



FILD Synthetic Diagnostics

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University of Seville, University of Milano-Bicocca, Istituto di Fisica del Plasma, Aalto University, Consorzio RFX, EUROfusion and Fusion for Energy

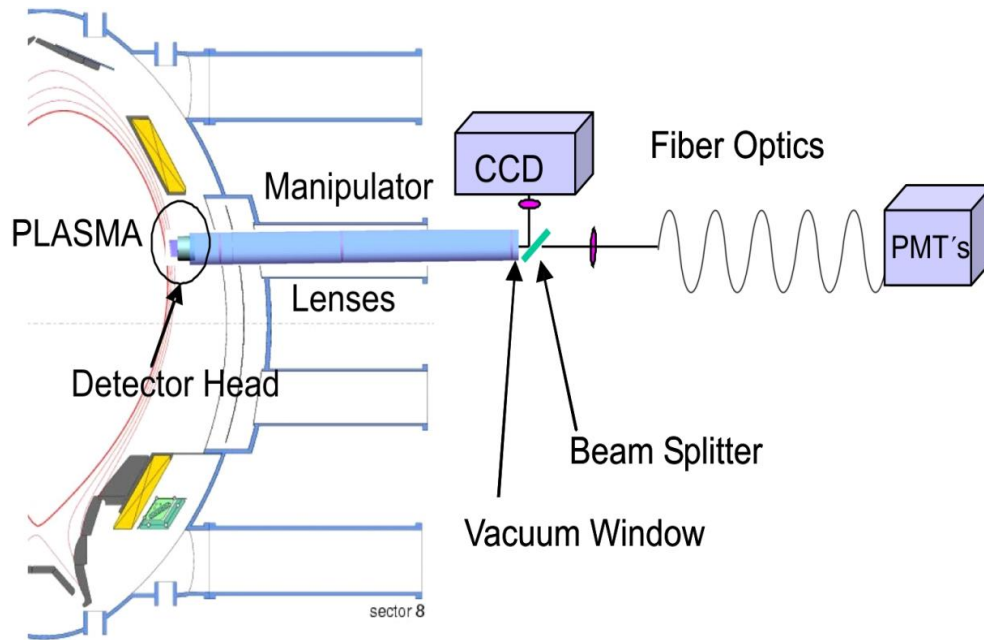


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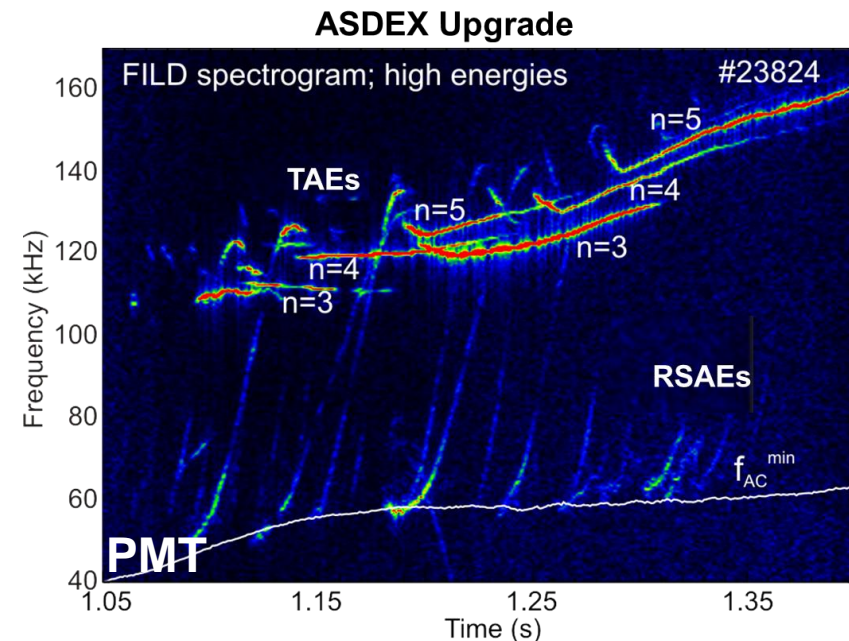
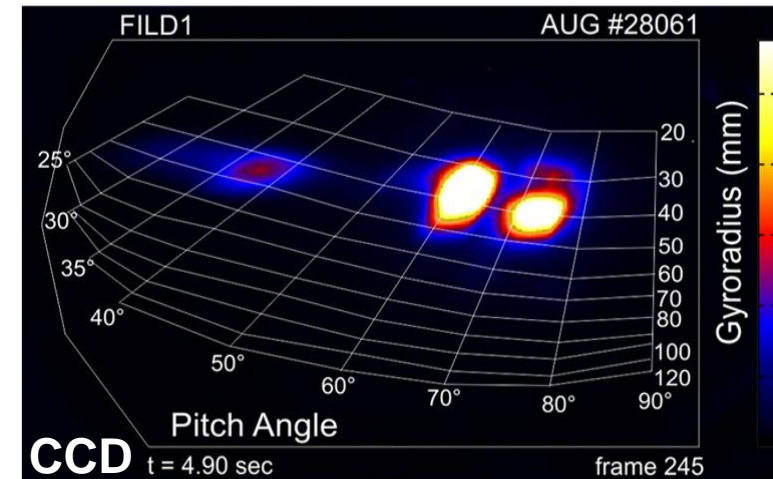
Fast-Ion Loss Detector (FILD^{1,2}) Provides Full Information on Velocity-Space of Escaping Ions



