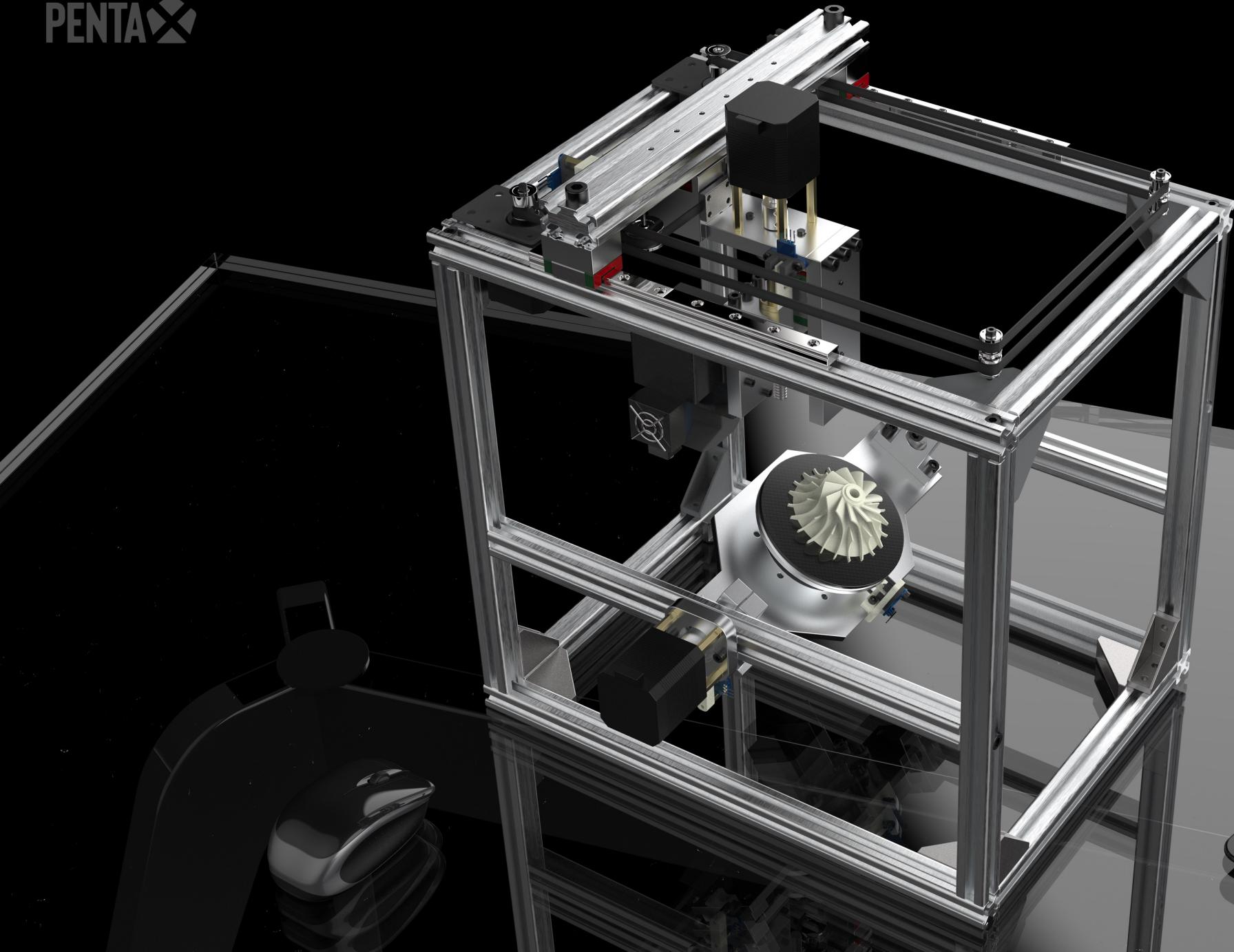


PENTA
X



PentaX

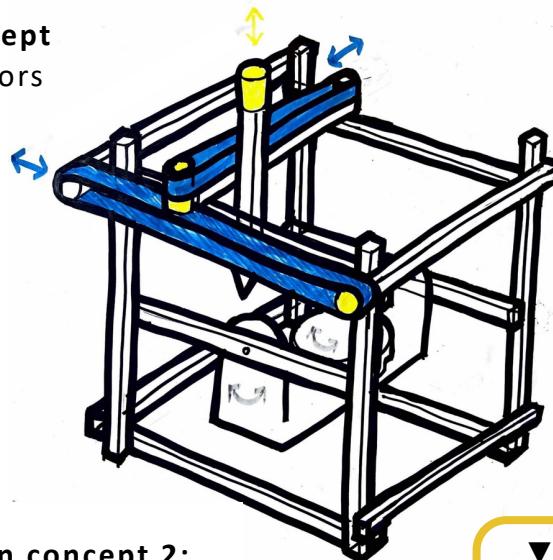


Initial Concept Generation

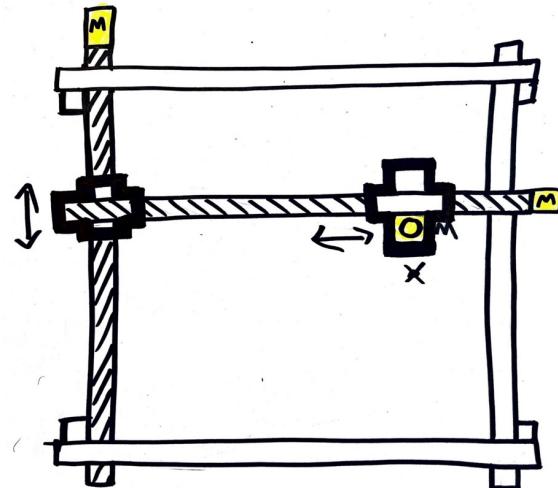
KINEMATIC DESIGNS

► Motion concept

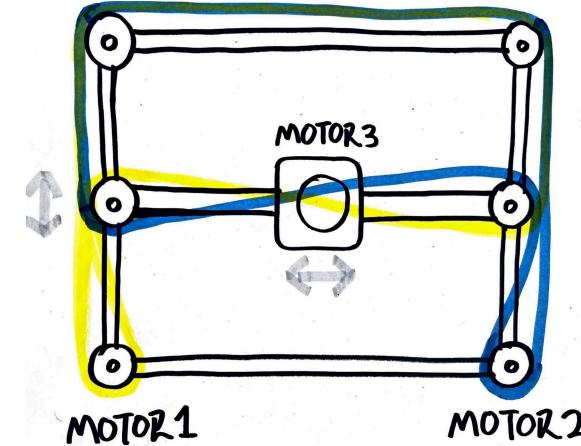
1: Moving motors with belts



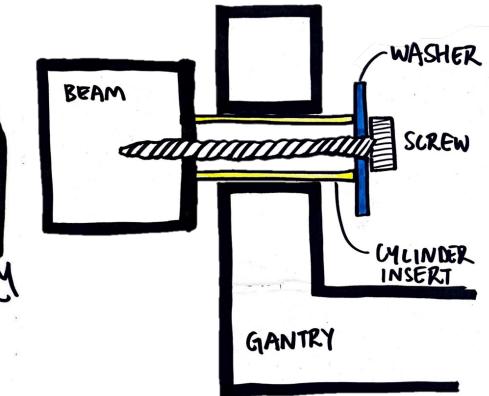
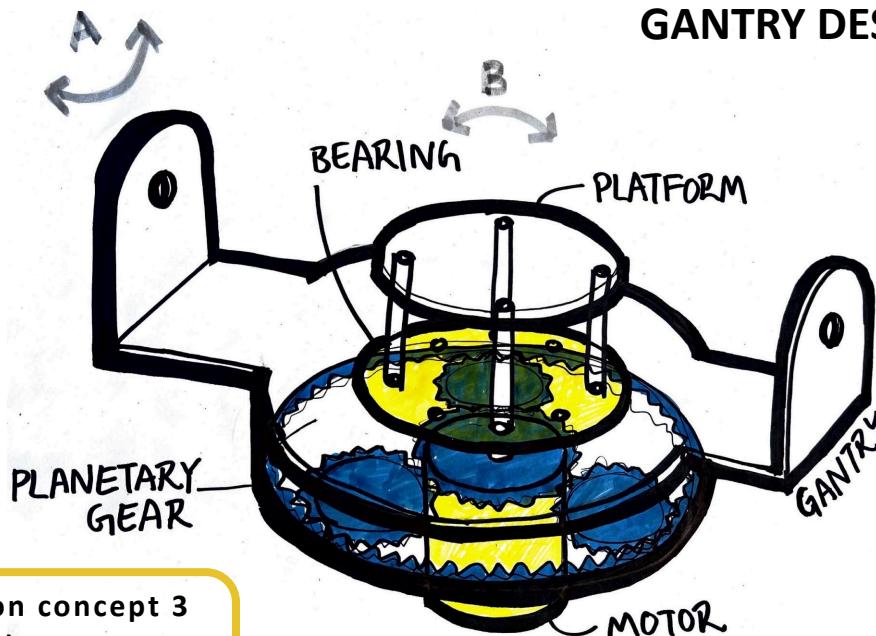
▼ Motion concept 2:
Moving motors with lead screws



