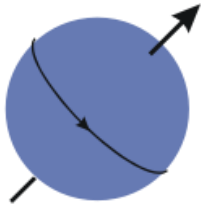


# INP-Minsk proposals to the FCC Study

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Research Institute



for Nuclear Problems



BSU

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Belarusian State University

**(INP-Minsk)**

- **Development of the novel techniques for electromagnetic and hadron calorimetry with time resolution in pico-second range;**
- **Development of the methods to control quality of the beams;**
- **Simulation of the radiation environment at future experimental facilities and machines.**

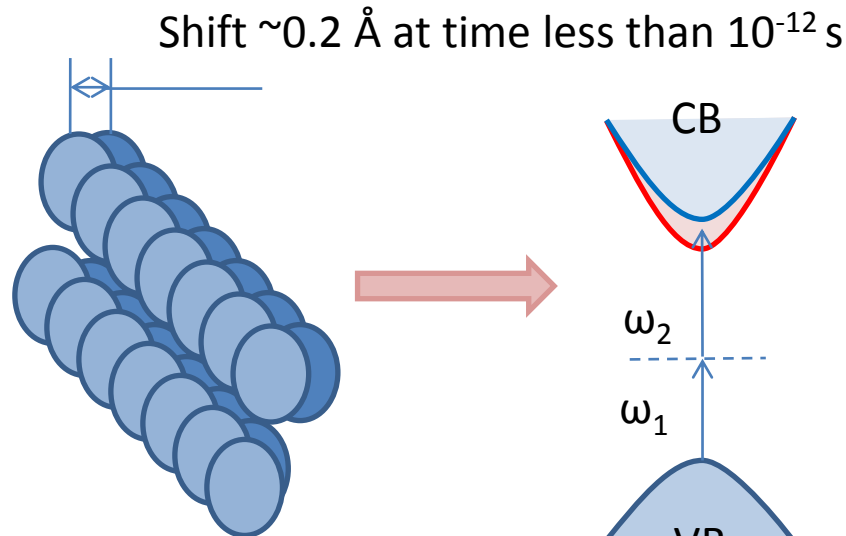
# Exploitation of the ultrafast transient phenomena to form timing marks in fs-ps range

Ionising radiation produces several transient phenomena occurring in a time interval of about  $10^{-12}$  seconds or shorter.

In case of dielectric materials the relevant process is the **short term polarization**

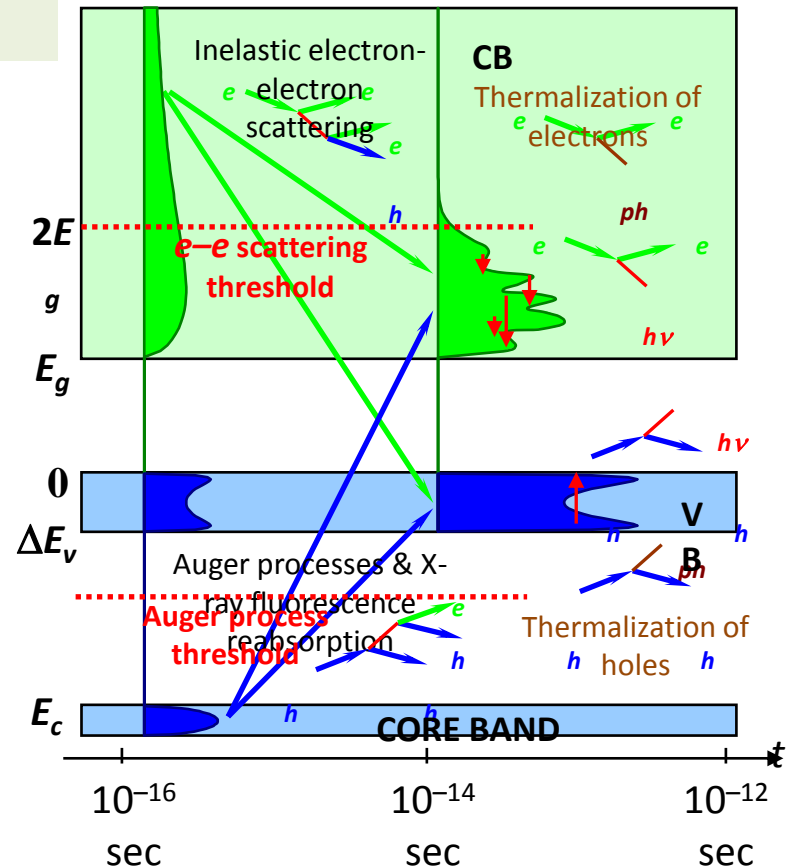
Two photons absorption - an effective tool to exploit ultrafast changes in the dielectric transparent media