FILD systems are charged particle collectors placed at the first wall



- Synthetic diagnostic must account for realistic fast-ion distributions, plasma effects, scintillator response, 3D geometries, optical transmission, response of light acquisition systems, etc

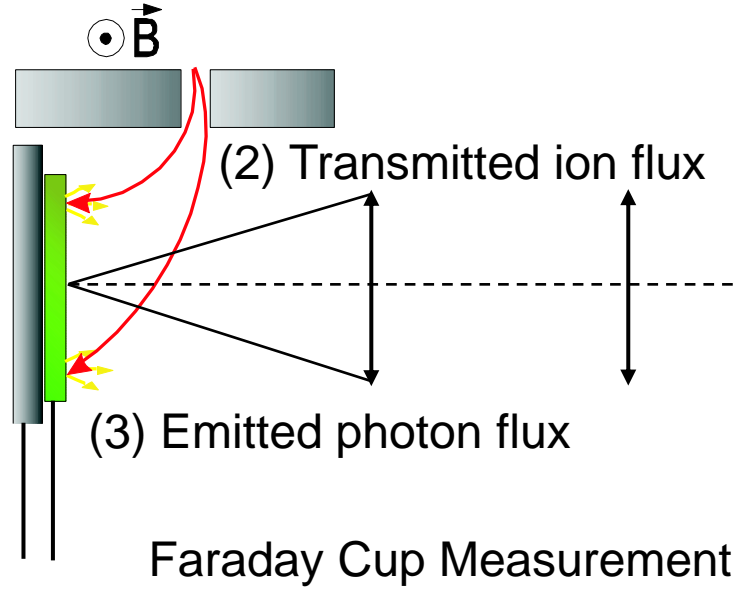


FILDSIM Code Simulates Expected Signal



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(1) Incident ion flux



(2) Transmitted ion flux

(3) Emitted photon flux

Faraday Cup Measurement

(4) Optical system throughput

(5) Light acquisition systems (CCD / PMT)

