

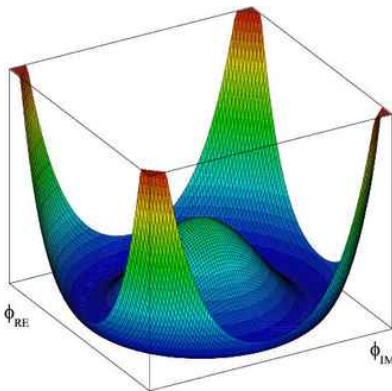
Process to Fabrication Higgs Potential Model From Equation to 3D Reality Model (short rough Manual)

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This short explanation step by step to how from formula to become 3D printing reality. We take information about Higgs model from https://en.wikipedia.org/wiki/Higgs_mechanism



$$S(\phi, A) = \int -\frac{1}{4} F^{\mu\nu} F_{\mu\nu} + |(\partial - iqA)\phi|^2 - \lambda(|\phi|^2 - \Phi^2)^2.$$

We want to plot potential part of the equation

$$V(\phi, \Phi) = \lambda(|\phi|^2 - \Phi^2)^2$$

we use $\phi=1$ and the Φ the complex number with can be describe as x and y axis

$$\Phi^2 = x^2 + y^2$$

The equation become

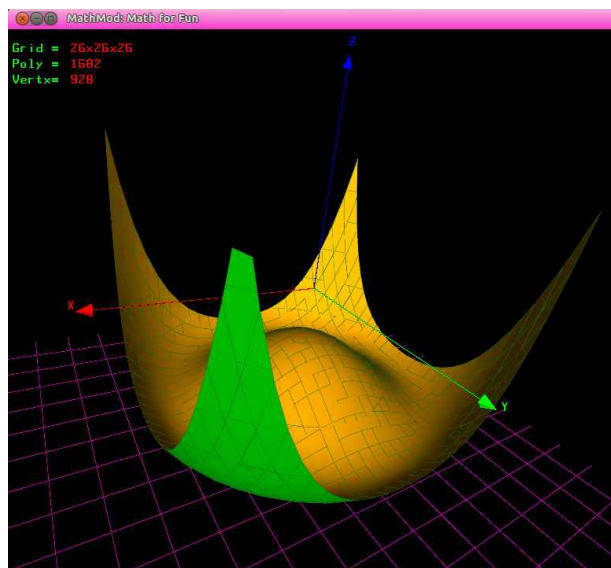
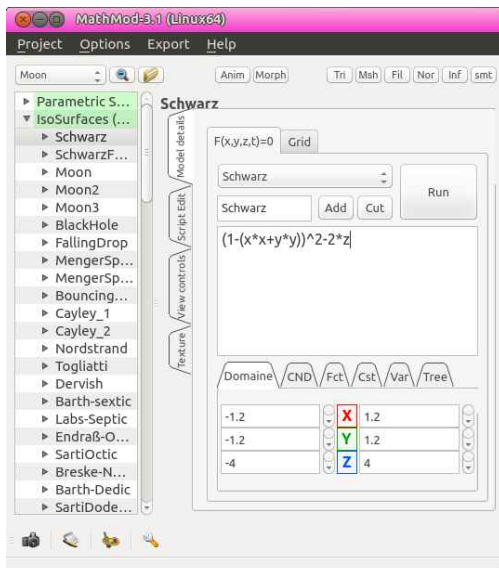
$$V = (1 - (x^2 + y^2))^2$$

