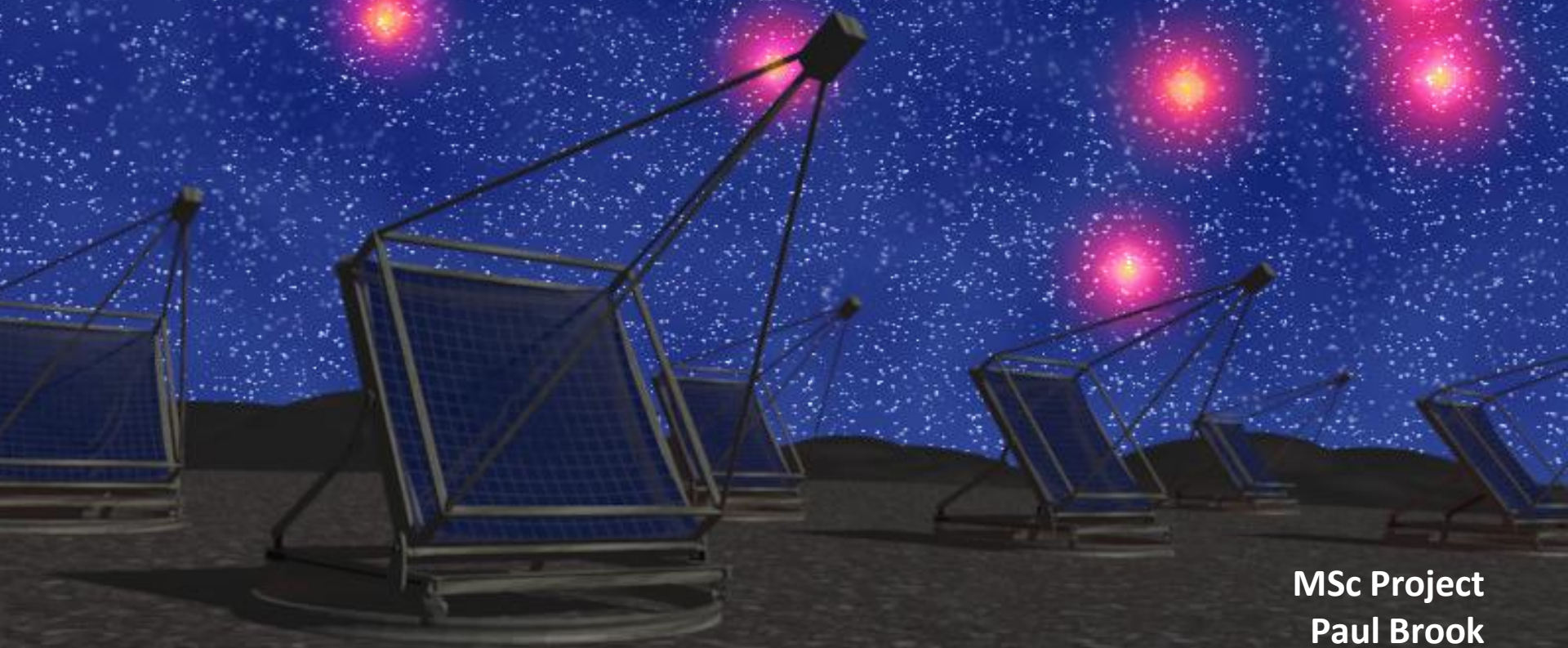


Can WR140, WR146 and WR147 be detected with CTA?