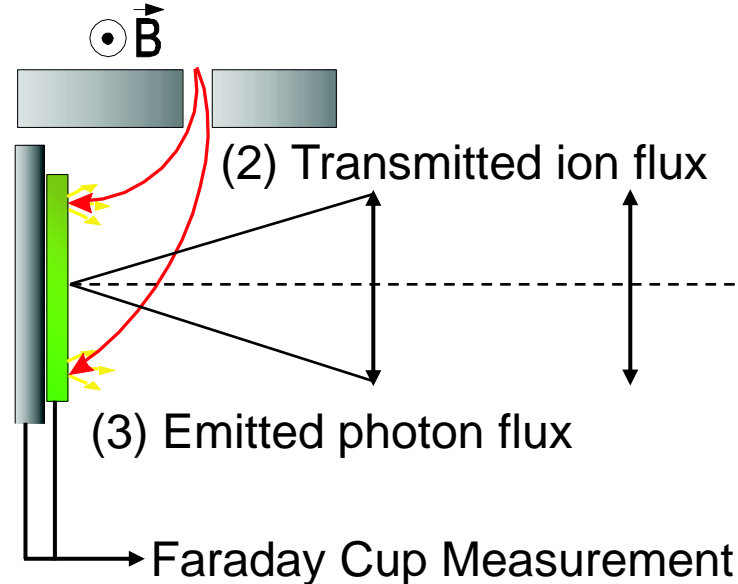


FILDSIM Code Simulates Expected Signal

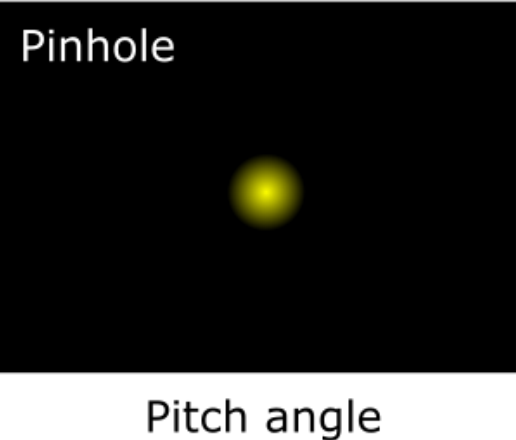
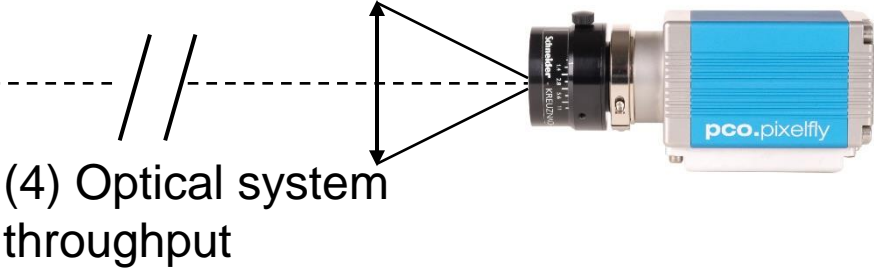


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(1) Incident ion flux



(5) Light acquisition systems (CCD / PMT)

