

GAMMA-RAY COMPACT BINARIES*

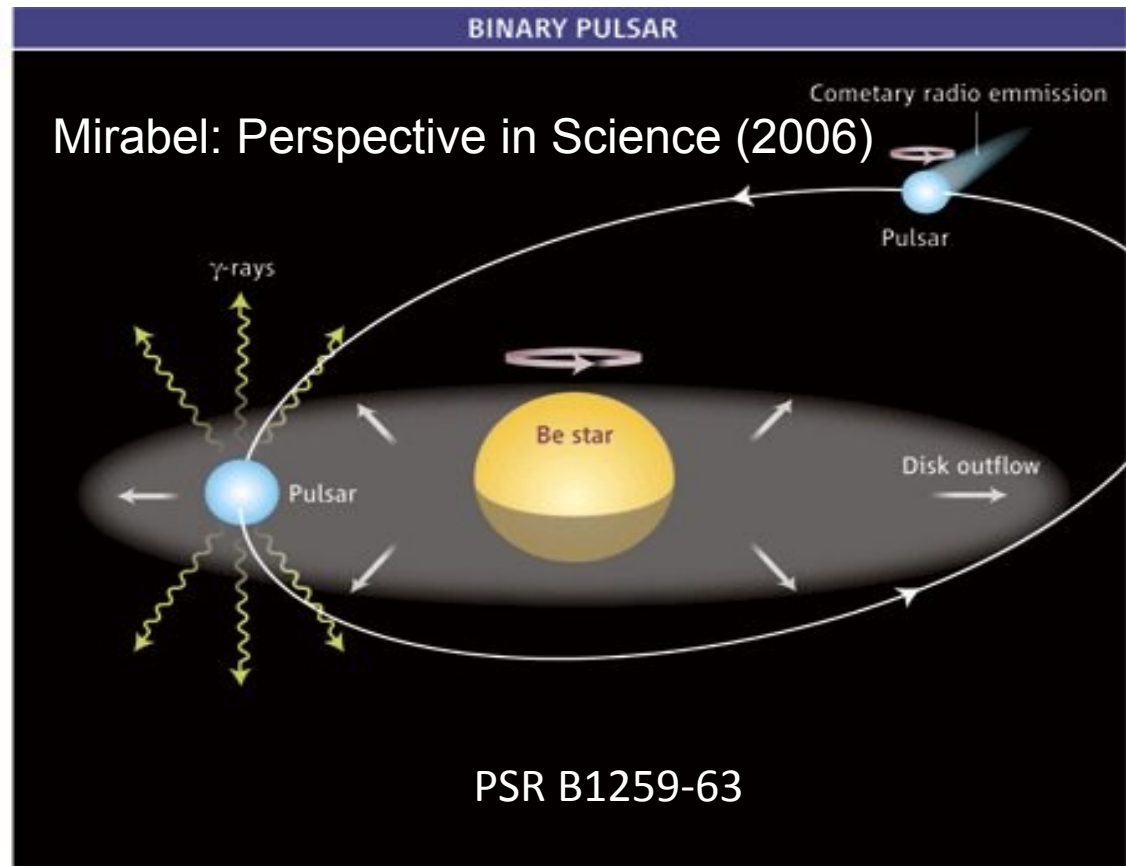
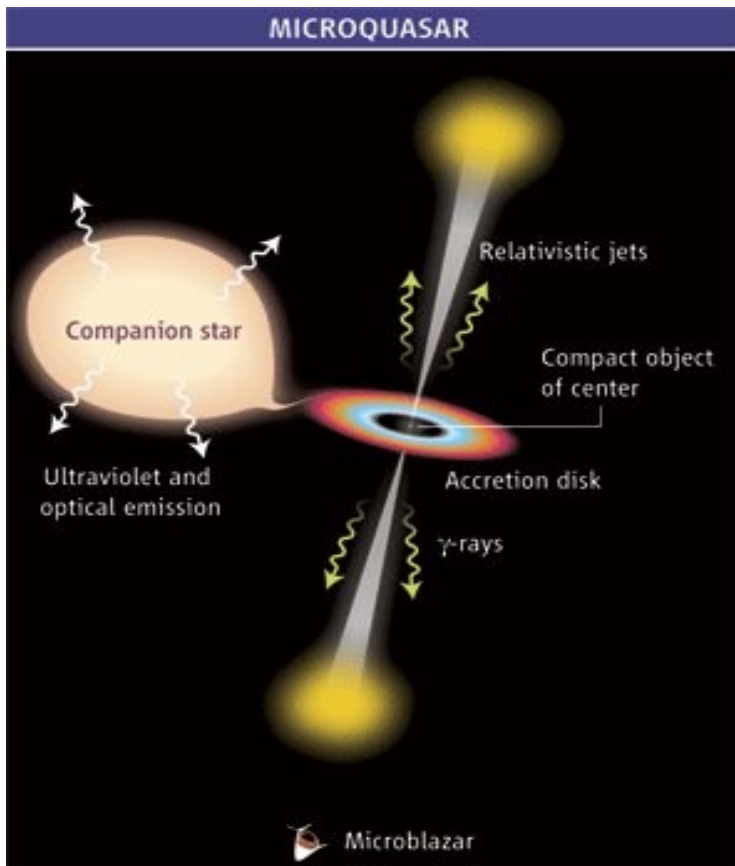
ASTROPHYSICAL SCENARIOS

