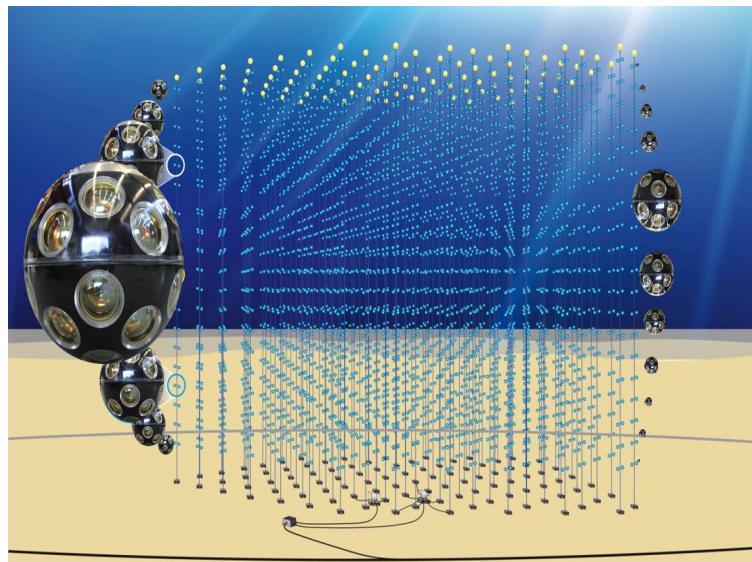
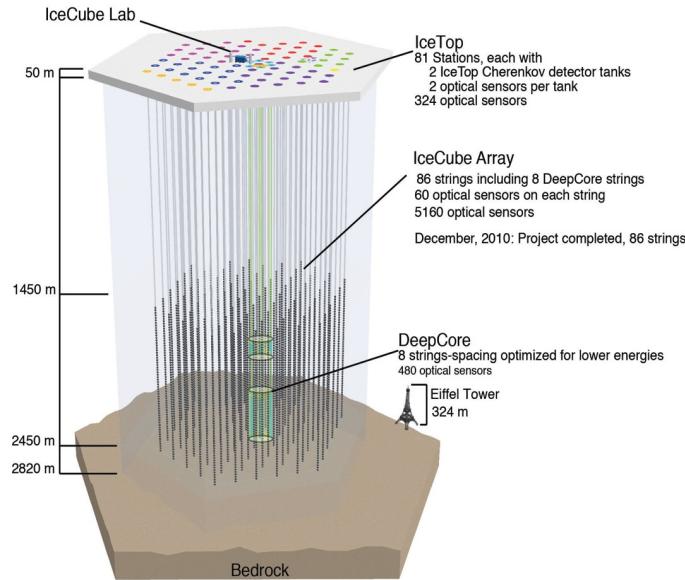


# Contre-parties optiques de neutrinos

D. Dornic (CPPM-Marseille)

# 2020: Context of the neutrino detection



## South Pole 2<sup>nd</sup> generation IceCube

construction: dec 2004 – dec 2010  
86 lines \* 60 DOM

Proposition to extend IC (2020?)

