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UNIVERSIDADE FEDERAL DE SANTA CATARINA
CENTRO DE CIÊNCIAS FÍSICAS E MATEMÁTICAS
PROGRAMA DE PÓS-GRADUAÇÃO EM FÍSICA

GRIFIM – Group of Interaction of Photons and Ions with Matter

Supervision: Prof. Dr. Lucio Sartori Farenzena

ANALYSIS OF POLYMERIC FILMS DEGRADATION SUBJECTED TO IONIZING RADIATION

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Doctorate Student

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OVERVIEW

WHAT DO WE DO?

WHY DO WE DO?

HOW DO WE DO?

PRELIMINARY RESULTS

CONCLUSIONS

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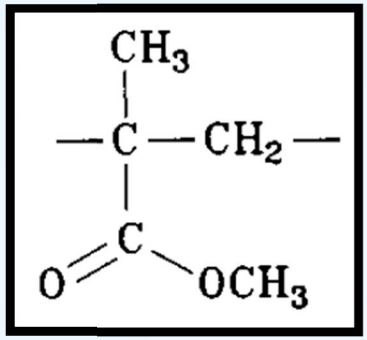
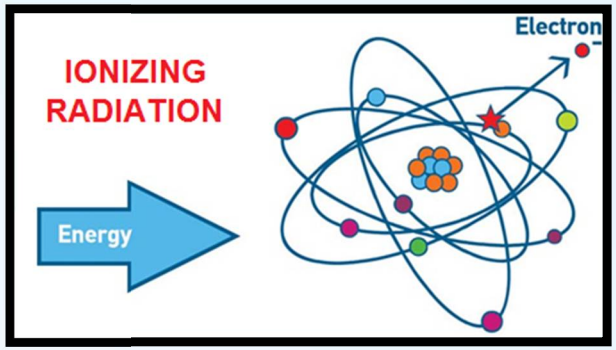
WHAT DO WE DO?

PMMA FILMS



Poly(methyl methacrylate)

+



UV (H Ly-Alpha 10,2eV)

H^+, He^+, C^+ e N^{2+} (~10^5-10^6eV)