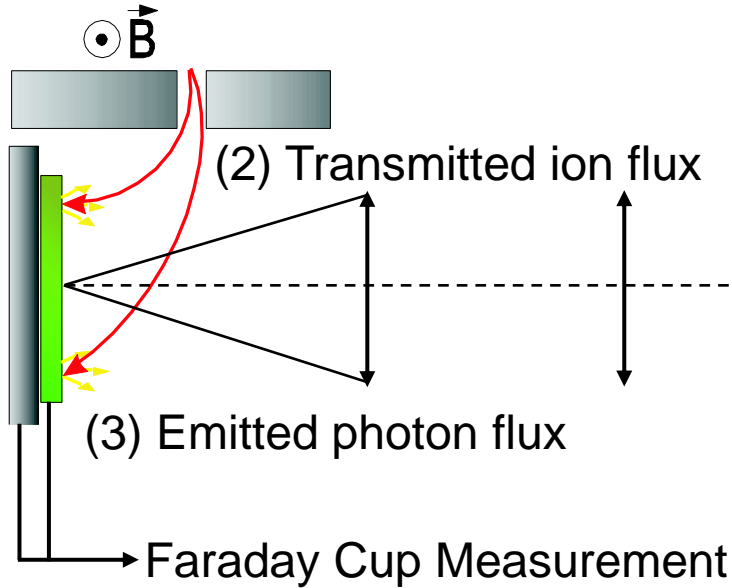


FILDSIM Code Simulates Expected Signal



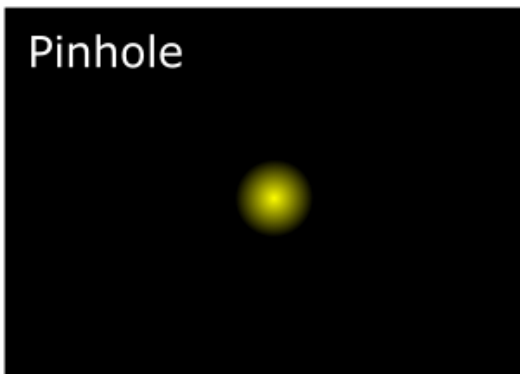
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(5) Light acquisition systems (CCD / PMT)

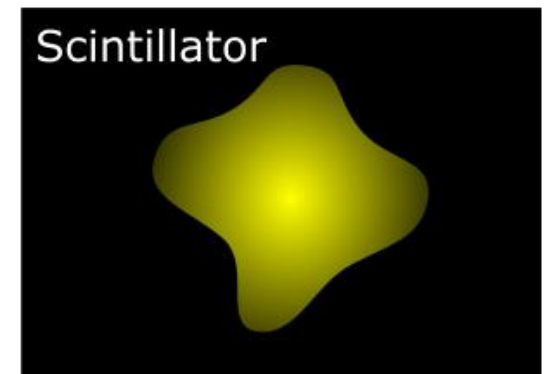
(4) Optical system throughput



Pitch angle

?

