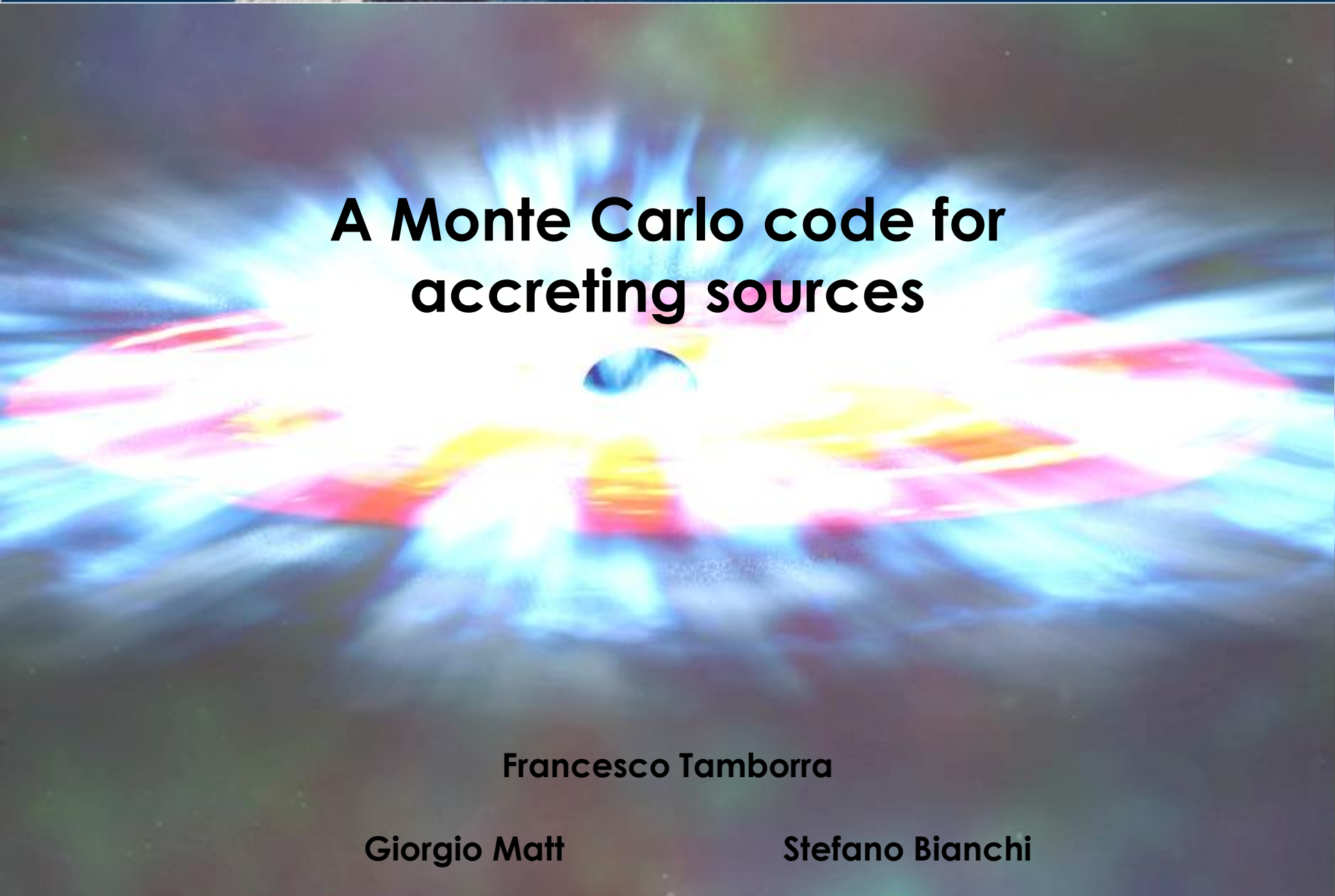
ROMA TRE
UNIVERSITÀ DEGLI STUDI
Dipartimento di Fisica "E. Amaldi"