=

Chemical & physical changes

Heating, surface mass ejection, aesthetical changes

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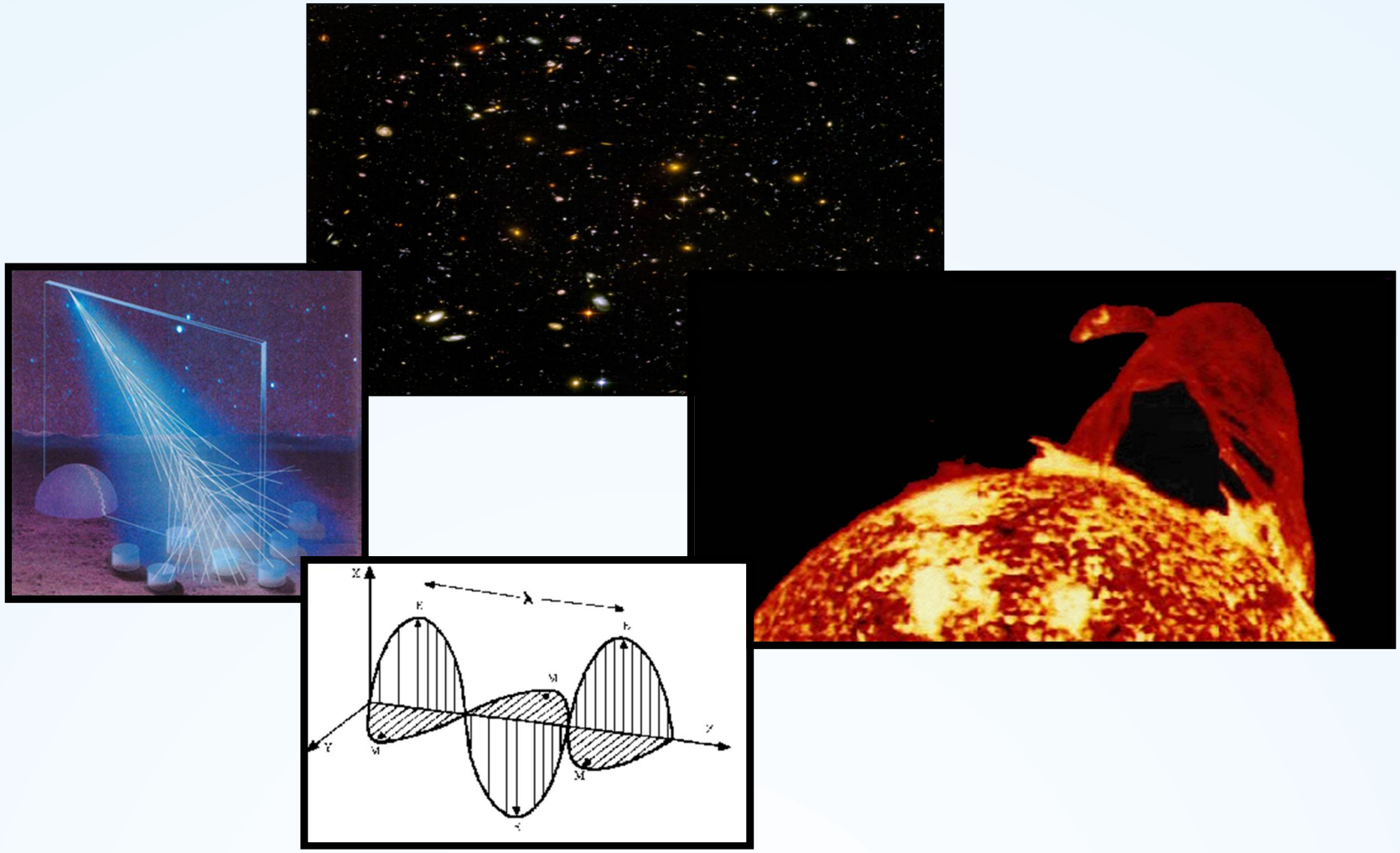
WHY DO WE DO?

1. Natural Ionizing Radiation



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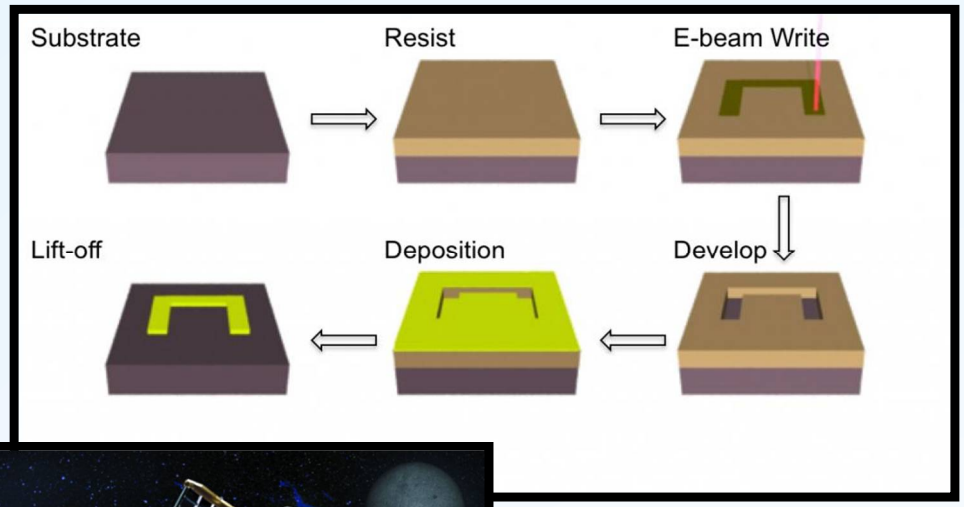
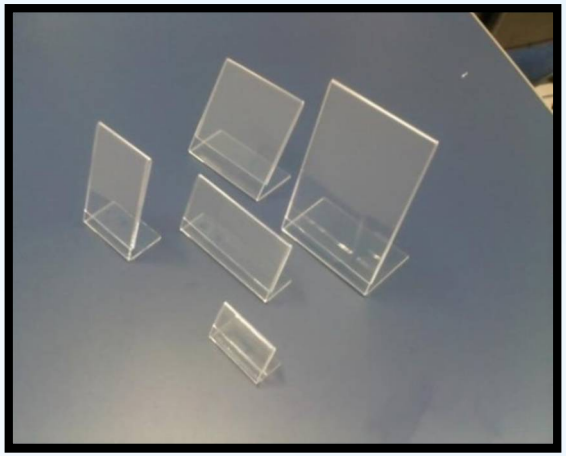
WHY DO WE DO?

