Structured scintillators review

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ESRF – The European Synchrotron

IFDEPS VT

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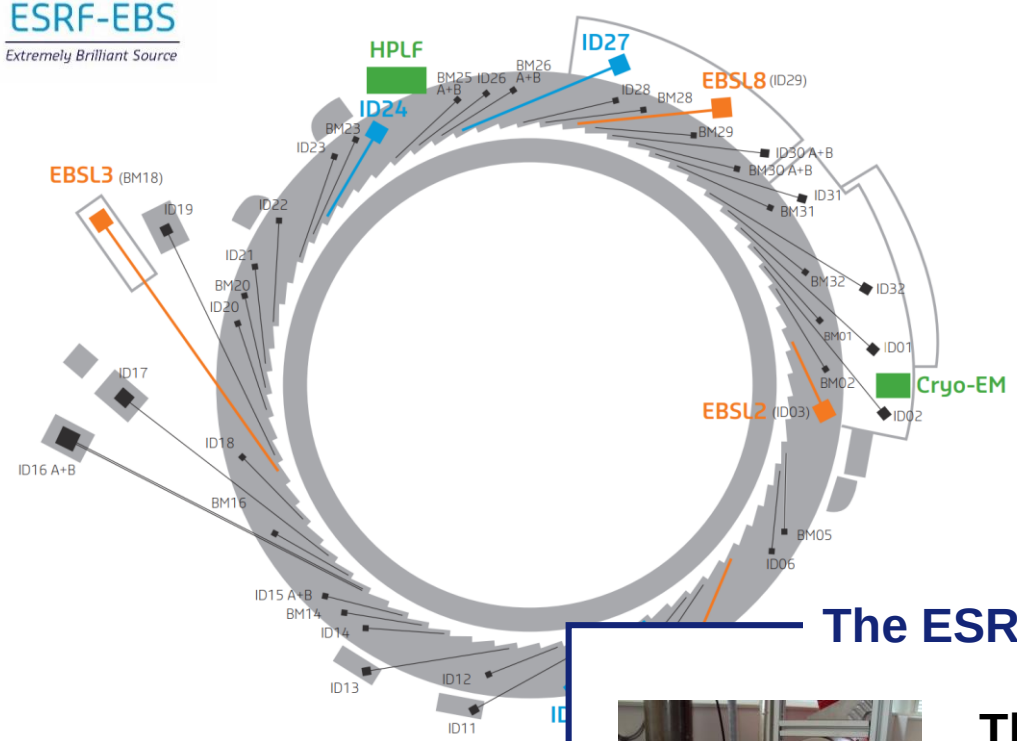
The upgraded ESRF-EBS requires new detectors

ESRF-EBS
Extremely Brilliant Source

- **unprecedented challenges**
- **an ambitious instrumentation program**



DETECTOR DEVELOPMENT PLAN (DDP)

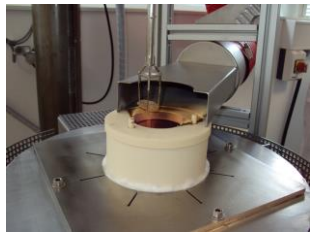
R&D to improve X-rays detectors + systems

Context:

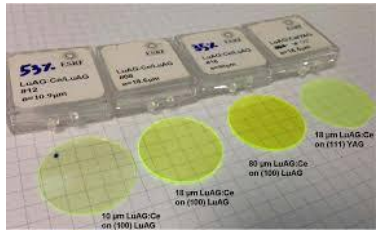
- Hard X-rays (30-100 keV)
- High flux
- Large areas

INVESTIGATE NEW SCINTILLATORS!

The ESRF / Detector Unit has demonstrated expertise in scintillation



Thin-film scintillators of high quality
Custom compositions and optimized process
Products purchased by many synchrotrons

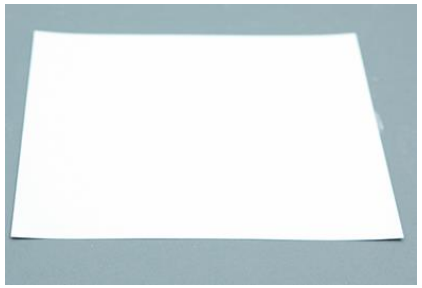


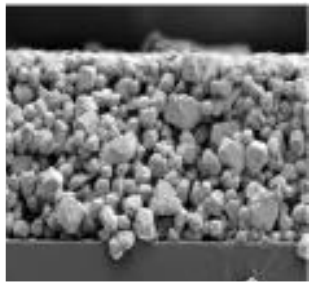
The requirements are ambitious!