And we choose nice view with $V=2z$, then

$$2z = (1 - (x^2 + y^2))^2$$

In the Mathmod the IsoSurfaces using form $F(x,y,z,t)=0$

$$(1 - (x^2 + y^2))^2 - 2z = 0$$

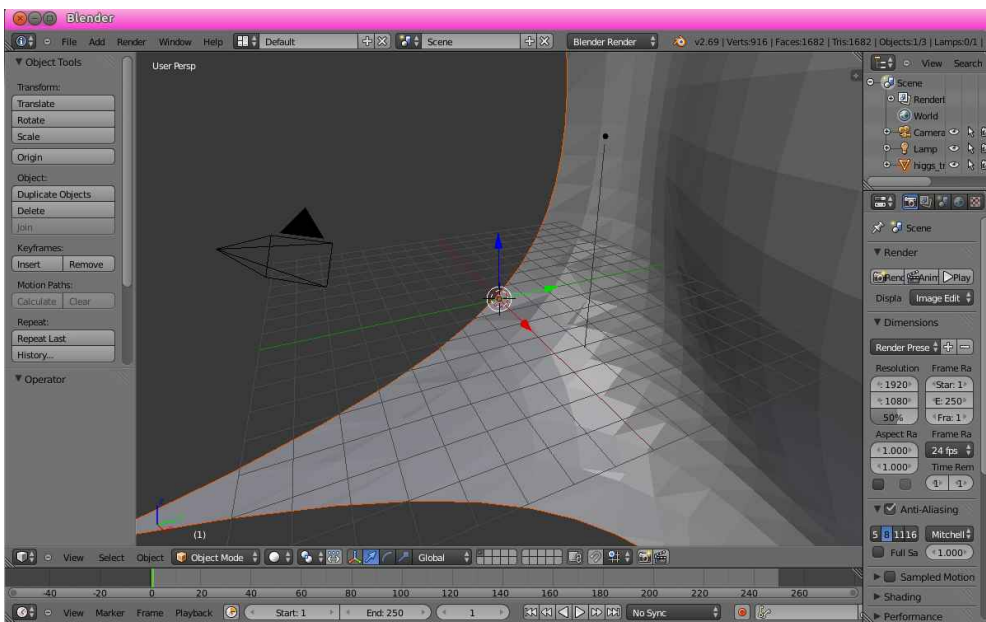


Save the result in obj format by selecting menu:
Export → TriangleWavefront.obj → higgs_tri.obj

The *.obj format in surface geometry and we need to make solid dan save in *.stl by using Blender software:

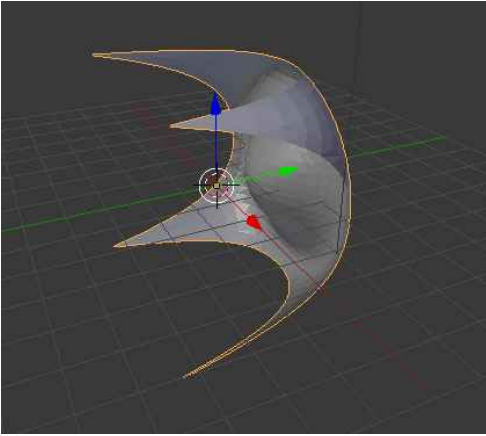
Blender → File → import → wavefront.obj → higgs_tri.obj

Deleted box which not need, choose the frame right top

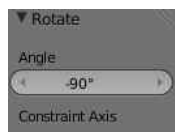
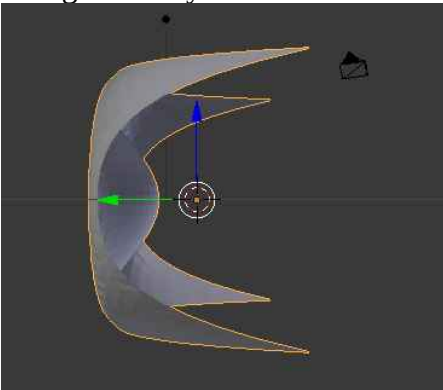