▼ Motion concept 3
(CHOSEN): Stationary motors with belts in CoreXY Configuration

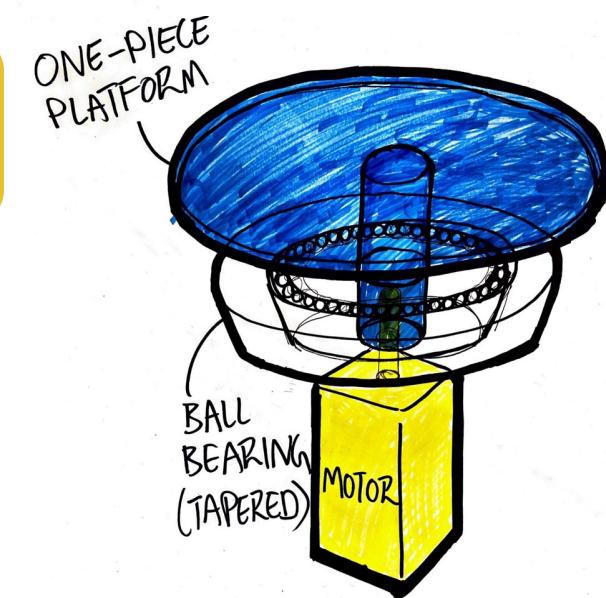


GANTRY DESIGNS

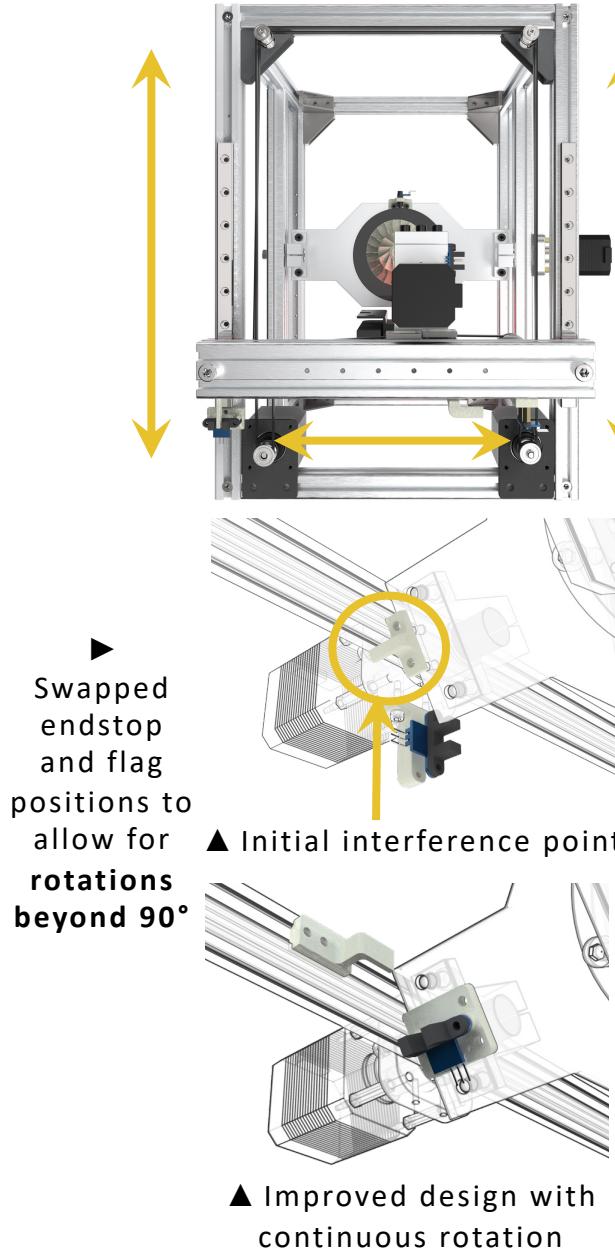


▲ Gantry
concept 1
(CHOSEN):
Slewing bearing

► Gantry
concept 2:
Ball bearing



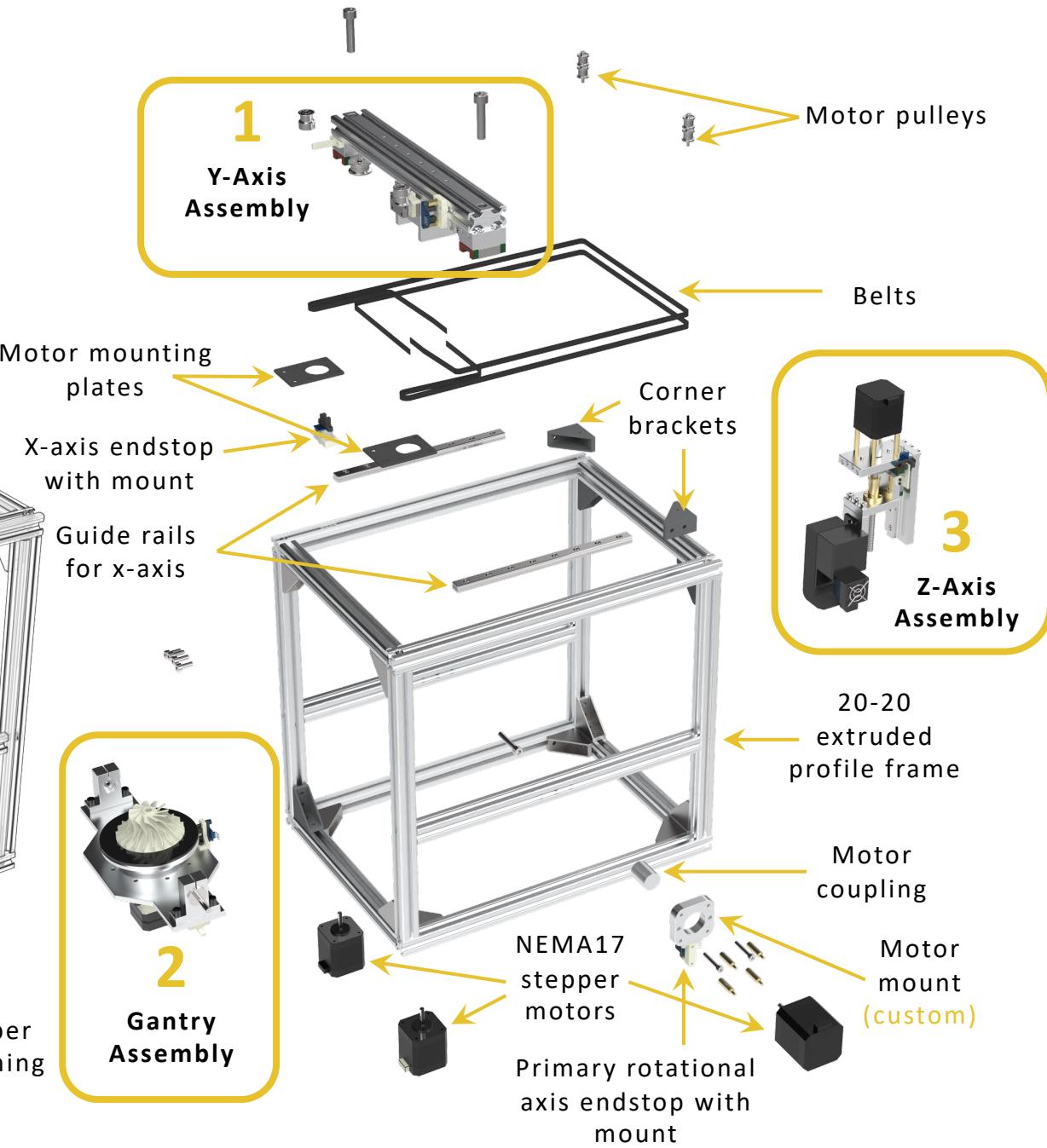
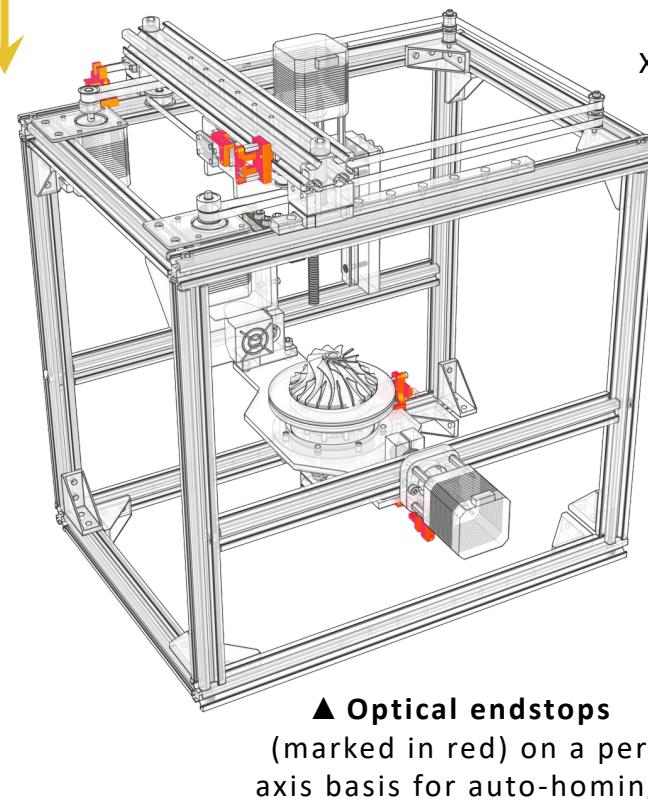
Design Overview



