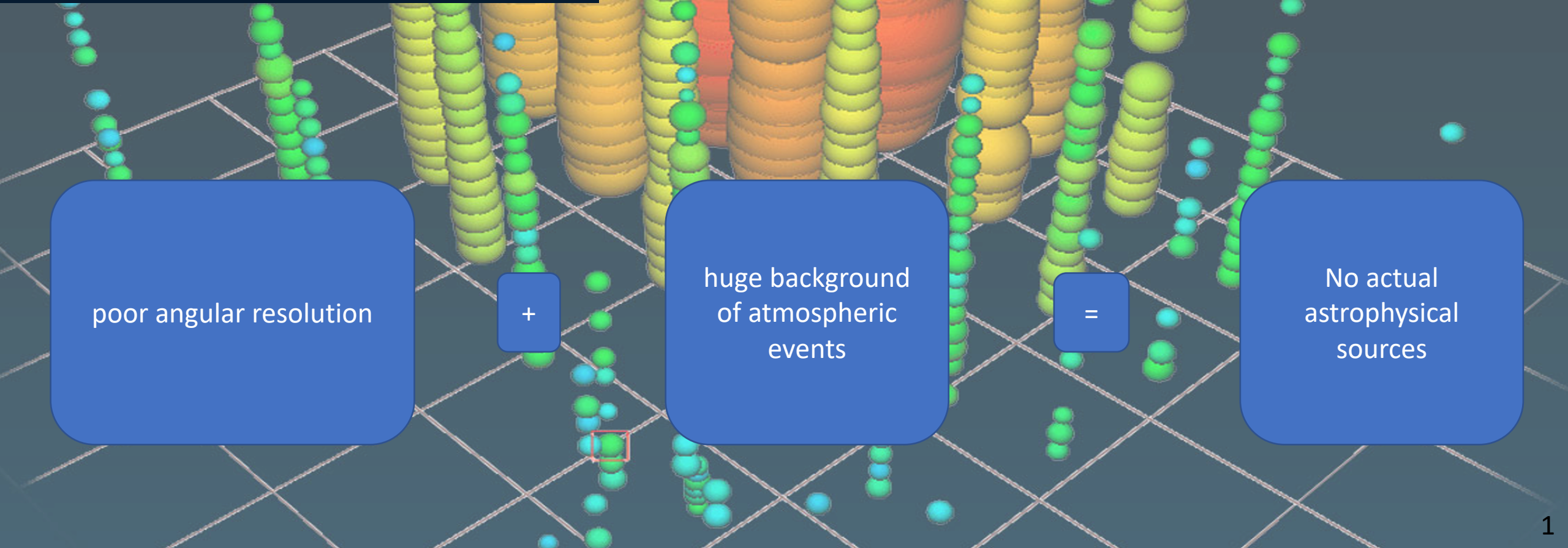
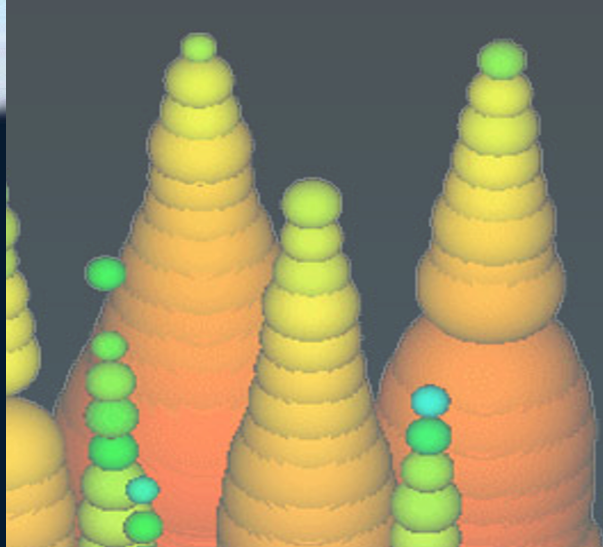
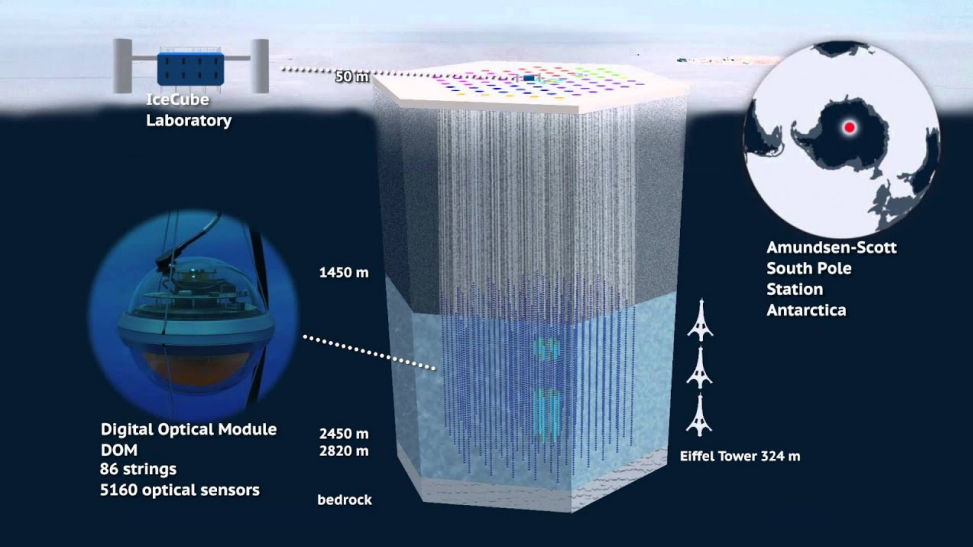


