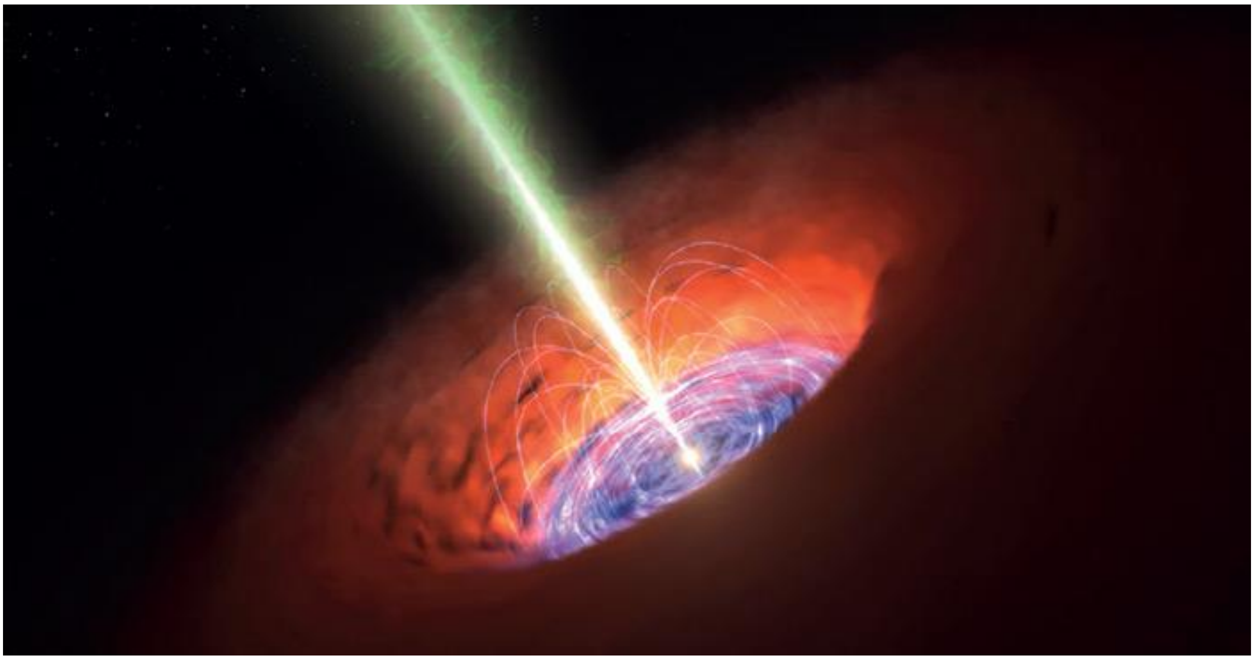
Blazers & Gamma-Ray Bursts



Blazars

About 10% of Active Galactic nuclei, beside accreting matter, have two anti-parallel jets in which the matter flows relativistically, reaching bulk Lorentz factors G~10-15. When the jet points in our direction the source is called *blazar*.
The fast motion makes the emission beamed, in such a way that the flux we receive from blazars is strongly enhanced, and for this reason well visible at high redshifts: blazar are therefore excellent probes of the far Universe. One example: we estimate that the black hole mass of some of them exceed one billion of solar masses even at redshifts 4-5, when the Universe was ~1 billion years old. And for each blazar with such a heavy black hole, there must exist hundreds of other sources, pointing elsewhere, with the same mass.
The emission produced by blazars ranges from the radio to the high-energy g-rays, reaching the TeV band. Due to this extreme energy emission, we wonder if blazars can be the sources of high energy neutrinos recently detected, and even of the highest energy cosmic rays *(Gabriele Ghisellini, Fabrizio Tavecchio)*.

The power of relativistic jets is larger than the luminosity of their accretion disks Ghisellini G., Tavecchio F., Maraschi L., Celotti A., Sbarrato T., 2014, Nature 515, 376

High energy cosmic neutrinos from spine-sheat BL Lac jets
Tavecchio F., Ghisellini G., 2015, MNRAS, 451, 6020

Gamma-Ray Bursts

The heaviest stars, at the end of their life, are able to produce colossal amount of energy in two ways: a supernova and a gamma ray burst (GRB). While the supernova involves the motion of a few solar masses at speeds of 5,000-10,000 km/s, in GRBs we have a tiny fraction (1e-4 - 1e-5 solar masses) of mass going at G~100-1000 along two well collimated jets (as in blazars). Even is the GRB research was frantic in the last 20 years, there still are controversial issues that deserve to be studied. The most serious one concerns the origin of the radiation we see during the 10-50 seconds of the so-called "prompt" emission, usually in the hard X-rays and very variable. Is it synchrotron? Inverse Compton? Multi temperature thermal emission? We do not know yet. This ignorance severely limits our ability to infer the physics from what we observe. At the same time, this implies a very active research about this issue *(Giancarlo Ghirlanda, Gabriele Ghisellini)*.

Short GRBs at the dawn of the gravitational wave era
Ghirlanda G., Salafia O.S., Pescalli A., et al., 2016, A&A 594, A84

The faster the narrower: characteristic bulk velocities and jet opening angles of Gamma Ray Bursts Ghirlanda G., Ghisellini G., Salvaterra R., et al., 2013, MNRAS, 428, 1410

Fast Radio Bursts
They have been discovered very recently and serendipitously, through radio observations able to catch bursts of flux lasting about a millisecond. From the dispersion of the arrival time as a function of frequency, we can infer the amount of material through which the emission passed, that implies that the sources are extragalactic, at a redshift around unity.
Recently, one of these events was seen to repeat, enabling the search of a counterpart, and confirming the extragalactic nature. This implies a huge power emitted in the radio band. Fast follow-ups in other bands have been made, with null results. The nature of these objects is still a complete mystery. And their emission process is a mystery as well: what we know is that only a coherent process can account for the huge brightness temperatures we observe, that are comparable to the ones of the radio pulses of pulsars, whose origin is still debated *(Gabriele Ghisellini)*.

Synchrotron masers and fast radio bursts
Ghisellini G., 2017, MNRAS, 465, L30

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