

## Dark Matter Phenomenology

### Dark matter halo

Milky Way surrounded by dark matter halo

→ Highest DM density expected towards the Galactic Centre

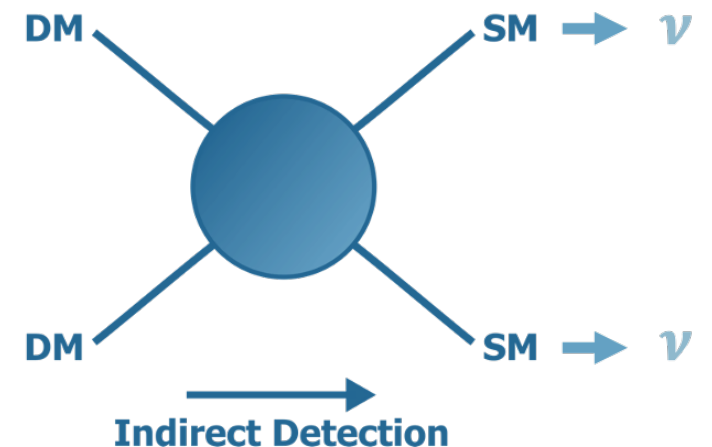
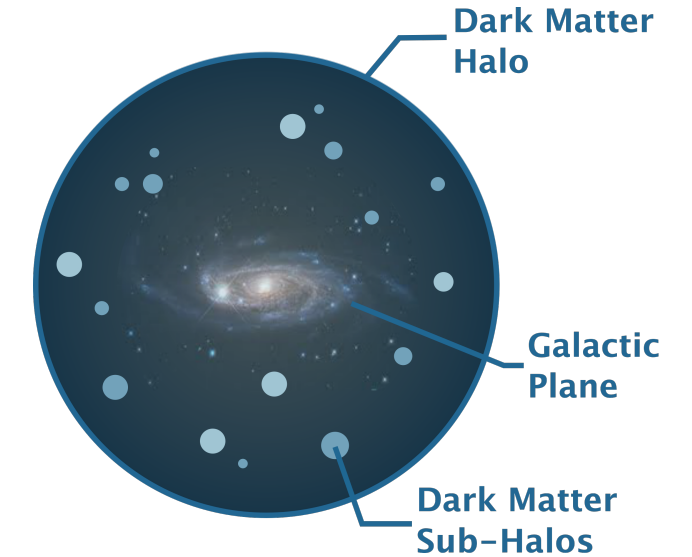
### Indirect search

SM particles are expected to be produced by DM decay or annihilation

→ Look for **neutrinos** produced by **DM annihilation** in the centre of the **Milky Way** with **IceCube**

**Expected neutrino flux** from DM annihilation in the GC:

$$\frac{d\phi_\nu}{dE_\nu} = \frac{1}{2} \frac{\langle \sigma_{AV} \rangle}{4\pi m_{\text{DM}}^2} \frac{dN_\nu}{dE_\nu} \int_0^{\Delta\Omega} d\Omega \int_{l.o.s} \rho_{\text{DM}}^2(r(\Psi, l)) dl \quad [1]$$



## Background and Signal Expectations

Event selection consists of **8.03 years of DeepCore data** recorded from 2012 to 2020

Use **3-dimensional PDFs** with the

- Opening angle to the GC:  $\Psi_{reco}$
- Energy:  $E_{reco}$
- Neutrino flavour: **PID**