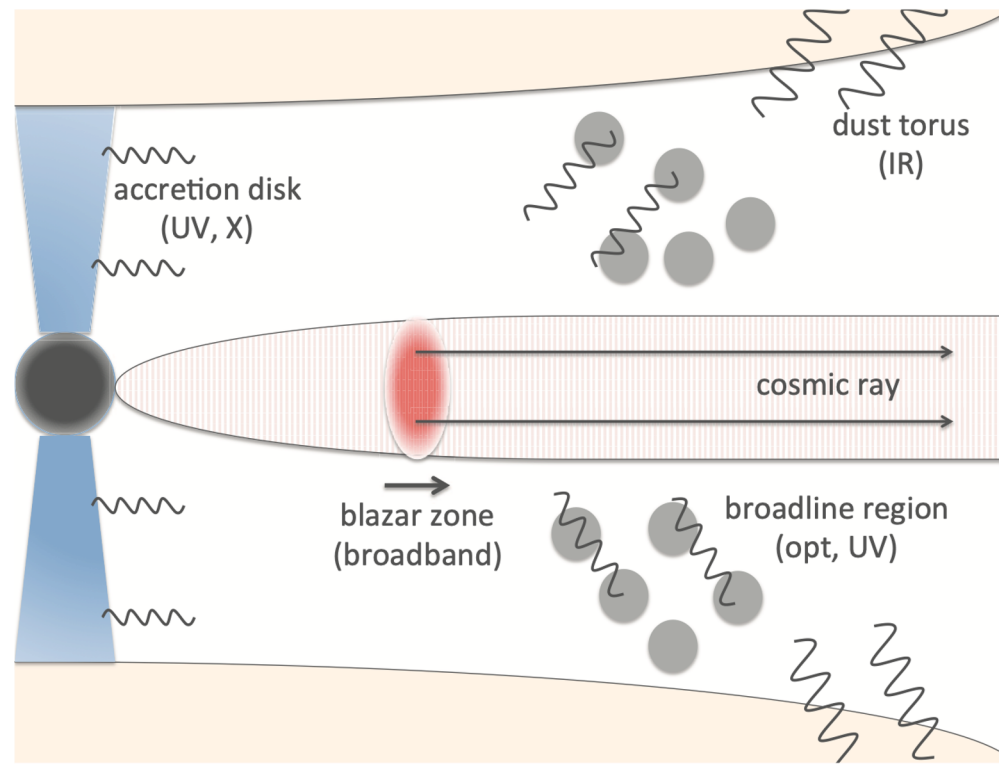


# Neutrino production in blazar radio cores

Polina Kivokurtseva, Sergey Troitsky, Oleg Kalashev

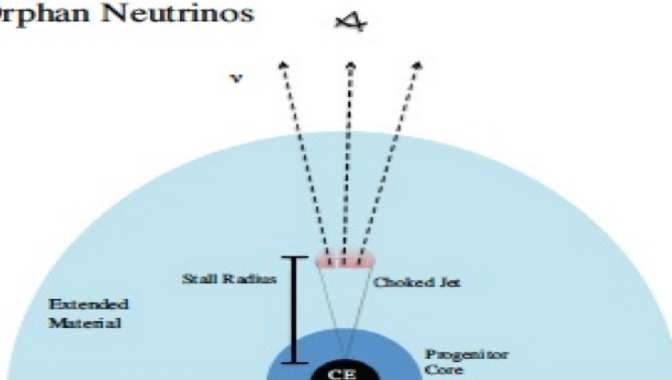


They predict mostly neutrino of PeV energies

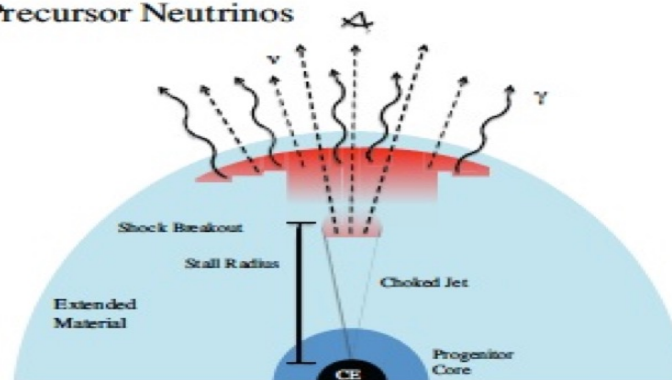


They do not predict the observed correlation between the neutrino and VLBI radio fluxes