A Monte Carlo code for accreting sources



Francesco Tamborra

Giorgio Matt **Stefano Bianchi**

Outline

- the project
- scientific goals
- the model
- the code
- future developments

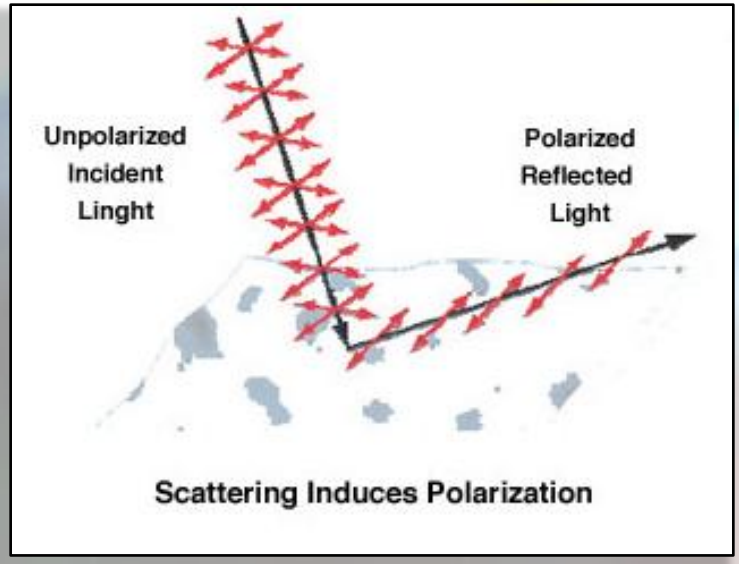
WORK IN PROGRESS

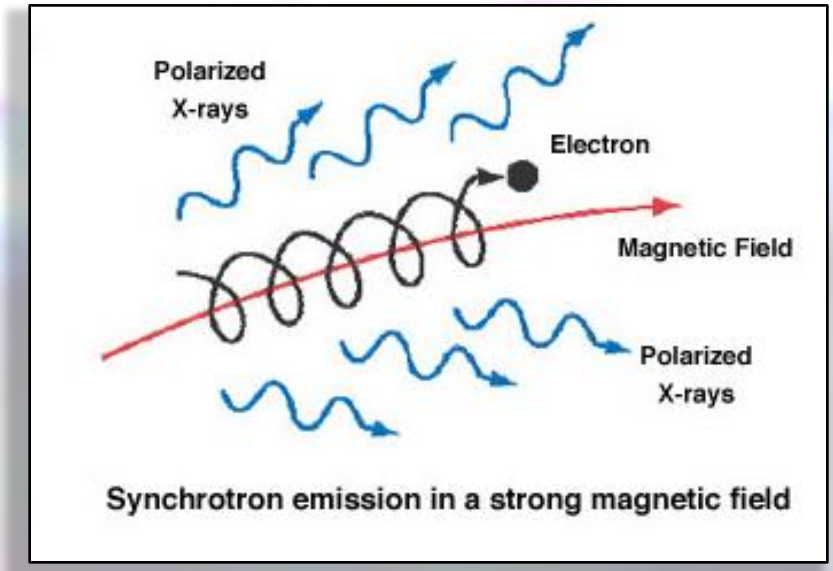
The project

Fully relativistic (special + general) code + polarimetry

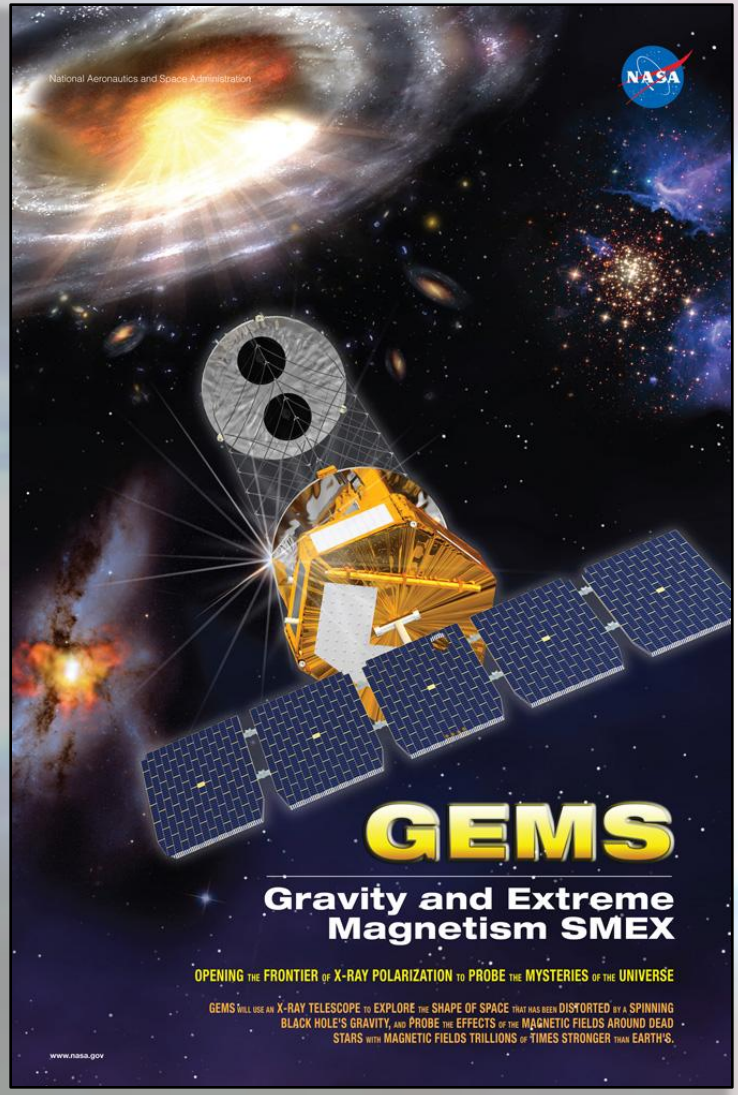
Polarization probes both
- the emission geometry
- and the emission mechanism

of processes characterized by high temperature and magnetic field.