$$S_{ij} = \mathbf{W}_{ijkl} P_{kl}$$

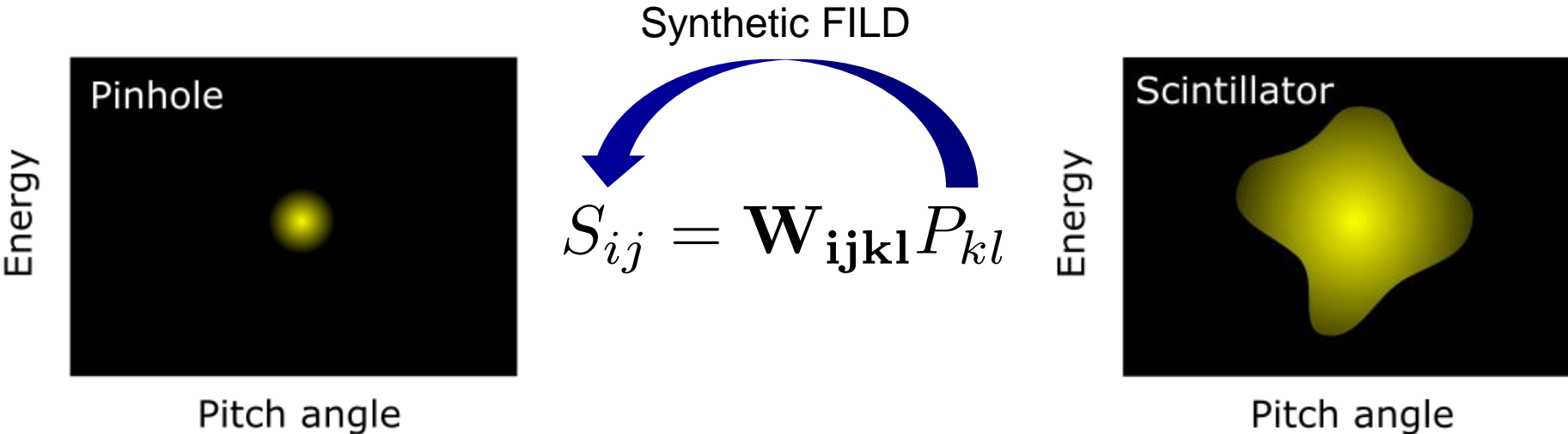
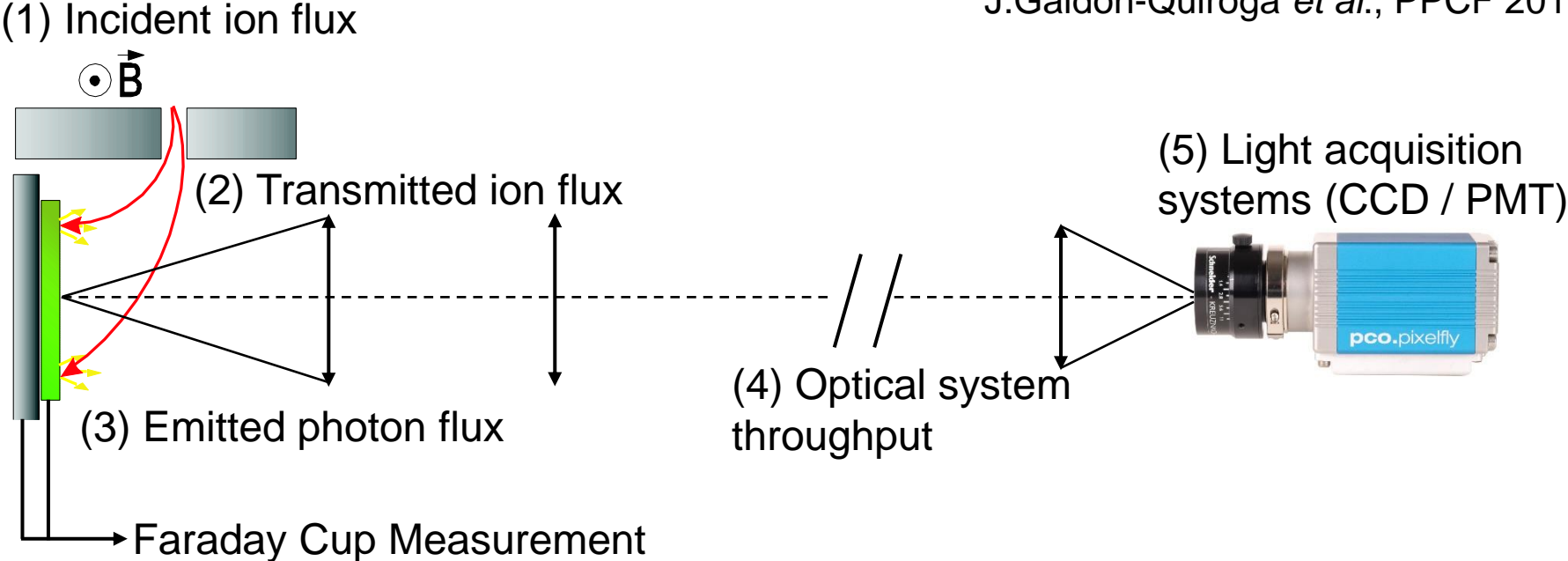