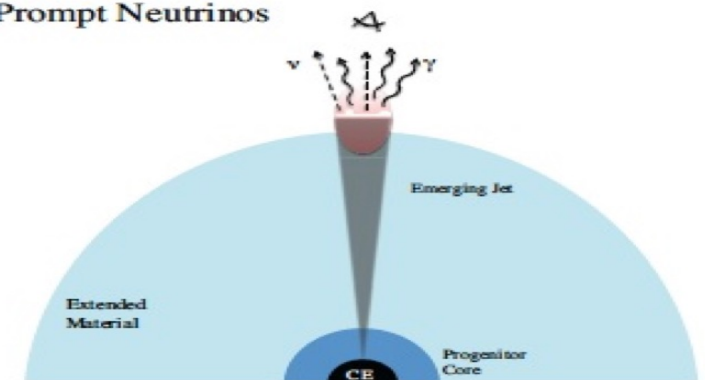
Orphan Neutrinos



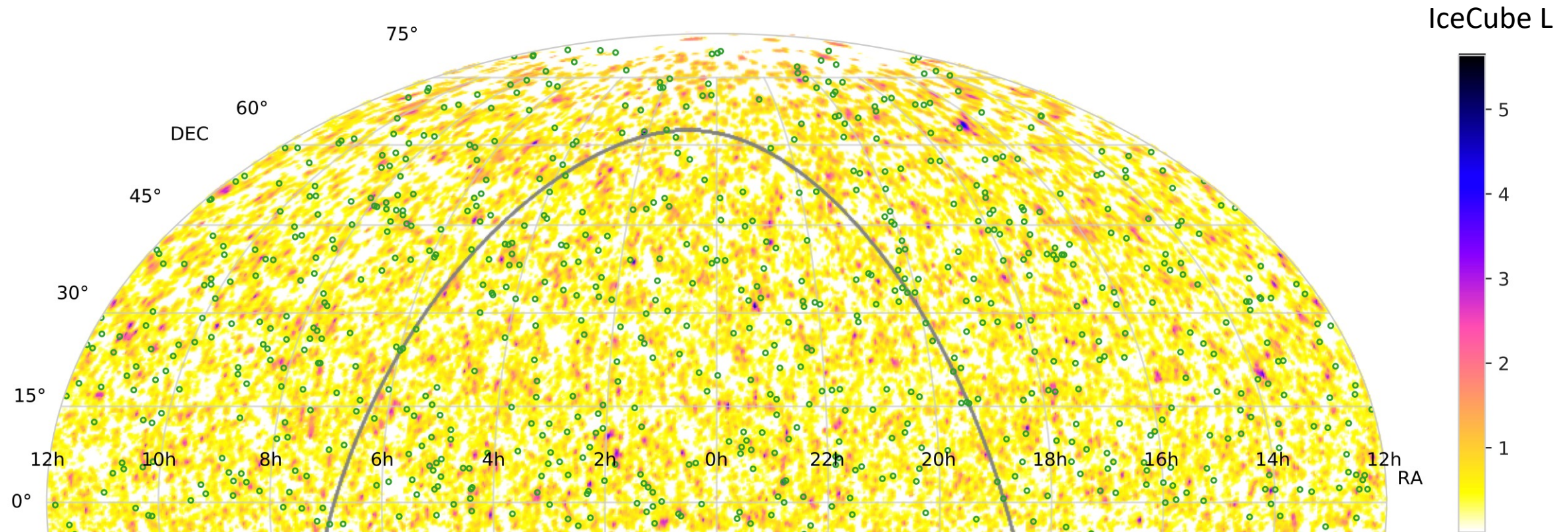
Precursor Neutrinos




Prompt Neutrinos



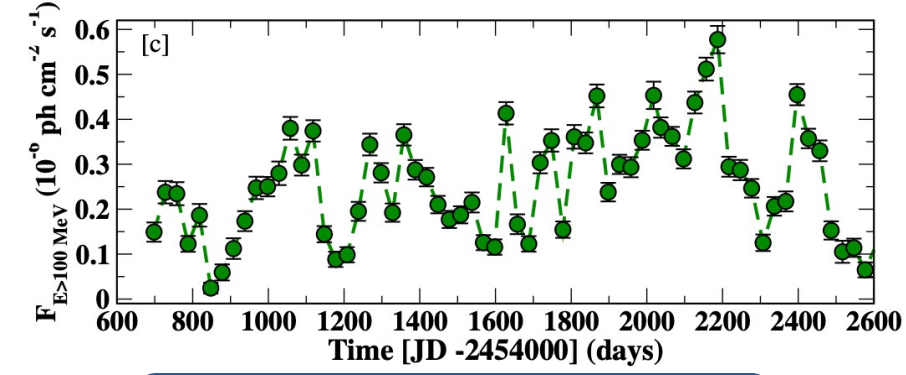
# There are correlations for all energies from TeV to PeV



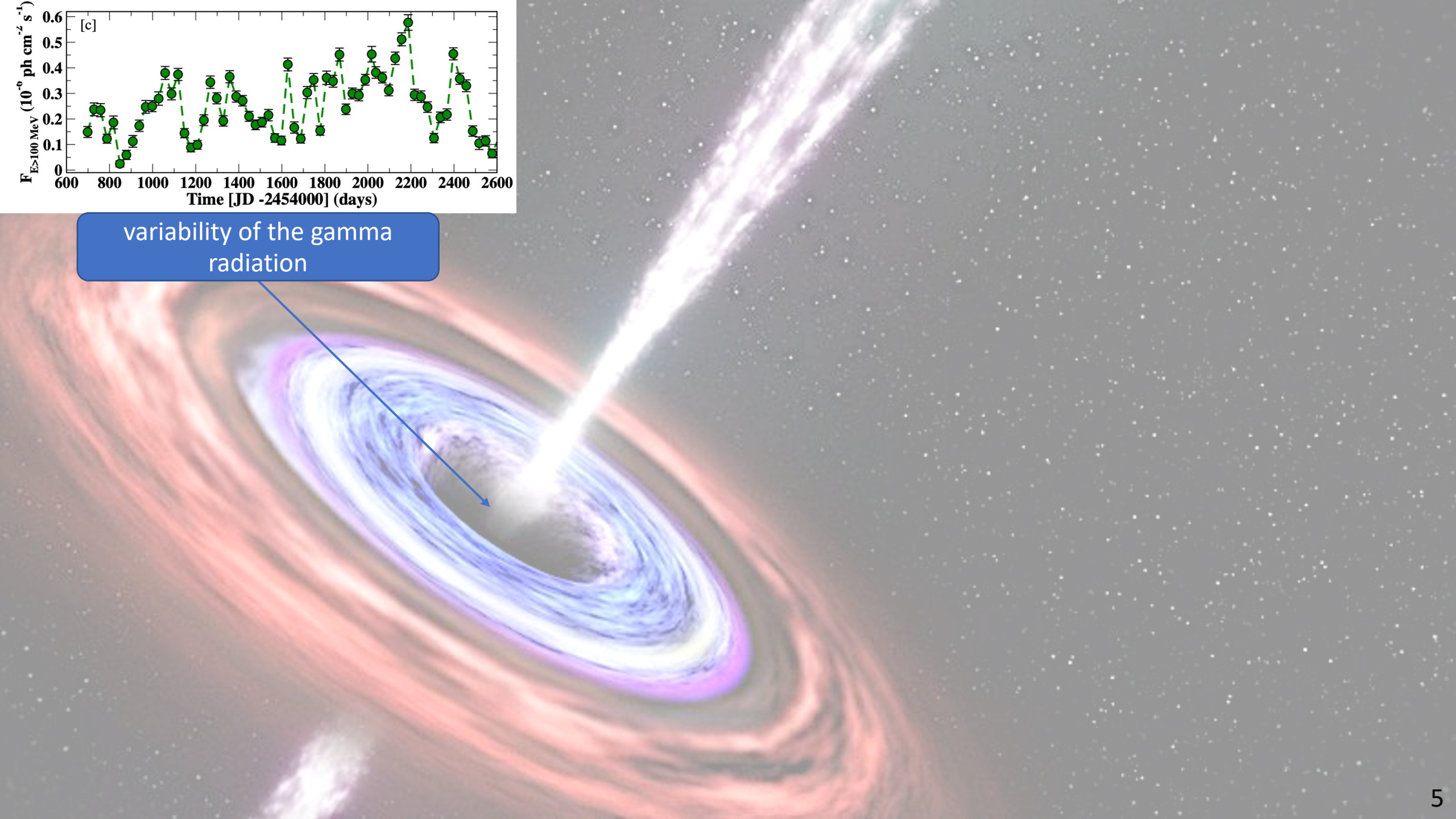


The mechanisms of jet launching are not firmly known but in any case should provide conditions for particle acceleration.