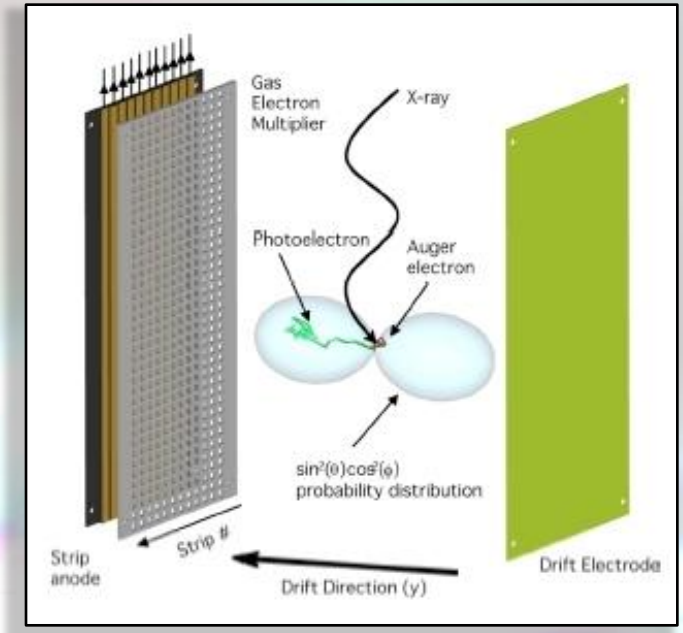




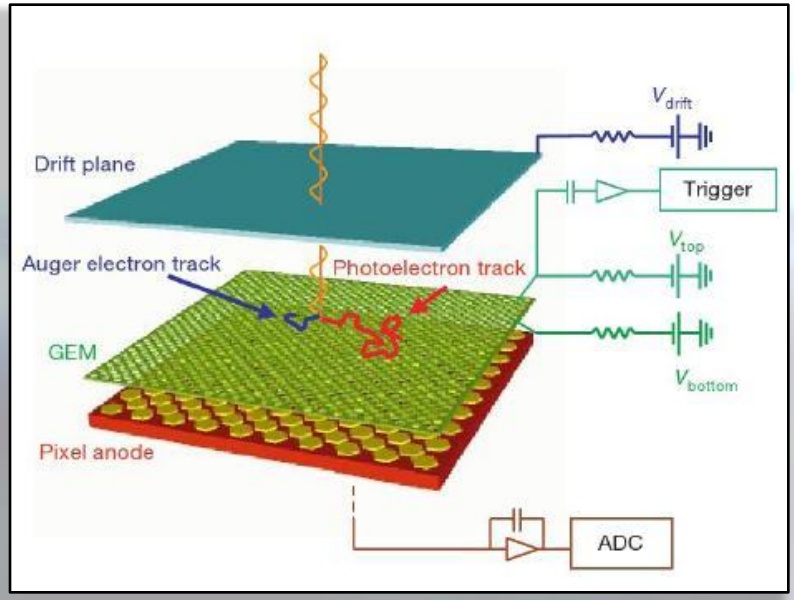
launch scheduled in 2014



(see Fabio's talk!)



Time Projection Chamber



Gas Pixel Detector

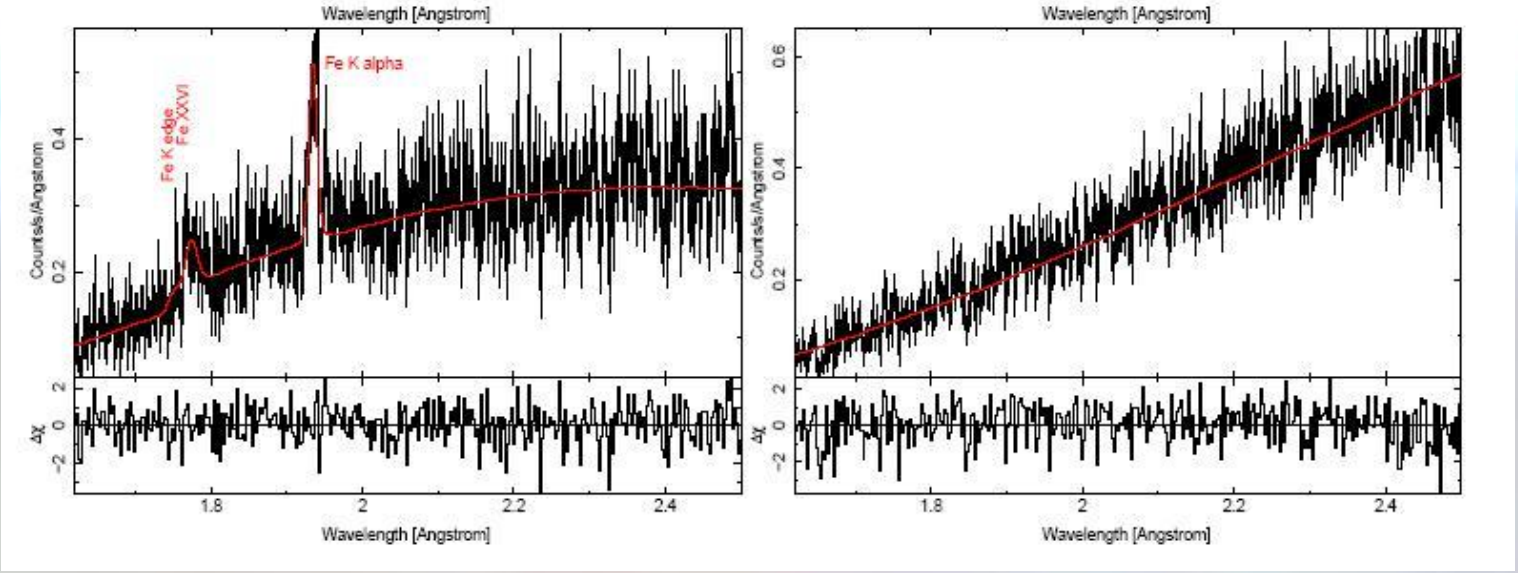
First scientific goals

Galactic BHs & AGN:

- property of the scattering medium: geometry, density, thermal energy
- property of the compact object: spin (see Michal's talk!)