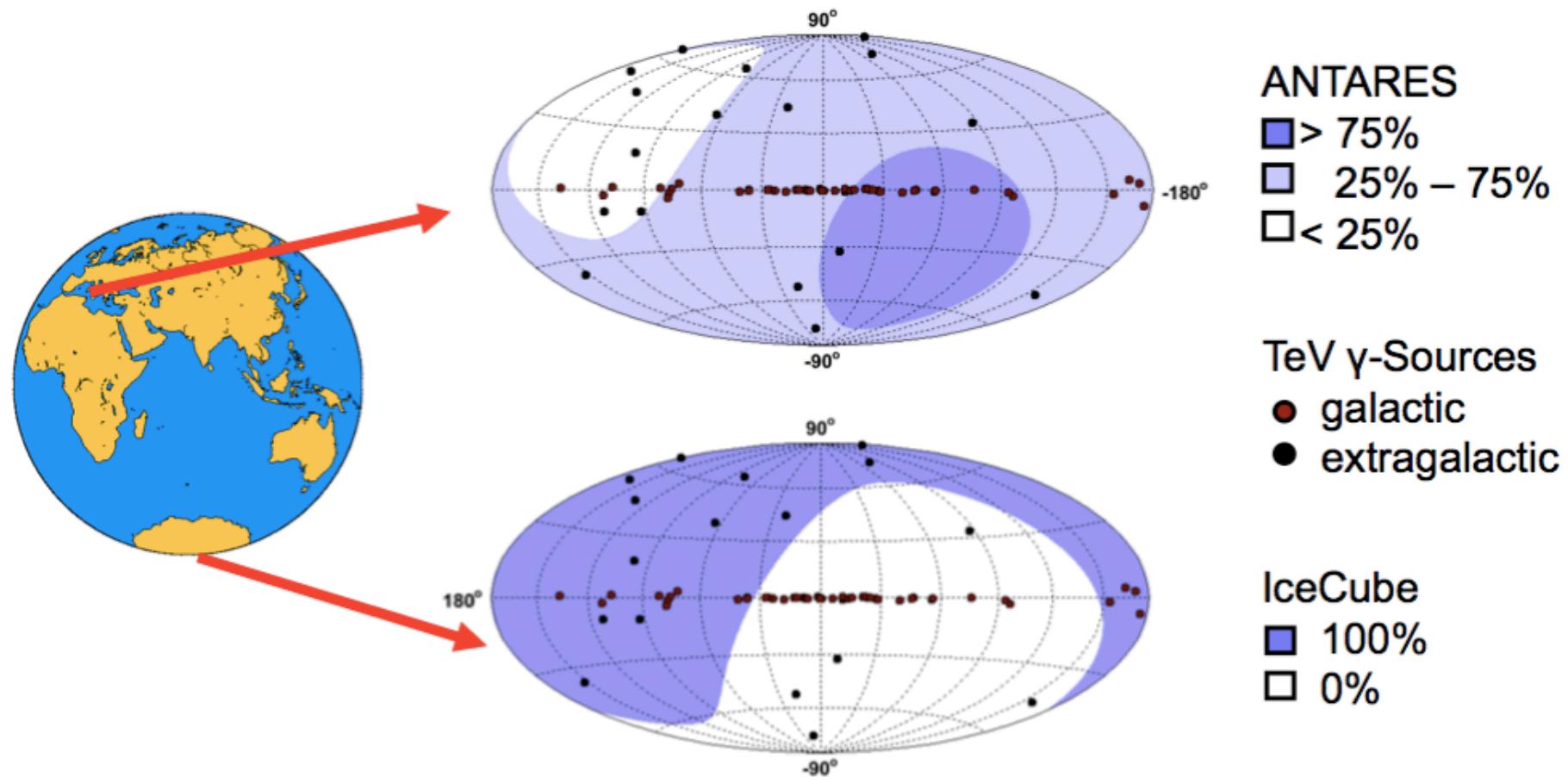
## Mediterranean sea:

**Antares:** 2007-2016(7) – data taking and analysis on going

**KM3NeT:** deployed on 2 sites (It + Fr)

phase 1: ~30 lines (2014-2016 funded)  
phase 1.5: 2 x 120 lines (2020 ?)  
phase 2: 6 x 120 lines