Small shifts of the atoms due to polarization of the media under ionization can change band gap for a short time

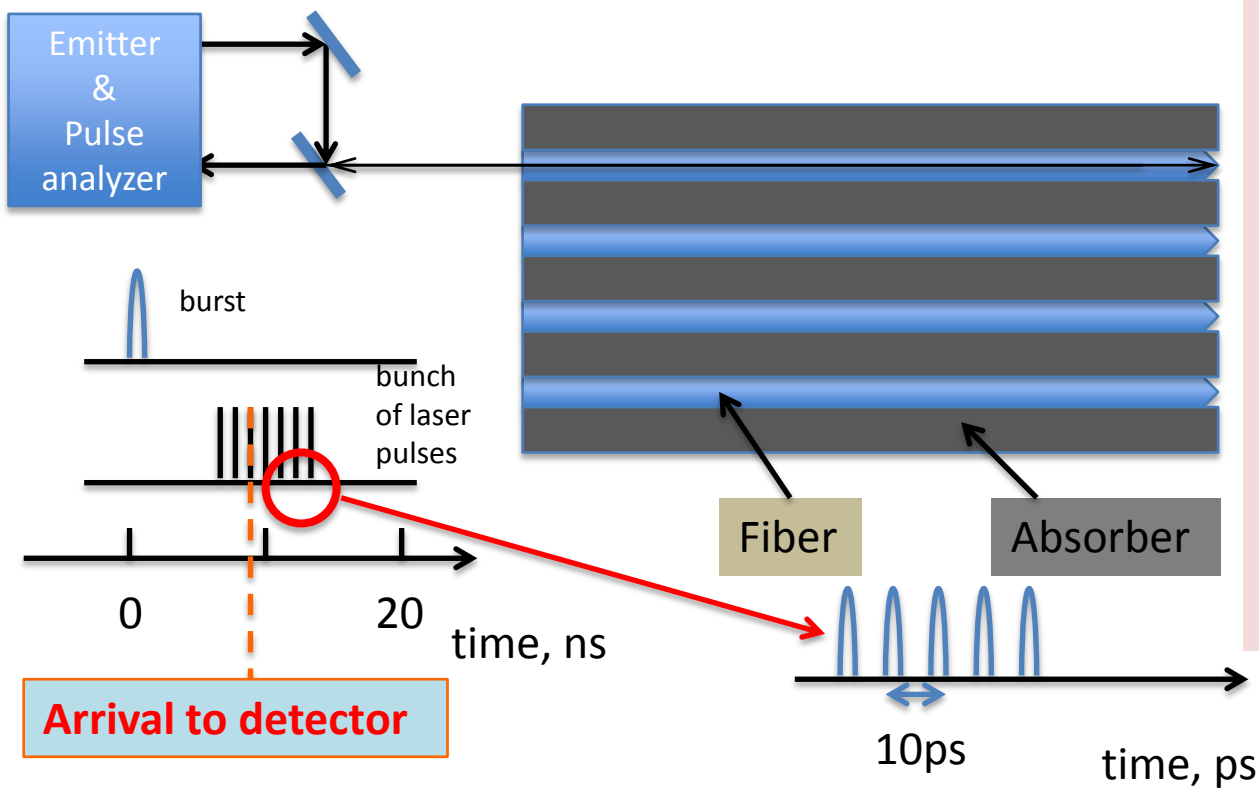


Change of the two photons absorption conditions in the media for a short time

Hot carriers evolution in insulating material due to ionizing radiation

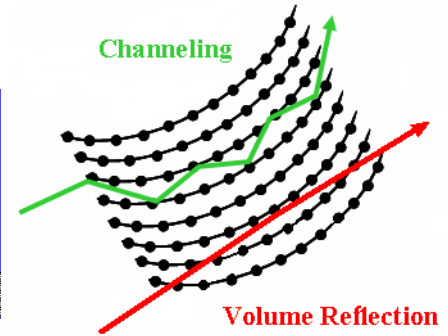
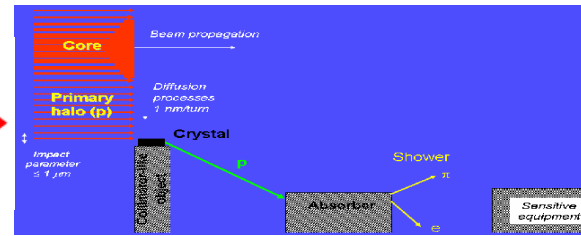
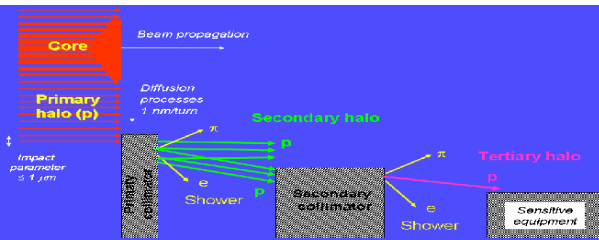


# How it can work in future detectors at FCC and what may be the benefits?



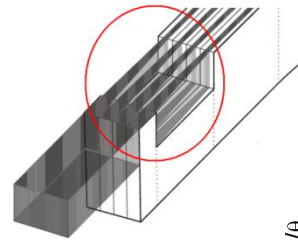