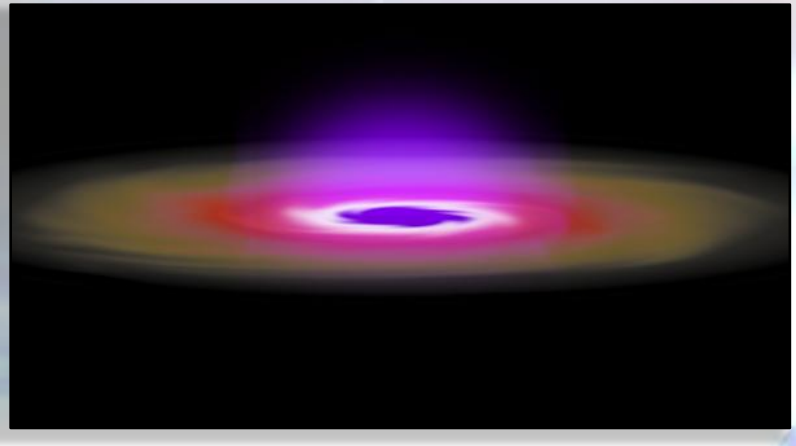
LMXRBs

- nature of broad in iron lines

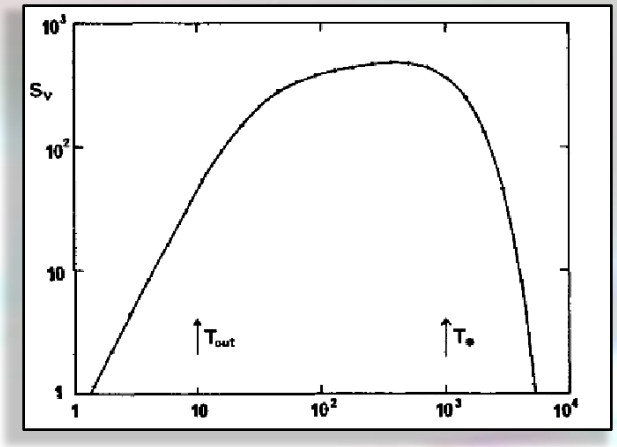


The model behind the MC

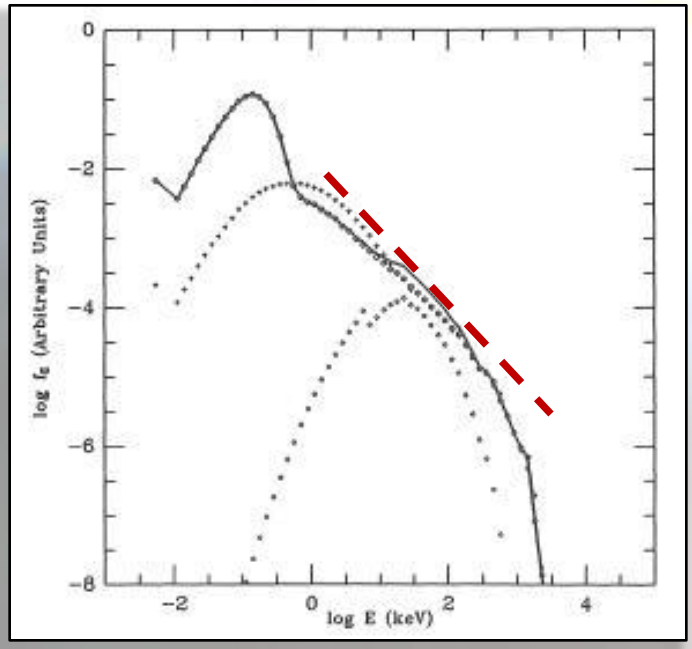
Optically thick, geometrically thin α-disc

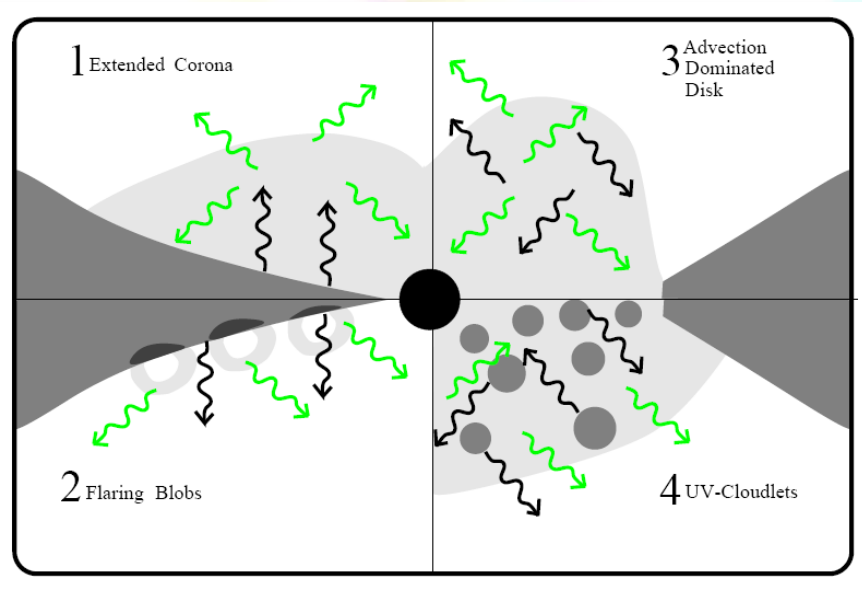


Shakura & Sunyaev, 1973



Haardt & Maraschi, 1991





The code

main.pro

vector oriented, image processing

- ShakSun.pro
- Planck.pro
- Chandra.pro
- Init_Direction.pro
- Renorm.pro
- Stokes.pro
- MFP.pro
- Controllers.pro
- MaxBoltz.pro
- Lorentz.pro
- CrossSec.pro
- InvComp.pro
- Sdriection.pro

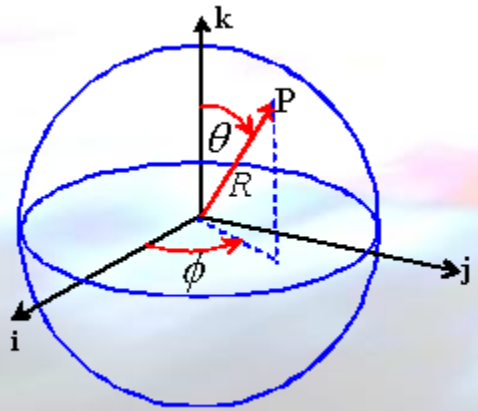
The code

Input parameters:

