



Extruded Scintillator for MINERVA

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What we are talking about

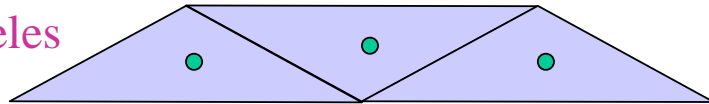


- Isosceles triangle **3.3cm base, 1.7cm height.**

AND

- Right triangle **1.65cm base, 1.7cm height.**

- ~ **6:5 ratio** of isosceles and right triangles.



- ~ **11000 isosceles and 9000 right triangles.**

- Isosceles triangles are **1.21 - 2.42 m.**

- The right triangles are **1.24 - 2.05 m.**

- The total volume of scintillator ~ **6.87E6 cc ~ 7000 kg**



Extruder

ZE 40A UTS Technical Data

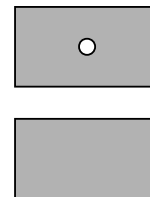
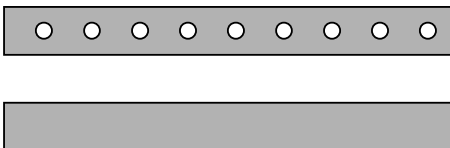
- Screw diameter • 44 mm
- Actual L/D • 30:9:1
- Screw speed • 1200 RPM
- Drive power • 200 HP
- Exp. Output • ~100 kg/hour
- Height • ~1100 mm
- Weight • ~3500 kg