2. Ionizing Radiation and PMMA





lifetime of satellites coverage

Polymer degradation subjected to environment radiation

Optical applications and lithography

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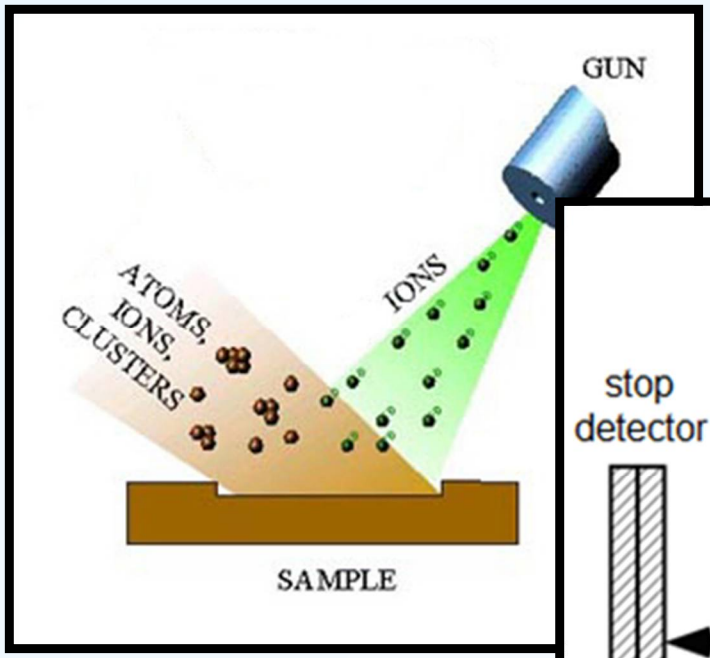
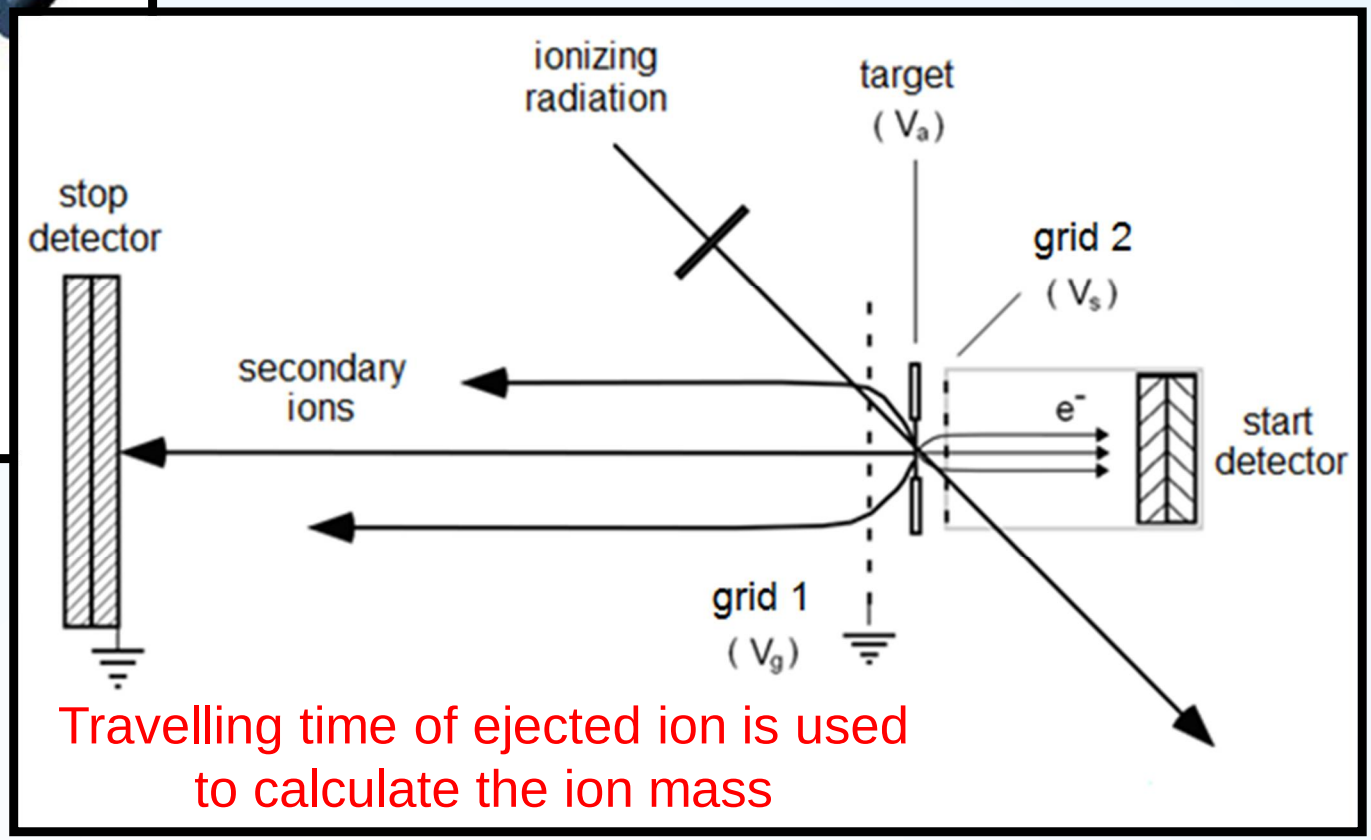
HOW DO WE DO?