Félix Mirabel

*Neutron stars & Black holes in stellar binary systems that radiate in gamma-rays.
(Will not refer to other types gamma-ray stellar binaries, e.g. Eta Carina)

COMPACT GAMMA-RAY BINARIES IN 2006

The only known were PSR B1259-63, LSI +61 303 & LS 5039



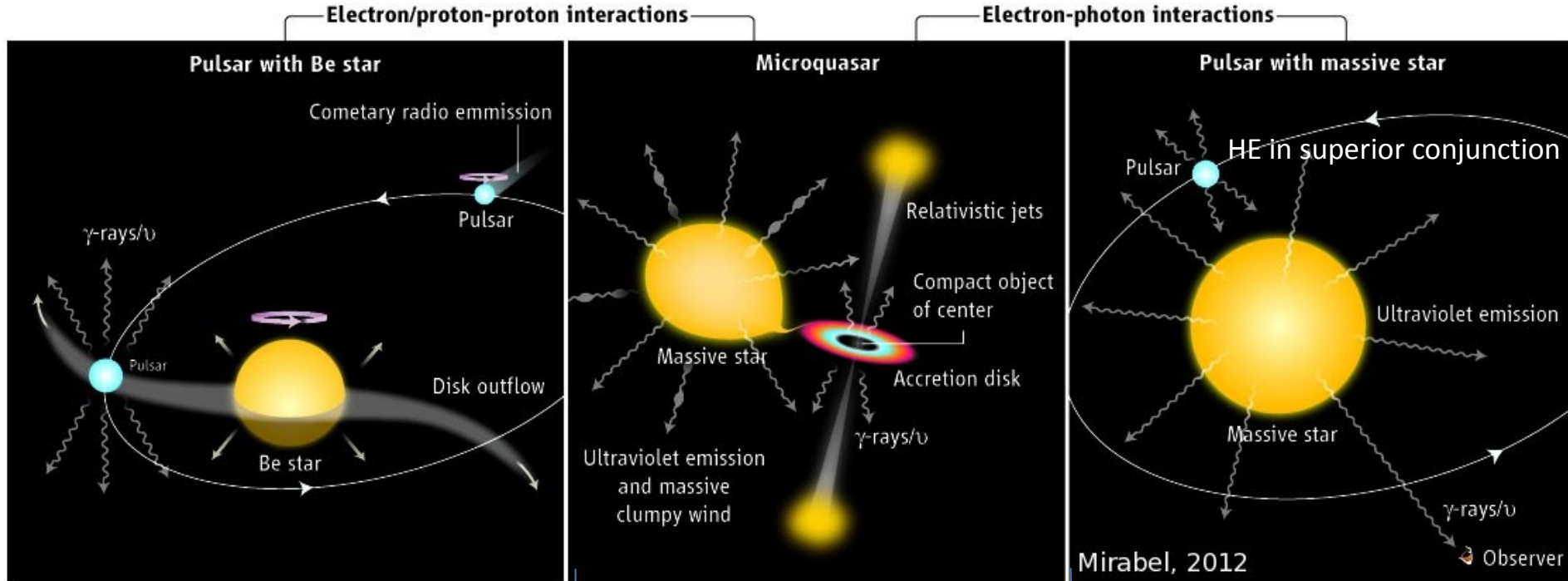
- γ -rays produced by inverse Compton scattering: relativistic electrons collide with stellar and/or synchrotron photons and boost their energies to HE & VHE ranges.
- In PSR B1259-63 the electrons are powered by the rotational energy of the pulsar. In microquasars relativistic electrons would come from accretion-powered jets and in that publication I proposed as candidate sources Cyg X-1 & Cyg X-3.