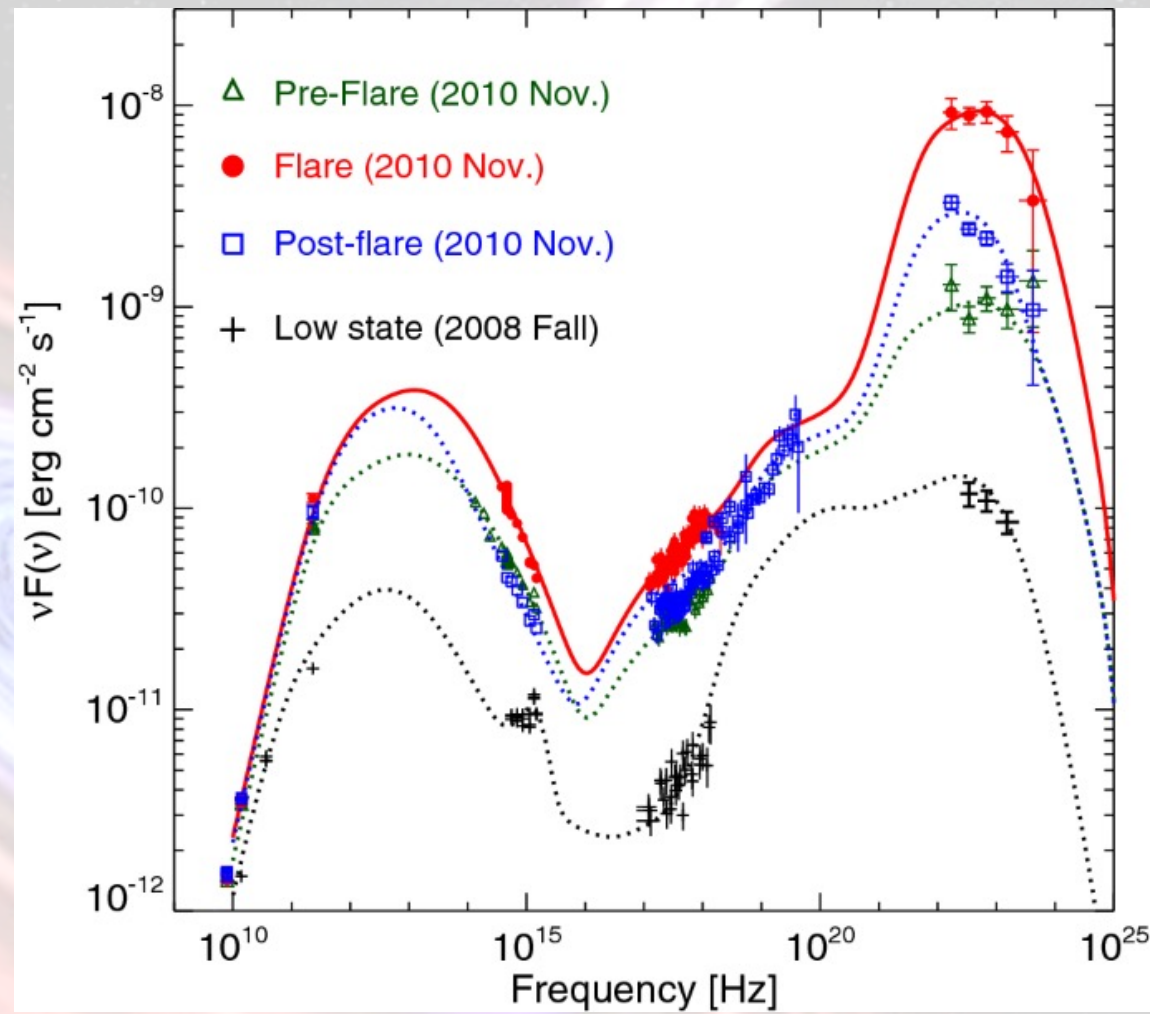




variability of the gamma  
radiation

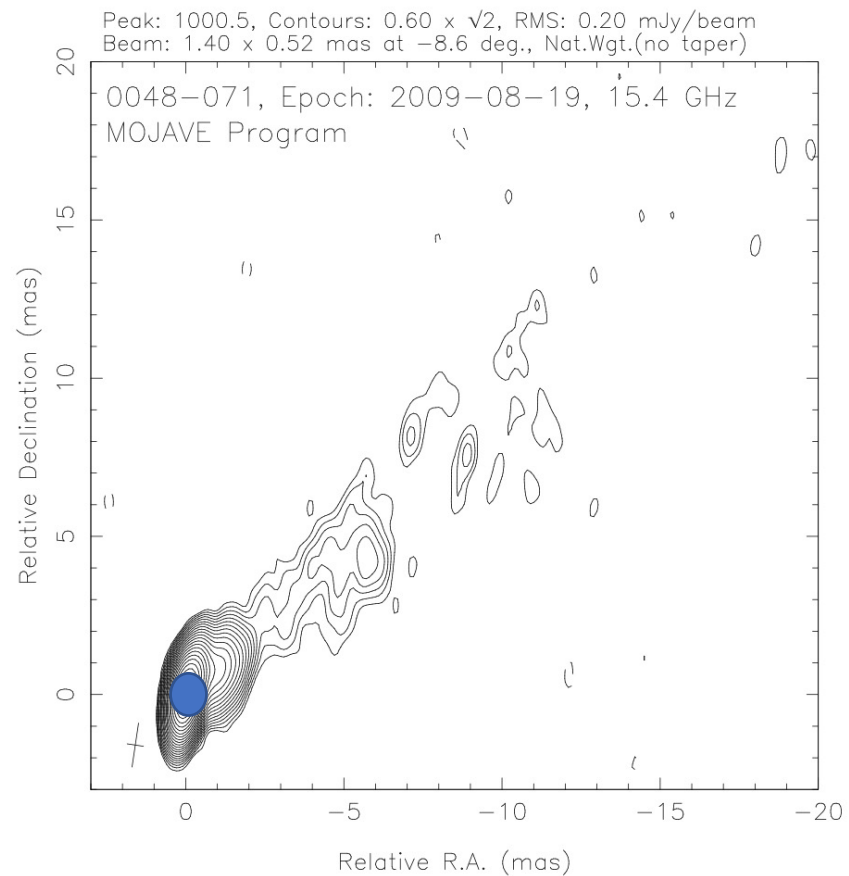
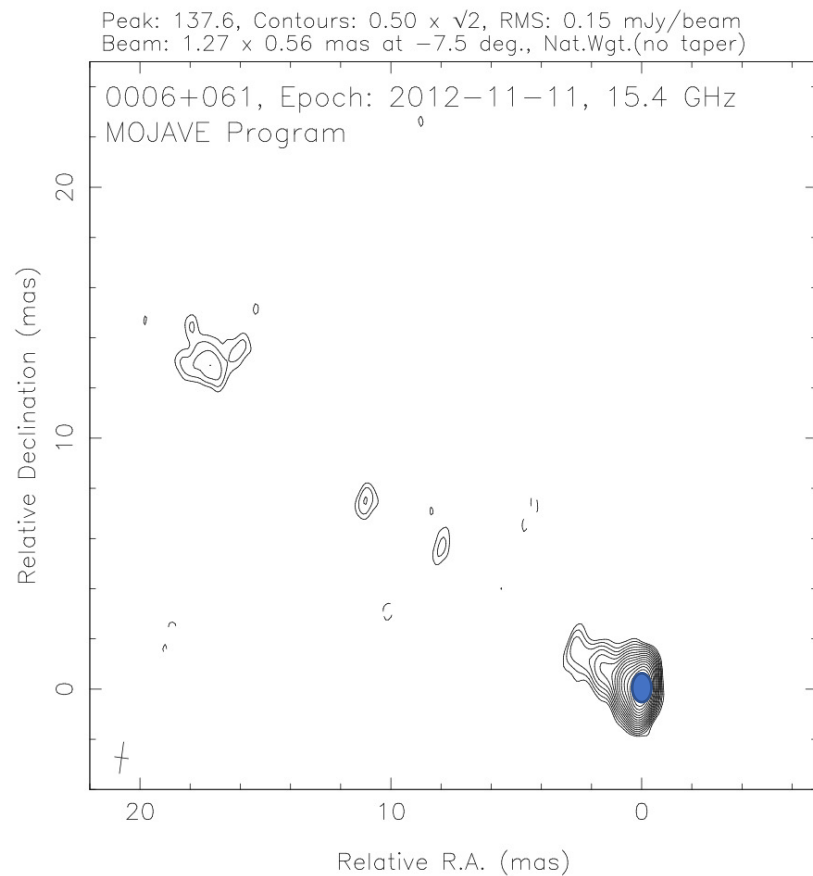