1. Surface Mass Ejection (Desorption)



Mass Spectrometry (ToF)



Travelling time of ejected ion is used to calculate the ion mass

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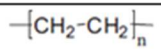
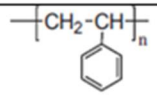
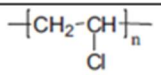
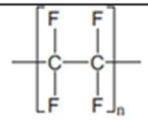
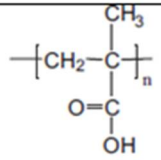
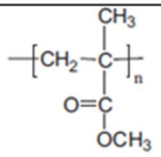
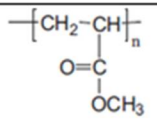
HOW DO WE DO?

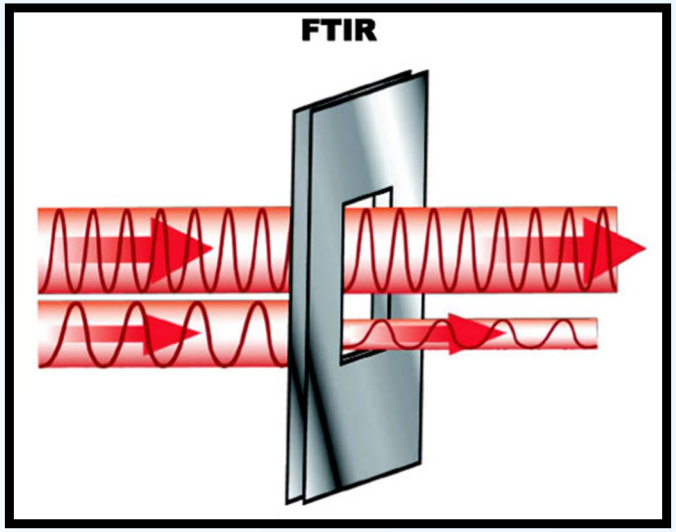
2. Chemical Changes (Degradation)

