External Trigger (S)News

LSC 2001 August Meeting

LIGO Hanford Observatory

Szabolcs Márka

and the the External Triggers Group

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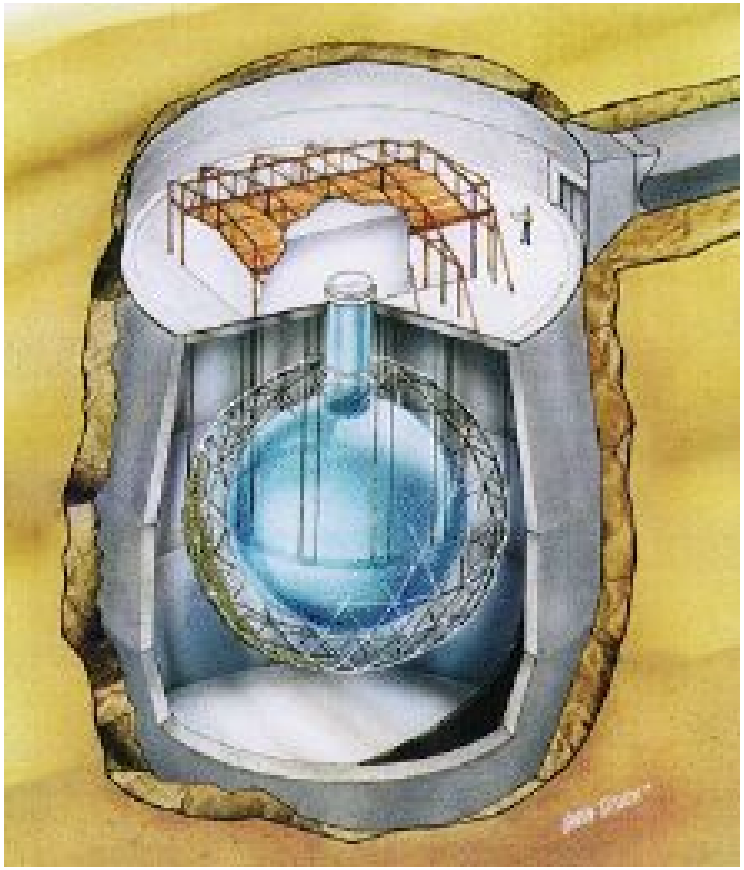
(Practical) SNEWS

NEWS!

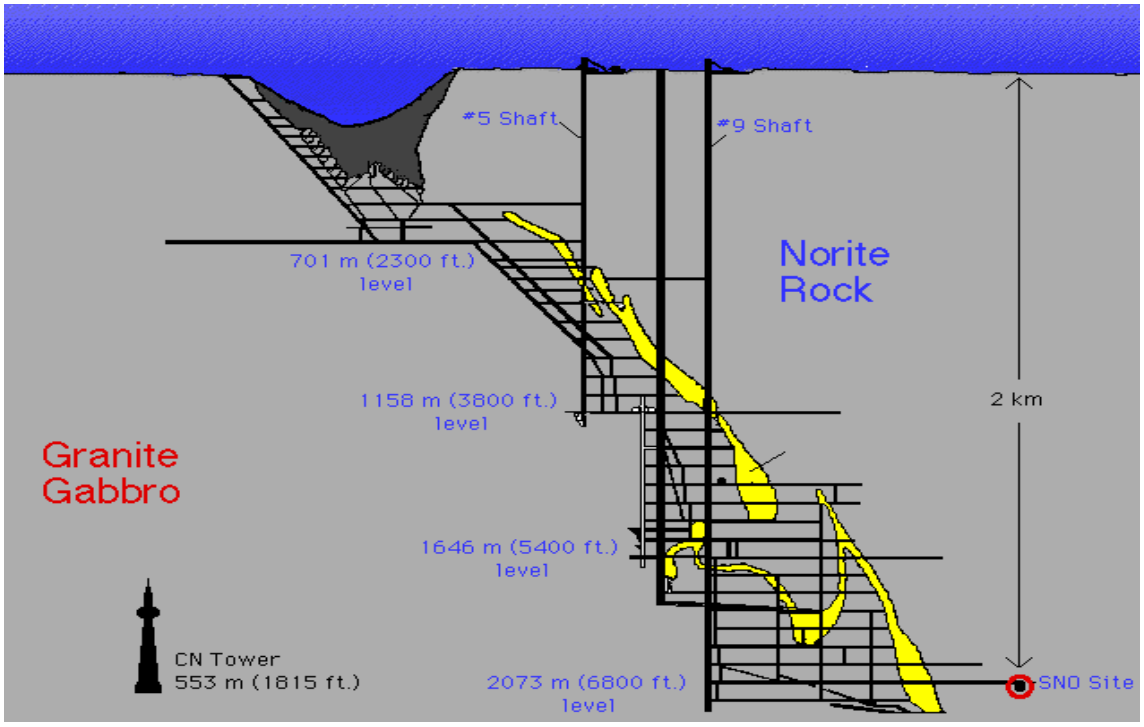
- (I believe) Successful high rate test during the summer
- Soon fully automatic
- SNO is onboard!