synchrotron radiation



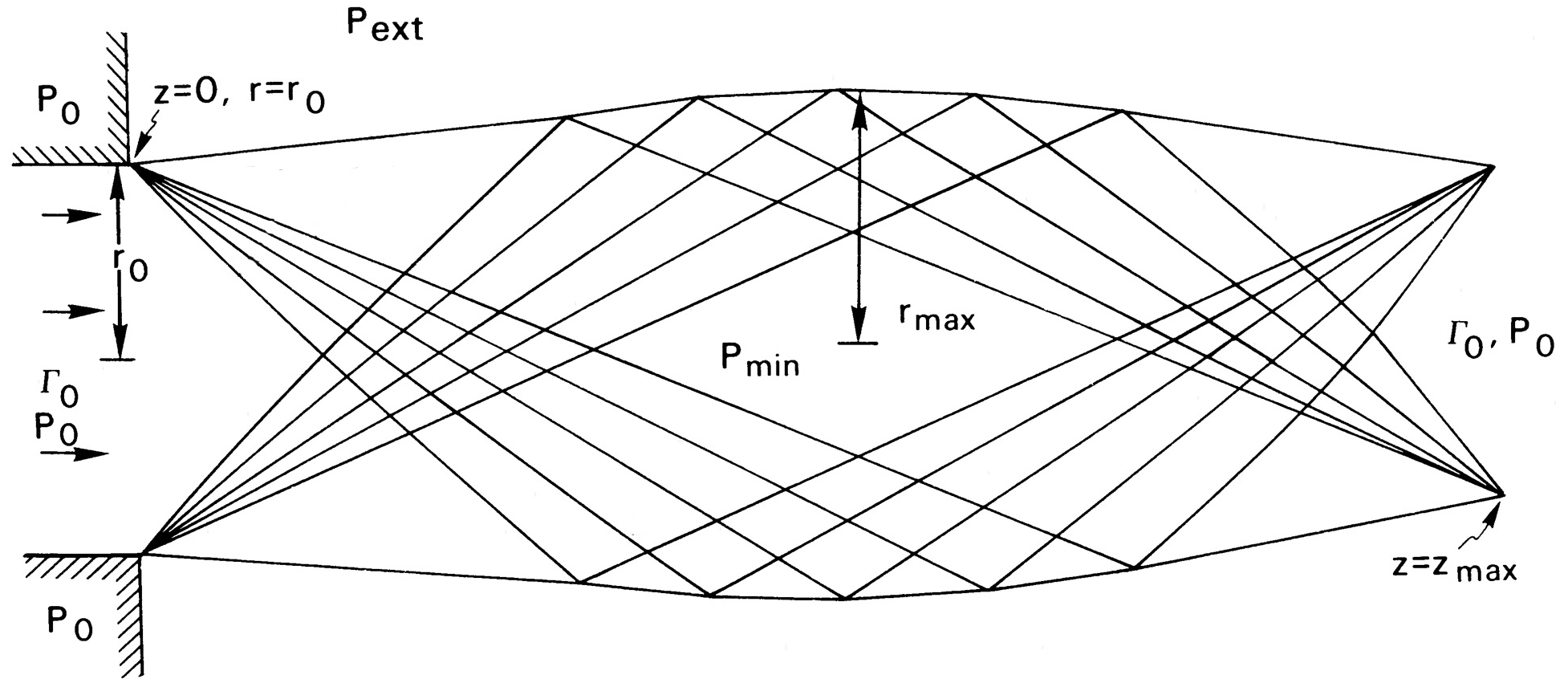
inverse Compton scattering of relativistic electrons