Polymer	*Abbreviation*	*Monomer*	*Type*
Polyethylene	PE		I
Polystyrene	PS		I
Polyvinyl chloride	PVC		I
Polytetrafluorethylene	PTFE		II
Poly(methacrylic acid)	PMAA		II
Poly(methyl methacrylate)	PMMA		II
Poly(maleic acid)	PMA		I

TYPE I
Reticulation

TYPE II
Degradation

Infrared Spectroscopy



$$A(\lambda) = -log\left(\frac{I(\lambda)}{I_0(\lambda)}\right)$$

Beer-Lambert Law for absorbance

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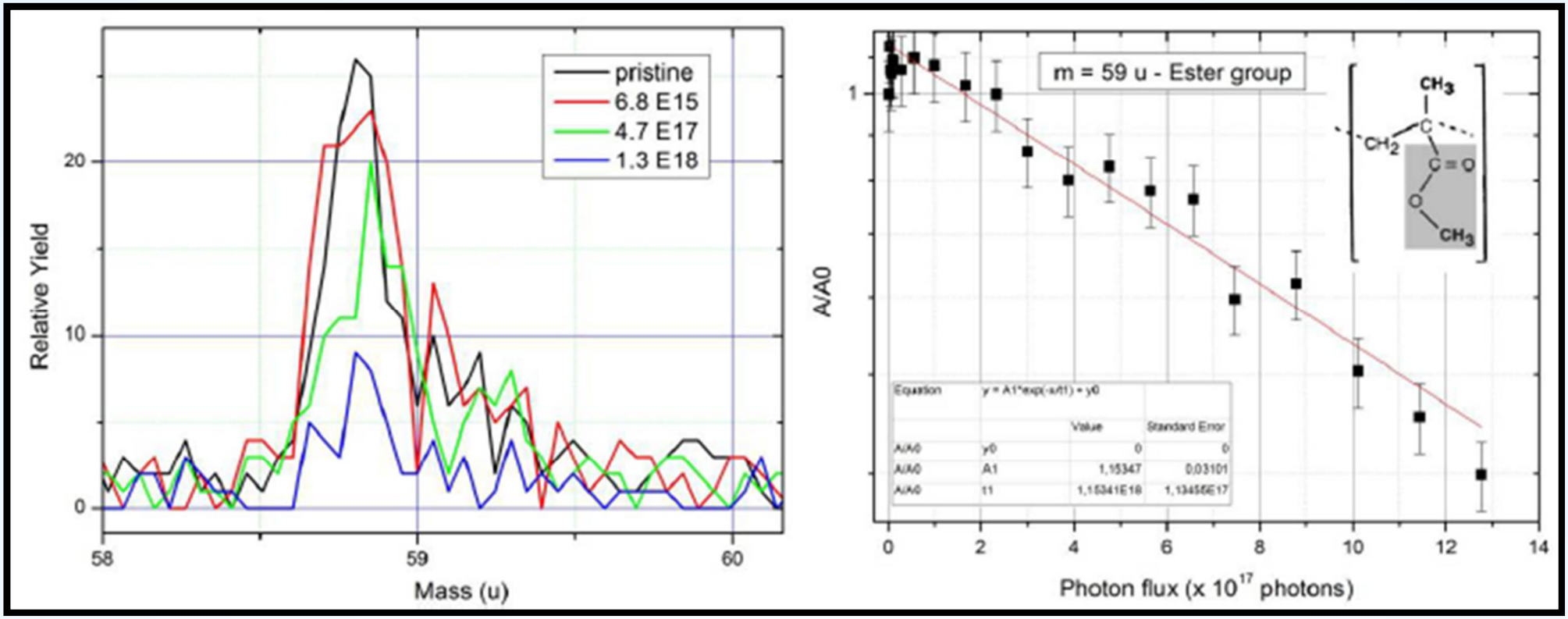
PRELIMINARY RESULTS