- Theoretical life • ~40000 hours



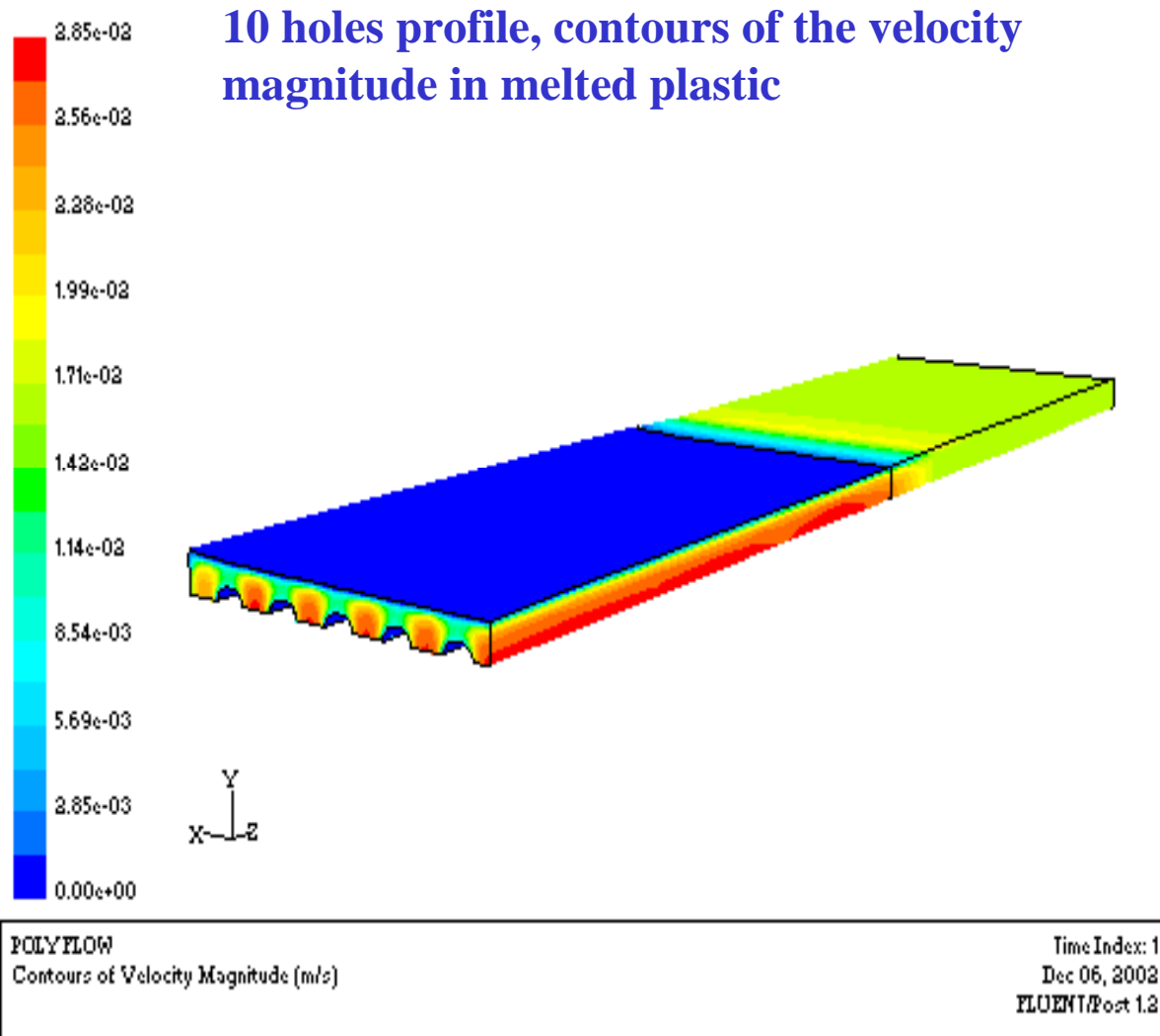
DIES

1. DIE allows us to make the profile we wish
2. Available dies :
 1. Rectangle $100*5 \text{ mm}^2$
 2. Rectangle $20*10 \text{ mm}^2$
3. Triangle (MINERVA) dies are not available and has to be designed and cut.





DIE simulation



We have collaboration with NIU Mech. Eng. Dep. to design the dies using simulations based on computational fluid dynamics package.