1. Fibers can have different refraction index to control light speed
2. Fibers can be also scintillating
3. Registration can be managed in the regime of standing or travelling wave

# New approach to HE beams collimation - crystal collimation

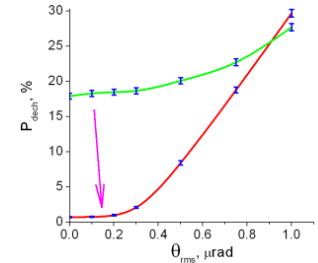
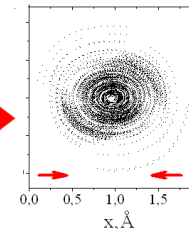
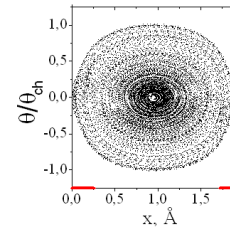


## Channeling mode

- **crystal cut idea**
- increases channeling fraction from 85 to 99%

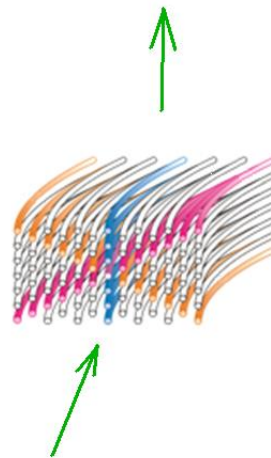


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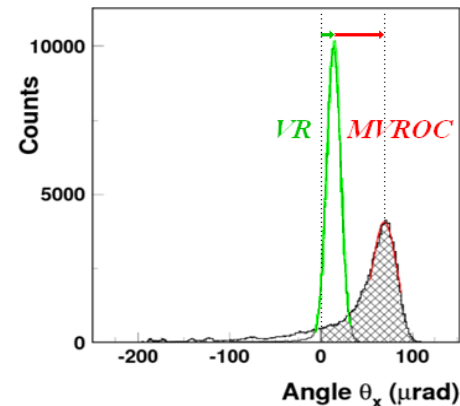