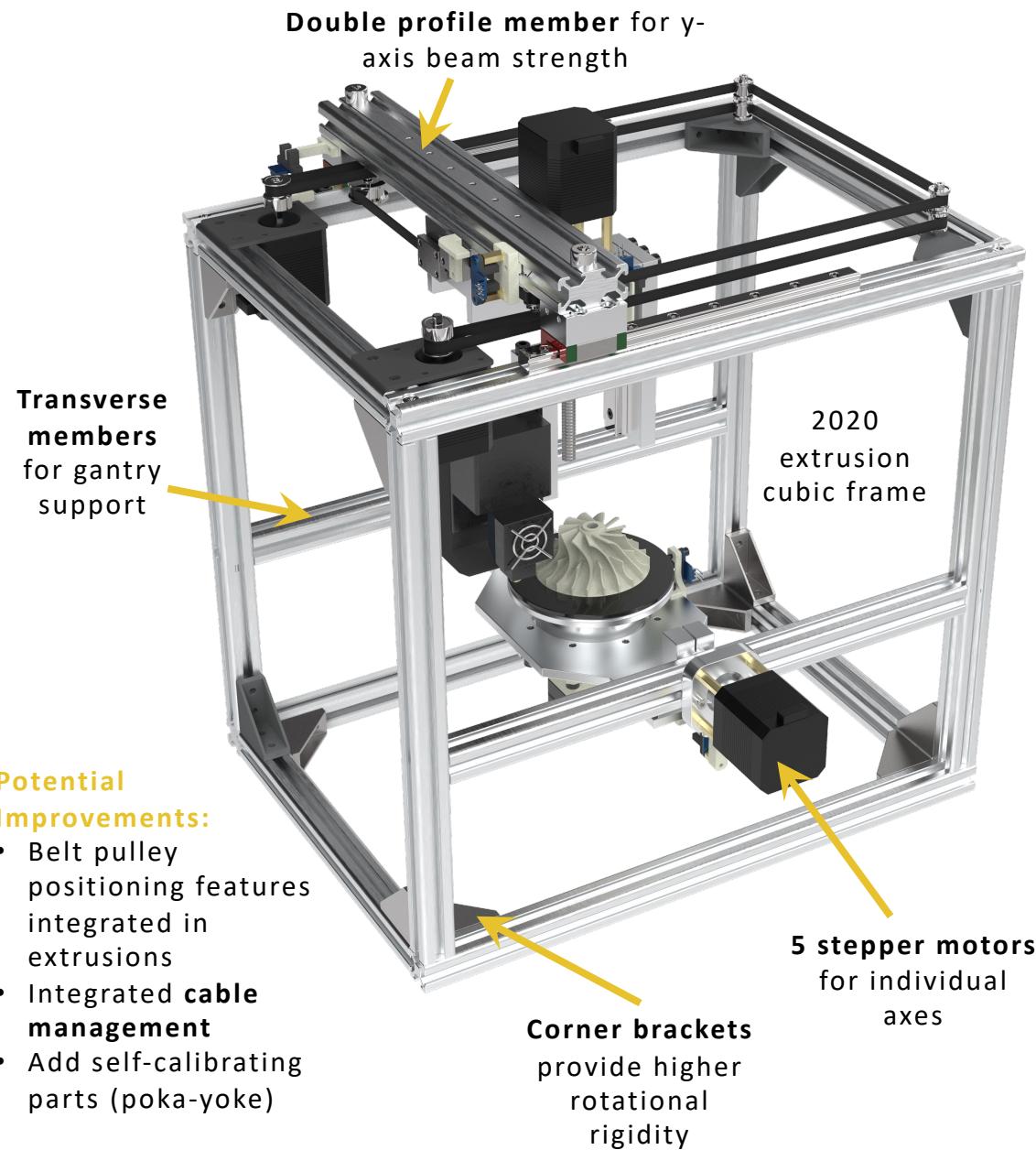
Overall Considerations:

- Parts are dimensioned relative to **available stock material**
- Prioritised using **standard components**

