Proton Crate

In [3]:
```
from IPython.display import Markdown as md
import matplotlib.pyplot as plt
import seaborn as sns
graphColors =["#e6194b","#3cb44b","#ffe119","#0082c8","#f58231","#911eb4","#
46f0f0","#f032e6","#d2f53c","#fabebe","#008080","#e6beff","#aa6e28","#fffac
8","#800000","#aaffc3","#808000","#ffd8b1","#000080","#808080","#000000"]
sns.set_palette(sns.color_palette(graphColors))
plt.style.use('seaborn-paper')
import scipy.constants as sc # see https://docs.scipy.org/doc/scipy/referenc
e/constants.html
import math
import numpy as np
from scipy.optimize import fsolve
%matplotlib notebook
```

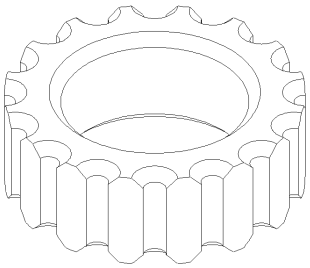
Powerboard dimensions?

In [4]:
```
# prototype dimemsions
min_height = 22 #mm
height = 25 #mm
controler_height = 15 #mm
width = 45 #mm
```

Height

Moritz' his coil design:

- ID = 16.2 mm
- OD = 26 mm
- Height = 10.5 mm



The wire is 2 mm. In addition, the wire has to bend. Looking at the current prototype in the lab, the **height of the full aircoil is < 16 mm**. Some extra space is needed for:

- Connection on the board, being mounted on top SMD components. **extra 1 mm**
- Cooling shielded if need. **extra 2 mm ?**

Board thickness: **1.57 mm**

Througth component and components on the bottom side: **1 mm**

Total : 21.57 mm

- Minimum Height: **{{min_height}} mm**
- Confortable Height: **{{height}} mm**

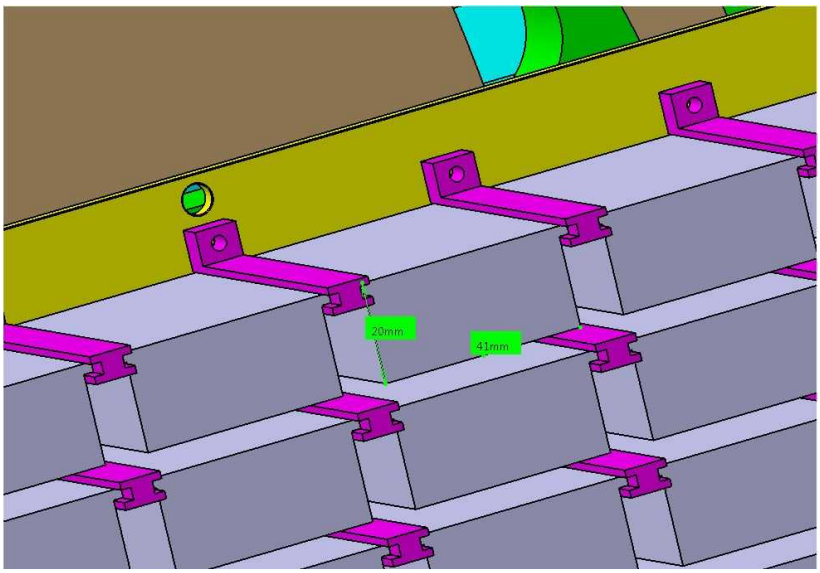
Width

First prototype has a {{width}} mm width. So **a width of maximum {{width+5}} mm** is feasible.

