# H.E.S.S. Stellar Working Group Priorities / Scientific Goals

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# **Working Group Activities**

### **Stellar Working Group**

#### This group is focused in the physics of the following objects:

- Pulsed emission in pulsars
- Binaries and periodic variations
- Massive, luminous stars
- Stellar clusters
- long-term evolution of SN, Novae

#### **Current Observation Proposals in the context of science goals**

PHYS / Observations	Vela	J1706	LMC	SNR 1987A	GC	J0632	J1832	Eta Carina	LS 5039	47 Tuc	J1311 J1723	MAXI J1820	ToO Binaries	ASKAP
Variability in the GC					x									x
A nearby GPS (LMC)			x	x										x
Isolated Compact Objects	x	x			x									
Compact Binary Systems										x	x	x	x	
Massive binaries						x	x	x	x				x	

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## **Projects: PeV emission related to Unidentified Sources & Binary systems**

#### **Scientific Framework:**

New instruments such HAWC or LHAASO are opening the >100 TeV regime. HESS, with its superior angular and energy resolution, should be able to put strong constrains in the 10-100 TeV regime, crucial to understand the results showed by the particle detectors.

#### **Science Topics:**

#### 1/ PeVatrons in disguise: Unidentified sources at VHE

The standard paradigm of CRs locates the origin of the CRs sea observed from a few hundreds of MeV to PeV in our Galaxy. The origin of these CRs has been attributed traditionally to SNRs, but recently several other stellar objects have been proposed. We aim to understand the VHE emission (>10 TeV) of the brightest unidentified sources on the HGPS to pinpoint common characteristics and the possible contribution on the PeV CRs distribution.

#### **Observation signatures / Other Experiments:**

Bright sources – extending to >10 TeV without cutoff. It is important to obtain results on the next months, before the new experiments data (LHAASO, etc) are released.

#### New observations: None

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## **Projects: PeV emission related to Unidentified Sources & Binary systems**

#### **Science Topics:**

#### 2/ Extreme accelerators: The spectrum of gamma-ray binaries from few GeV to >10 TeV

The spectrum of several binary systems have been found to be extended to VHE, above the limits one would expect due to the K-N regime. These can be attributed to an extreme efficiency accelerator or to several regions involved in the gamma-ray regime. We aim to understand common features of the spectra of these binaries, modelling it to constrain the binary system parameters.

#### **Observation signatures / Other Experiments:**

Periodic Emission / Flares. Binaries are in general bright objects for HESS, comparable to results achievable with CTA for selected objects. Good projects to collaborate with other experiments.

**Observations**: Data archive + New binaries.

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### **Projects: Pulsars as multi-TeV emitters**

#### **Scientific Framework:**

The detection of Vela with a hard 1.4 spectrum up to 20 TeV opens a complete new window for Pulsar astronomy in the VHE. Beyond this, the detection of the hardest source in TeV (from the GeV softest population) opens new physics to explore.

#### **Observation signatures / Other Experiments:**

Periodic Emission. Vela is unique and still lots of physics to dig in. Detection of other PSRs might be costly, when comparing with CTA sensitivity, but we can pave the way.

#### **Science Topics:**

#### 1/ Deep Observations of Vela Pulsar

Produced by the highest-energy particles, VHE gamma rays which are beyond the reach of satellites, are valuable tools for testing acceleration and emission processes in their extreme energy limit probing emission regions in PSRs. These observations have implications in all the pulsar studies field and might change the stablished theories.

#### Observations: 60h x 3 seasons

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### **Projects: Pulsars as multi-TeV emitters**

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#### **Science Topics:**

#### 2/ Is Vela unique?

With its optimal sensitivity above 1 TeV the HESS GPS data set provides a good data sample to look for hints of multi-TeV pulsed emission. If find it, we should aim to increase the population of multi-TeV PSRs.

**Observations**: GPS + follow-up/

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### **Projects: Extreme Compact Objects**

#### **Scientific Framework:**

Detection of new TeV source class, including LXRB, novae, Black widows and other spiders.

#### **Observation signatures / Other Experiments:**

Periodic Emission / Flares. HESS 2 sensitivity is only a few factors worse than CTA, and much better than LAT. Exploring the short-term variable sub-100 GeV sky.

#### **Science Topics:**

#### 1/ Plasma physics in extreme environments

HE observations have revealed a new plethora of new phenomena, related to compact objects. HESS observations would determine not only the maximum energies to which objects are able to accelerate particles but also the nature of these radiation, which is currently unknown in many cases (related to GPS varibbility)

**Observations**: Upcoming observation campaigns.

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### **Projects: TeV emission from SFR**

#### **Scientific Framework:**

Probing CRs acceleration in SFRs

#### **Observation signatures / Other Experiments:**

Large emission halos might be challenging for HESS in comparison with other particles detectors (and CTA). Exploring new analysis techniques can help (see Wd1 and GalCenter diffuse).

#### **Science Topics:**

#### 1/ The Quest of GCRs

Massive stars isolated and in binary systems can accelerate particles to VHE, by the collective effect of their winds. Open clusters such Westerlund 1 and Westerlund 2 can potentially explain a large fraction of the CR sea we observe, and systems like Eta Carina have been probed to effectively accelerate particles to VHE.

**Observations**: Upcoming observation campaigns and old data (apply very large sources techniques).