# 2020: Context of the neutrino detection



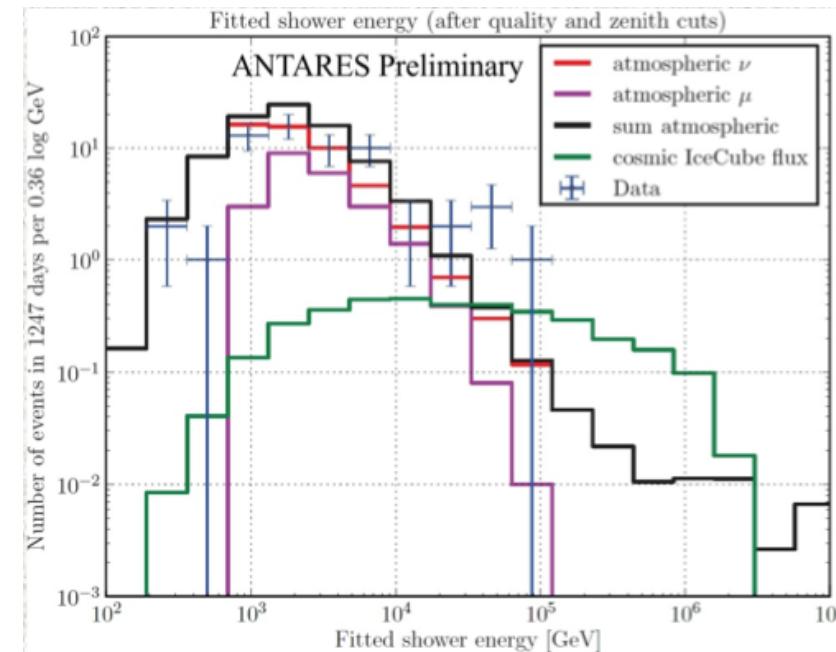