► **3 cartesian axis motion** for extruder, dual x-axis guide rails

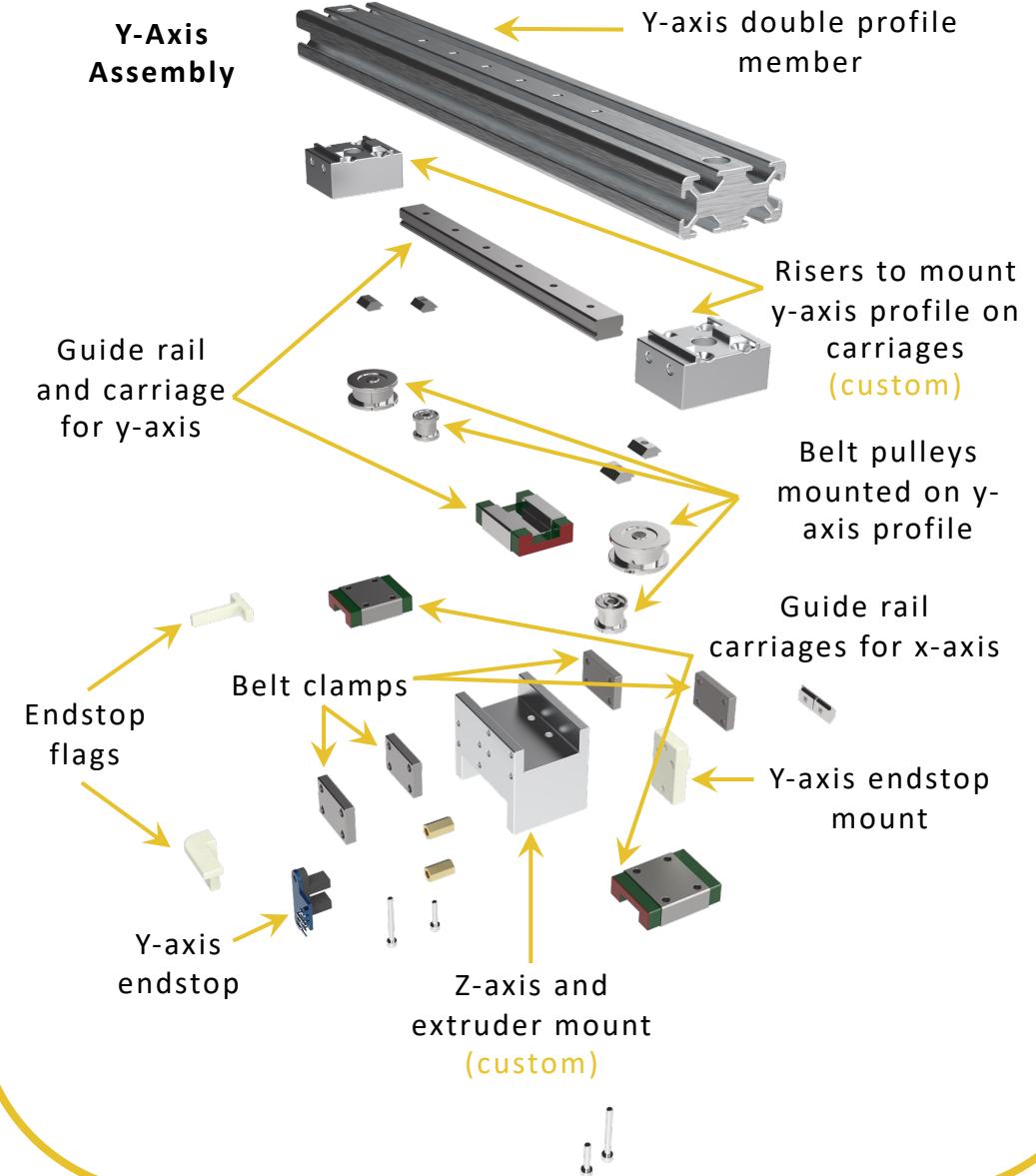


Design Considerations (Main Frame & Kinematics)

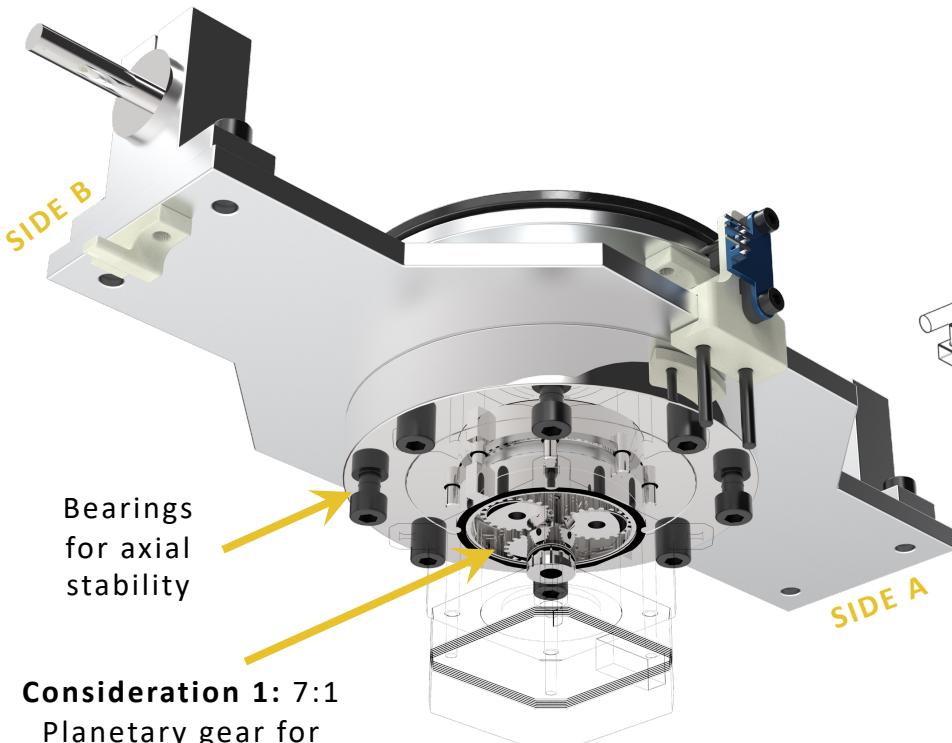


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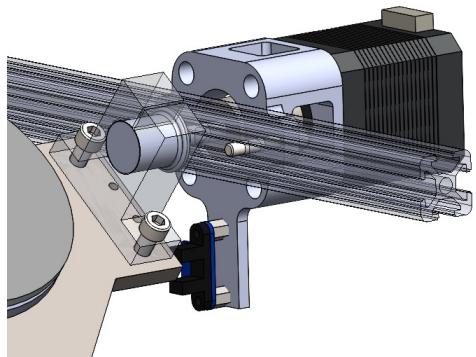
Y-Axis Assembly



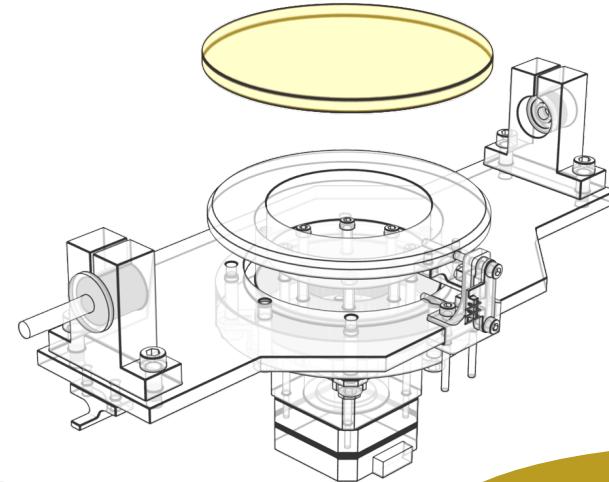
Design Considerations (Gantry)