## Motivation for the multi-zone blazar models

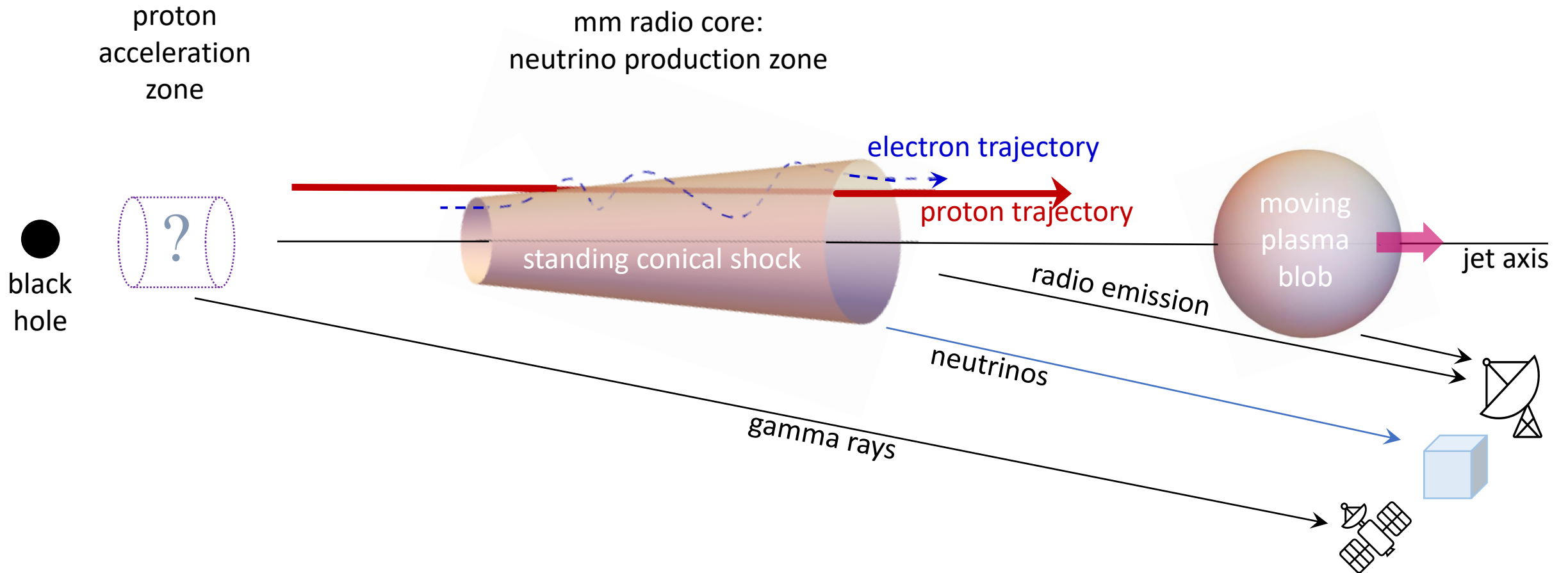


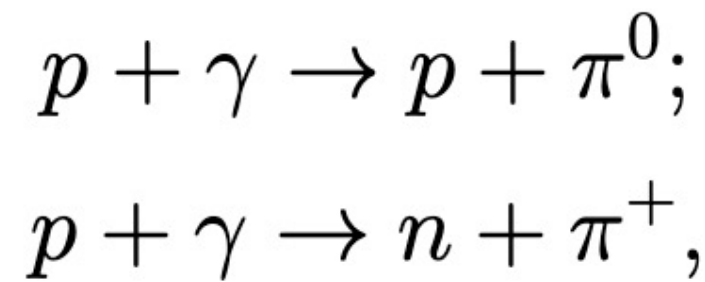
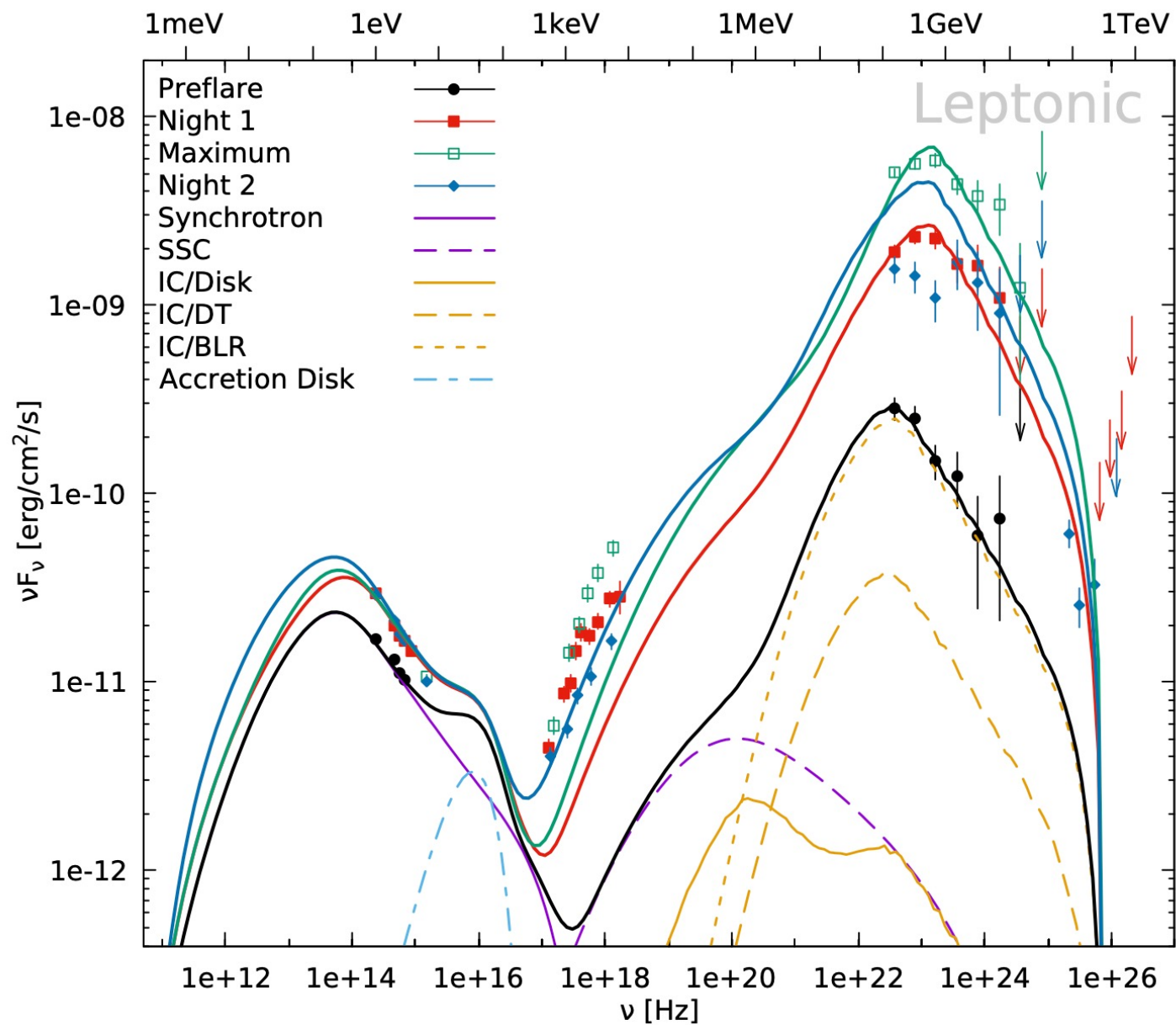


# The shock model of the core

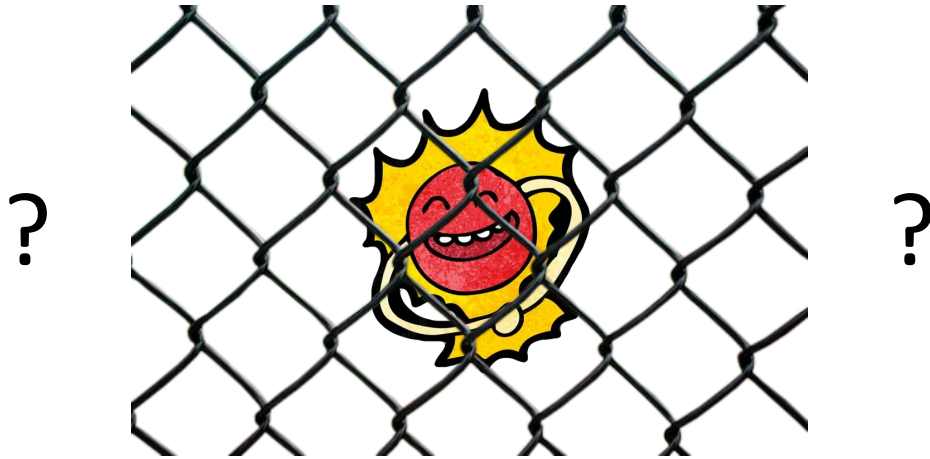


Sketch of central parsecs of a blazar and jet structures relevant for neutrino production and radio observations.