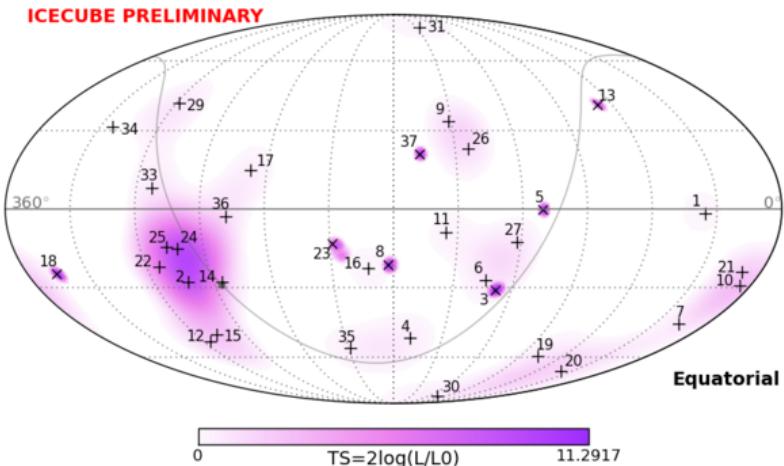
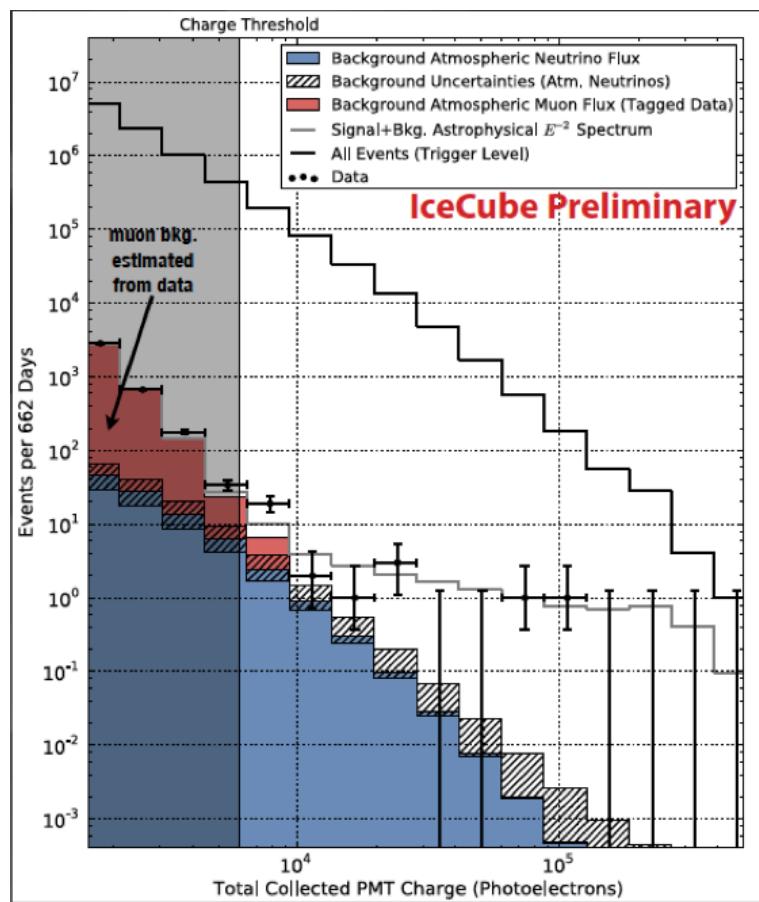
# 2020: Context of the neutrino detection