Black Hole: Mass, Mdot

Disc: Inner radius, Outer radius

Corona: Geometry, tau (n_e)



Initial position

$\varphi_{0(d)} \in [0, 2\pi]$ random

$\theta_{0(d)} = \pi/2$ fixed

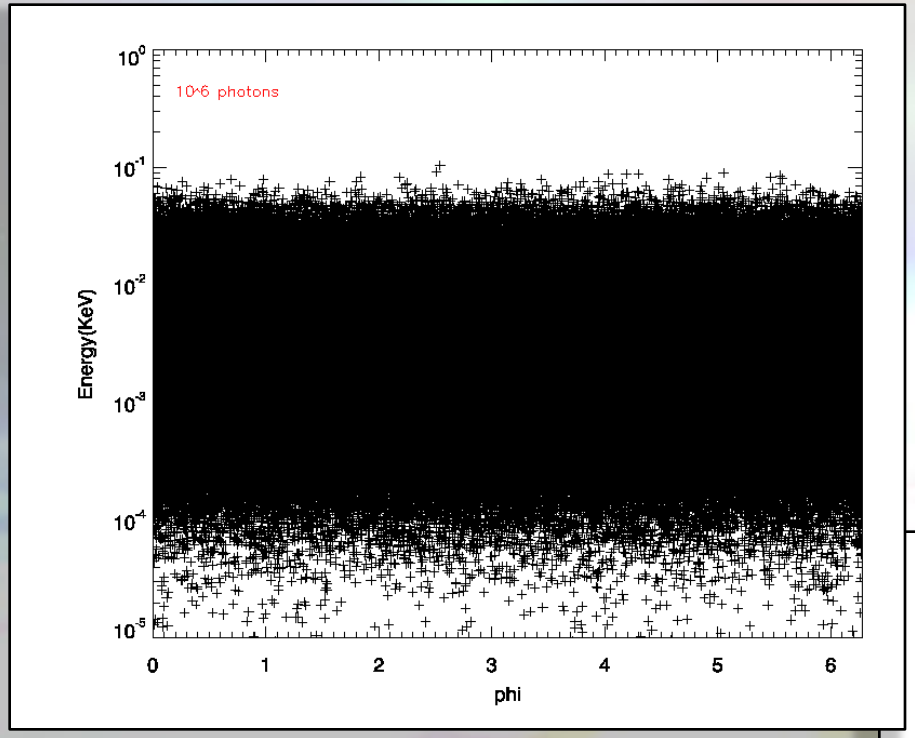
$R_{0(d)} \in [R_{min}, R_{max}]$ emissivity law (α R^{-1})

Initial direction

$\varphi_{(d)} \in [0, 2\pi]$ random

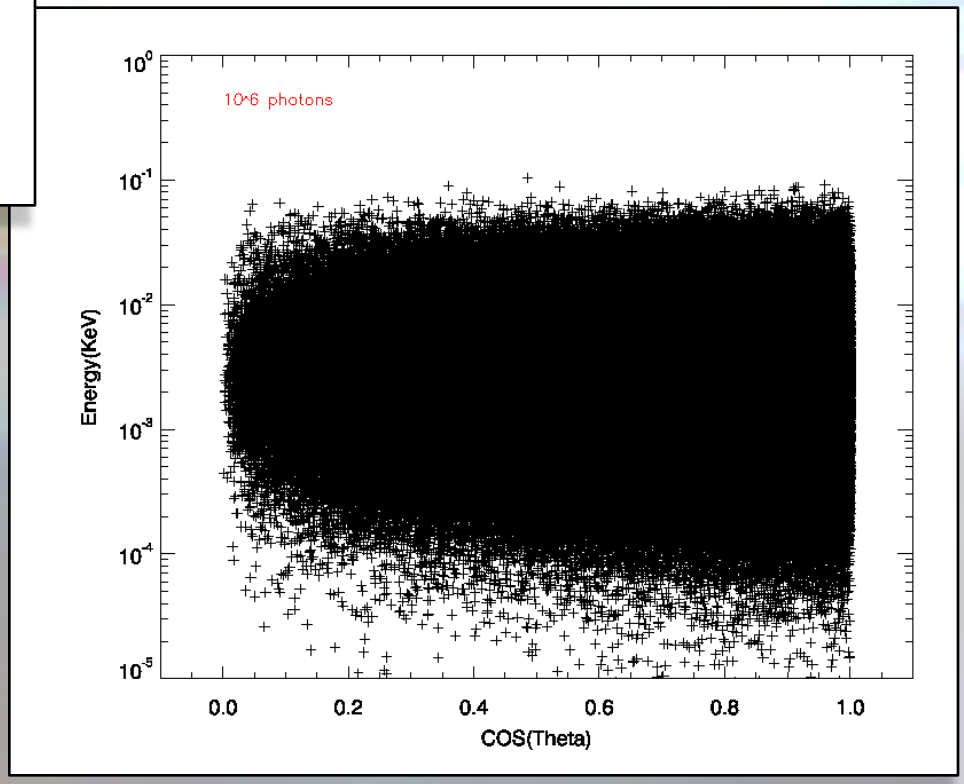
$\mu = \cos(\theta_{(d)}) \in [0, 1]$ according to Chandrasekhar, 1960