Bright	>10 ph / keV	**Sensitivity**
Good spatial resolution	20-70µm	**Contrast**
Good stopping power	~ 50% at 70 keV	**Conversion efficiency**
Low afterglow	12-16 bits	**Dynamic range**
Radiation hard	10^{8}-10^{15} ph/mm²/s 100 kGy/s!	**Lifetime**

Today's commercial scintillators have limitations

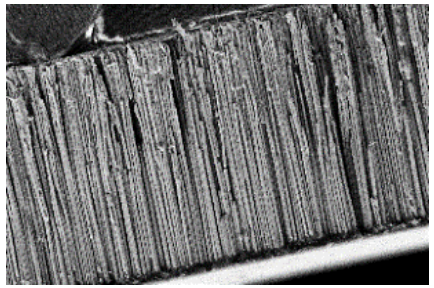
Powder screens

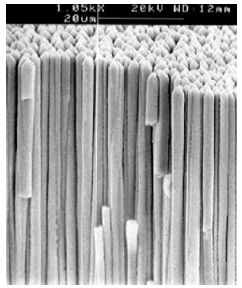




e.g. scintacor

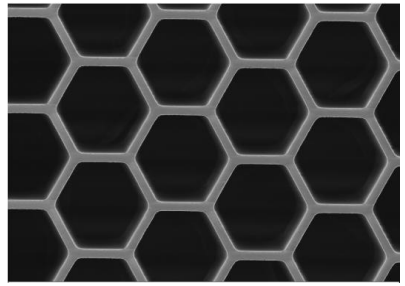
Micro-columns





e.g. Hamamatsu

Micropores



e.g. scintX

Not combining stopping power and spatial resolution

Only available with <u>one</u> scintillating material: Cesium Iodide (CsI)

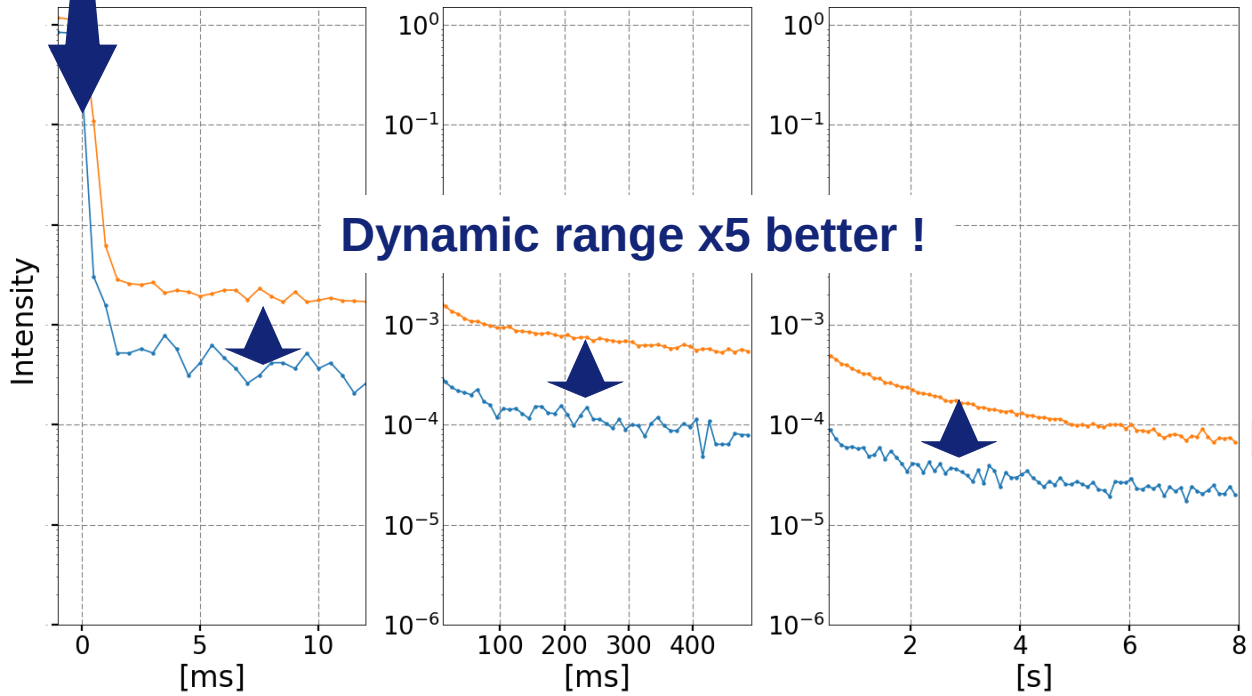
Significant Afterglow
Not radiation hard