**Cosmic neutrino:** the signal seen by IceCube

2010-2013 as diffuse fixes the scale

=> 37 events for 15 expected for background

=> dominated by shower (poor resolution)



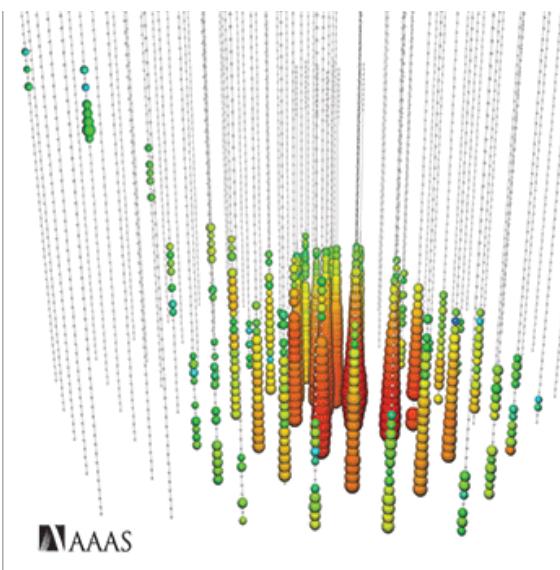
Antares not so far...

# Transient sources detection

Telescopes provide alerts (opt/radio/X-ray/gamma)

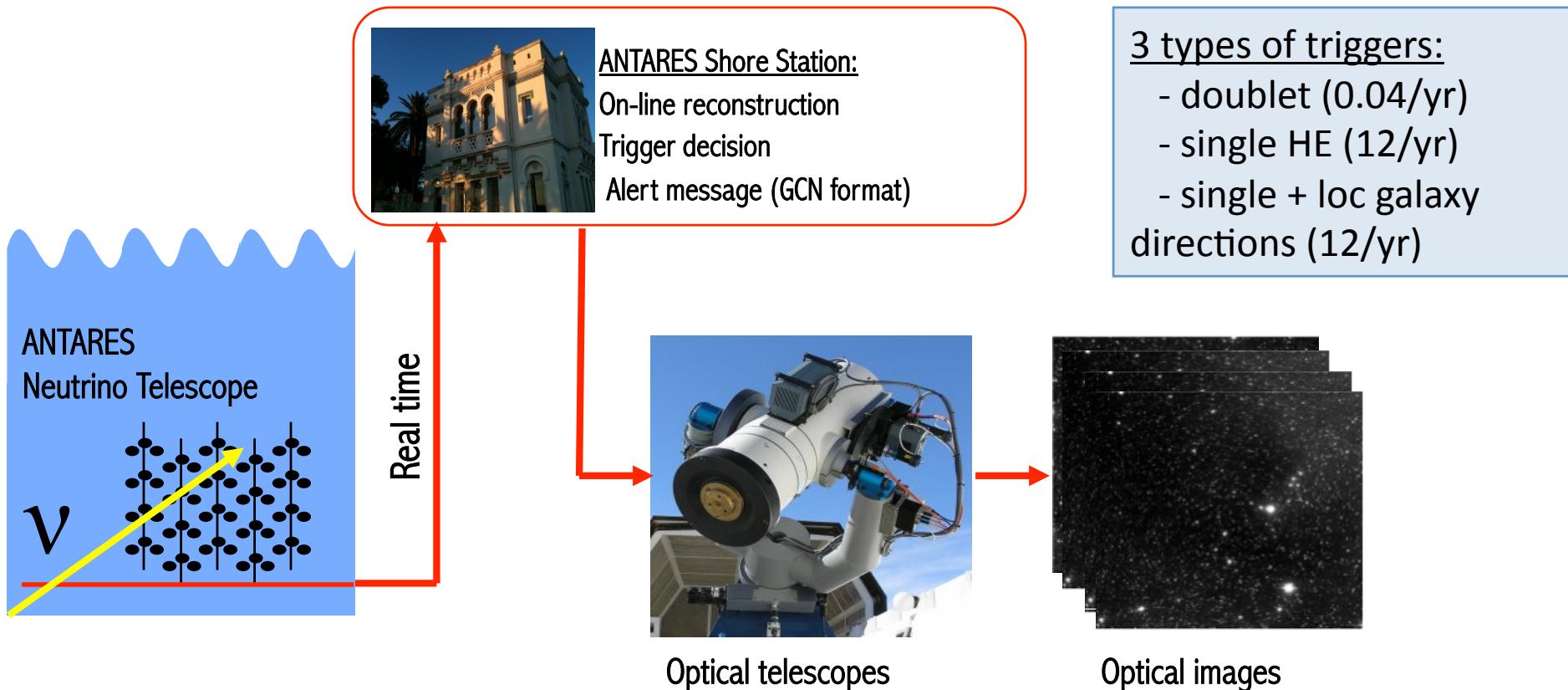
Examples: GRB, X-ray binaries, blazars, SN Ib,c

