Challenges

Background is not a serious concern for a SN neutrino burst (event duration <10s):
(i) Natural Radioactivity (~10% above 0.7 MeV), (ii) Cosmogenics (~3 Hz muon rate), (iii) Reactor Neutrinos (0.1 Bq in 100), (iv) Geoneutrinos (0.002 Bq in 100)

Main issue is represented by DAQ

Handle huge number of overlapping events
Baseline rate (based on MH determination): ~10 Hz
Depending on SN distance, several scenarios occur:
Typical SN is around 10 kpc (bottom plot)
JUNO must handle Betelgeuse (top plot):
best for physics, worst for DAQ (5-100 MHz)
Currently investigating trigger and reconstruction improvements when using 3 PMT's

Why
Earth's surface heat flow has been established to be 46±3 TW, but the community is still debating what fraction of this power comes from primordial vs radioactive sources. Such debate revolves around the understanding of:
- the composition of the Earth (namely of the chondritic meteorites that formed our Planet)
- the chemical layering in the mantle and the nature of mantle convection
- the energy needed to drive plate tectonics

What
Detect electron antineutrinos from the 3(13+7) and 2(7) decay chains via inverse beta decay

Challenges

Reduce the shape uncertainty in the low energy part of the reactor ν spectrum
Disentangle the mantle from the crust contribution
Needed for geological, geochemical and geophysical surveys of the area surrounding JUNO

Why

What

20 k Liquid Scintillator (LAB) in Acrylic Sphere
18000 20 PmTs
75-80% coverage
3% vs Energy Resolution
Additional 3500 3' PmTs
Still under consideration to Improve Systematics

Water Buffer
Mogose Port radiative
Suppress Fast Neutrons
Water Cherenkov (µ veto)
2000 PmTs
Top Tracker (µ veto)
700 m Overburden

Main Experimental Goal
Determine Neutrino Mass Hierarchy via disappearance of reactor νe (see Wei-Wang’s poster)
Location optimized accordingly (53m from nuclear power plants)

More Information + References + Plot Credits:
The JUNO Collaboration, “Neutrino Physics with JUNO”
aXiv: 150705613

UNDERSTANDING OUR PLANET: GEONEUTRONS

The Sun is a powerful source of electron neutrinos with Q1 (1 MeV) energy produced in the thermonuclear fusion reactions in the solar core. The JUNO solar neutrino program focuses on those emitted in the 7Be and 8B chains.

Why

MSDW effect: propagation of neutrinos through matter behaves differently than in vacuum. Such effect is energy dependent (being almost negligible for low-E neutrinos). The transition between the two regimes should be in the 1-3 MeV range. Super-K recently reported a mild evidence for such an up-turn in the spectrum, but a high-significance test is required to confirm the consistency of the LMA-MSW solution.

Solar metallicity problem: former agreement between Standard Solar Model and solar data has been compromised by the revision of solar surface heavy element content. Different abundances result in different neutrino fluxes that can be used to constrain the model.

How

High precision measurement of the 7Be and 8B ν flux
Detailed analysis of the low-energy part of the 8B ν spectrum
Study of the day-night asymmetry in the 8B ν rate

What

Solar neutrinos are detected via elastic scattering on electrons (single flash of light)

High radiopurity is a must for solar ν
1) Baseline: S=1.13 (KamLAND solar phase)
2) Ideal: S=1.0 (Betelgeuse phase 1)
Even baseline is very hard with 20k LS
Requirements for PH are worse than baseline
- External ν removed via fiducial volume
- Alpha decays tagged via pulse shape
- Only β and γ decays considered in table
- Reactor ν interacting via ES is a negligible (and well measured) background

3Be: only detectable signal in case of baseline radiopurity

Long-lived spallation radioisotopes are hard to veto (without introducing large dead-time). Tagged via 3-fold coincidence (muons + anti-neutrino decay) and subtracted statistically

Why

How

What