

Crystal Handling

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October 4th, 2017

Journey of crystal - ideally

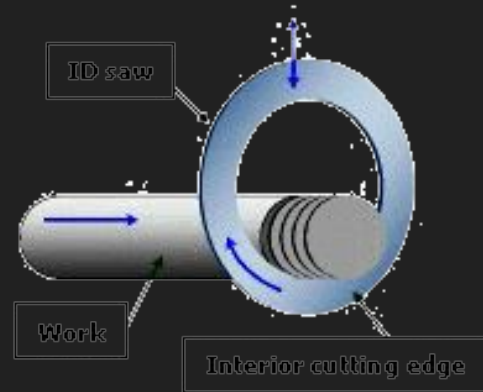
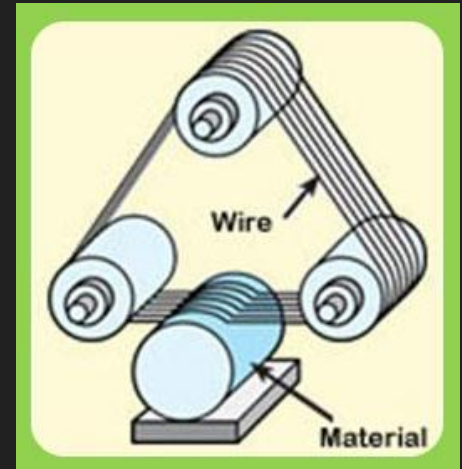
- Powder purification and preparation at LNGS
 - Underground
- Growth:
 - Underground
 - Assumes no earthquake, no avalanches
- Cutting, polishing and assembly:
 - Underground
 - ID cutter
 - Lots of high-purity chemicals
 - Operation in glovebox in radon-free cleanroom

Journey of crystal - in reality

- Growth - RMD
- Cutting:
 - RMD - Diamond Wire Saw
 - Princeton - ID cutter
- Polishing:
 - High-purity
 - Optical quality
 - Light yield
- Assembly:
 - Cleaning
 - Reflector
- Shipping:

Cutting

- Cutting:
 - RMD - Diamond Wire Saw:
 - Equipment proved to work
 - Larger stress
 - Princeton - ID cutter
 - Maintenance needed
 - Less stress
 - Cutting can be done eventually in radon-free cleanroom
- Best to have RMD cut it



Traditional method of slicing

Polishing

- High-purity requirement:
 - Use material with even higher purity than crystal
 - Procedure must be carried out in radon-free, water-free environment - glovebox is better
- A potential method has been found but still under study:
 - Previous study - optical properties can be restored
 - Effect on light yield - study currently going on but progress is delayed due to availability of electronics
 - Expected to finish in a few weeks

Assembly

- Procedure must be carried out in glovebox:
 - Remember operator will be wearing at least 2, probably 3 layers of gloves
- Material must be cleaned thoroughly before assembly:
 - High-purity chemical
 - Metal parts - deionized water, acetone, isopropanol
 - Commonly used in nanofabrication
 - Plastic - avoid acetone
 - Inert plastic and glass - hot dilute acid leach for weeks

Assembly - reflector

- Currently 3M foil vs teflon
- 3M foil:
 - Specular reflector
 - Cutoff at NaI scintillation frequency (~ 420 nm)
 - Might leave small gap between foil and crystal
- Teflon:
 - Diffuse reflector
 - Proven to work well
 - Can be attached tightly to crystal

Shipping

- Cosmic activation - via ship
- NaI doesn't like water
 - Enclosure must be gas-tight
 - Additional hermetic seal for additional protection - Mylar can be used, or special container
- Thermal stress
 - Add thermal insulation to make sure temperature does not change rapidly
 - Once arrives in lab, make sure thermal equilibrium before opening
- Mechanical shock
 - Shipping in a crate
 - A lot of buffer / cushion
 - PMT should be fixed firmly wrt crystal to avoid misalignment
 - Enclosure signal test before and after shipment to see if everything is OK
- Reopening in LNGS glovebox in case of misalignment
 - In the future, might want to ship bare crystal directly to LNGS when LNGS is ready