Analysis neutrino: offline / real-time



Neutrino telescopes provide neutrino alerts to the community  
Analysis online

# ANTARES: follow-up program



## Avantages:

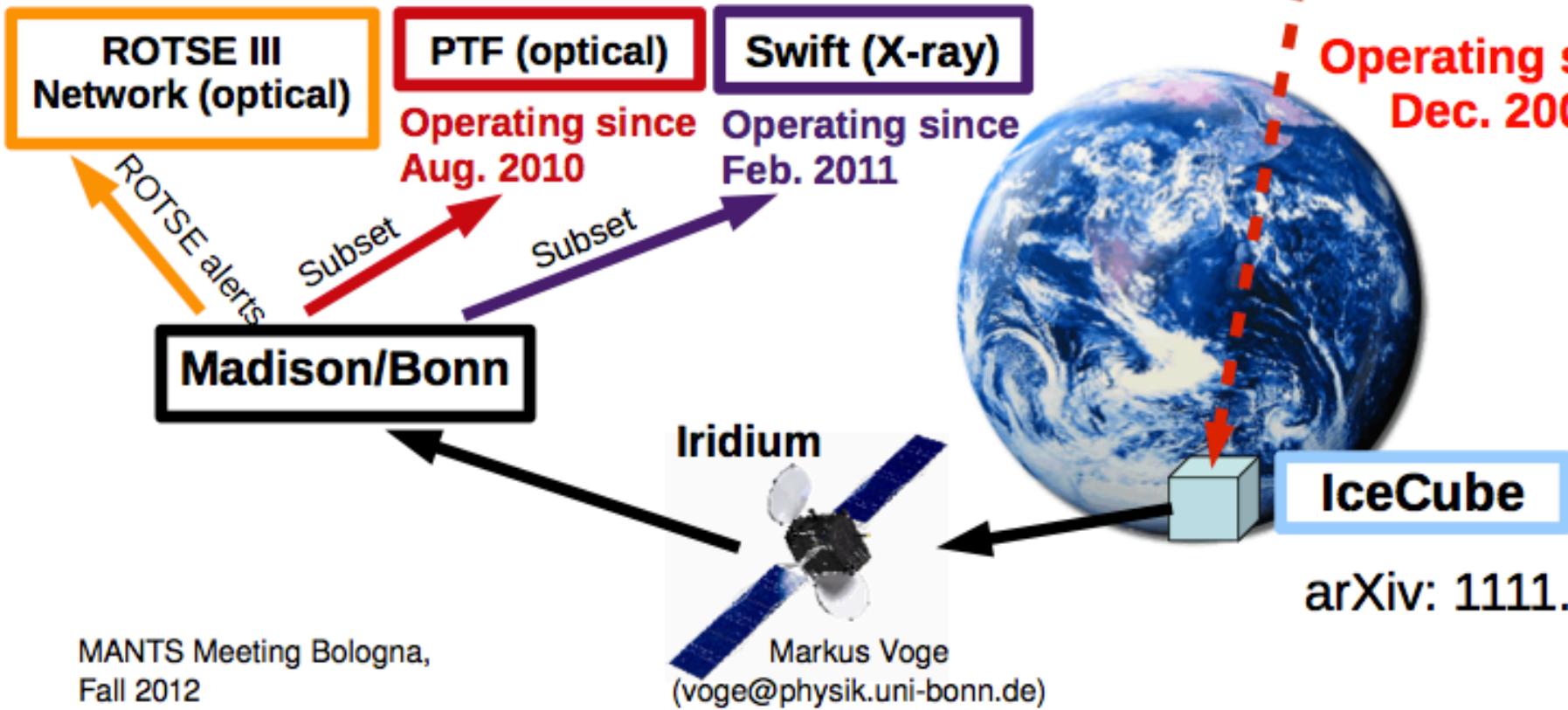
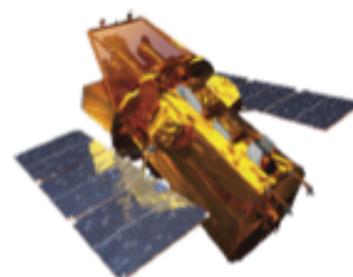
$\left\{ \begin{array}{l} \text{Sky coverage } (>2\pi \text{ sr}) + \text{high duty cycle} \\ \text{Very good sensitivity (1 neutrino could yield to a discovery !!!)} \\ \text{No hypothesis on the nature of the source} \end{array} \right.$