## Volume reflection mode

- **multiple volume reflection** effect
- increases deflection angle to 5 times



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# Crystal calorimetry using enhancement of radiation and pair production in crystals

Strong-field EQD effects in radiation and pair production:

allow to

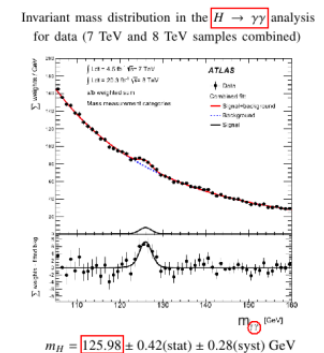
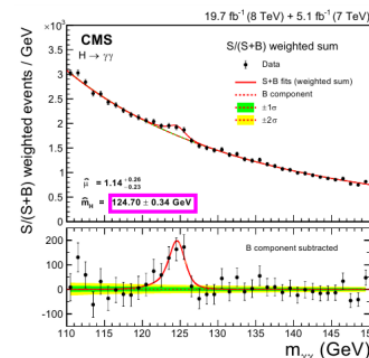
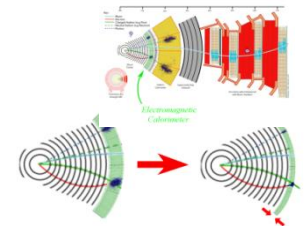
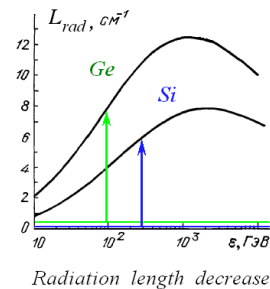
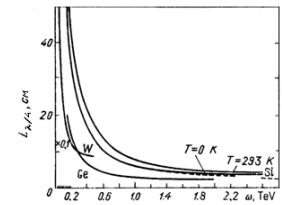
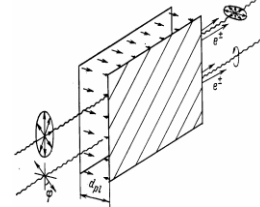
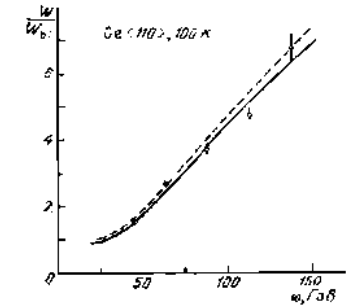
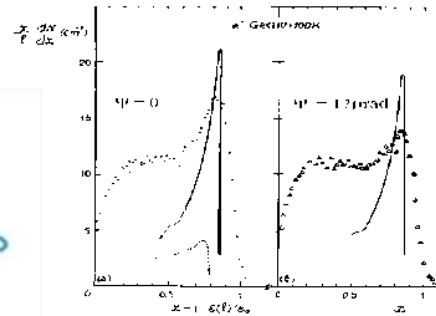
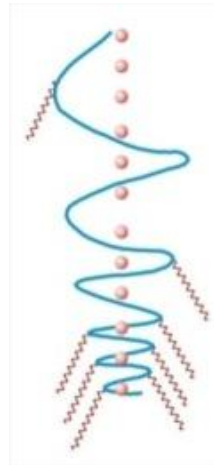
– to produce and measure electron, gamma and hyperon polarization:

– to reduce radiation length and thickness of an electromagnetic calorimeter:

– increase mass resolution of an electromagnetic calorimeter:

$$M_{Higgs}^{CMS} \rightarrow M_{Higgs}^{ATLAS} ?$$

Geant4, Fluka, EGS4, etc. can be supplemented with crystal structure effects



**THANK YOU**