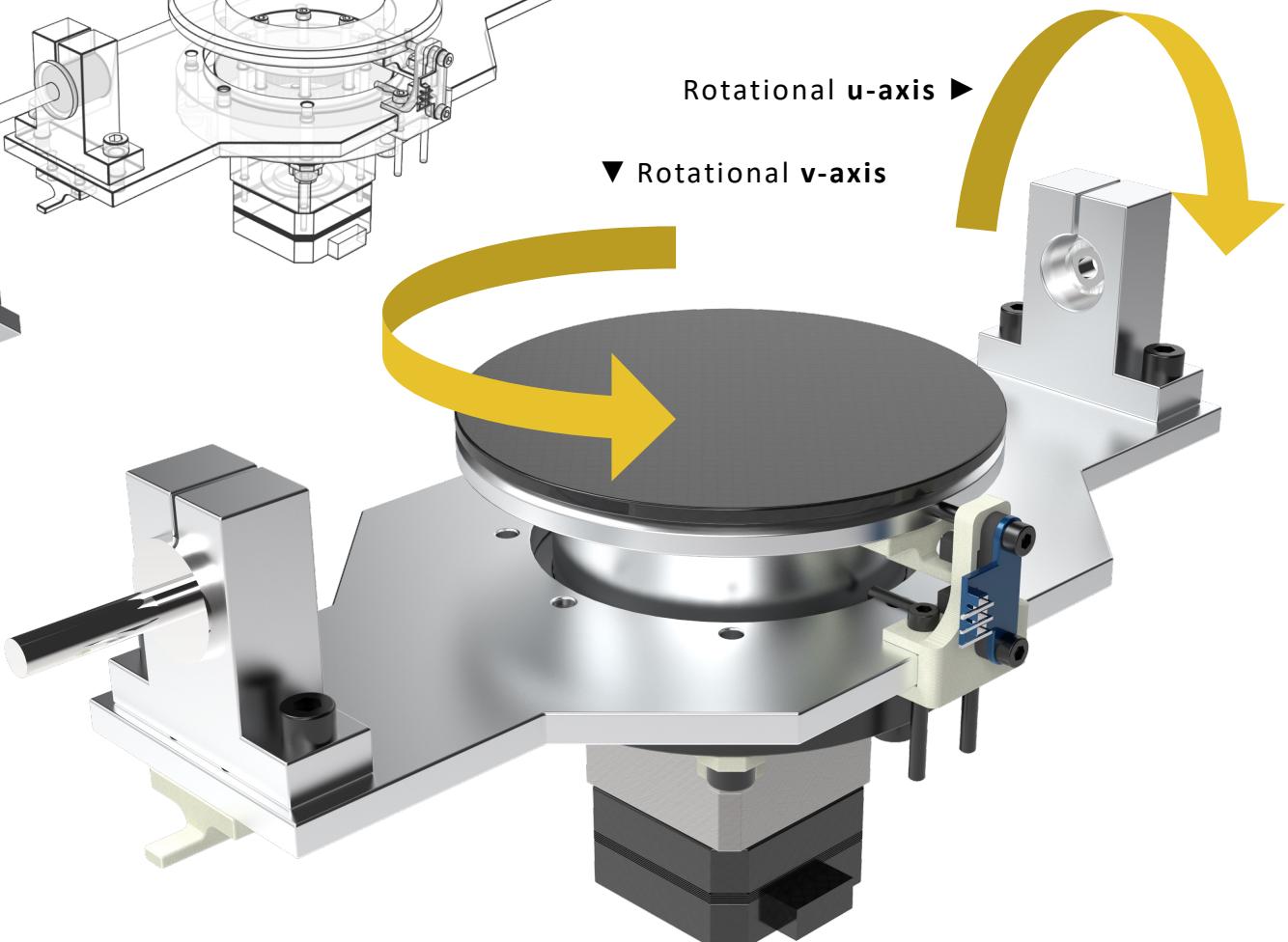
Consideration 1: 7:1
Planetary gear for
increased resolution
(0.9° per motor step)



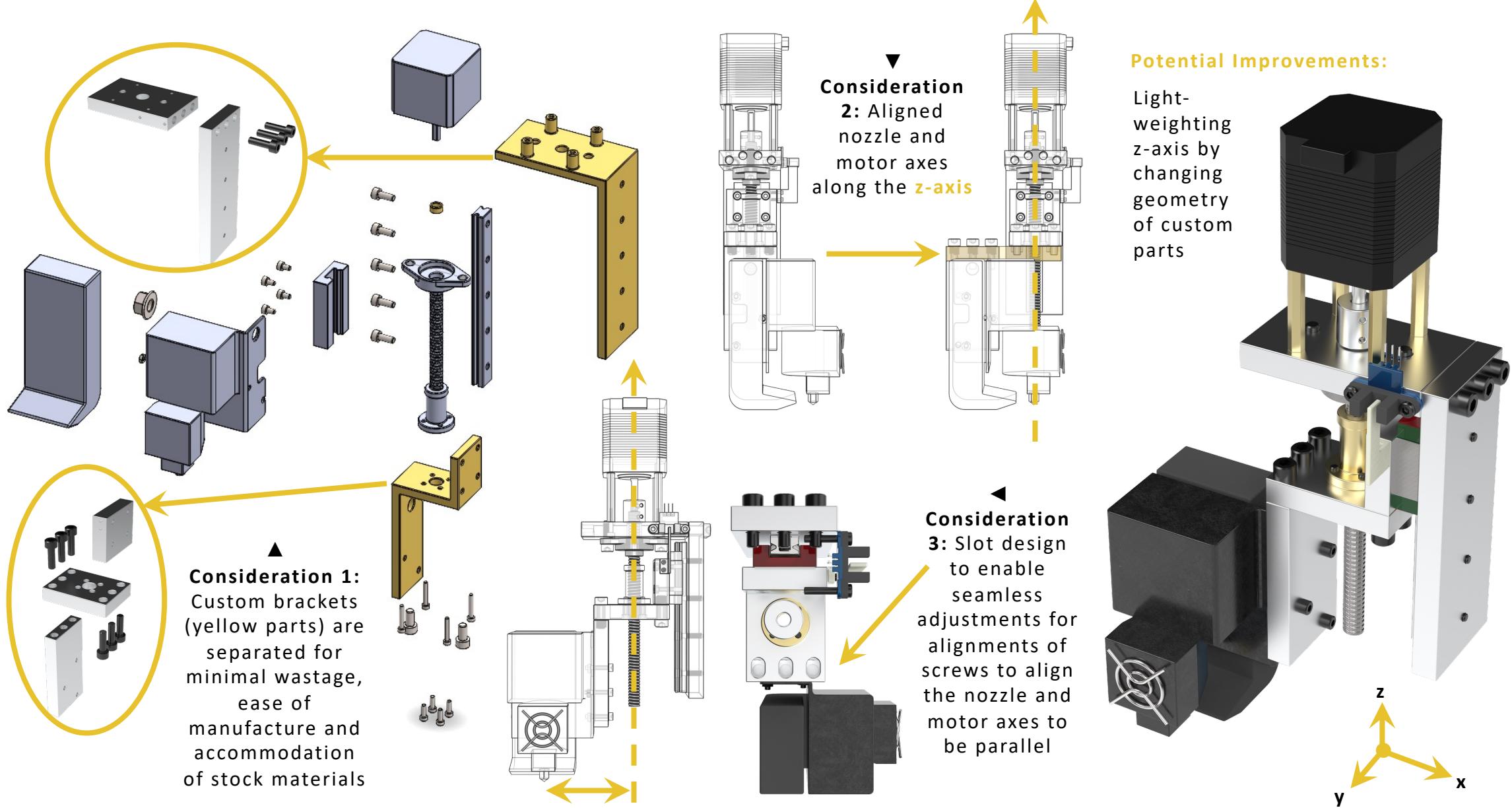
Consideration 2:
Motorization of
u-axis:
SIDE A: Deep groove
ball bearing
◀ SIDE B: Coupling to
NEMA 17 Motor