Pitch angle

FILDSIM Code Simulates Expected Signal



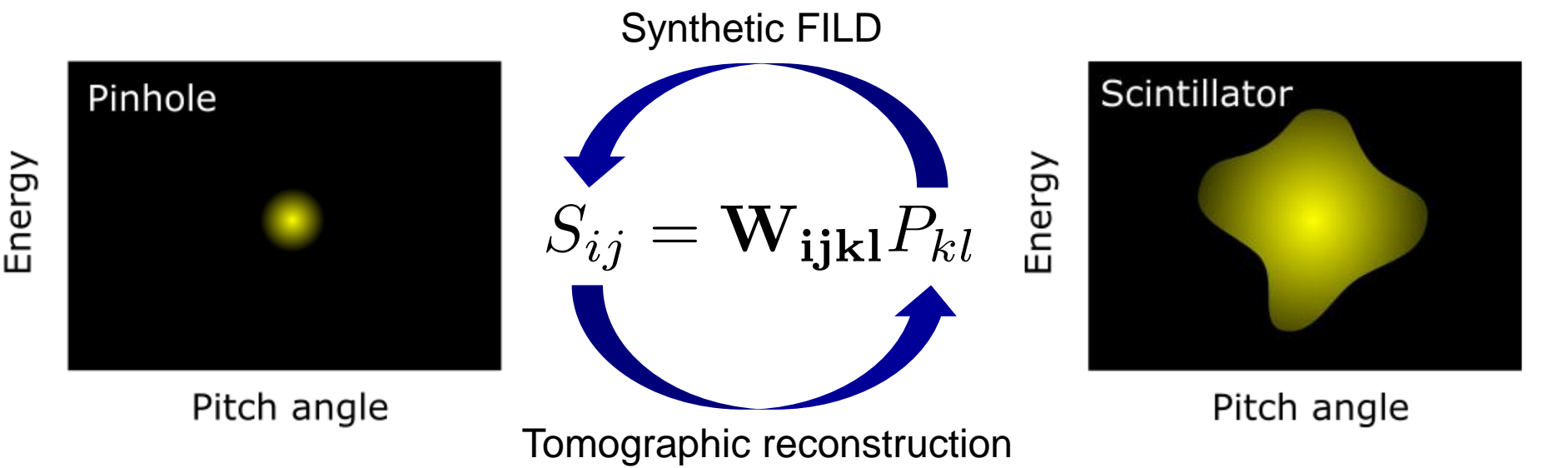
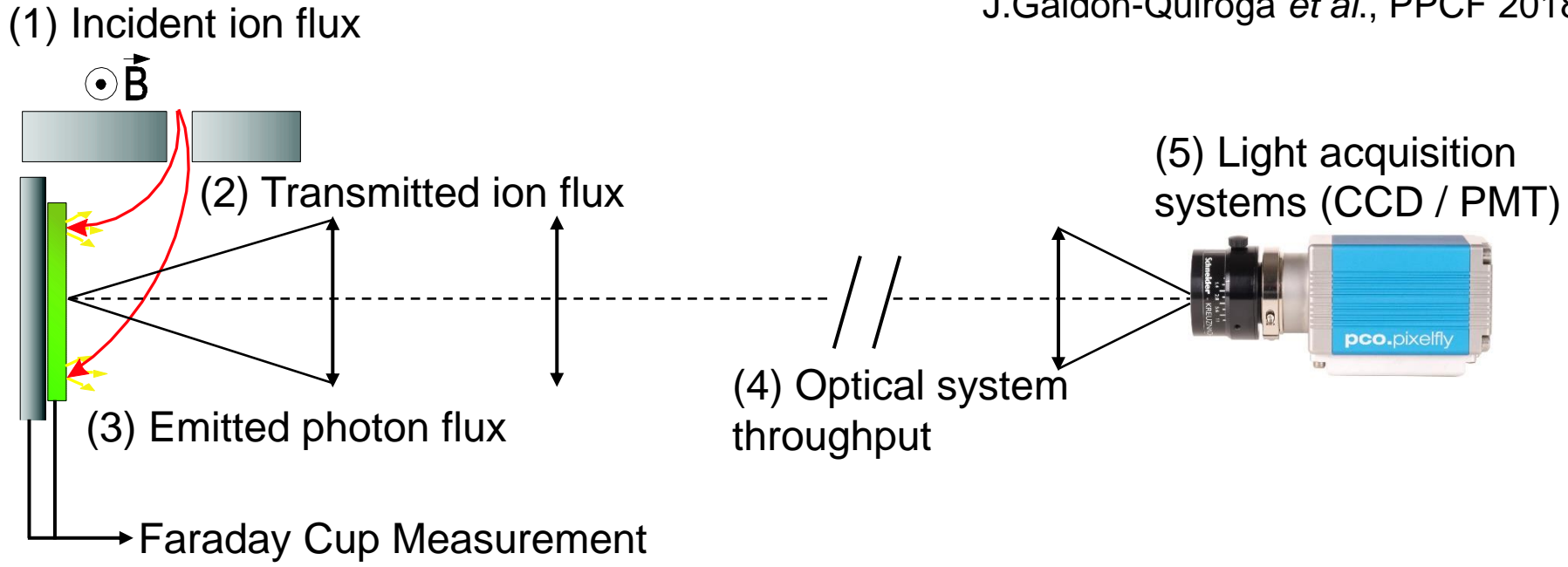
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FILDSIM Code Simulates Expected Signal