## Performances:

$\left\{ \begin{array}{l} \text{Send alerts in } \sim 10\text{s with a precision of } 0.4\text{-}0.5\text{deg} \\ \text{Alerts sent to TAROT, ROTSE, ZADKO, SWIFT/XRT} \end{array} \right.$

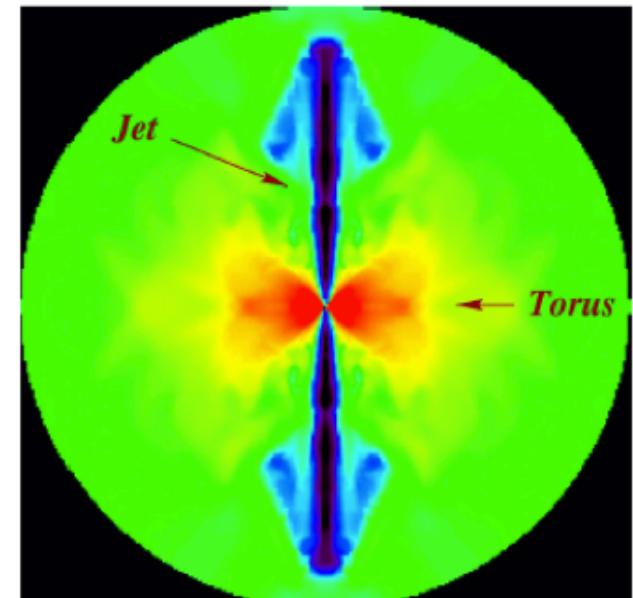
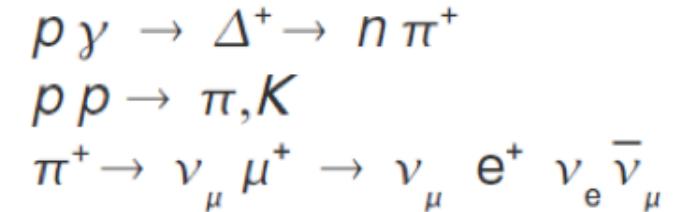
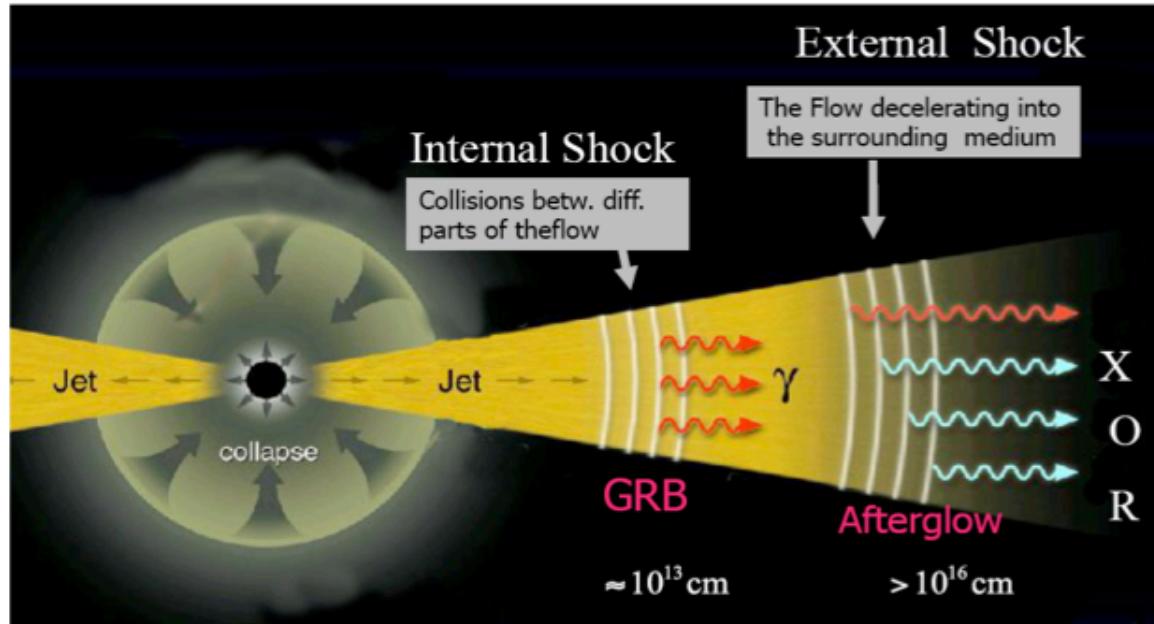
3 types of triggers:  
- doublet (0.04/yr)  
- single HE (12/yr)  
- single + loc galaxy directions (12/yr)

# Follow-up program of IceCube



Main targets: GRB, SN...