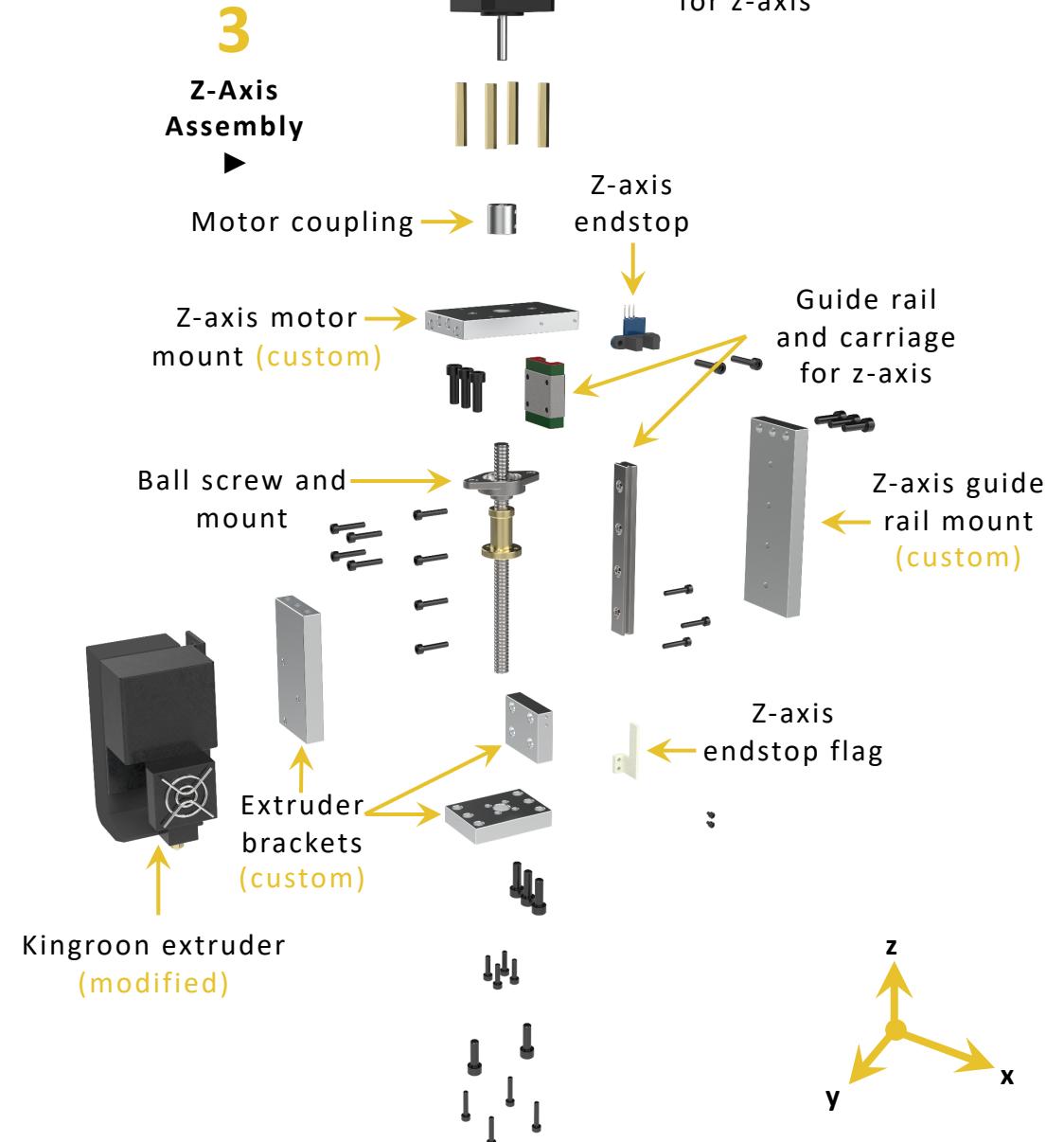
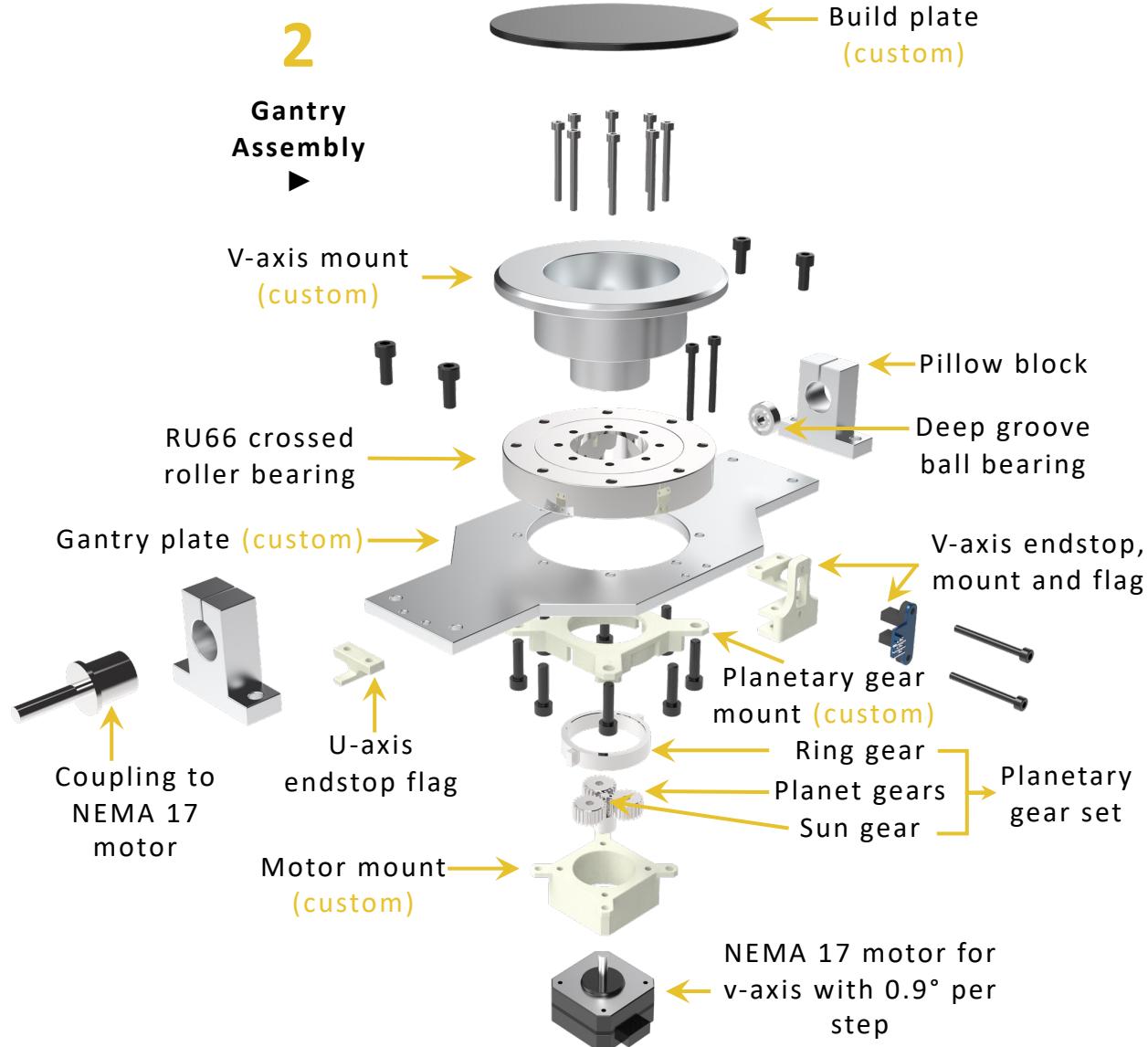
◀ **Consideration 3:**
Circular build plate
to reduce collision



Design Considerations (Z-Axis)



Assembly Explosion (Gantry & Z-Axis)



Electronics & Software

1 G-code

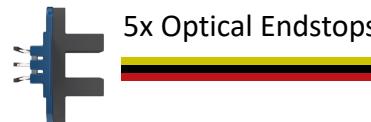
Software for G-Code Generation:

- Sub-elements of part are sequentially sliced in traditional 3-axis slicer
- Part printed in segments with U&V rotations of coordinate frame in between

Development Opportunities:

- Continuous 5-axis toolpath slicing
- Collision detection

3 Sensing



5x Optical Endstops

4 Extrusion

Ceramic resistance heater ►



NEMA 17
Filament
Drive ►



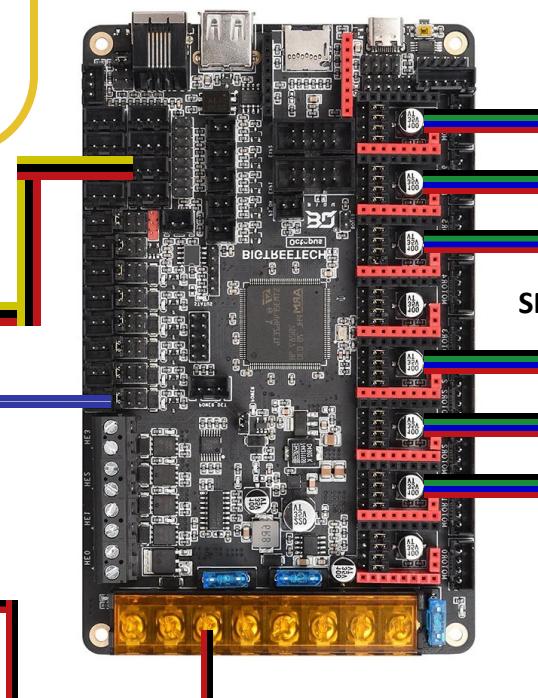
2 Firmware



Customized open-source

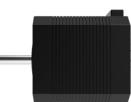
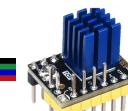
3D NC Library