Length

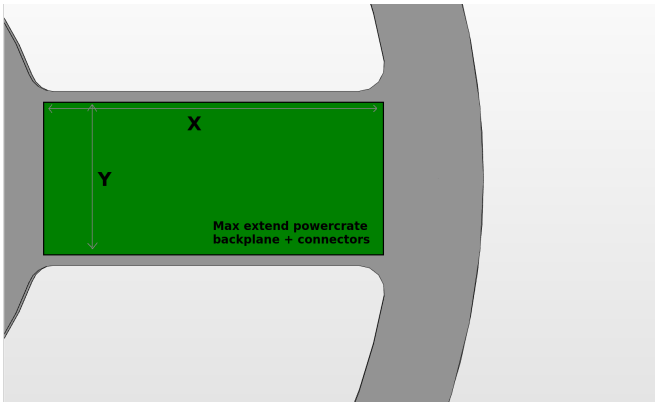
Current prototype has a length of 70 mm. It would be better put the secondary filter nice in line with the main LC filter. We **aim for 80 to 100 mm**?

This is a bit bigger than the space currently foreseen:

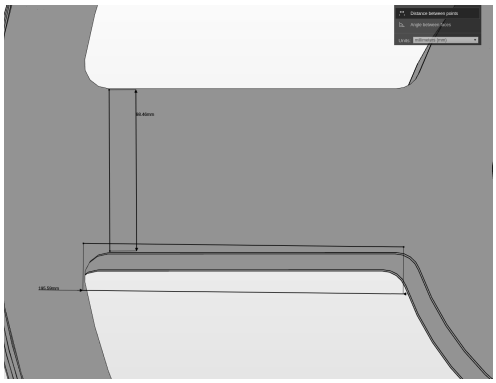


Detector cage constrains

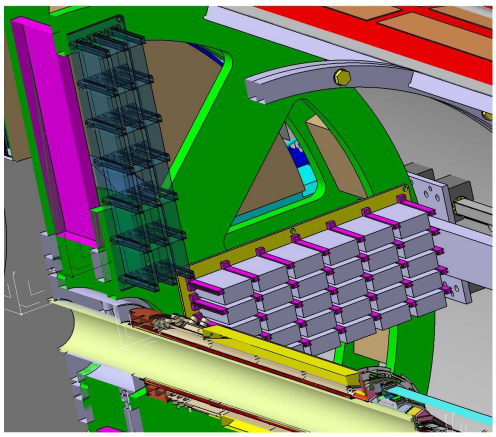
This is not clear from the grabcad drawings.



- 20 x 10 cm should definitely be now problem, but that is a to little space
- 30 x 15 cm seems feasible?



But Stefan Hetzel's drawing does not show the same cage? Or just and extra support spoke?



Power board arrangement

Number of boards

112 (2 VDC / power partitions) + 14 (3.3 VDC MALIBU) = 126 → 32 power boards per side + 2 controlers

==> 2 x (1 controler + 16 power boards)

Arrangement

Space for controller: {{controler_height}} mm (?)

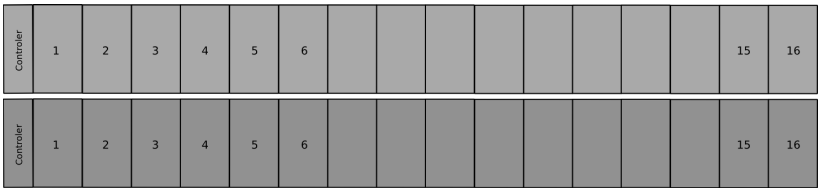
To the below estimates, some space needs to be added for mounting mechanics and connectors

Controler + 16 boards crate

The elegant option of 1 crate with 16 boards probably does not fit

Total width crate = **{{16*height + controler_height}} mm** (tight fit = {{16*min_height + controler_height}} mm)

