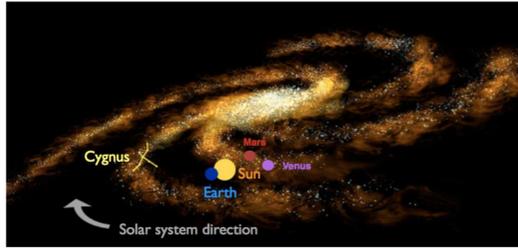
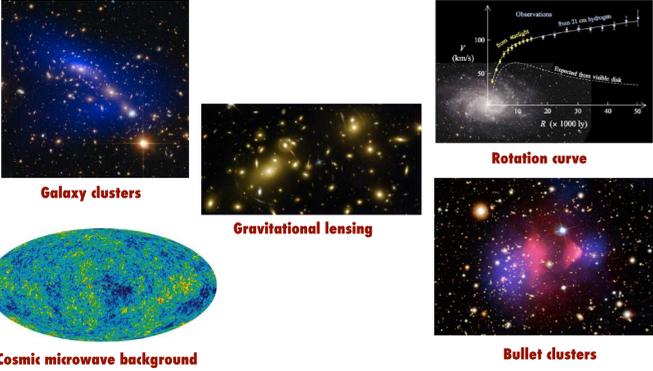


Directional Dark Matter Search

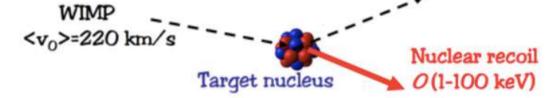
with high-precision gaseous Time Projection Chamber

These available in: simulation, data analysis and detector development for **UNDER** and **CYGNUS-RD**

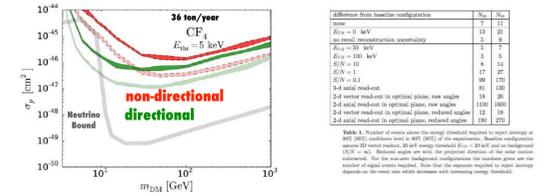
Dark Matter is an established yet still mysterious paradigm



Nuclear recoil direction encodes WIMP wind modulation



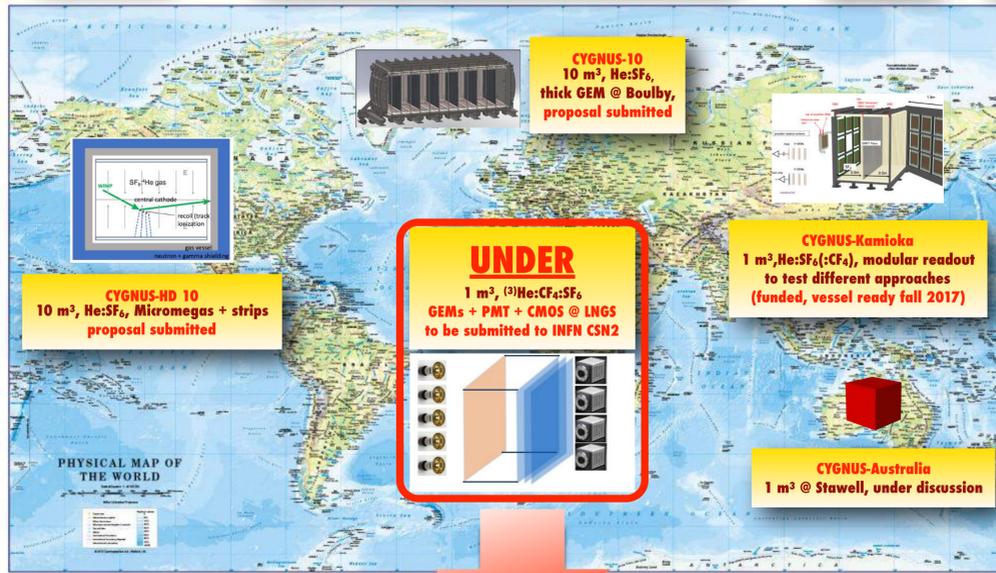
Directional Dark Matter search can provide an unambiguous positive identification of signal even in presence of unknown amount of backgrounds



The CYGNUS project

CYGNUS key concepts

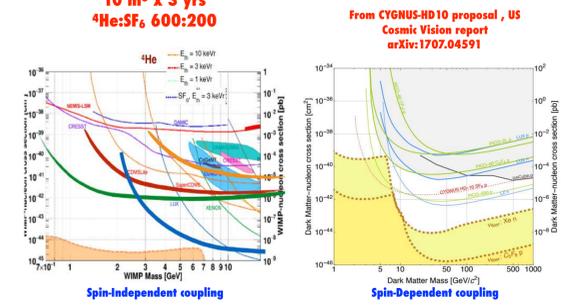
- Galactic Directional Recoil Observatory at the ton scale for directional DM search and neutrino physics
- Gaseous TPC in multiple underground sites
- Negative ion drift in He for reduced diffusion and fiducialization
- Goal of zero background operation after electron/gamma rejection and fiducialization
- Directional and gamma/electron rejection thresholds at 0(keV)