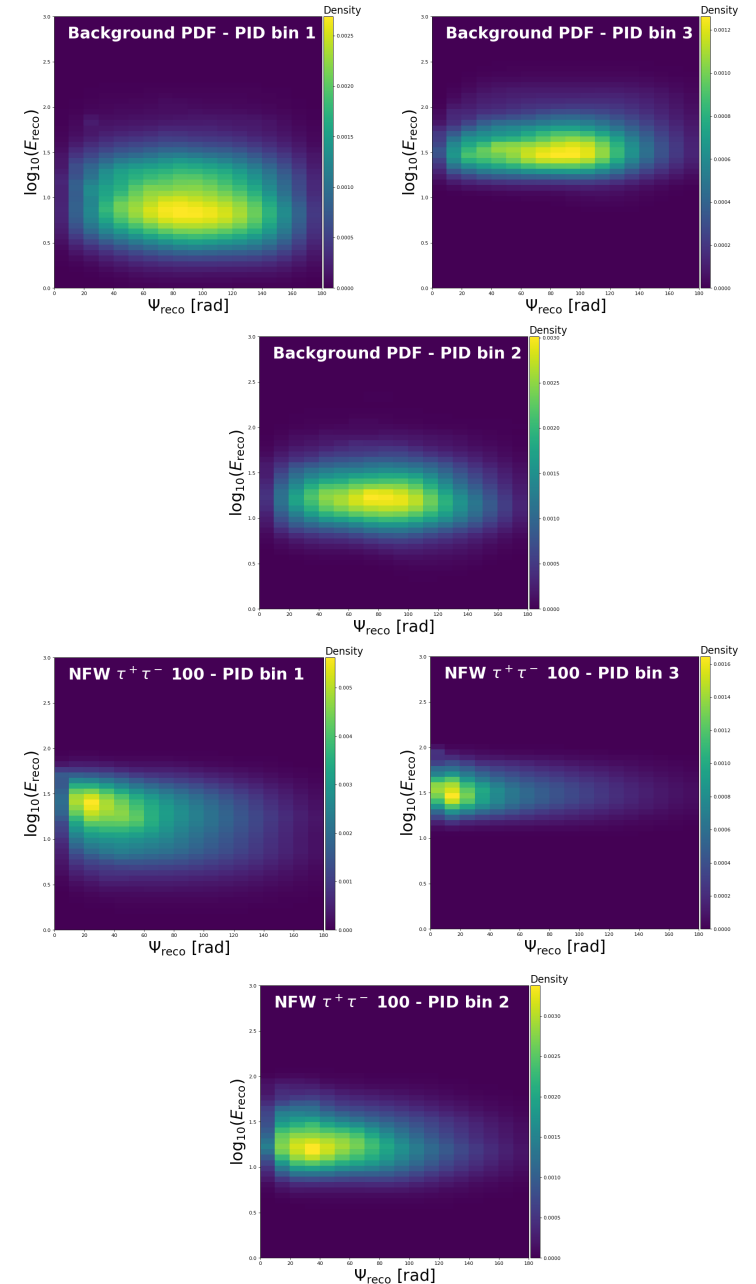
### Background PDF

Monte Carlo (MC) simulations weighted according to the **expected atmospheric flux**

### Signal PDFs

Generic MC weighted **source morphology** and **annihilation spectra** according to Eq. 1 where:

- **DM halo profile:** NFW and Burkert
- **DM annihilation channel:**  $W^+W^-$ ,  $b\bar{b}$ ,  $\nu_i\bar{\nu}_i$ ,  $\tau^+\tau^-$ ,  $\mu^+\mu^-$
- **DM mass:** 5 GeV to 1 TeV



Background PDF

Signal PDF NFW  $\tau^+\tau^-$  100 GeV

## Sensitivities

**Binned likelihood method** method assuming the likelihood function:

$$\mathcal{L}(\mu) = \prod_{i=\min}^{\max} \frac{(n_{obs}^{tot} f^i(\mu))^{n_{obs}^i} e^{-n_{obs}^{tot} f^i(\mu)}}{n_{obs}^i!} f^i(\mu), \quad [2]$$