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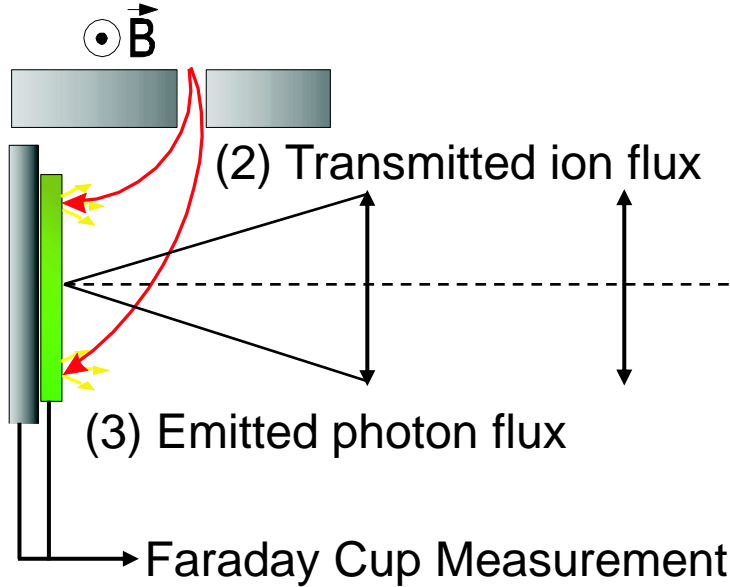


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(1) Incident ion flux



(5) Light acquisition systems (CCD / PMT)

(4) Optical system throughput

$$(1) \Gamma_{ions}^{incident} \quad [ions/s \cdot cm^2]$$

$$(2) \Gamma_{ions}^{transmitted} = \Gamma_{ions}^{incident} \cdot A_{pinhole} \cdot f_{col} \quad [ions/s]$$