Simulation and die design



- DIE with one hole , DIE simulation and Exploded drawing of the real die

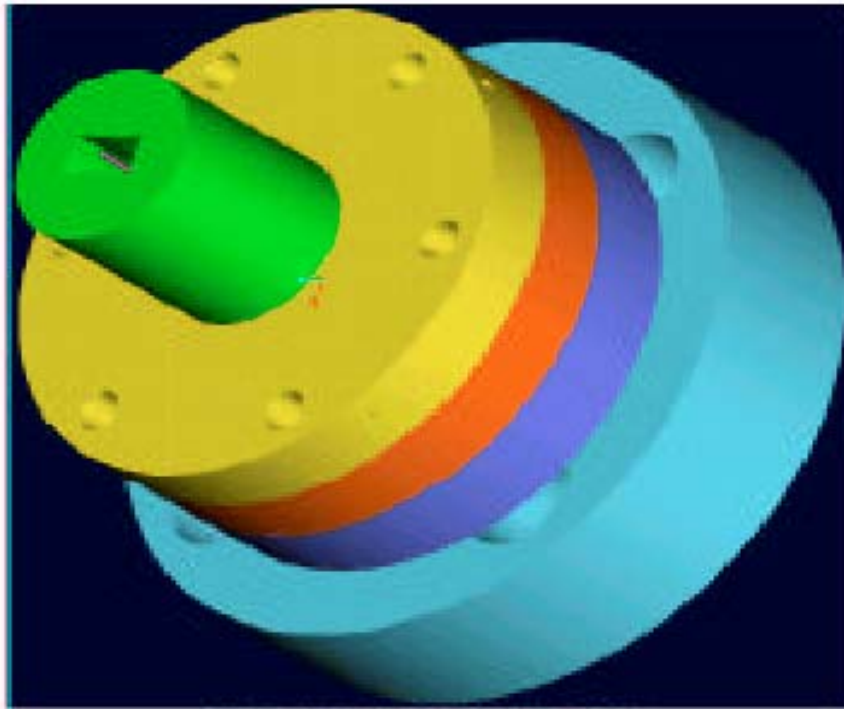


Figure 15: Assembled view of whole die

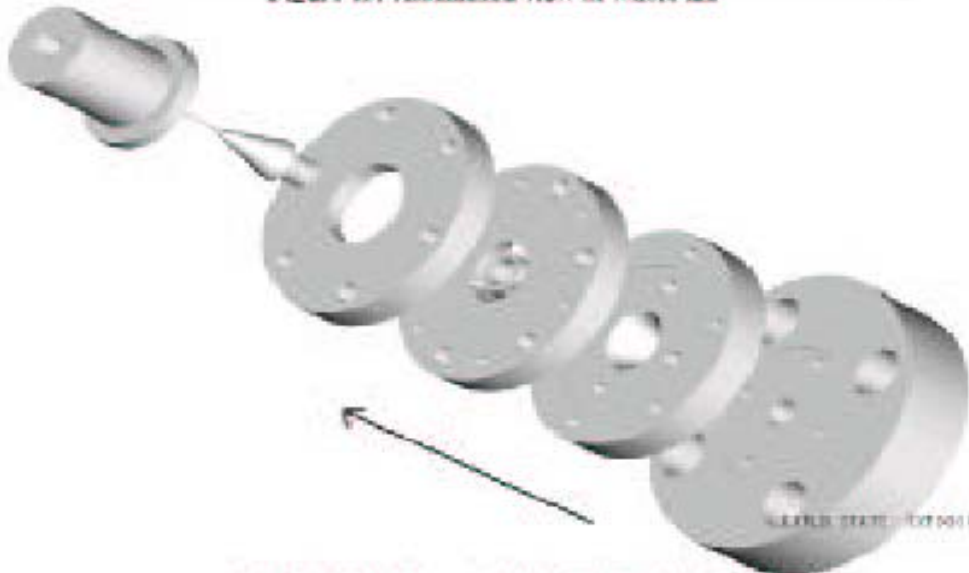


Figure 16: Exploded view of whole die (Full shade model)



DIES for MINERVA



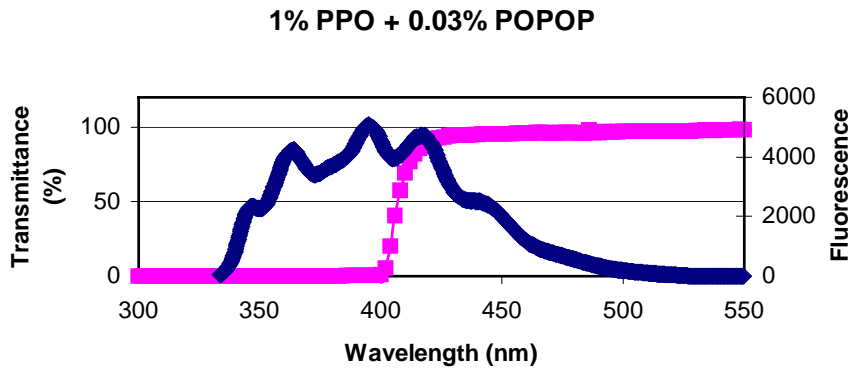
- **Two different dies are necessary.**
- **New die simulation process has to be initiated.**
- **Central hole (recommended) or side groove (needs additional R&D) ?**
- **Painting or MINOS type coextrusion ? (coextruder needed)**
- **R&D financial support is necessary.**



Scintillator options



- The same recipe as MINOS and K2K

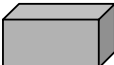
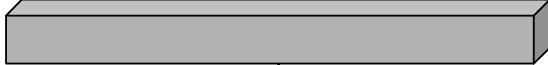


4.87 ± 0.03 mm
20 cm intervals
44 m total





Scintillator options

Parameter (bulk scintillator)	FNAL-NICADD	MINOS or K2K	BC408
Light output  20*20 mm ²	~ 0.74	~ 0.74	1 BC404 ~1.2
Light attenuation length (short component)	 ~ 34 cm	~ 6.9 cm	~ 200 cm *