where

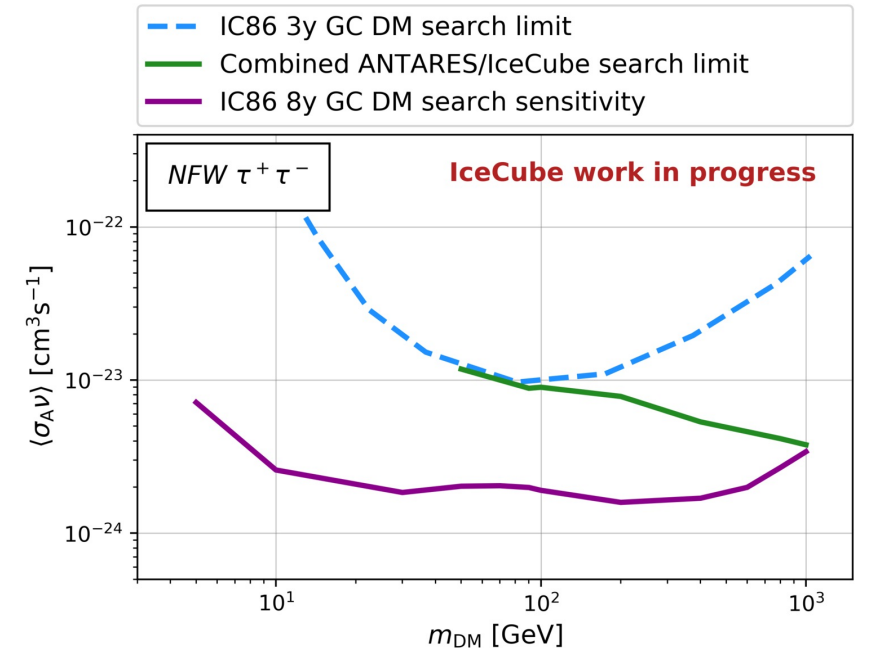
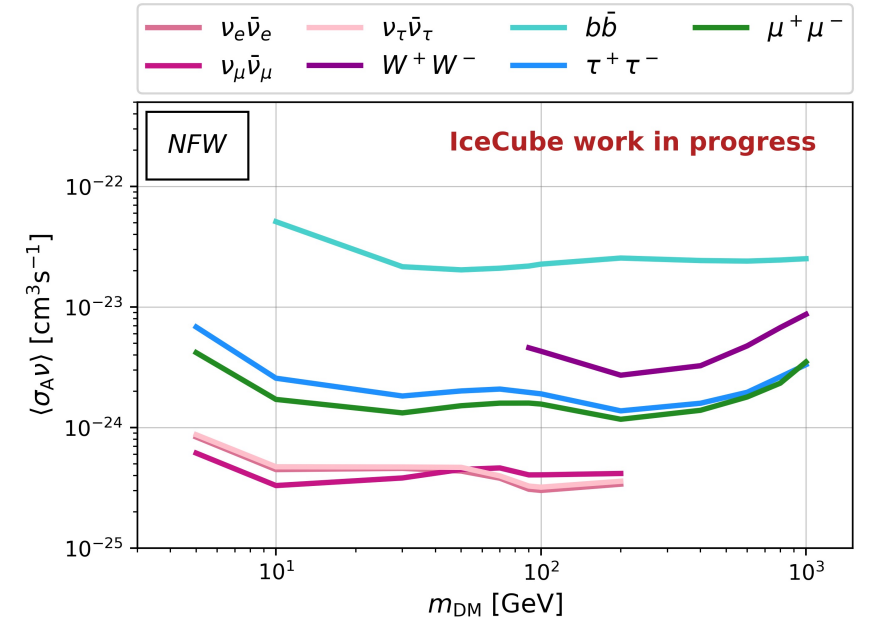
$$f(i; \mu) = \mu f_s(i) + (1 - \mu) f_{BG}(i), \quad [3]$$

**Upper limit** on signal fraction at 90% CL,  $\mu_{90}$ , computed according to the **likelihood interval method**

**Sensitivity** defined as median value of the 90%CL upper limits obtained for 100,000 **pseudo-experiments** sampled from the **background-only PDF**

Sensitivities show **considerable improvement** with respect to:

- IC86 3y GCWIMP search [1]
- Combined ANTARES/IceCube search [2]



## Conclusion

- Computed **sensitivities on  $\langle\sigma_A\nu\rangle$**  for a dark matter search in the Galactic Centre with 8 years of IceCube data
- Sensitivities show **considerable improvements** with respect to previous IceCube results
- Improvement of the sensitivities due to:
  - Data set: **more years** of data and **enhanced event selection**
  - Additional information in PDFs:  
**Energy** and **flavour information**

## Outlooks

- The final official results should soon be available
- If no signal neutrinos were to be found, limits on  $\langle\sigma_A\nu\rangle$  will be computed