Initial angular distribution

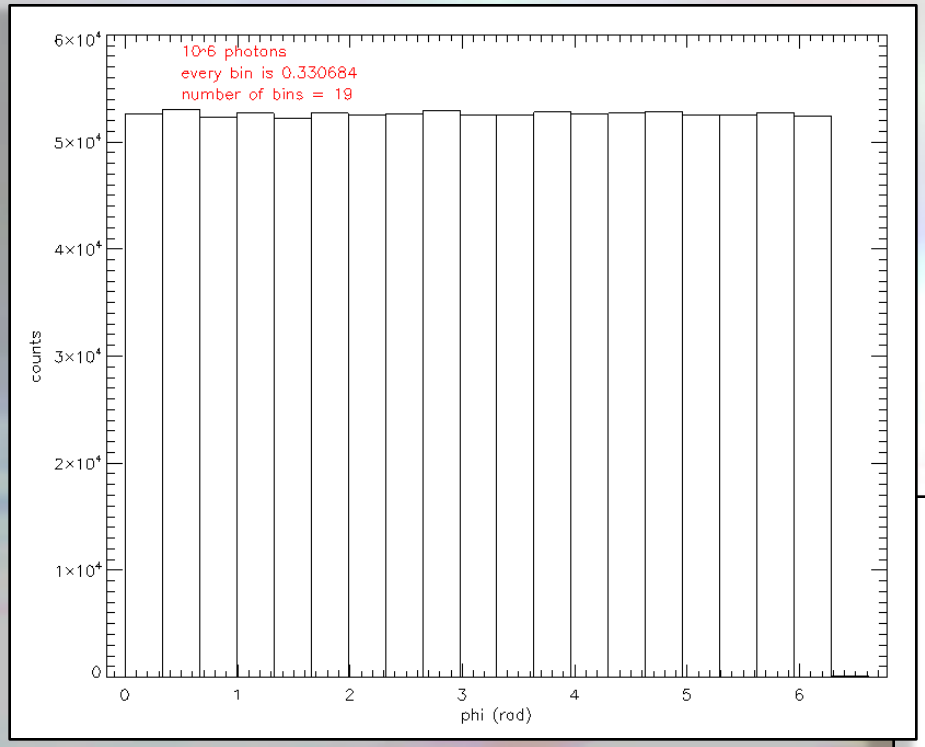


isotropic

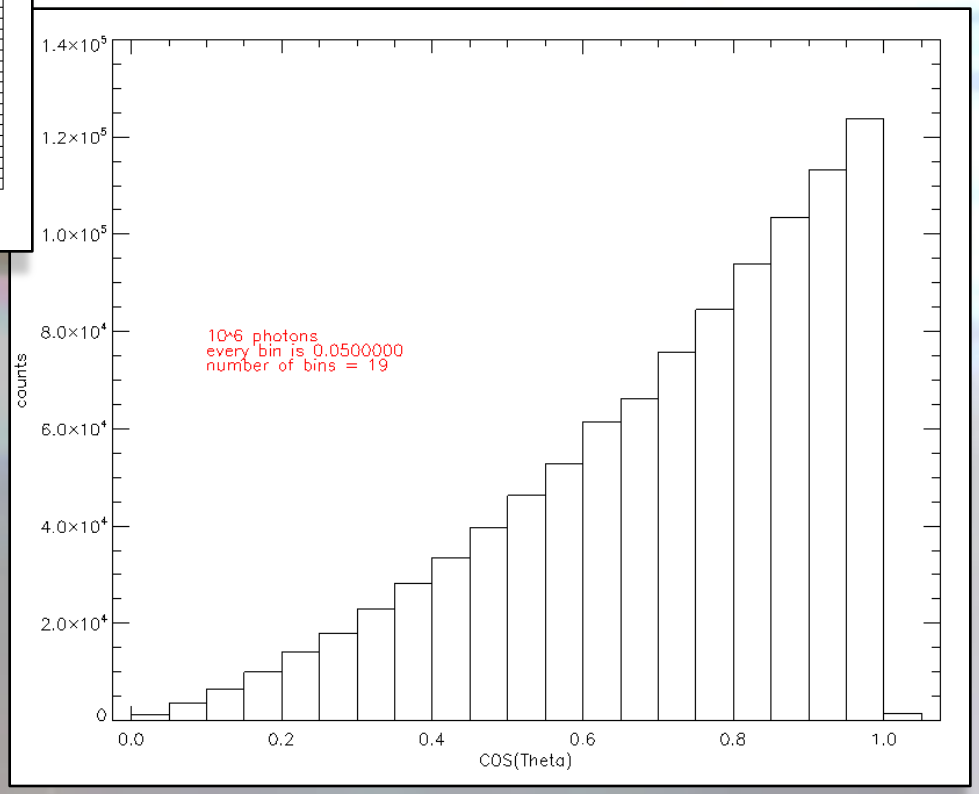
limb darkening



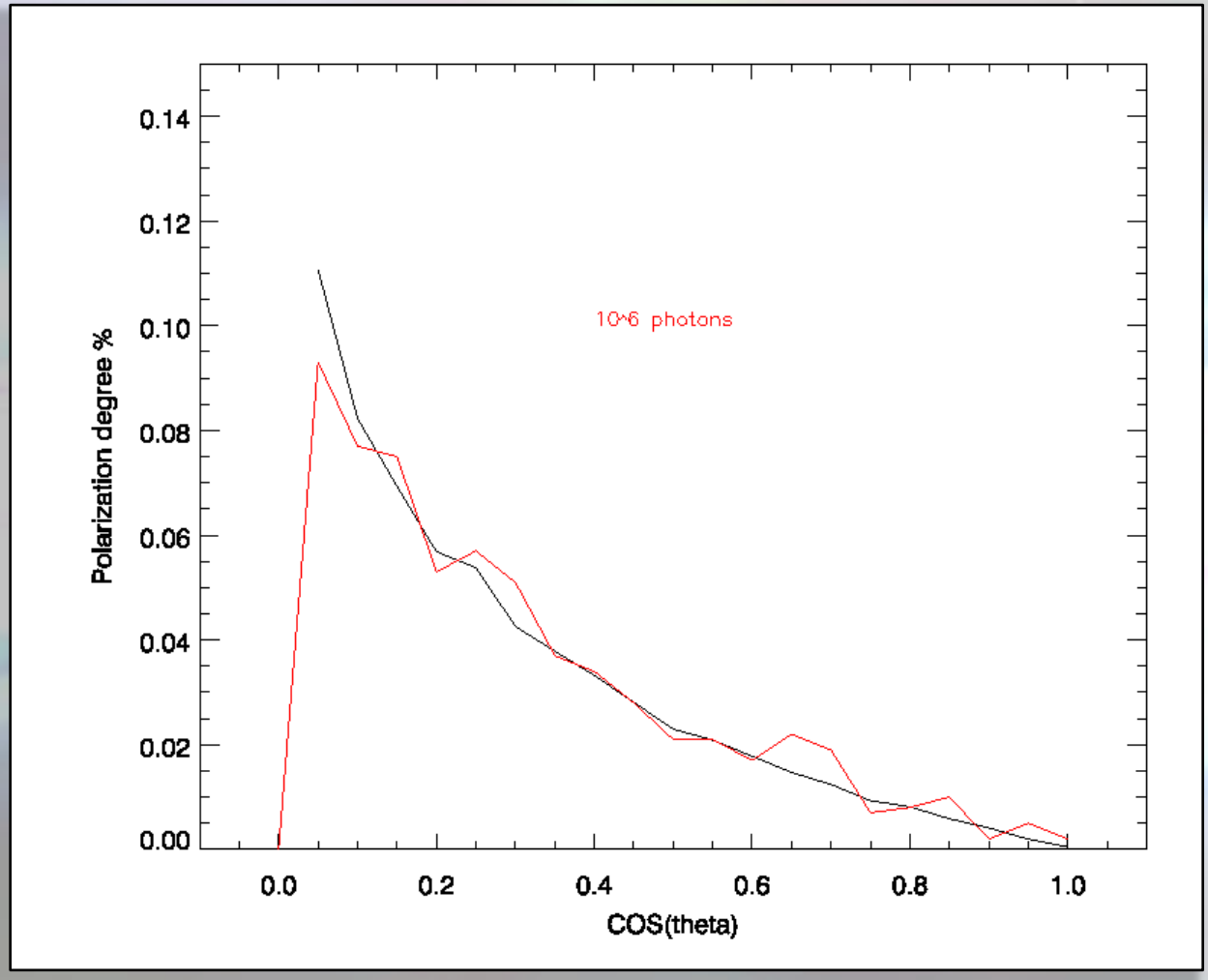
Initial angular distribution



Binned



Initial degree of polarization



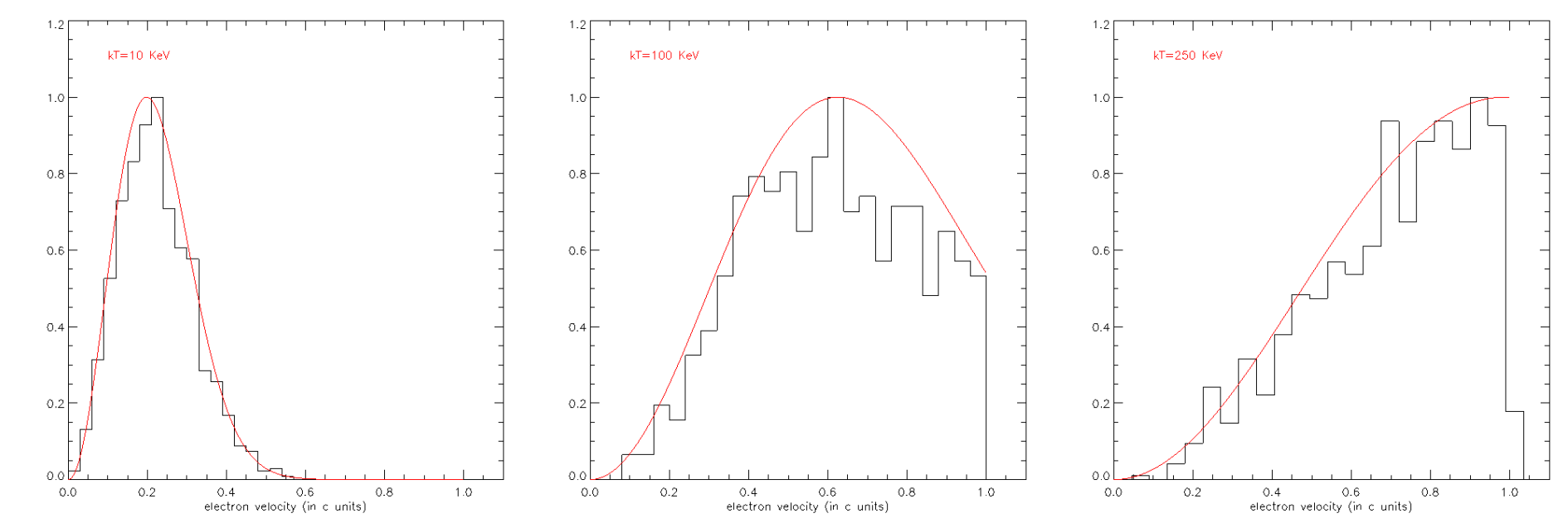
Chandrasekhar, 1960

The scattering

MFP → potential point of interaction