MSc Project
Paul Brook

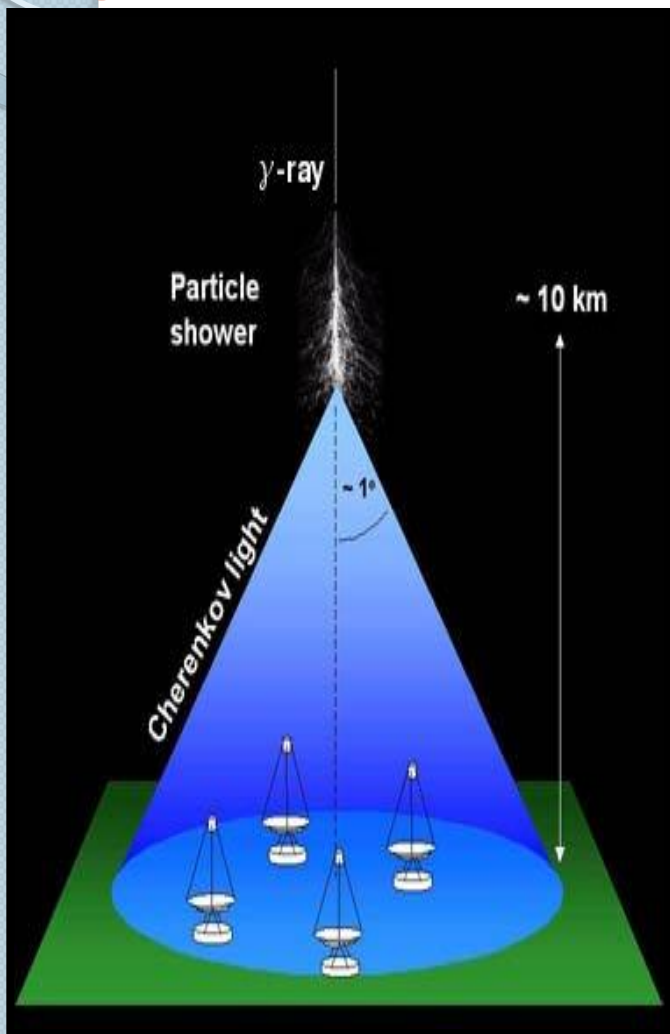
University of Leeds



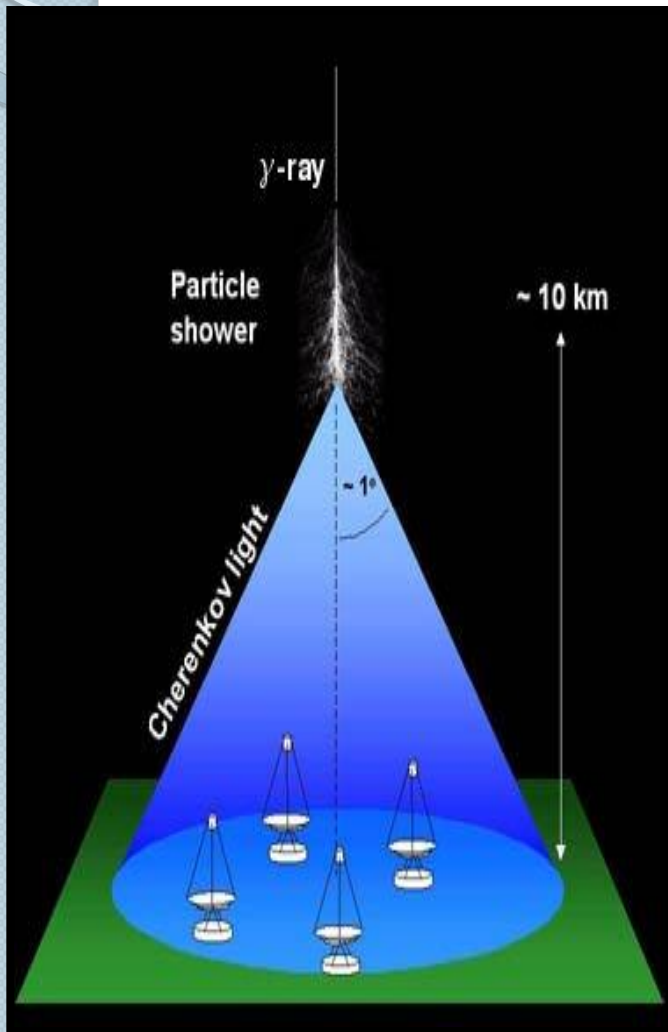
Contents:

1. CTA Overview
2. Colliding Wind Binaries
3. Systems WR140, WR146 and WR147
4. Detecting CWBs with CTA

Cherenkov Telescope Array



Cherenkov Telescope Array



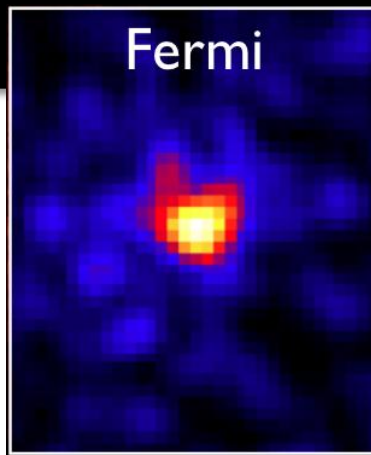
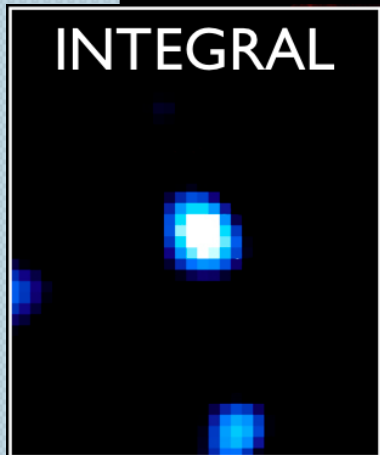
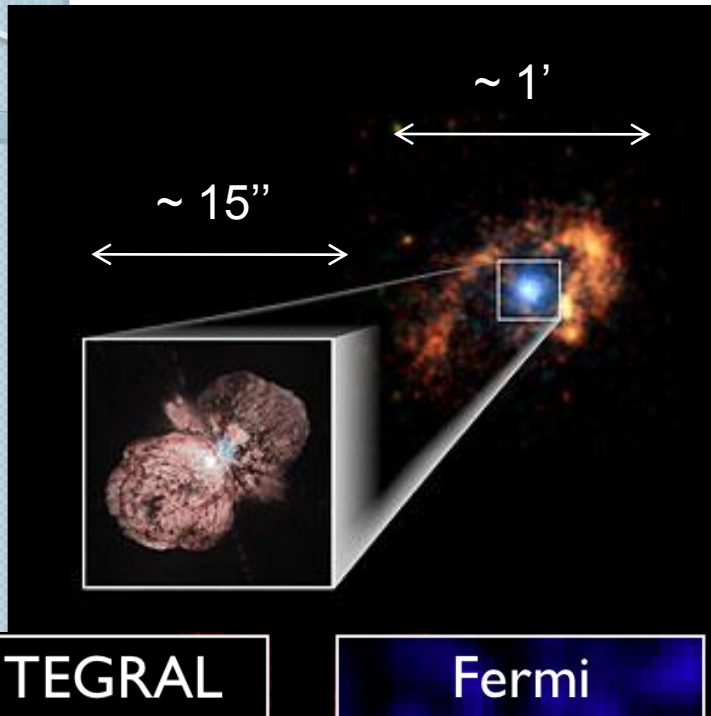
- 10 x sensitivity
- Larger energy range
- Better angular and energy resolution
- Larger field of view

Colliding Wind Binary Systems



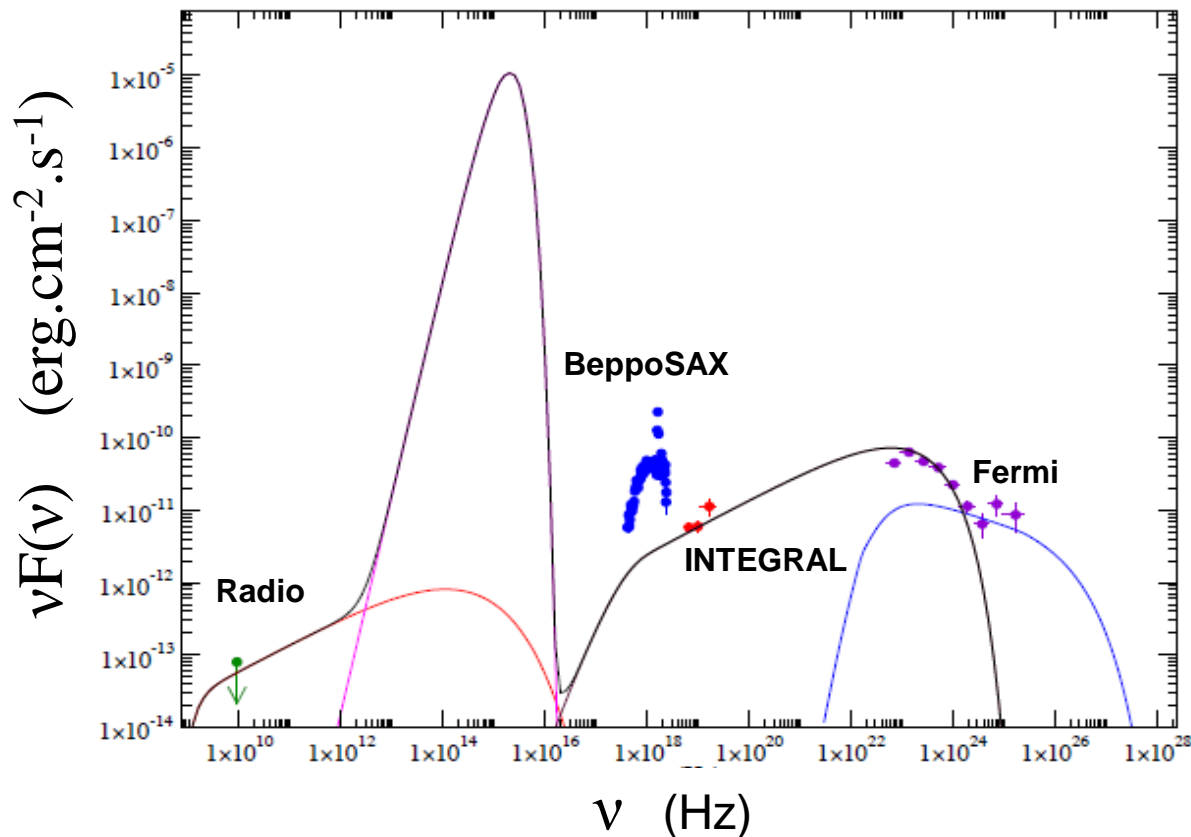
- Stellar winds collide in binary star system
- Wind collision region produces a strong shock front
- Particle acceleration occurs due to Fermi acceleration