▼ STM32 Arm Cortex Controller



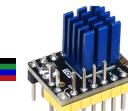
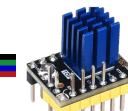
5 Motion

Bipolar NEMA 17
Stepper motors

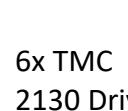
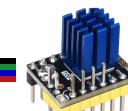


CoreXY

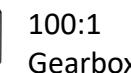
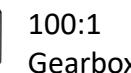
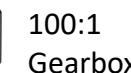
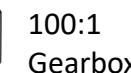
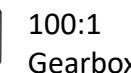
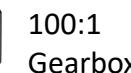
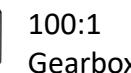
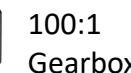
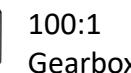
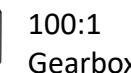
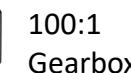
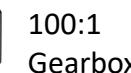
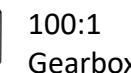
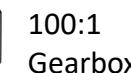
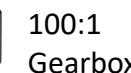
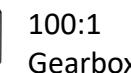
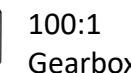
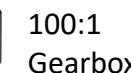
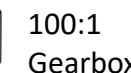
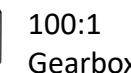
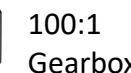
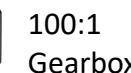
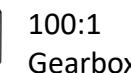
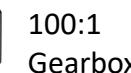
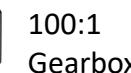
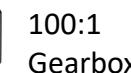
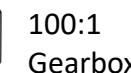
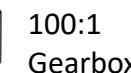
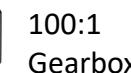
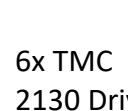
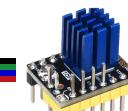
X Axis



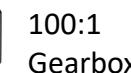
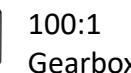
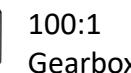
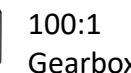
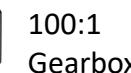
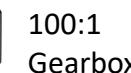
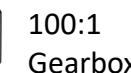
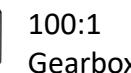
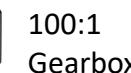
Y Axis



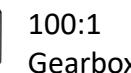
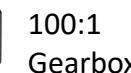
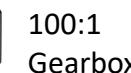
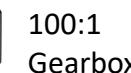
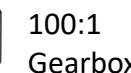
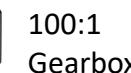
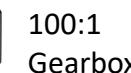
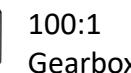
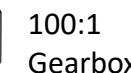
Z Axis