The velocity of an hot, but thermal, electron is extracted…

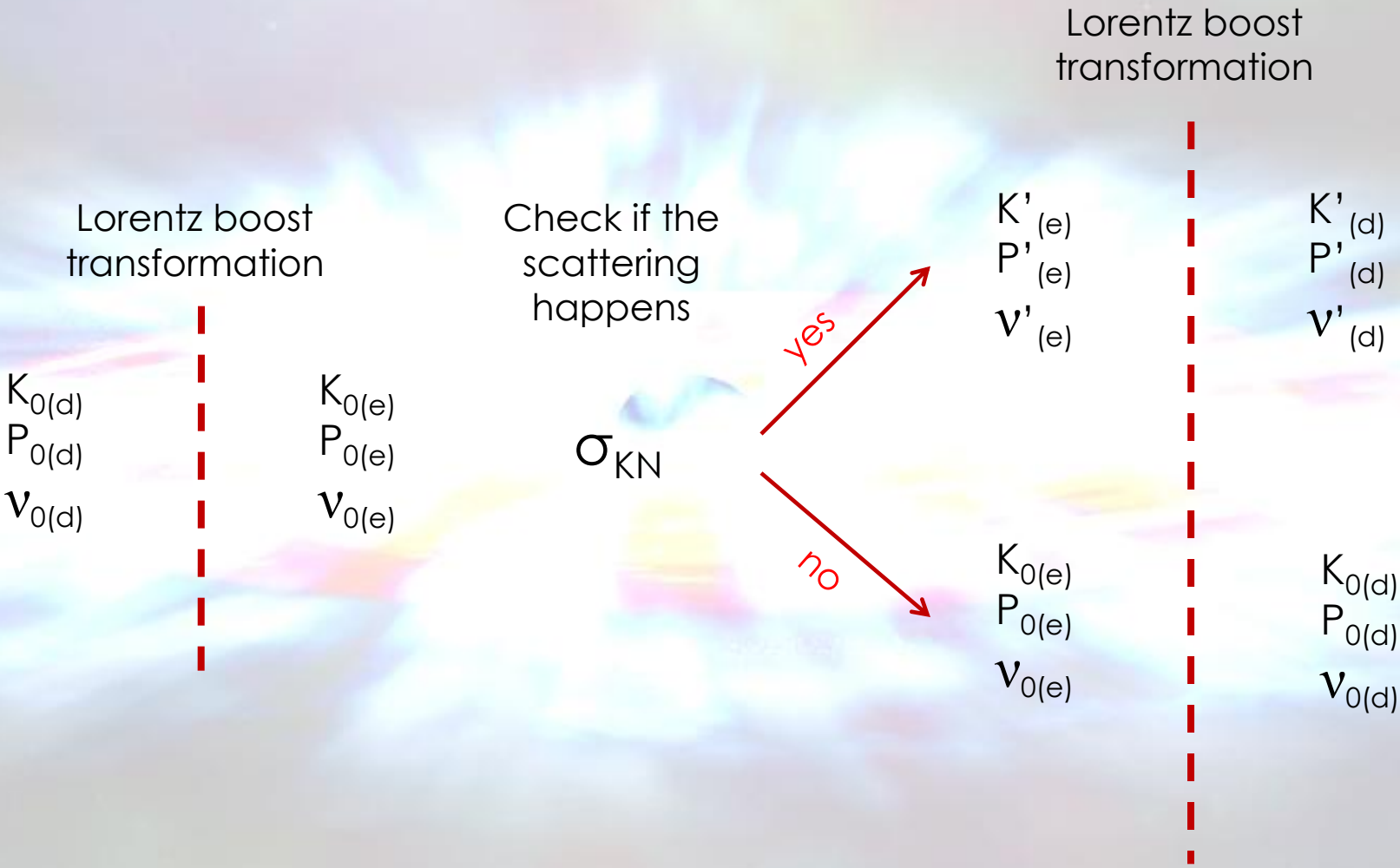
…but the Maxwell-Boltzmann distribution cannot be used above 100KeV!



$k_B T$= 10 KeV 100 KeV 250 KeV

the proper distribution should be the Maxwell-Juttner one!

The scattering



energy, phi, theta, Stokes parameters of the photon are saved (and binned)