total height 2 crates = {{2 * (width + 5) }} mm

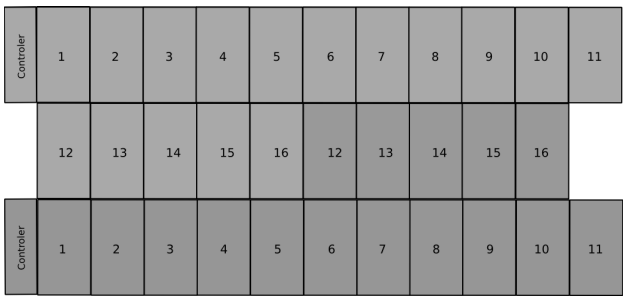


3 x 11 slots

This probably fits, not to elegant though regarding the back plane

Total width crate = **{{11*height + controler_height}} mm** (tight fit = {{11*min_height + controler_height}} mm)

total height = {{3 * (width + 5) }} mm



2 x 2 x 8 slots

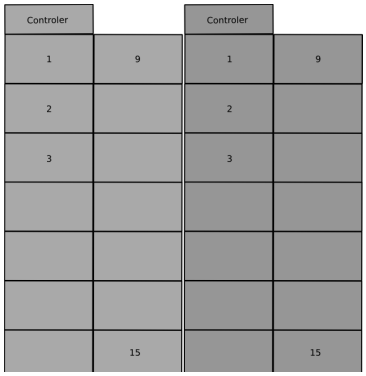
This is a *double* crate arangement. Quite high (ignoring the controler board):

Height = **{{8*height }} mm** (tight fit = {{8*min_height}} mm)

Has space for the controler board and input connectors in the corners

Width = {{4 * (width + 5) }} mm

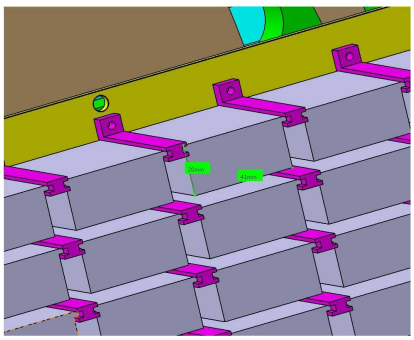
(+ some extra space for mechanics)



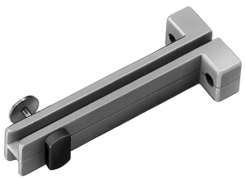
Mechanical design

"Box" design

In the first CAD implementation, every powerboard is a separat box containing the PCB



Held, and separated my these rails:



(https://www.fischerelektronik.de/web_fischer/de_DE/K%C3%BChlk%C3%B6rper/E02.02/F%C3%BChrungsschienen/PG/MSVL/search.xhtml)

This actually allows for a fairly close packing, with only 3 mm space between 2 rows/columns. The 2 mm gap is more then the PCB thickness (standard?). We can either

- Shove the PCB in the rails and add a narrower shielding box
- Make a narrower PCB, and mount it in a box. This has some cooling and shielding advantages

"Crate" design

Vendors of flexible/mini crates:

- Subrack (http://www.pixustechnologies.com/products/category/subracks) with individual components (http://www.pixustechnologies.com/assets/Uploads/Subrack-components-individual.pdf)
- EuropacPRO (https://www.digikey.de/product-detail/de/schroff/24563172/1439-1210-ND/4209939) kit
- various digikey options (https://www.digikey.de/products/en/boxes-enclosures-racks/card-racks/588) and here (https://www.digikey.de/catalog/en/search?filters=51728)

Standard dimensions:

- HP pitch: the standard horizontal pitch on crates. 0.2 inch, or 5.08 mm. 5 HP's for Power boards would then be 25.4 mm.
- 1U is 1.75 inch or 4.45 cm. However, there are no crate kits with 1U in height

The problems with these kits, is that you add e.g. 16 mm to the width of a card from the guide rails (https://www.vectorelect.com/card-guides-cg1-series.html) and the mechanics (https://www.vectorelect.com/1404-0017-84.html). Unless we find a more compact option, this wont work.

"Homebrew/custom" crate

aka make all components custom

"Bigger" cards

We have could combine 2 or 3 converters, electricly isolated. Not my favorite option, but we can make 3U cards then.