Competitive with non-directional approaches in the low mass WIMP region

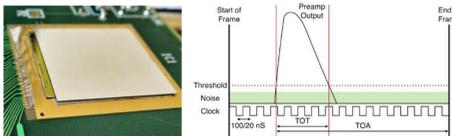
90% C.L. upper limit no background
10 m³ x 3 yrs
4He:SF₆ 600:200

PRELIMINARY



Charge readout

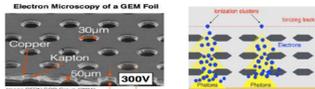
Timepix: 55 x 55 um² pixels with TOA, TOT or counting mode



3D reconstruction via TOA in each pixel

CYGNUS-RD funded by INFN CSN5

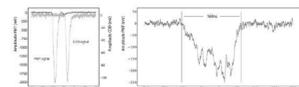
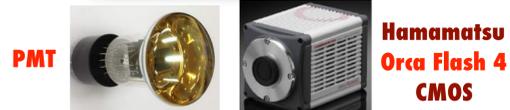
R&D for the development of a high resolution TPC for rare events search with GEMs amplification and pixel (charge or light) readout and innovative gas mixtures with negative ion drift



High gain, high stability, high granularity

Both electrons and photon are produced in the amplification avalanche

Light readout



Light time profile



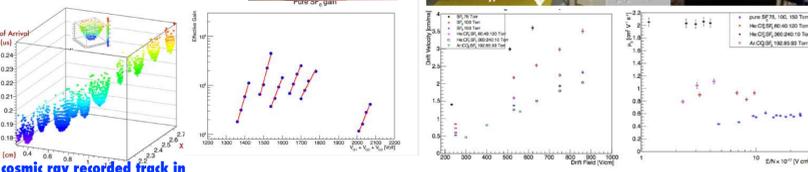
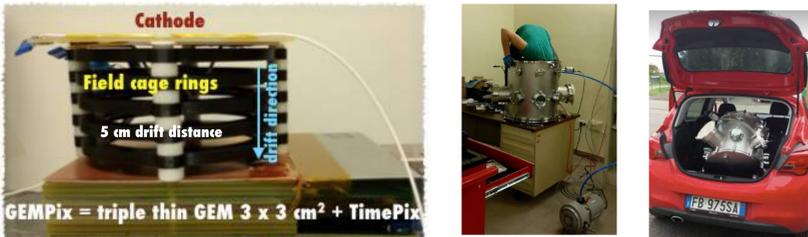
2D x-y projection

3D reconstruction combining the two

This project has been funded by the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 657751

NITEC: Negative Ion Time Expansion Chamber

Test of innovative negative ion drift gas mixtures based on SF₆ at nearly 1 bar



G. Cavoto et al., Eur. Phys. J C 76 no.6, 349

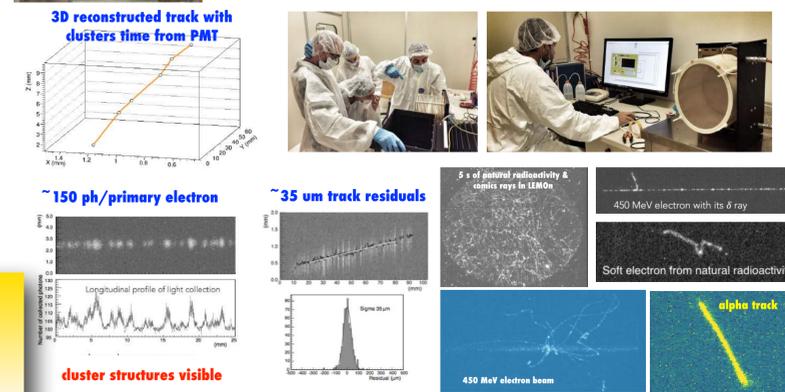
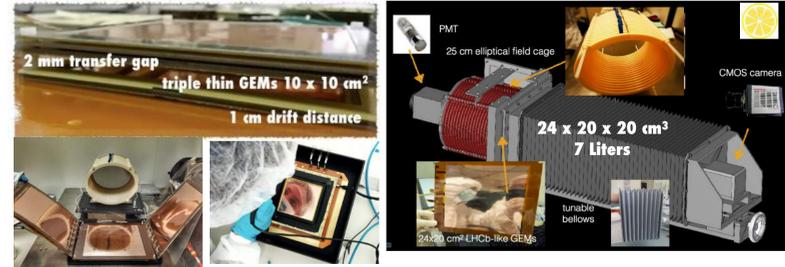
V.C. Antochi et. al, arXiv:1707.02549

E. Baracchini et al arXiv:1710.01994

ORANGE: Optically Readout GEM

LEMON: Large Elliptical Module Optically readout

Test of combined PMT (t,z,E) and CMOS (x,y, dE/dx,E) readout



M. Marafini et al., JINST 10, P12010 (2005)

M. Marafini et al., NIM A 824 (2016) 562

D. Pinci et al., PoS(EPS-HEP2017)077

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- G. Mazzitelli, S. Tomassini (INFN LNF)
- G. Cavoto, E. Di Marco, D. Pinci, F. Renga, C. Voena (INFN Roma 1)
- M. Marafini (Centro Fermi)

Find us on the web!
<https://web.infn.it/cygnus>
#socialdetector #infn