Xray dose = 5 kGy
e.g. 30 min @ 10^{11} ph/mm²/s

Effort to reduce afterglow in CsI micro-columns

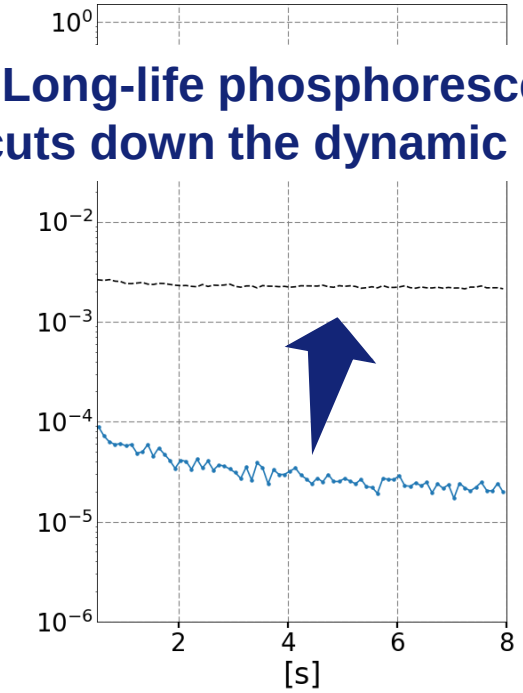
X-rays OFF

1s x-ray ON *(10^7 ph/mm²/s)*



Dynamic range x5 better !

… after 5 kGy

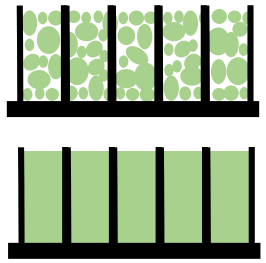


Long-life phosphorescence cuts down the dynamic range

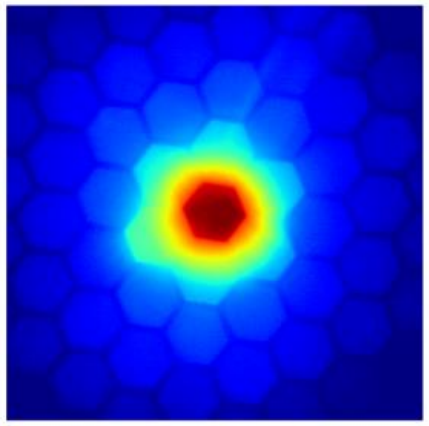
> Afterglow can be decreased for low flux x-ray beams
> High x-ray doses systematically give rise to phosphorescence in CsI

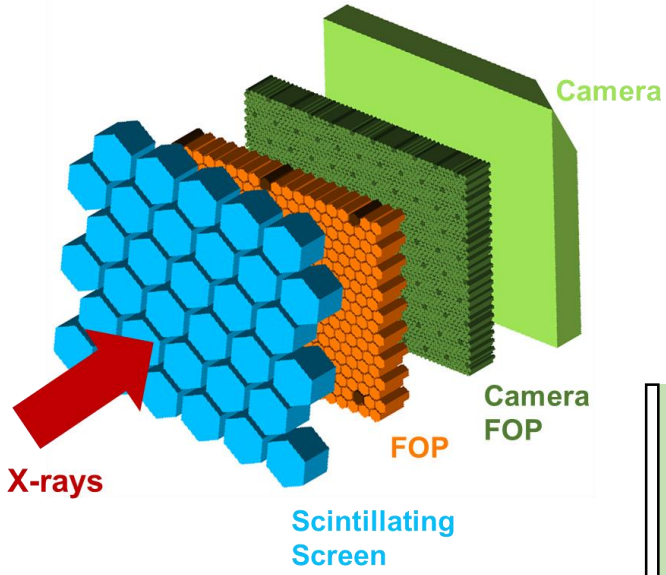
On-going study of micro-columns grown with new materials