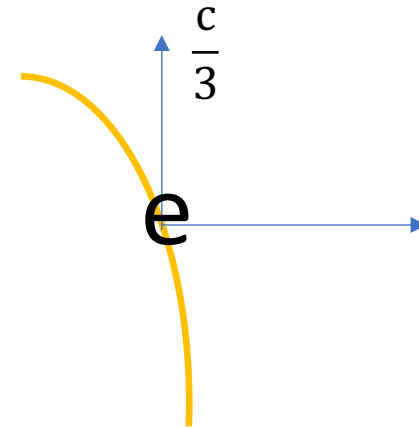


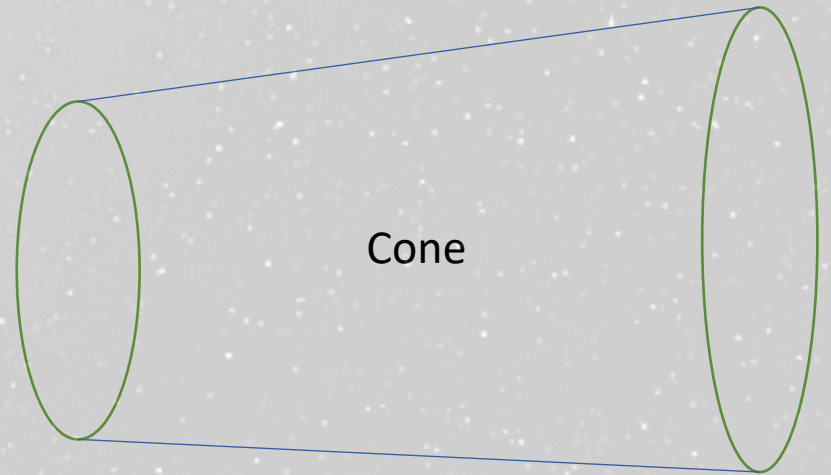
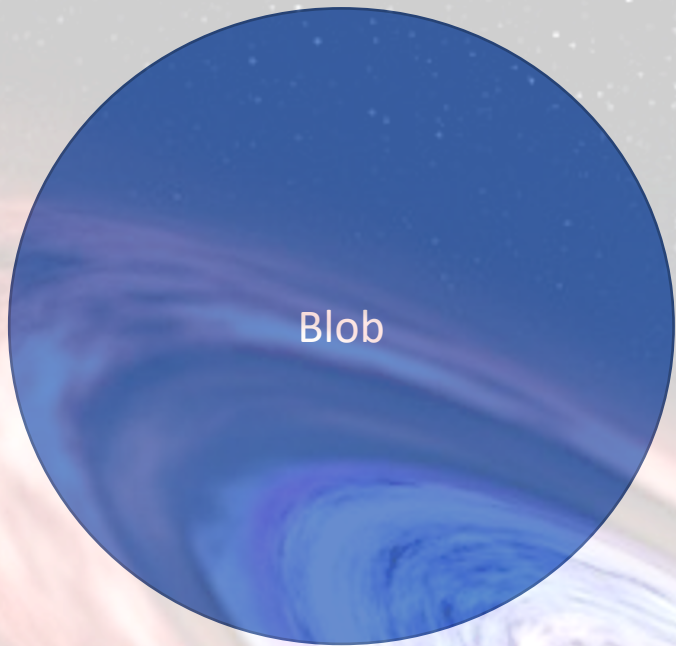
# proton trajectory