Eta Carinae



Distance	2.3 kpc
Orbital period	5.5 years
Eccentricity	0.9
Binary separation at periastron	1.66 AU
Wolf-Rayet wind terminal velocity	500 km.s ⁻¹
Companion wind terminal velocity	3000 km.s ⁻¹
Wolf-Rayet mass loss rate	2.5×10^{-4} solar masses.year ⁻¹
Companion mass loss rate	1×10^{-5} solar masses.year ⁻¹

Eta Carinae spectral energy distribution

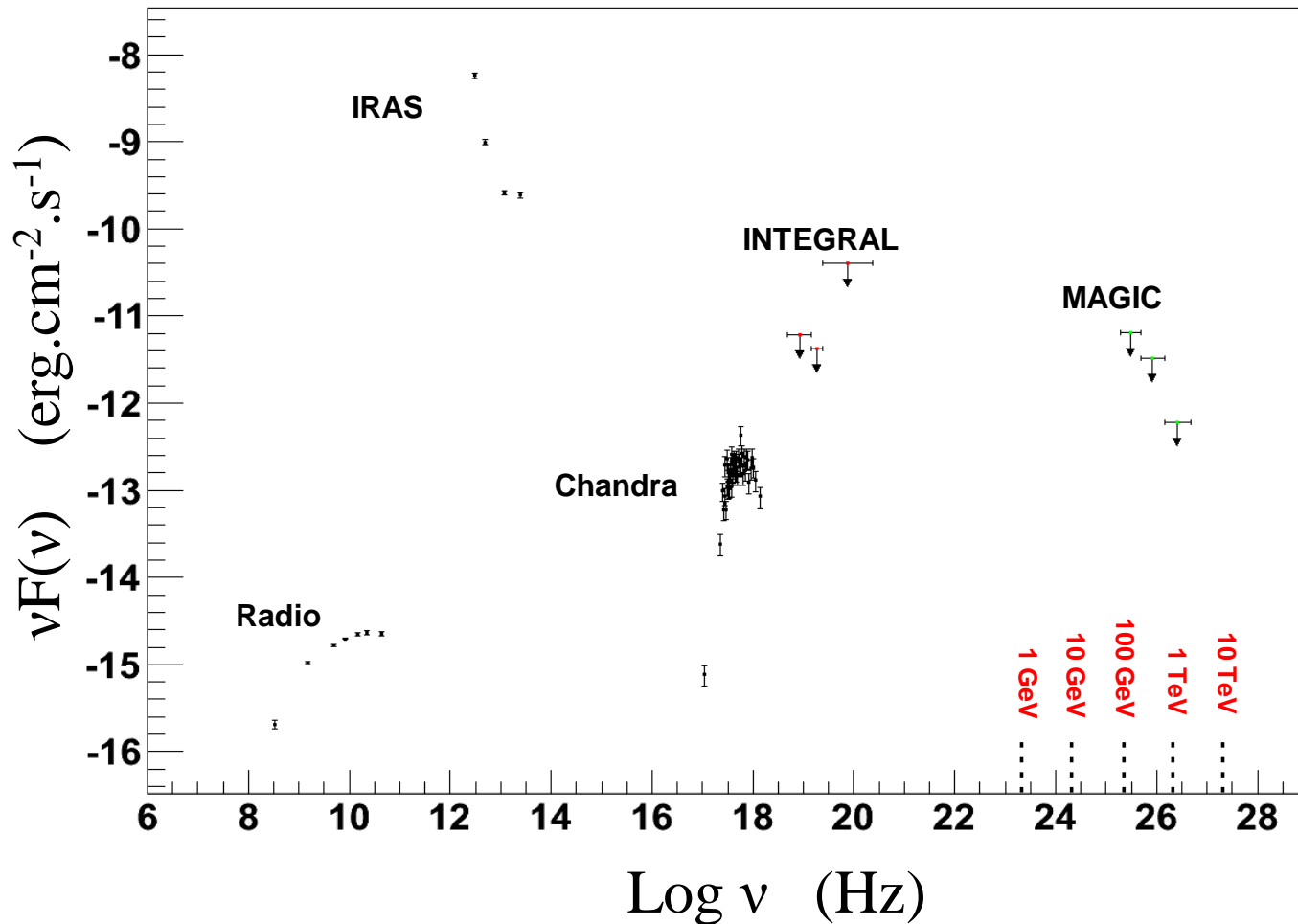


Taken from “ η Carinae: a very large hadron collider” - R. Walter, C. Farnier, J.C. Leyder (2010)