Previous works

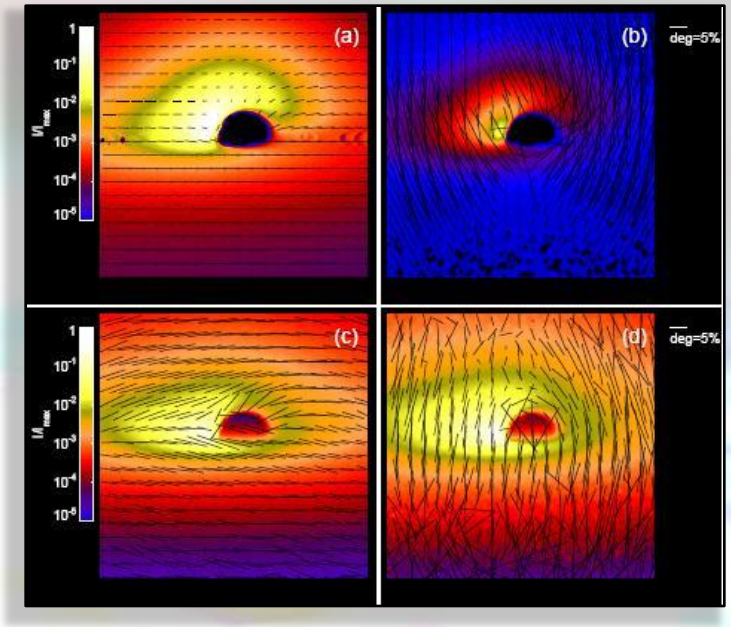
Schnittman & Krolik, 2009

Polarization ✓

General relativity ✓

Thomson scattering ✗

Maxwell-Boltzmann distribution (?) ✗



Future developments

- finish it! (at the end of this summer)
- solve MB issue
- include general relativity (spin)
- include reflection from the disc

ray-tracing code