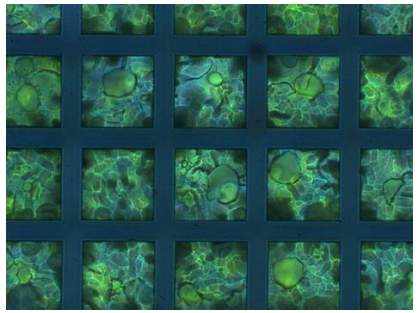
Scintillators assembled into microstructures (ESRF R&D)

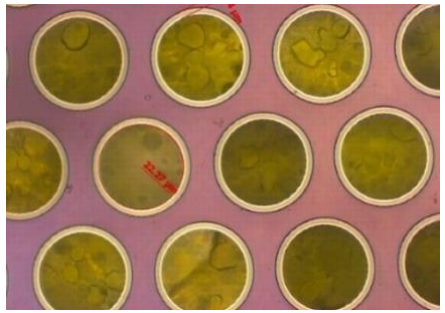


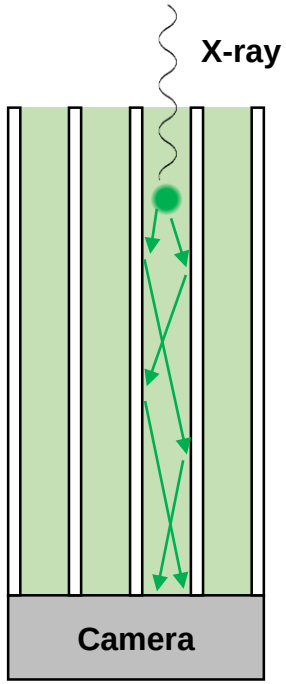
Microstructures (pores)
filled with custom scintillators



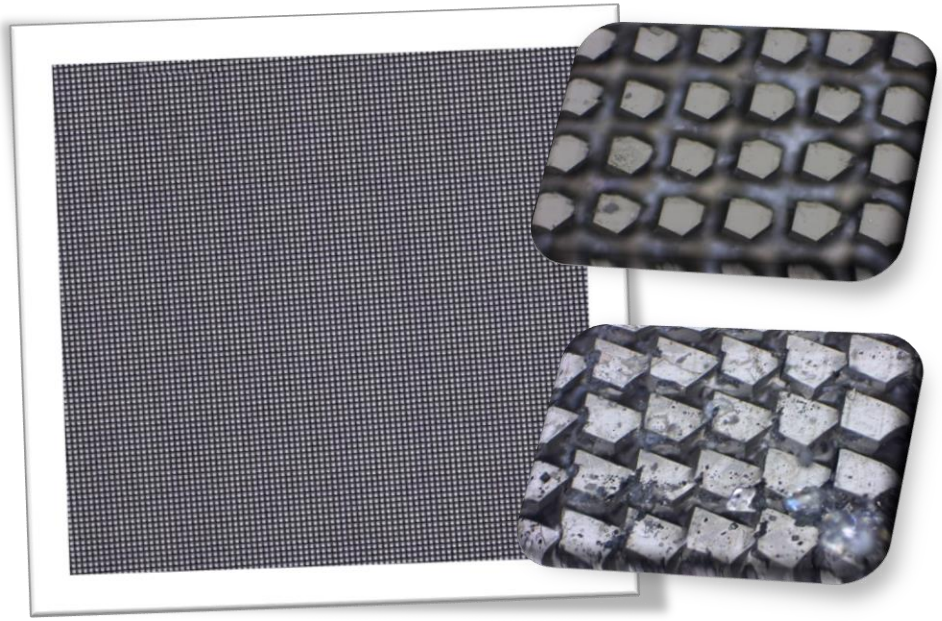








Investigation of crystal growth
with microstructure shape



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