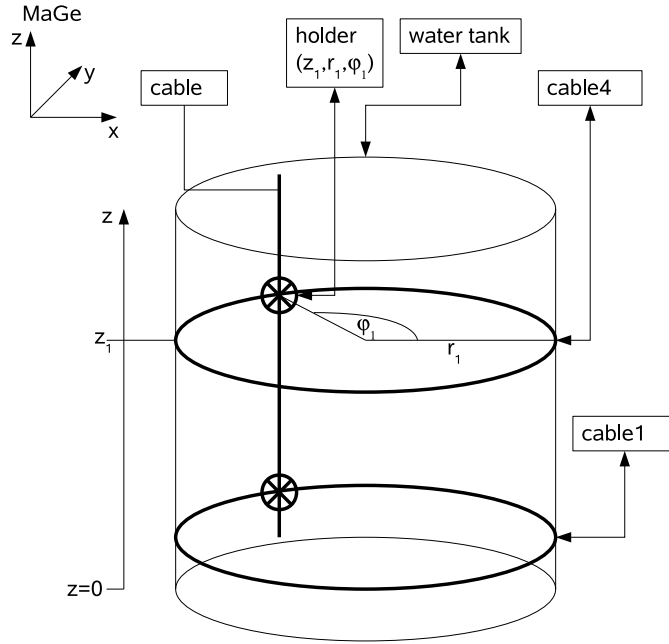


Figure 2: Coordinates  $(z,r,\varphi)$  for the distribution of holders for cables and VM2000.

### 3 Studs for the cable tray

For the cable tray we will need two rings of studs, one of them 250 mm lower than the upper edge of the water tank wall ( $z_{max}$ ), the other 450 mm lower than  $z_{max}$ . The distribution is given in Table 3. A sketch of a holder is given in Figure 3.

Table 3: Distribution of studs for horizontal cable tray.

name	number of attachments	z [mm]	r [mm]	$\varphi$ [°]
uppertray	30	$z_{max} - 250$	5000	0,12,24,36,48,...
lowertray	30	$z_{max} - 450$	5000	0,12,24,36,48,...

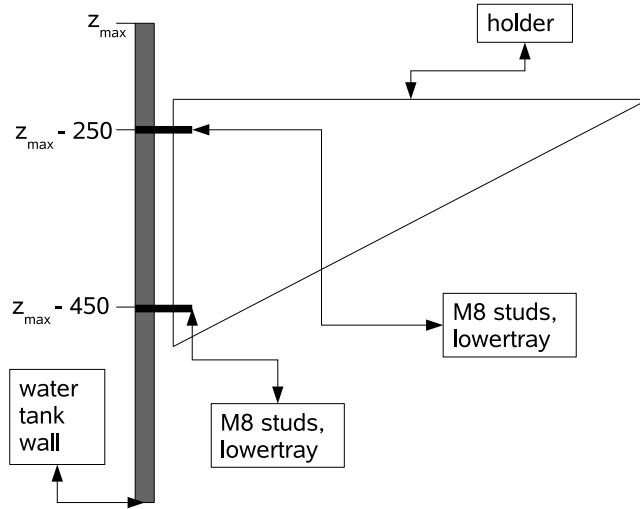


Figure 3: Sketch of the attachment of the holders for the cable tray.

## 4 Studs for mounting

Finally, we need some studs during the mounting of the PMTs for auxiliary attachments. They will be directly below the cable trays, between the holders of the trays. We suggest to use at least M14 studs for this.

Table 4: Distribution of studs for security attachments.

name	number of attachments	$z$ [mm]	$r$ [mm]	$\varphi$ [°]
mount	30	$z_{max} - 400$	5000	6,18,30,42,54,66,...