COMPACT GAMMA-RAY BINARIES IN 2012

Mirabel: Perspective in Science (2012)

Sp Types of donors: Casares et al. (2012)

HE, $E > 100$ MeV & VHE, $E > 100$ GeV PRODUCED BY LEPTONIC AND HADRONIC INTERACTIONS



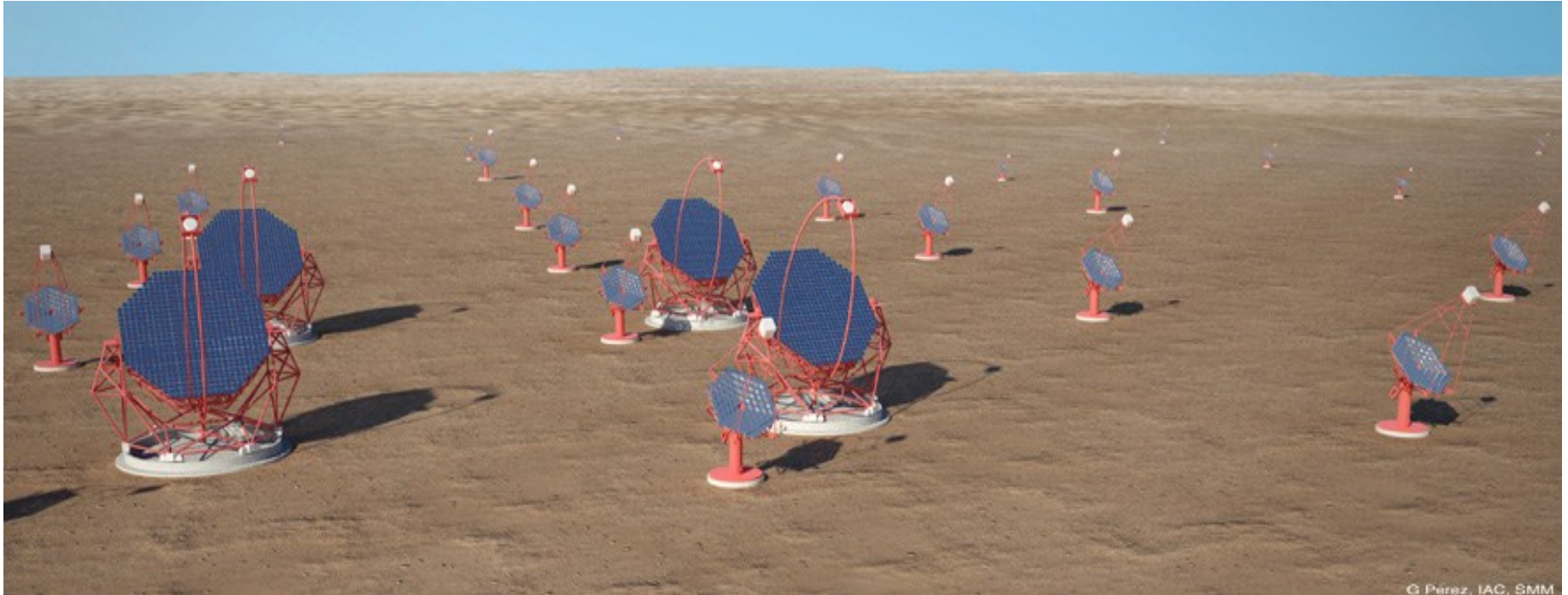
Name	γ -ray s	Sp Type	Name	γ -ray s	Sp Type	Name	γ -ray s	Sp Type
PSR B1259-63	HE, VHE	O9.5 Ve	Cyg X-3	HE	WNE([2,5])	LS 5039	HE, VHE	O6.5 V((f))
AGL J2241?	HE	B3 IV ne+sh	Cyg X-1	HE, VHE?	O7 V	1FGL J1018	HE, VHE?	O6 V((f))
HESS J0632+057	VHE	B0 Vpe						
LS I+61 303	HE, VHE	B0 Ve (?)	LS I+61 303	HE, VHE	B0 Ve (?)			

- γ -RAY BINARIES ARE NSs AND BHs ORBITING MASSIVE STARS
- SO FAR NO DETECTION OF ANY LMXB (e.g. GRS 1915+105)

FUTURE CHALLENGES IN THIS AREA OF RESEARCH

- Identify as γ -ray sources the dust enshrouded supergiant compact binaries detected by INTEGRAL in the hard X-rays (Chaty et al.)
- Confirm the hadronic mechanism that produces high energy gamma-photons (Aharonian+ 2006; Reynoso & Romero, 2009) by the detection high energy neutrinos from the decay of secondary mesons produced at p-p and/or p- γ photon interactions.
- CTA may provide the high sensitivity and angular resolution, to reveal a larger populations of gamma-ray sources in the Milky Way.
- However, the typical confusion in star formation regions can be overcome by correlated orbital modulations in the gamma-rays, X-rays, IR, and radio waves. (e.g. Cyg X-3, 1FGL J1018.6-5856).

In this context, high photon statistics at a few tens of GeVs would be an advantage to unambiguously identify compact gamma-ray binaries in the Milky Way,



In this area of research, (namely “Compact γ -ray binaries”), it would be convenient if CTA could have a low energy threshold. This is also the case to make progress in other areas of high energy astrophysics, such in studies of Pulsars, GRBs & AGN (see document by the Science WP)