* BICRON measurements



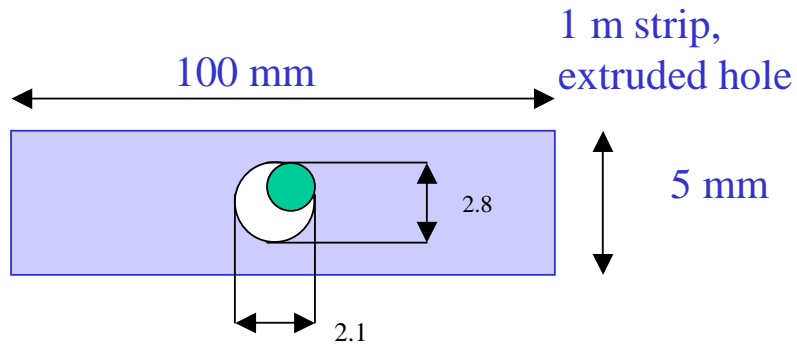
Scintillator options

Glue

~70 %,

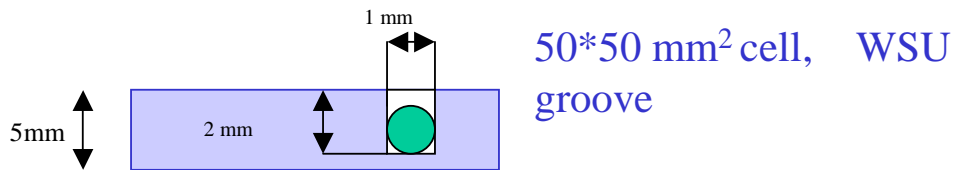
Fiber diam. of 0.94 mm.

NICADD



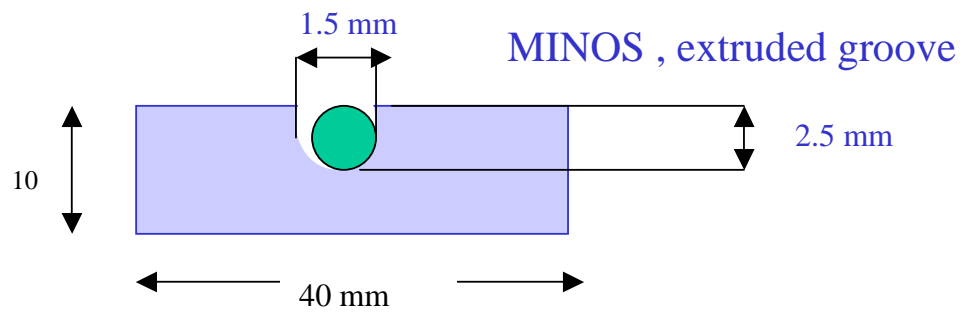
~ 17 %, Fiber diam of 0.94

NICADD



~ 60 %, 1.2 mm

NUMI -L-603

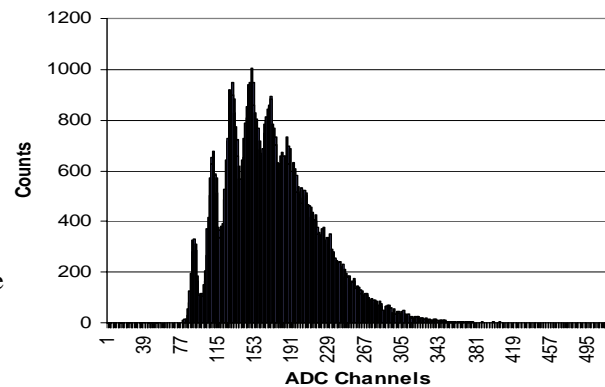
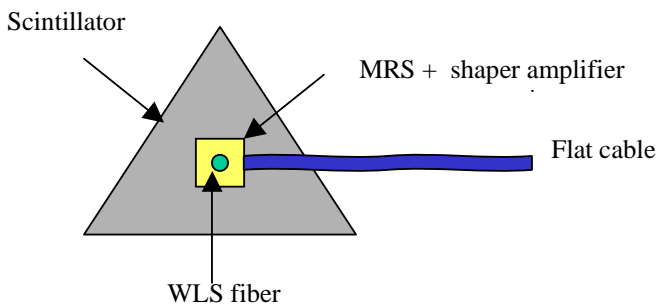




Some R&D

Missed MRS chance for MINERVA

1. Save some money !?



Gain ~ 10^6

Size ~ $1 \times 1 \text{ mm}^2$

QE ~ 20% (500 nm)

$\sigma(t) < 100 \text{ ps}$

cost/sensor ~ \$10

HV ~ 50 Volt

NICADD is already doing R&D with MRS, Si PM and the results are promising.

NICADD may be able to perform R&D for MINERVA.



Summary

- 1. NICADD and the SDDL (FNAL) are available to do the R&D.**
- 2. FNAL-NICADD have most of the equipment and the expertise needed for scintillator production.**
- 3. Waiting for adequate funding to meet MINERVA request.**