When load the size to big and need to reduce

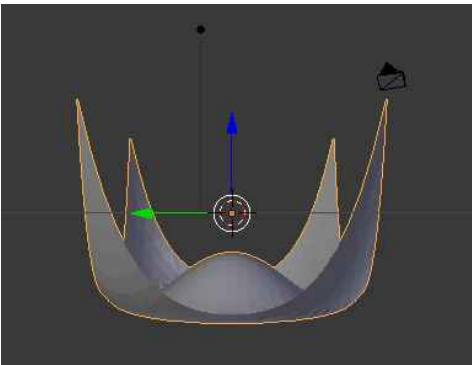
press s → 0.01,



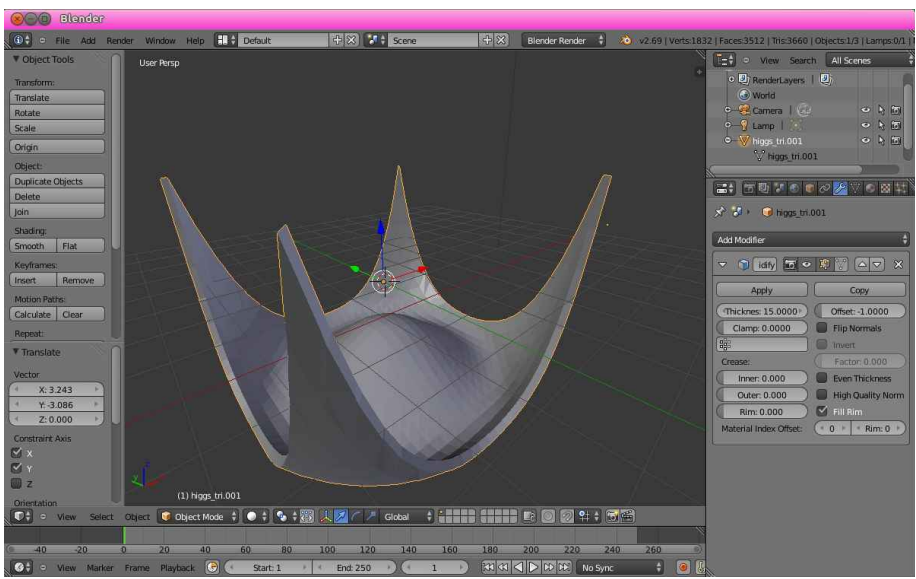
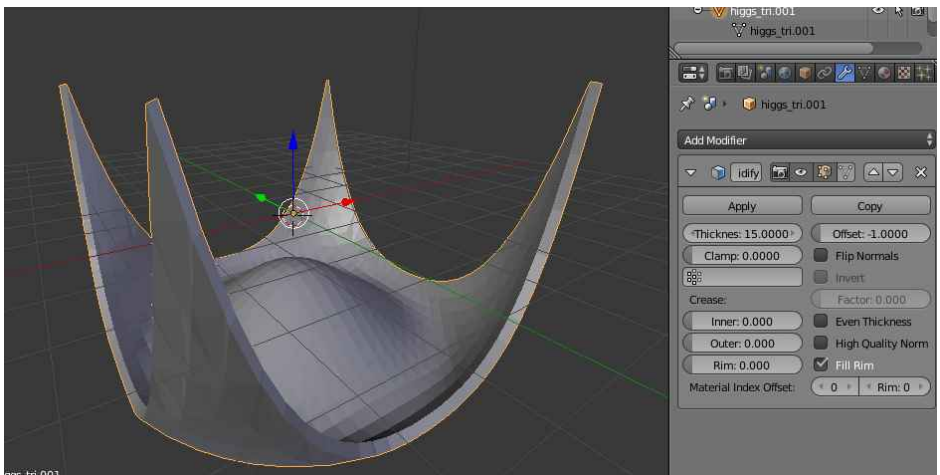
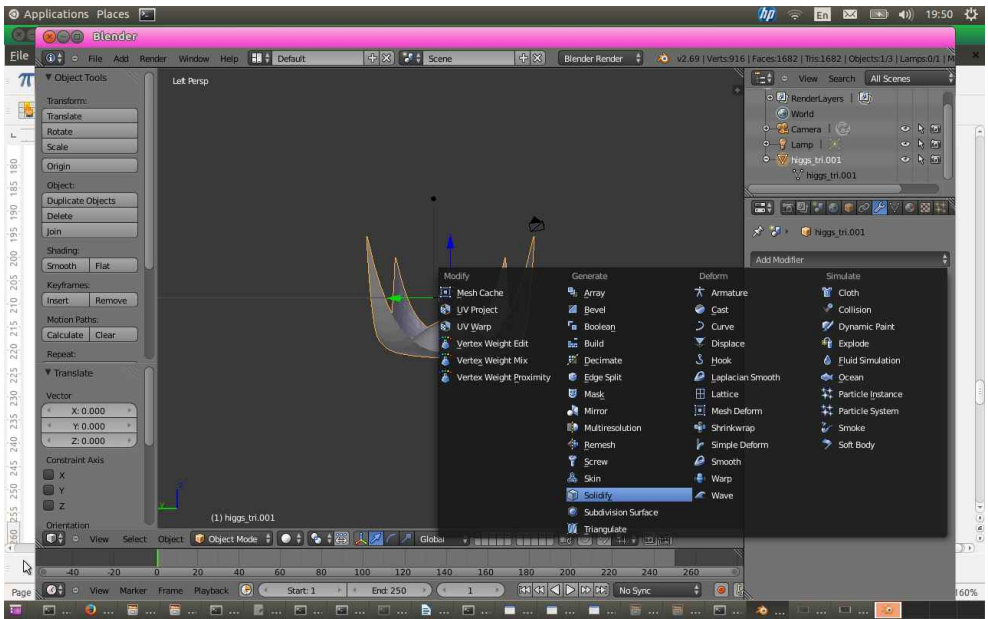
change view by click view at bottom bar choose view left