Surface Mass Ejection



Ester group mass signal on spectrum has exponential decay with radiation dose

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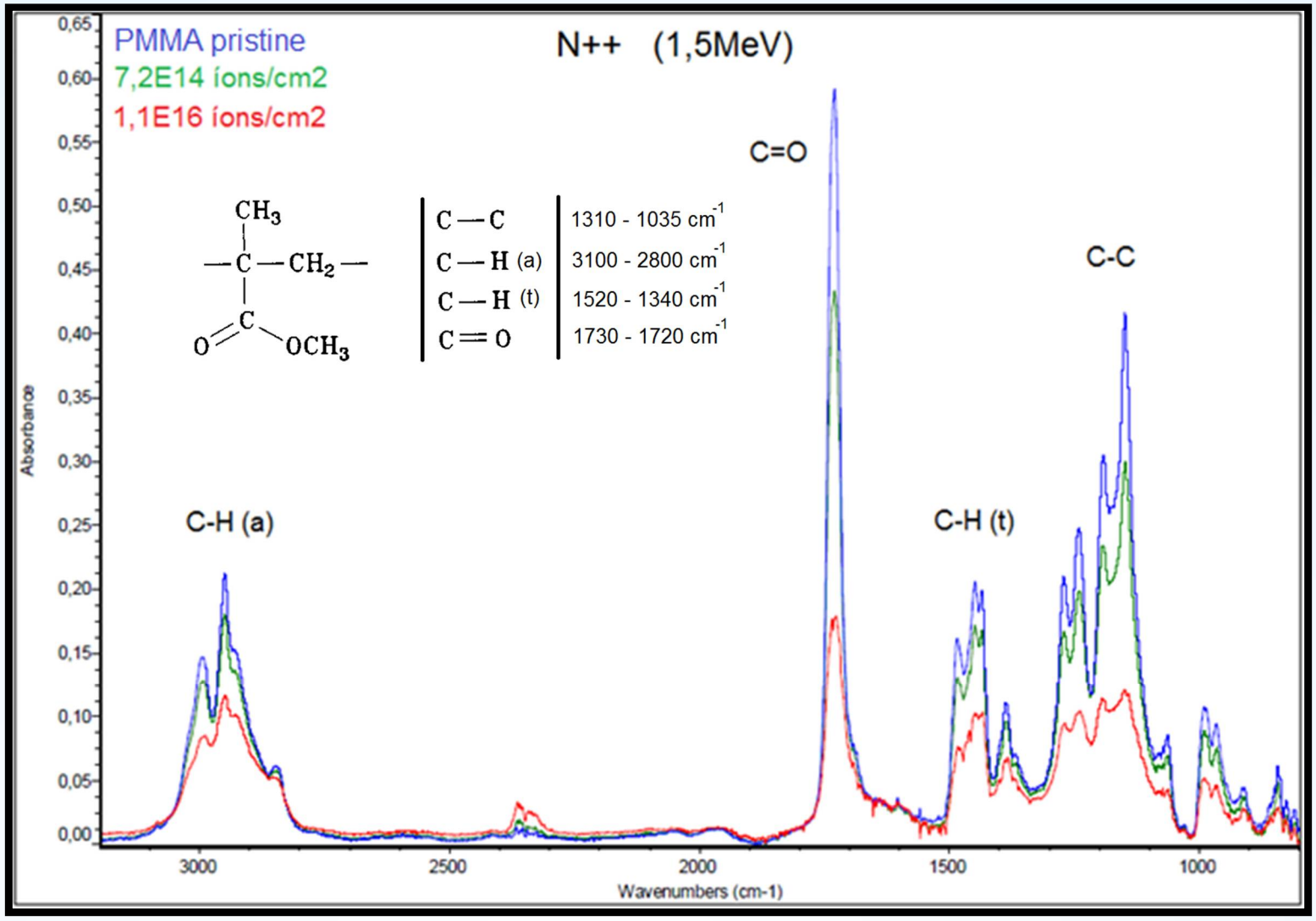
PRELIMINARY RESULTS