Protons go through only 1 time

# electron trajectory



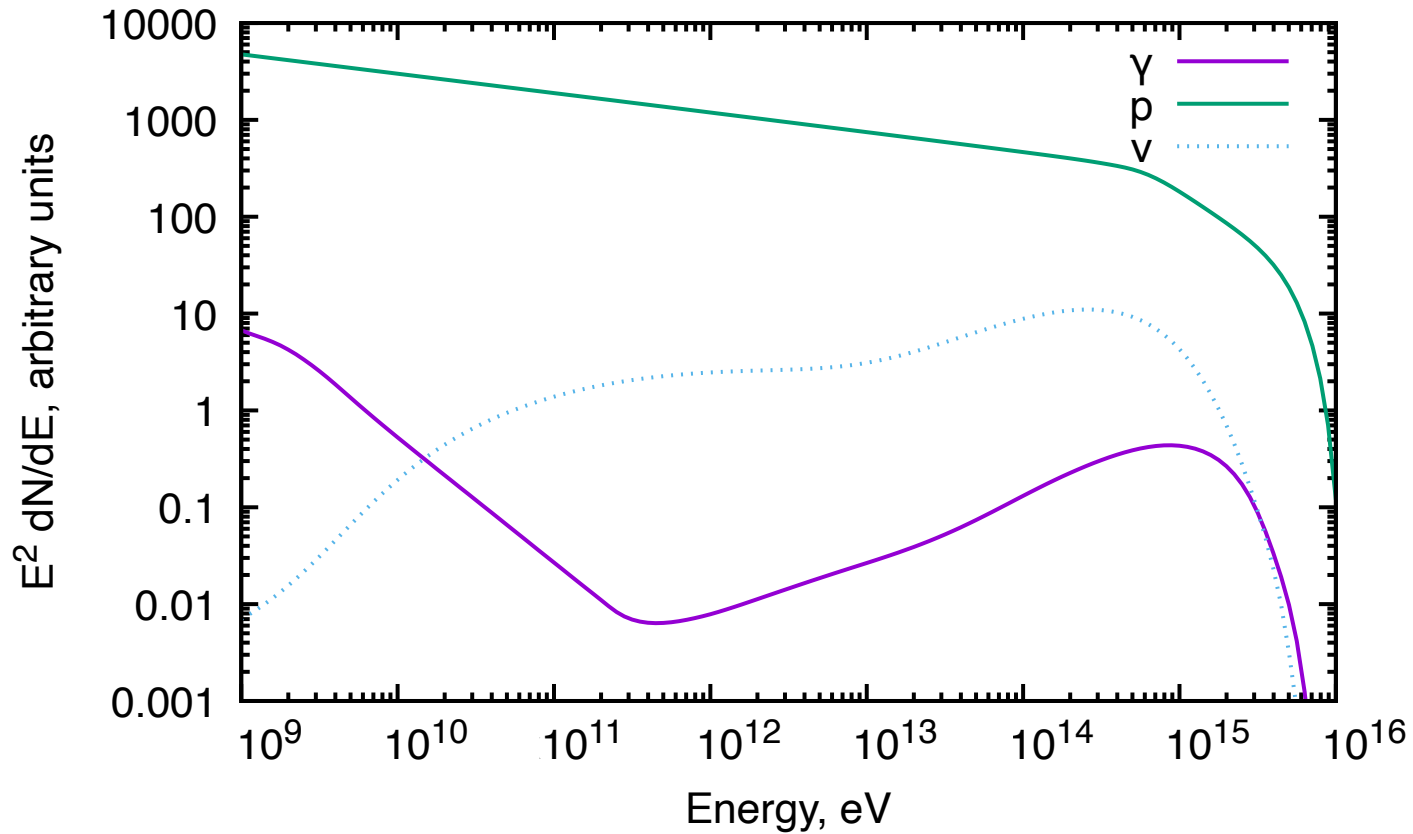


$$\left(E'_\gamma n'_\gamma(E'_\gamma)\right)_b = \frac{3d_L^2 \mathcal{F}}{\delta^4 E'_\gamma r'^2};$$



$$E'_\gamma n'_\gamma(E'_\gamma) = \left(E'_\gamma n'_\gamma(E'_\gamma)\right)_b \cdot \frac{4}{3} \left(\frac{\delta}{\delta_c}\right)^4 \left(\frac{r'}{l'}\right)^{2/3}.$$

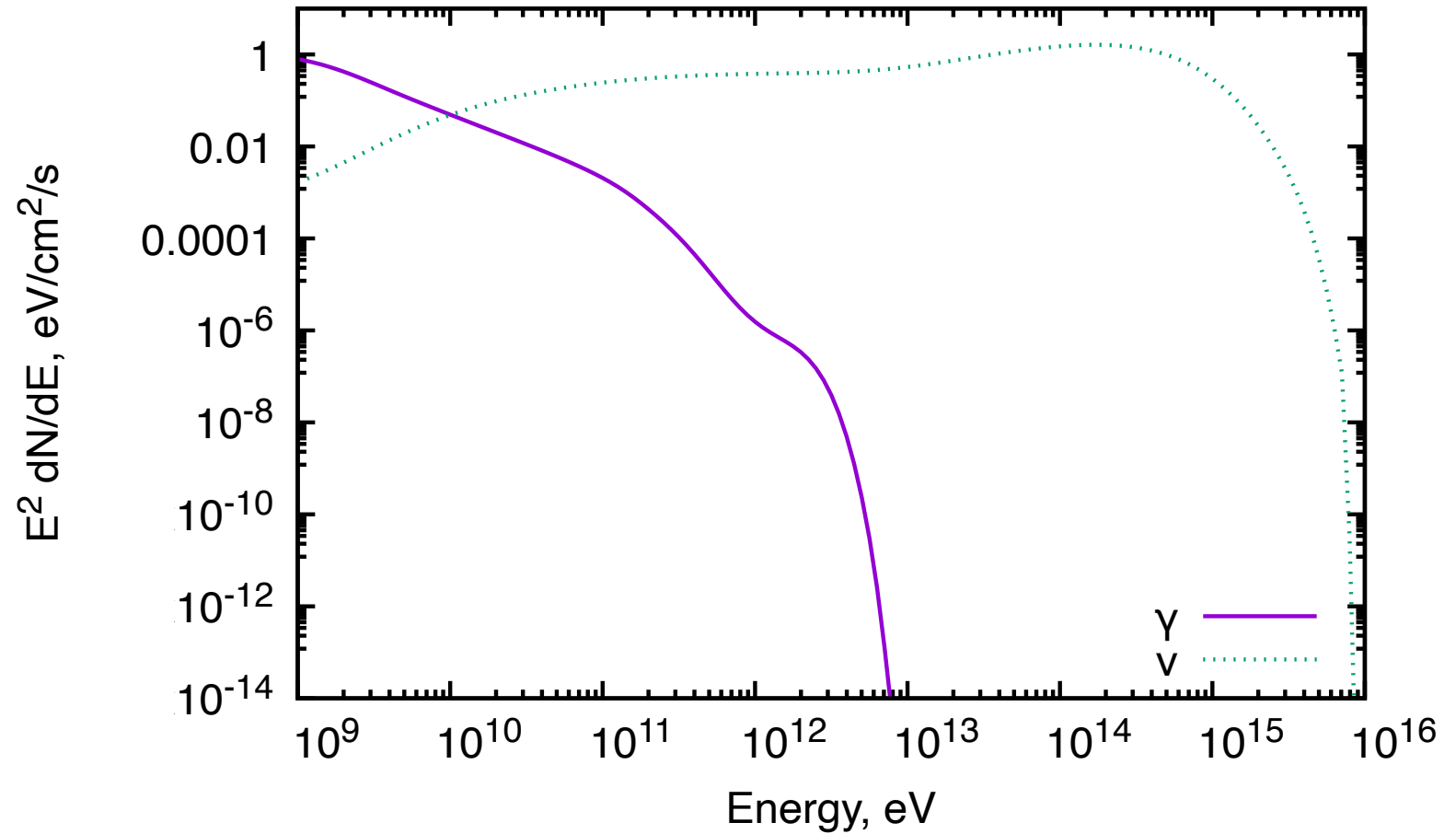
# Numerical calculation



Prediction of the neutrino spectrum  
(all flavours) from the 3C279 core just  
out of blazar

# Numerical calculation

Predictions of the observed spectra of neutrino (all flavours) and neutrino-associated gamma rays from the 3C279 core.



Future studies of astrophysical neutrinos, together with VLBI monitoring of promising neutrino emitting blazars, are required in order to determine the mechanism

IceCube

VLBA

RATAN-600



# Summary

1. This mechanism explains the connection of neutrinos of various energies from TeV to PeV with radio blazars and the correlation between the neutrino and radio flux.
2. This model does not predict a correlation with gamma radiation
3. A connection is expected between neutrinos and hard X-ray radiation from blazars.
4. A small fraction of the total energy release goes to neutrinos



arXiv: 2212.03151

Thank you for your attention!