then rotate by press r and at then type -90 , then

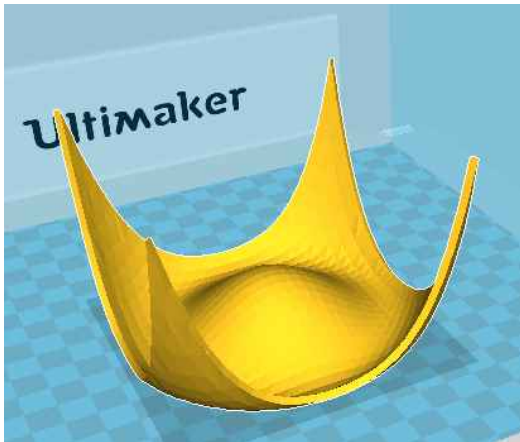
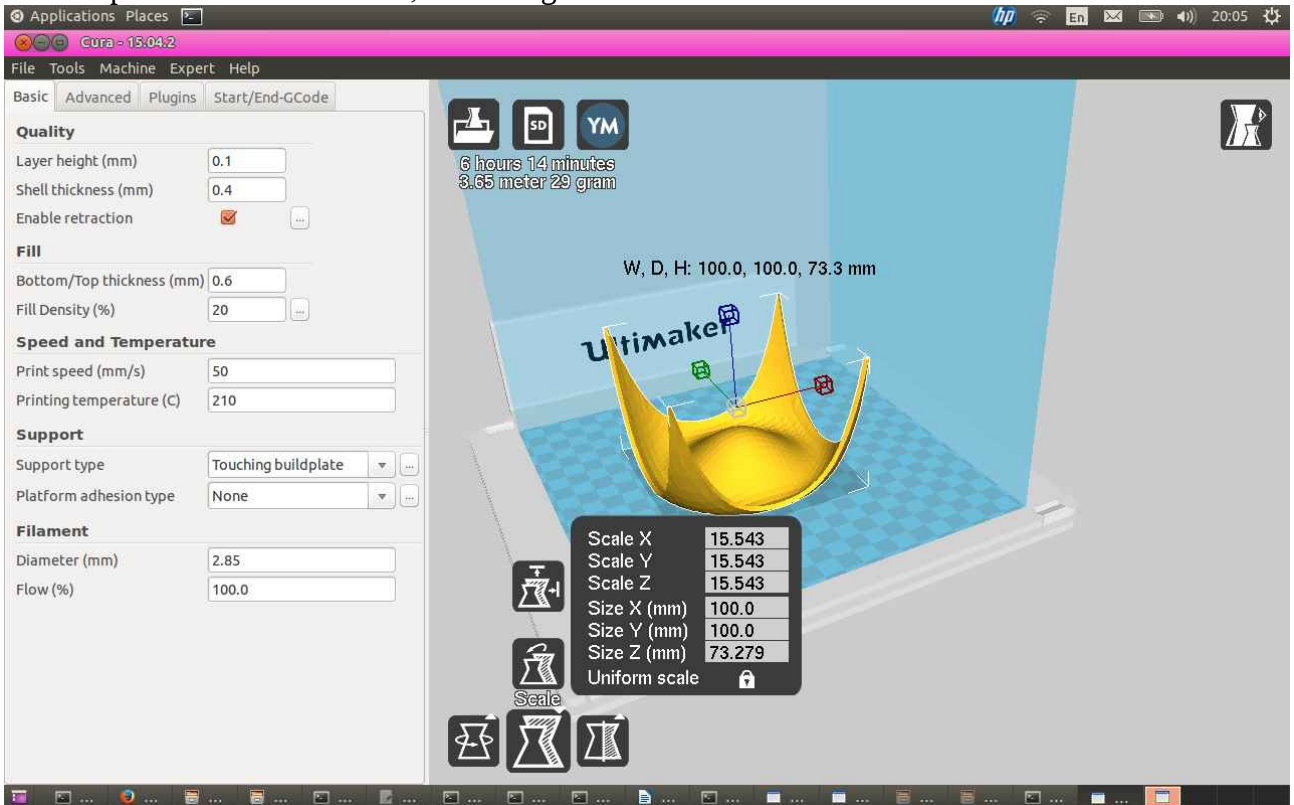