Chemical Changes



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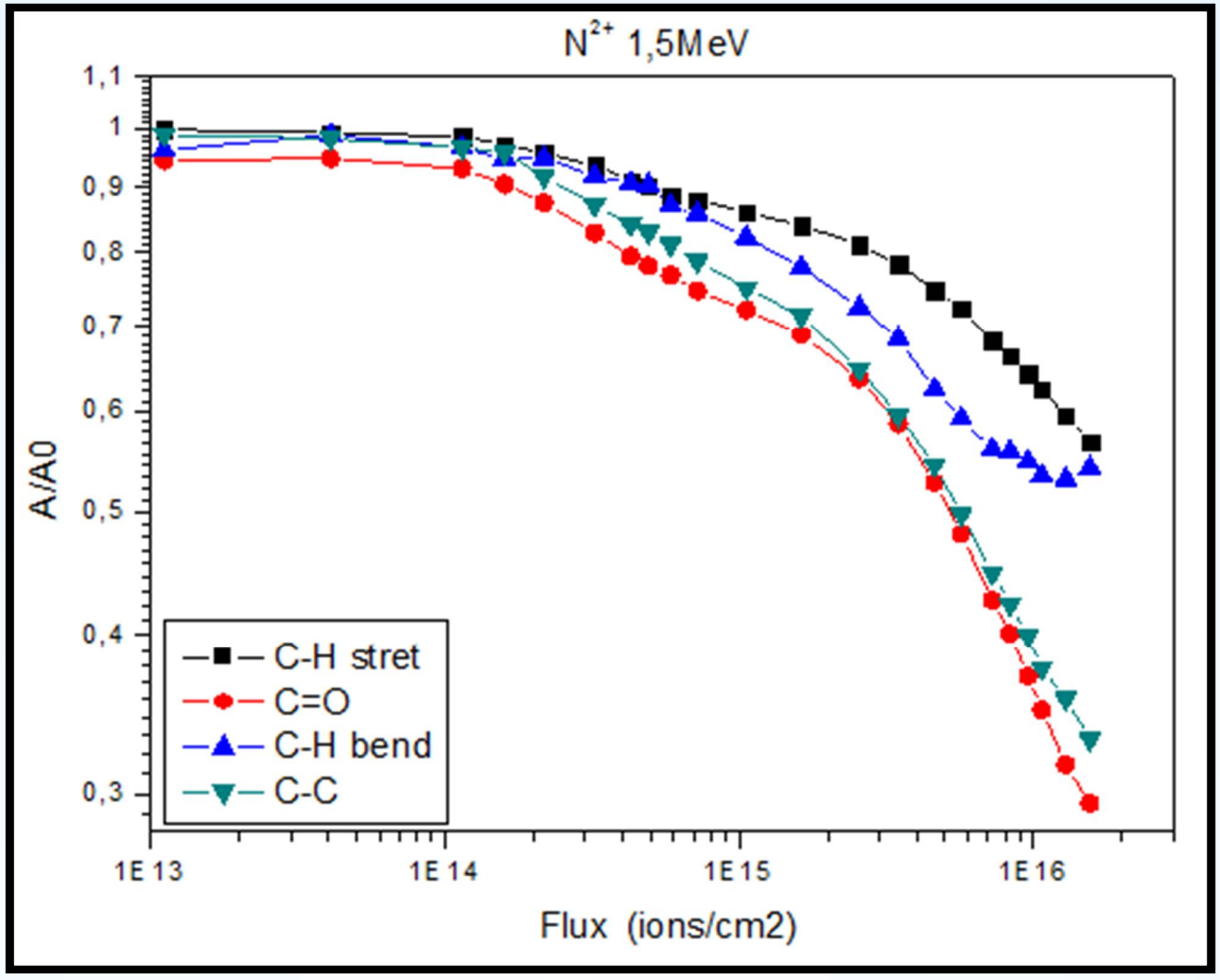
PRELIMINARY RESULTS

Chemical Changes



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CONCLUSIONS

PMMA is degrading polymer when subjected to ionizing radiation

Degradation increases with the energy deposited by each projectile (depending on the electronic *stopping power*)

The degradation process can be analyzed with two complementary analytical techniques: FTIR (bulk information) and ToF (ejection information)

These two techniques can lead us to have a better understanding about degradation routes on polymers subjected to ionizing radiation

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END