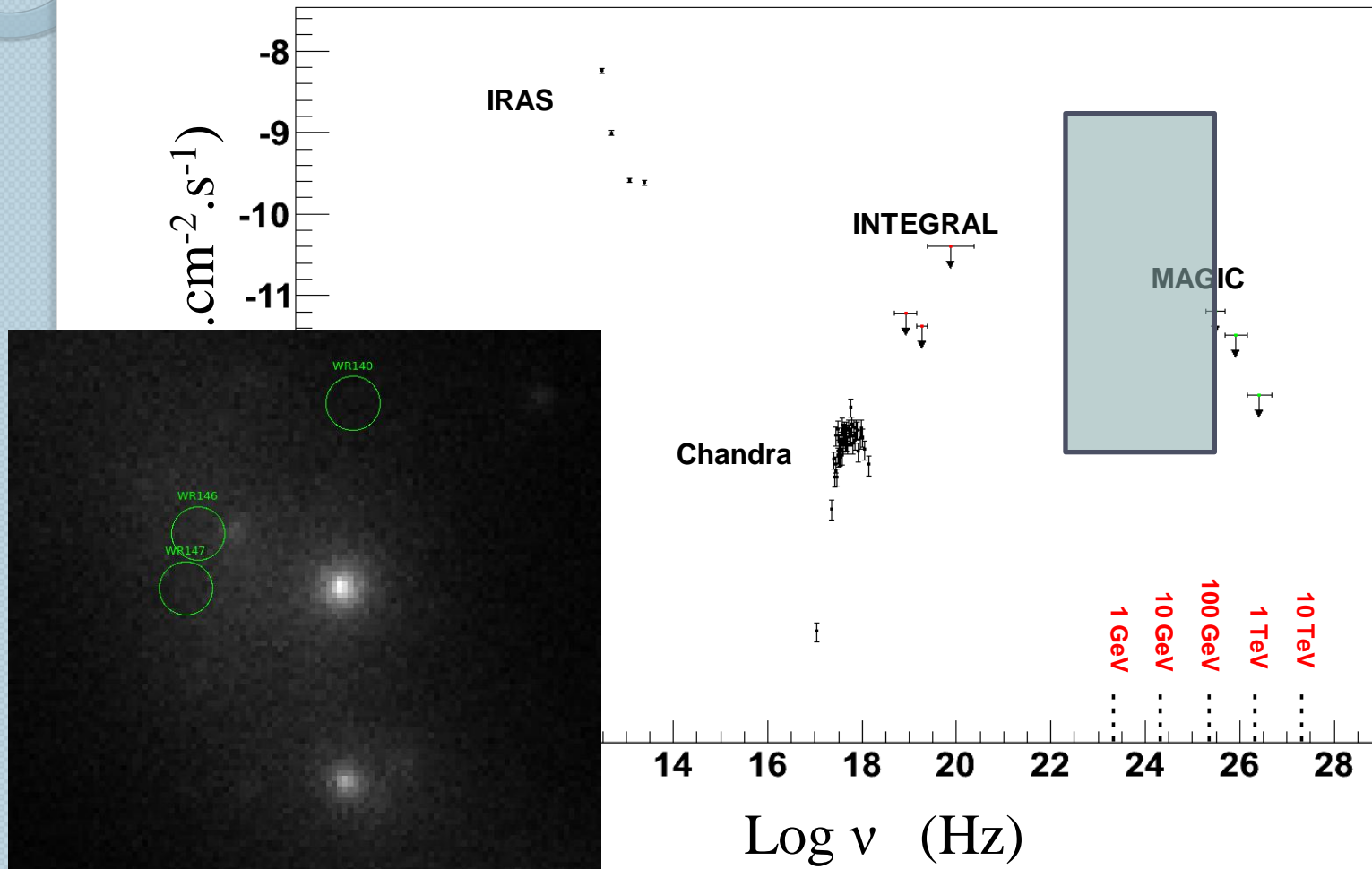
Other promising objects

	WR140	WR146	WR147	Eta Carinae
Distance	1.8 kpc	0.75-1.7 kpc	0.65 kpc	2.3 kpc
Orbital period	7.9 years	300 years	1000s of years	5.5 years
Eccentricity	0.88	unknown	unknown	0.9
Binary separation	2-30 AU	100 AU	417 AU	16.64 AU (periastr.)
Wolf-Rayet wind terminal velocity	2860 km.s ⁻¹	2900 km.s ⁻¹	950 km.s ⁻¹	500 km.s ⁻¹
Companion wind terminal velocity	3200 km.s ⁻¹	1600 km.s ⁻¹	800 km.s ⁻¹	3000 km.s ⁻¹
Wolf-Rayet mass loss rate	4.3 x 10 ⁻⁵ solar masses.year ⁻¹	4 x 10 ⁻⁵ solar masses.year ⁻¹	2.5 x 10 ⁻⁵ solar masses.year ⁻¹	2.5 x 10 ⁻⁴ solar masses.year ⁻¹
Companion mass loss rate	8.7 x 10 ⁻⁶ solar masses.year ⁻¹	8 x 10 ⁻⁶ solar masses.year ⁻¹	4 x 10 ⁻⁷ solar masses.year ⁻¹	1.0 x 10 ⁻⁵ solar masses.year ⁻¹

