PhD Open Days

Numerical study of photon-pair plasmas in high fields scenarios

APPLAuSE

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The astrophysics context

Supernova remnants are one of the most exotic objects in our universe and their complete understanding is yet to be understood. Many models[1,2,3] have been developed to explain the radiation emitted by these object.

The engine of this emission is believed to be related with the dynamics of particular regions called gaps where pair cascades develop.
The gaps are of three kind:

- polar cap[4] (pulsar)
- outer gap[5] (pulsar)
- vacuum gap[6] (black holes)

The study of these gaps can give a deep insight on how such radiation is produced, from its engine to the peculiar characteristics it possesses.

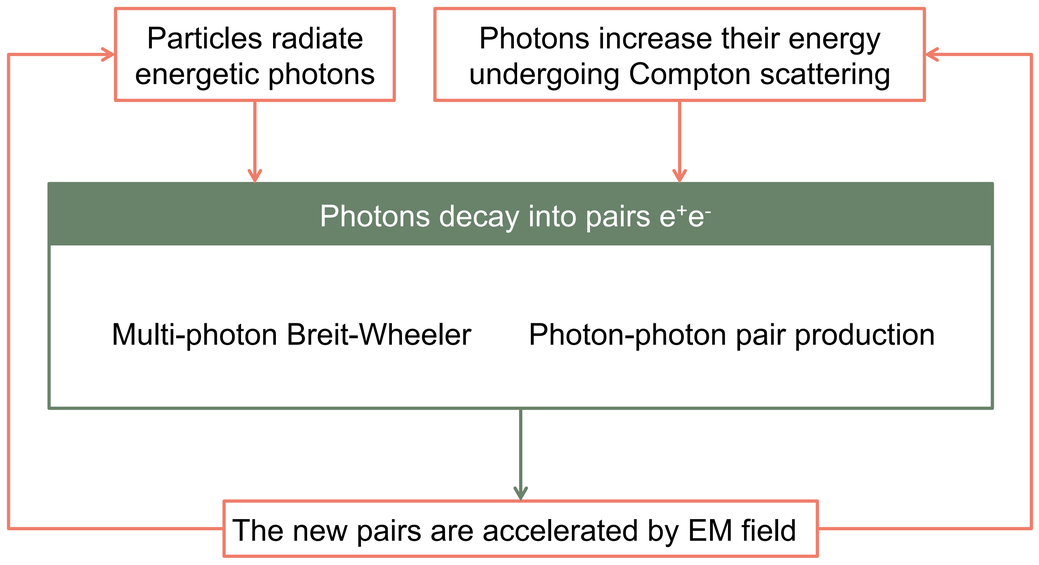


figure 1: DEVELOPMENT OF PAIR CASCADES

Objectives

1st year: O1 Inclusion in Osiris QED-PIC of a collision module

O1.1 Compton scattering
O1.2 Photon-photon decay
O1.3 e^+e^- annihilation

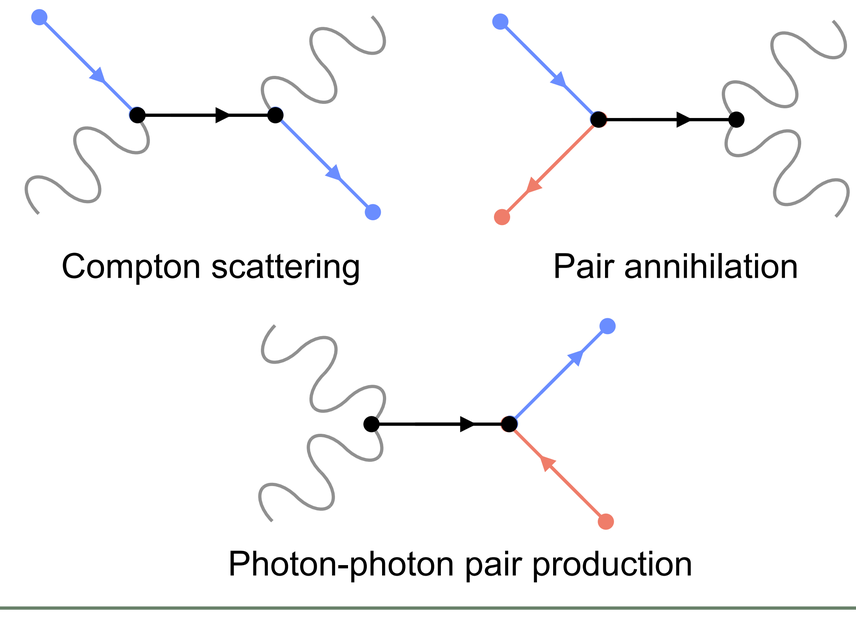
2nd year: O2 Study various QED processes concurring in the pair cascade

O2.1 Study of pair cascades in presence of ultra intense fields, in simplified geometries
O2.2 Study of pair cascades in complex field geometries, representative case studies in astrophysical scenarios
O2.3 Assessment of the contribution from different QED processes to the pair cascade

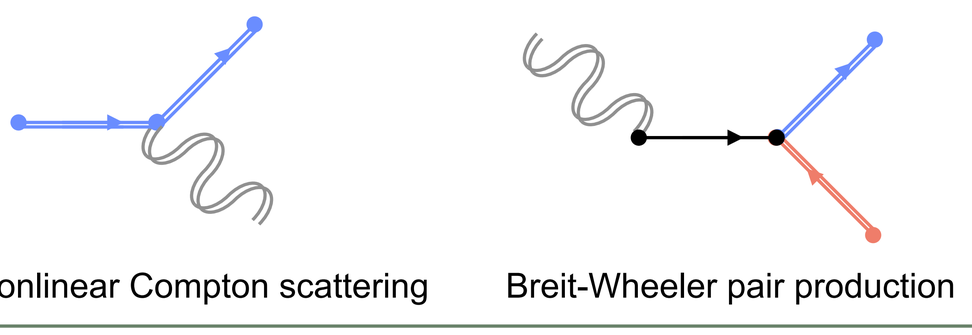
3rd year: O3 Characterization of the pair plasma region

O3.1 Study of the evolution of plasma density, current and pair multiplicity
O3.2 Characterization of streaming particles with focus on their radiation signature and capability to trigger plasma instabilities

QED processes to include in OSIRIS



QED processes already included in OSIRIS



Scientific goal

The need to match astrophysical observations with models for pulsars or black holes led to study pair cascades deeply embedded in the framework of the astrophysical object under attention.
The resulting models are heavily dependent on assumptions and may not capture all the features of the cascade process.

For the first time we address astrophysical pair cascades on their own with multidimensional theoretical and numerical study, but bearing in mind the need of a bridge with astrophysical observations.

References & Acknowledgements

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