this surfaces we change to solidify, then put thickness 15

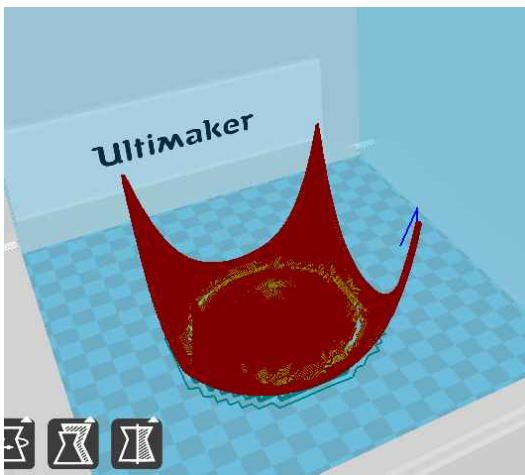


Then save to higgs_t.blend (this saving for next editing with blender if needed)
then export to higgs_t.stl (this for read by cura)

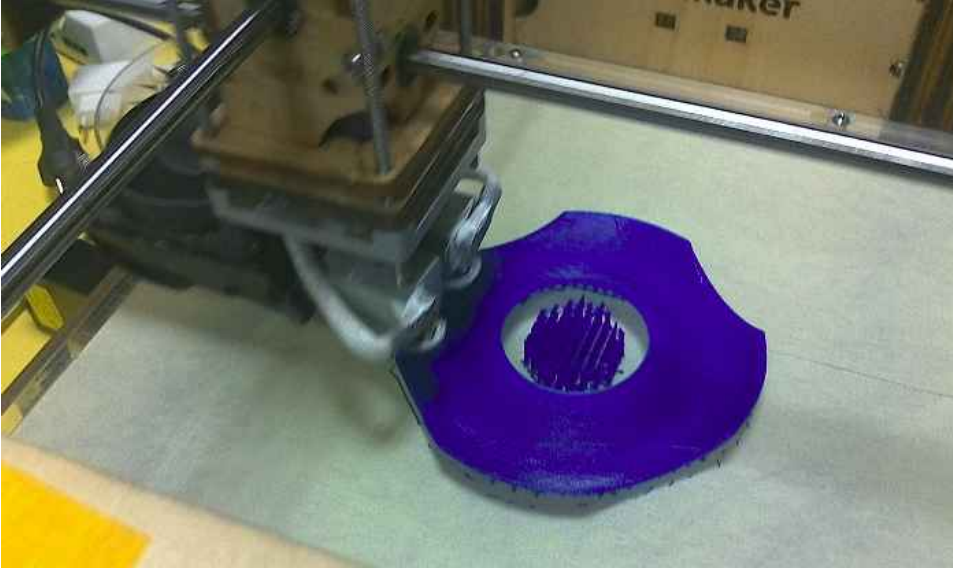
Next step load to Cura software, and change the dimension



Cura → Machine → Ultimake Original+



Process



Thank to FabLab ICTP and kindly help from Alba Marina Malaga Sabogal during workshop 5-7 October 2015. <http://indico.ictp.it/event/a14297/other-view?view=ictp timetable>

info: this software free and run on ubuntu 14.04.

Sorry for this short rough manual my be useful.