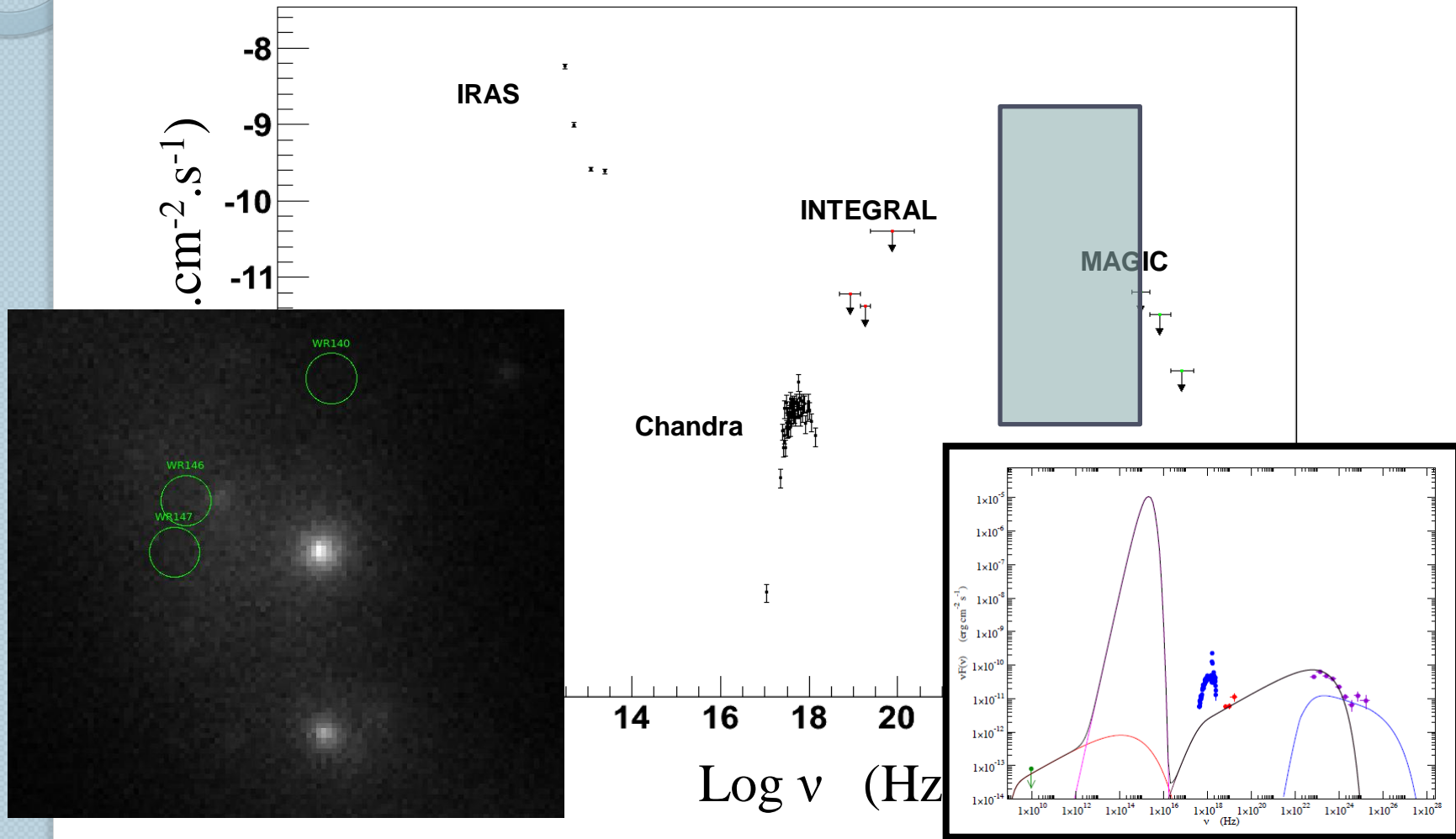
WR146 spectral energy distribution



WR146 spectral energy distribution

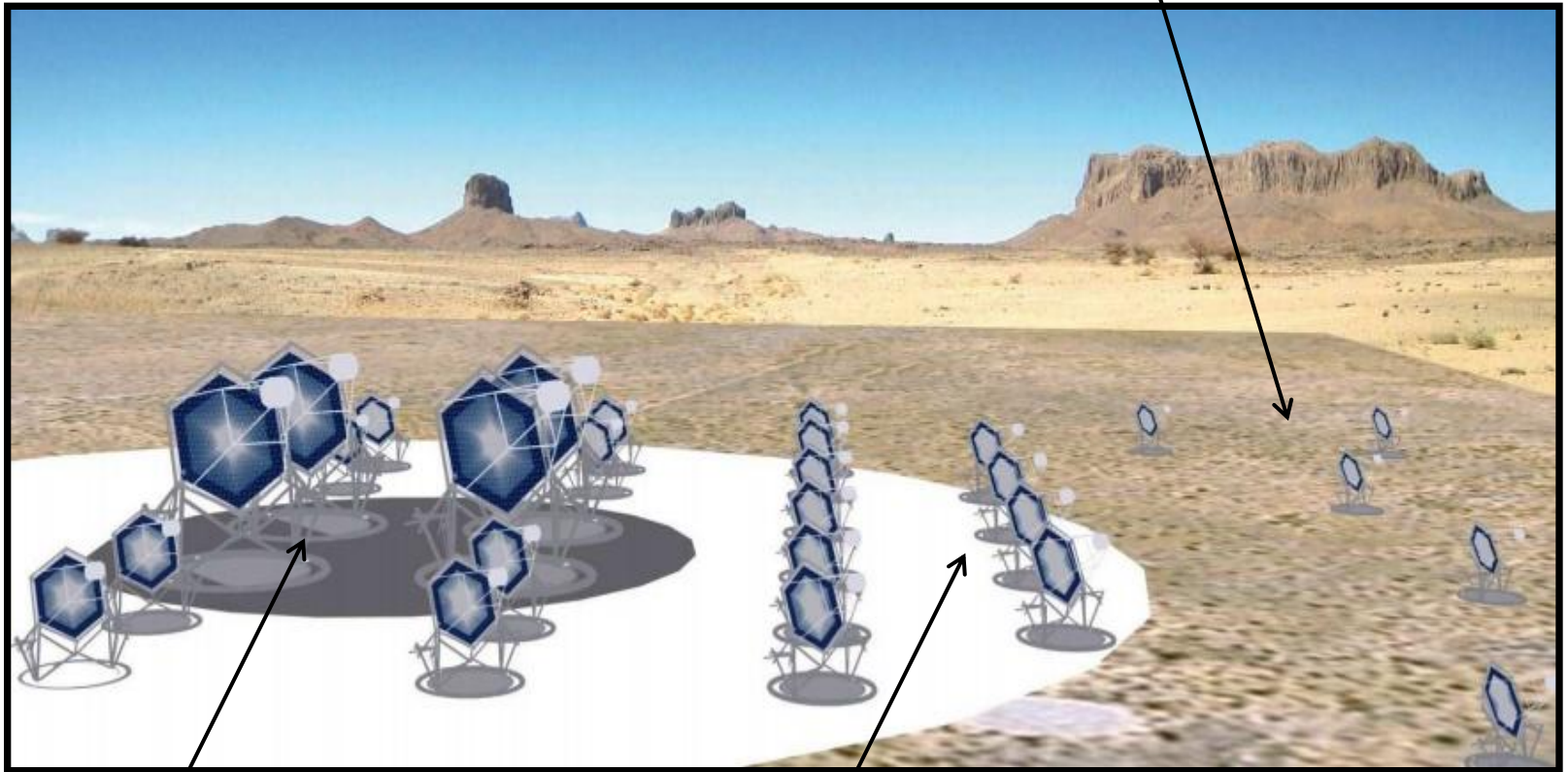


WR146 spectral energy distribution



CTA telescopes

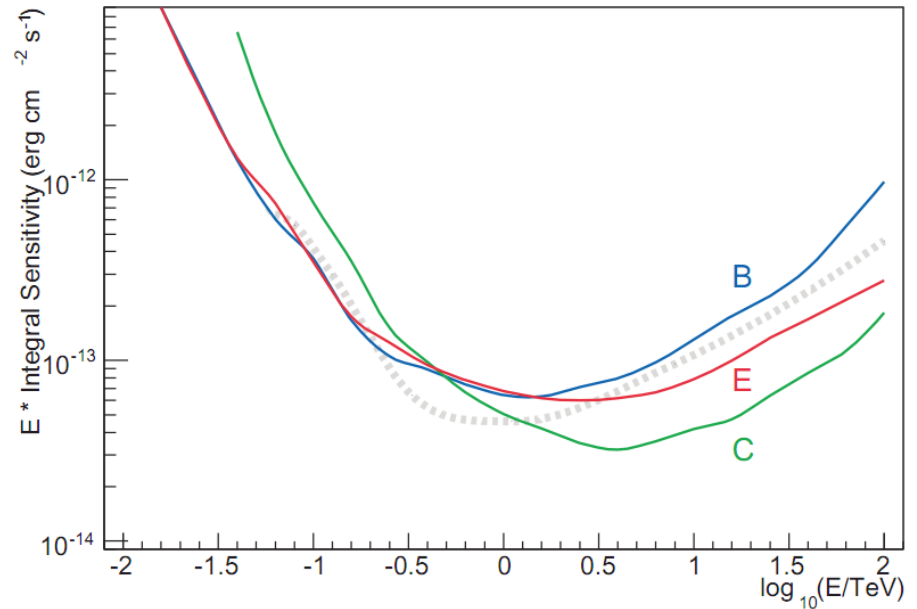
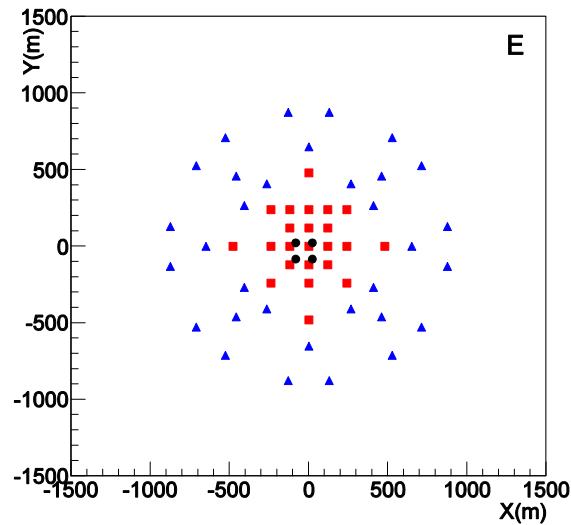