**GRB neutrinos**: relativistic jets (Fireball model) => 10 TeV–10 PeV neutrino  
Meszaros & Rees, Waxman

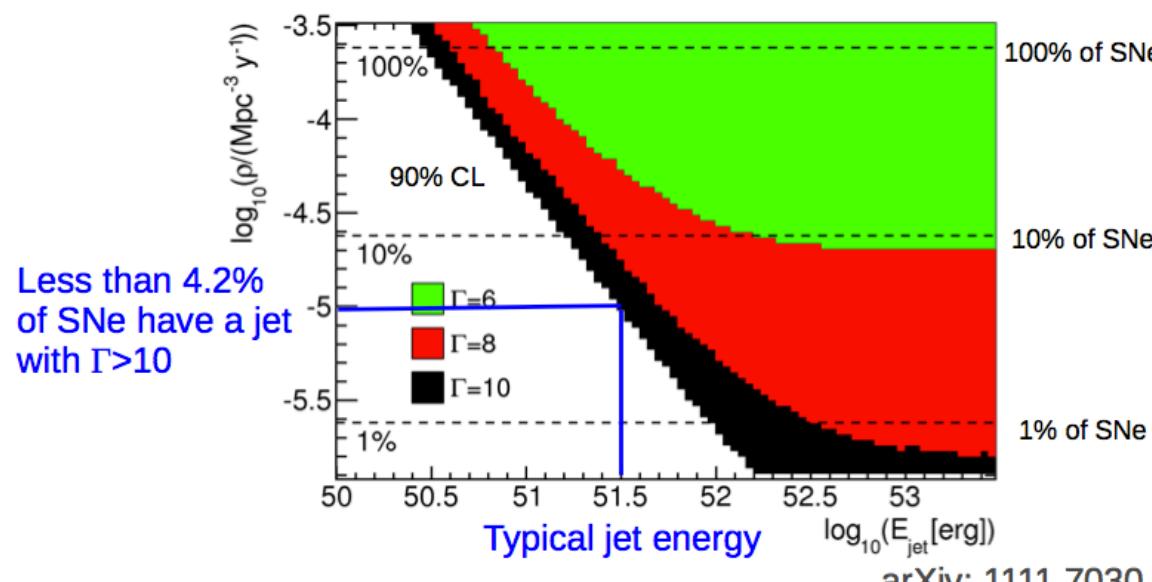
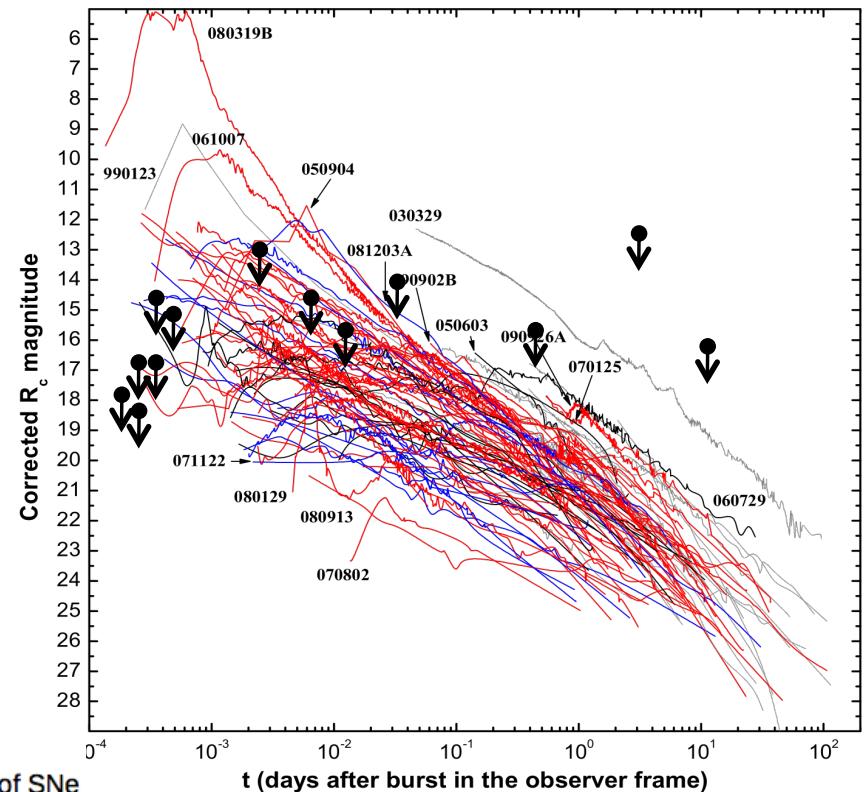


**SN neutrinos**: connection GRB-SN  
(choked jet, mildly relativistic)  
=> 100 GeV-10 TeV neutrino  
Razzaque & al., Ando & Beacom

## Some results

ANTARES:

- Prompt data analysis 2009-2013 to search for fast transient



Limit on choked jet SN model, Ando & Beacom (2005)

IceCube:

- Data analysis 2009-2011 to look for core-collapse SN

## Perspectives

### First neutrino signal (diffuse flux)

⇒ no source identified

⇒ To detect first source => transient source

⇒ 2 ways: triggered : access to catalogues ?

alerts : access to time (or real time catalogue)

Remark: it is more easy for us to identify cosmic electron neutrino: poor resolution from the background compare to muon track.