U Axis



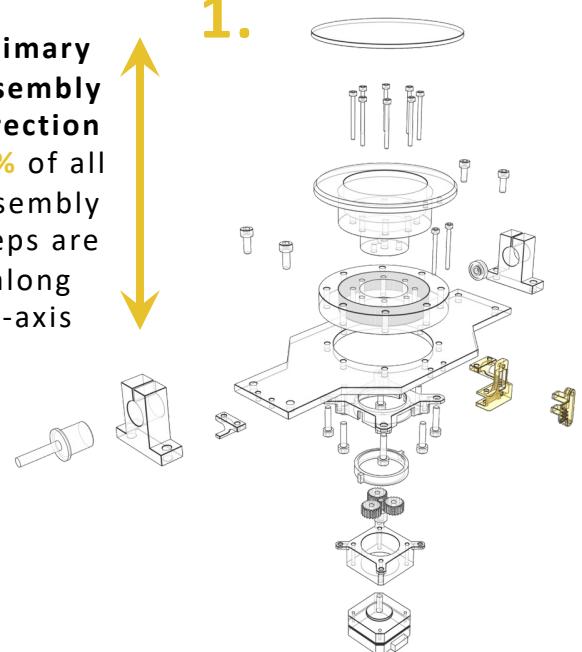
V Axis



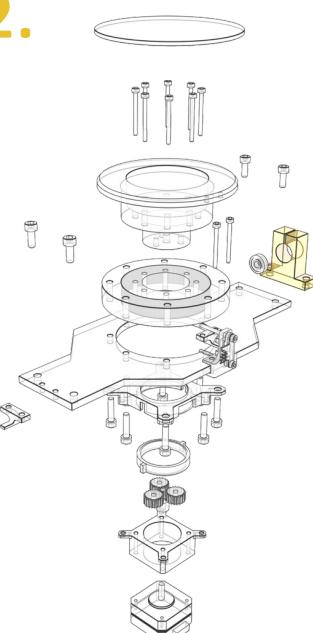
Gantry Assembly Sequence

Primary assembly direction
63% of all assembly steps are along z-axis

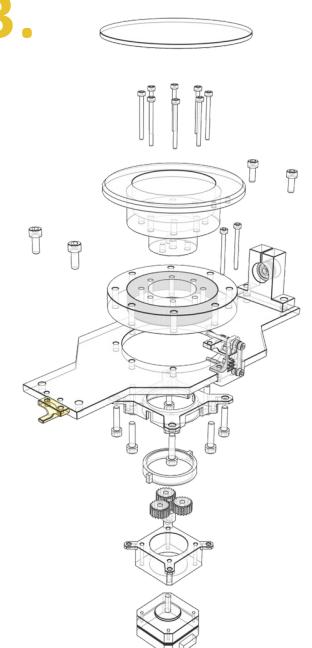
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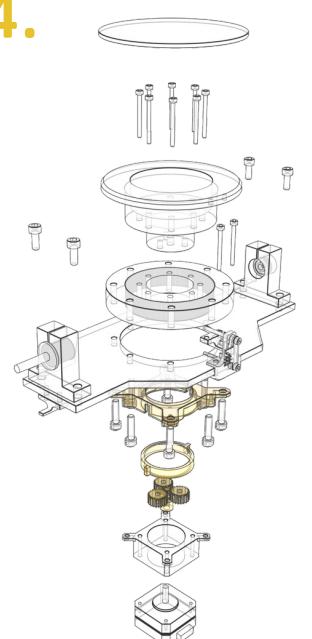
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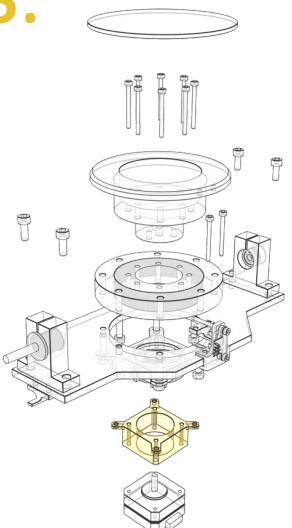
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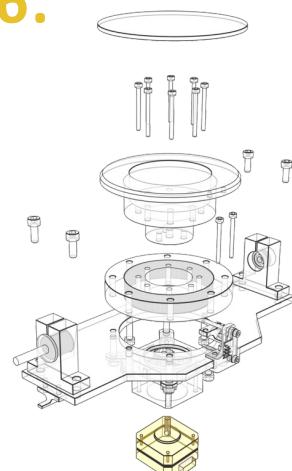
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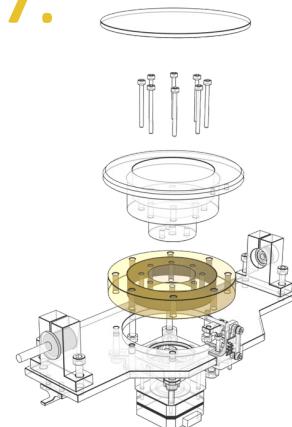
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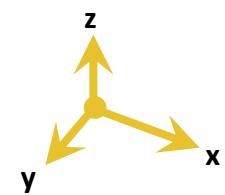
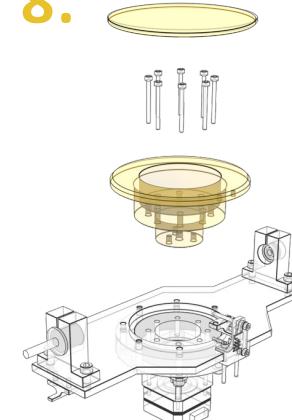
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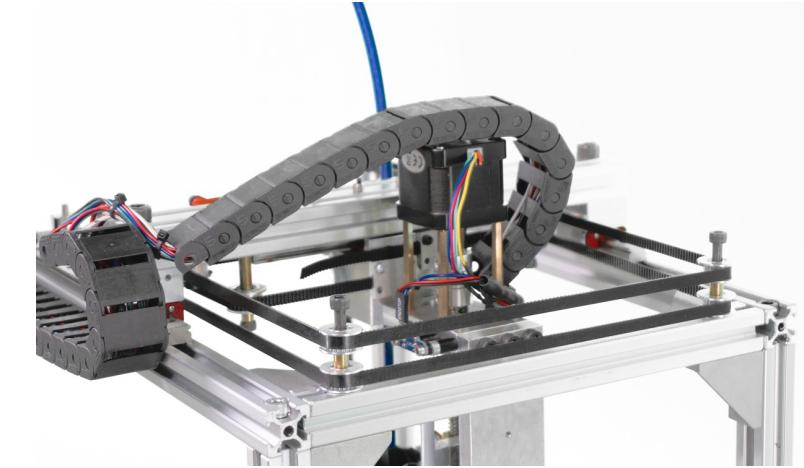
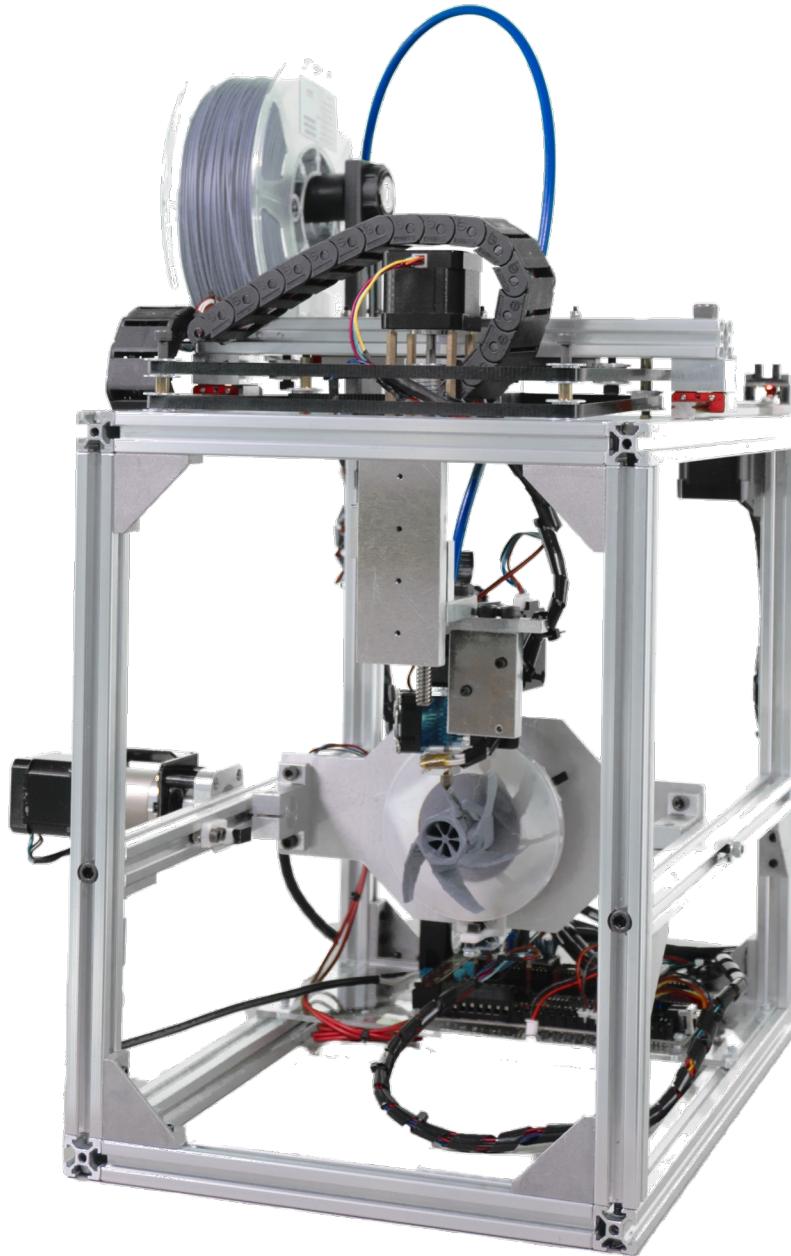
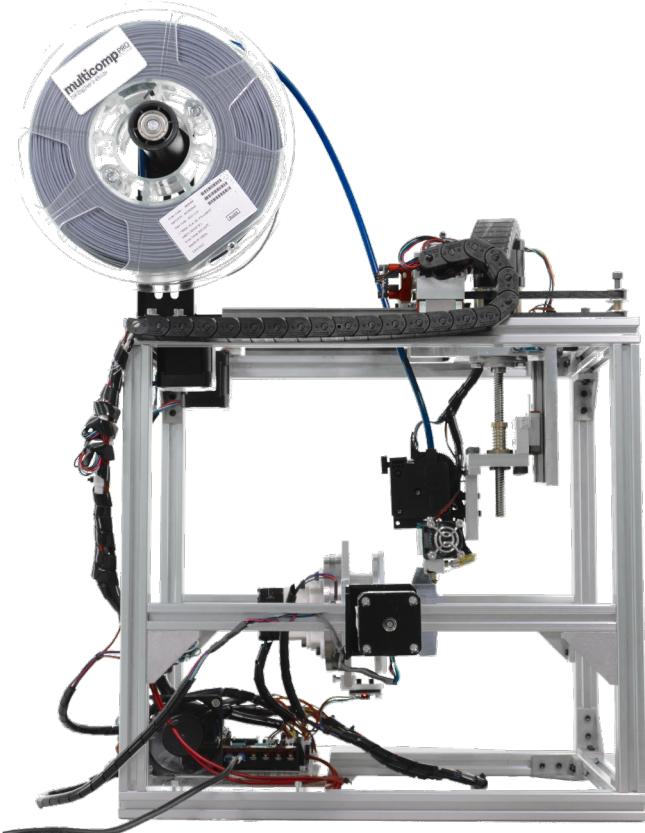
7.



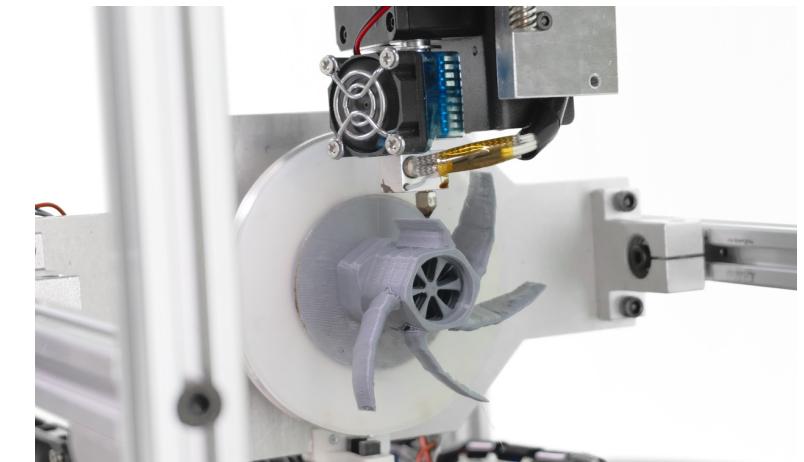
8.



Actual Product



▲ **CoreXY configuration:** Details of the belt system used to control movement of the x- and y-axes



▲ **The PentaX in action:** Printing an object with unsupported overhangs

Final Product

PENTA