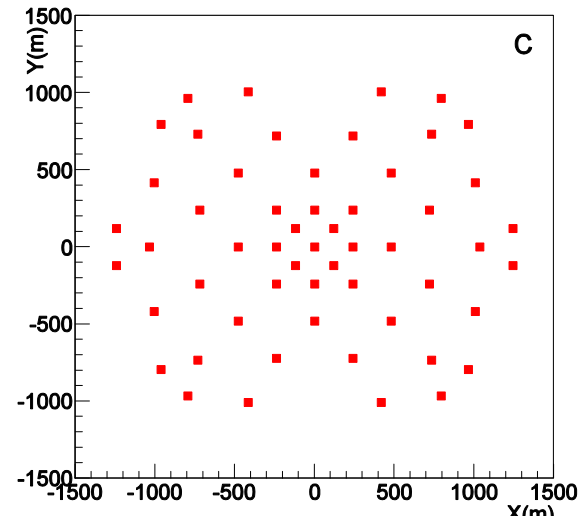
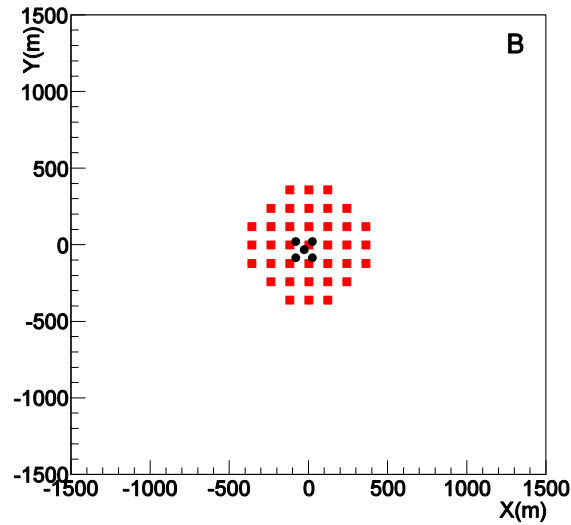
High-energy section:
10 km² area at multi TeV
energies



Low-energy section:
Energy threshold of
some 10 GeV

Core-energy array:
mCrab sensitivity in the
100 GeV – 10 TeV
domain

Telescope layouts



Summary:

- Non-thermal emission can be seen in CWB systems
- Eta Carinae shows that this emission can extend into the gamma ray regime
- Performance of CTA will hopefully reveal the VHE emission of other similar CWB systems
- Optimum observing strategy can be deduced