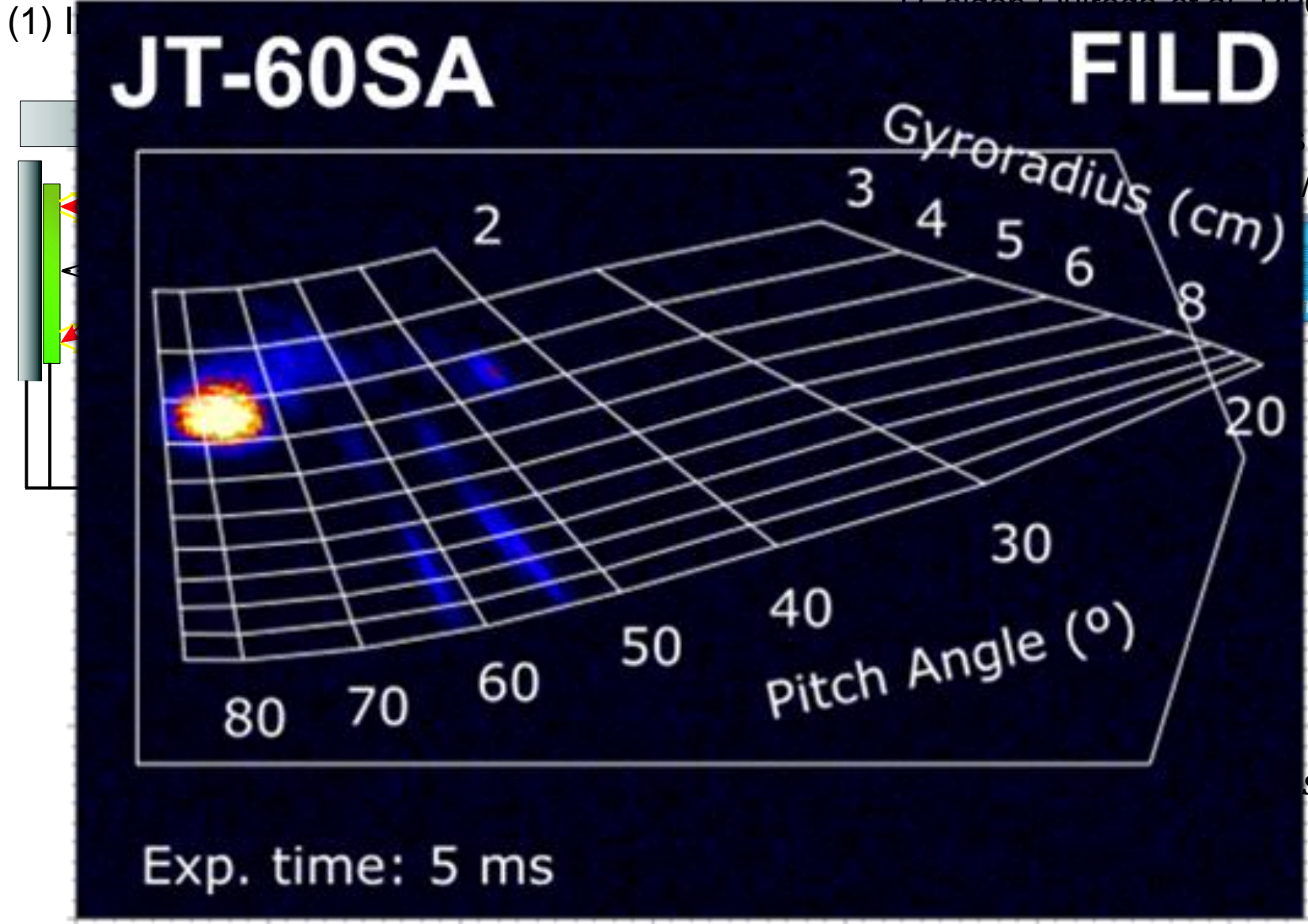
$$(3) \Gamma_{photons}^{emitted} = \Gamma_{ions}^{transmitted} \cdot Y_{scint} \cdot \frac{1}{4\pi} \quad [photons/s \cdot sr]$$

$$(4) \Gamma_{photons}^{transmitted} = \Gamma_{photons}^{emitted} \cdot \Omega \cdot T_{optics} \quad [photons/s]$$

FILDSIM Code Simulates Expected Signal



L. Golden, Quiroga et al., PFCF 2018



Position / PMT)



sr]



Outlook

- Select **scenario**
- Run **ASCOT** to
 - obtain fast-ion losses on first wall
 - estimate thermal plasma heat load on detector head
- Run **FILDSIM** to optimise detector head geometry
 - Iterative process that includes thermomechanical FEM analysis
- Run **MCNP** to estimate background noise in scintillator due to nuclear reactions
- Estimate **optical throughput**
- Construct final **synthetic diagnostic**