- **International collaboration of SN sensitive neutrino detectors**
  - » **Super-K**
  - » **LVD**
  - » **Amanda**
  - » **SNO**
  - » **LIGO (observer)**
- **Provides near-real time coincidence based SN alarm**
  - » **Timing and pointing information**
  - » **Very high confidence**
    - – Less than 1 false alarm/100y !
- **Coordinates detector downtime**
- **Centralized timing verification**
- **Privacy is ensured**
  - » **Input data is strictly secured**

SNO (Sudbury Neutrino Observatory)



- Creighton mine; Sudbury, ON, Canada
- 1000 Tons of heavy water
- Surrounded by several kTons of water
- ~9700 PMTs
- ~2Km below surface



SNO supernova sensitivity

Number of Particles From 10 kpc Supernova:

Neutrino Reaction	Type	SNO Counts [ε = 100%]	SNO Counts [monte carlo]
$\bar{\nu}_e + p_{H_2O} \rightarrow n + e^+$	CC	356	331
$\bar{\nu}_e + p_{D_2O} \rightarrow n + e^+$	CC	0.2	
$\bar{\nu}_e + p_{AV} \rightarrow n + e^+$	CC	5	
$\nu_e + d \rightarrow p + p + e^-$	CC	83	72
$\bar{\nu}_e + d \rightarrow n + n + e^+$	CC	53 (x 3) 82 [D_2O]	138 [salt] 90 [NCD]
$\nu_e + {}^{16}O \rightarrow {}^{16}F + e^-$	CC	1	
$\bar{\nu}_e + {}^{16}O \rightarrow {}^{16}N + e^+$	CC	3	
$\nu_e + d \rightarrow \nu_e + p + n$	NC	36 12 [D_2O]	30 [salt] 20 [NCD]
$\bar{\nu}_e + d \rightarrow \bar{\nu}_e + p + n$	NC	36 12 [D_2O]	32 [salt] 21 [NCD]
"ν_μ" + $d \rightarrow$ "ν_μ" + p + n	NC	192 60 [D_2O]	164 [salt] 110 [NCD]
"ν_μ" + ${}^{16}O \rightarrow (n, \gamma, n + \gamma)$	NC	7	
$\nu_e + e^- \rightarrow \nu_e + e^-$	ES	26	20
$\bar{\nu}_e + e^- \rightarrow \bar{\nu}_e + e^-$	ES	9	8
"ν_μ" + $e^- \rightarrow$ "ν_μ" + e^-	ES	12	9
TOTAL SNO SN COUNTS:		**917 606 [D_2O]**	**804 [salt] 681 [NCD]**

From the talk by R. Trafirout at MarinaDel Rey, 2001

- Still "only galactic" sensitivity…
- but we can count on exceptional results from SNO
  - ~1000 neutrinos are expected (10Kpc)!
  - Excellent sensitivity
- "Rock solid" SNEWS coincidence trigger
  - Super-K provides comparable number of events
  - LVD and Amanda will have considerably less
- Detailed information on SN evolution is expected!
- It is probably conceivable to build an accurate numerical model for this particular SN based on this info…

Can we predict the GW signature??

GRB (notices from GCN)

- **We receive a fair number of triggers**
  - » **Have a chance for half a dozen or more during E6**
  - » **Mostly HETE related**
    - – Must coordinate E6 with HETE runs
- **We receive**
  - » **Arrival time**
  - » **Direction**
  - » **and more…**
- **Utilize Finn/Mohanty/Romano method**
  - » **However, we must …**
    - – Tune it to low number of events
    - – Find best use of info provided
    - – Develop a full practical implementation
    - – before E6…
- **Survey predicted GW waveforms associated with GRBs**

```
TITLE:          GCN/HETE BURST POSITION NOTICE
NOTICE_DATE:    Mon 02 Jul 01 03:39:30 UT
NOTICE_TYPE:    HETE S/C_Last
TRIGGER_NUM:    1576,   Seq_Num: 2
GRB_DATE:       12092 TJD;   183 DOY;   01/07/02
GRB_TIME:       12846.52 SOD {03:34:06.52} UT
TRIGGER_SOURCE: FREGATE Trigger,
GAMMA_RATE:     850  [cnts/s] on a 0.020 [sec] timescale
XG_TRIG_TIME:   3.600 [sec]
WXM_SIG/NOISE:  28 trigger sig/noise
SC_-Z_RA:       280 [deg]
SC_-Z_DEC:      -22 [deg]
WXM_CNTR_RA:   281.982d {+18h 47m 56s} (J2000),
               282.003d {+18h 48m 01s} (current),
               281.280d {+18h 45m 07s} (1950)
WXM_CNTR_DEC:  -12.779d {-12d 46' 42"} (J2000),
               -12.777d {-12d 46' 36"} (current),
               -12.835d {-12d 50' 04"} (1950)
WXM_MAX_SIZE:    38.17 [arcmin] diameter
WXM_LOC_SN:      2 image sig/noise
SUN_POSTN:      101.24d {+06h 44m 58s}  +23.04d {+23d 02' 10"}
SUN_DIST:       169.72 [deg]
MOON_POSTN:     238.64d {+15h 54m 33s}  -17.12d {-17d 07' 27"}
MOON_DIST:       42.04 [deg]
MOON_ILLUM:     88 [%]
GAL_COORDS:     21.13,-5.02 [deg] lon,lat of the burst
COMMENTS:       Possible GRB.
COMMENTS:       Possible XRB.
COMMENTS:       WXM error box is circular; not rectangular.
COMMENTS:       There is no WXM or SXC position in this notice.
```

Summary (of interesting questions)

- **All right we can get excellent triggers…**
  - » **Neutrino, Gamma Ray Burst, Optical,…**
- **How can we use the information the best?**
  - » **Can we construct an accurate enough simulation of SN gravity wave signature based on the result of neutrino searches?**
  - » **Is it advantageous to use more than the direction and arrival time?**
  - » **Can we use a single external event or we need plenty?**
    - – Can we use half a dozen event?
      - Is the Finn/Mohanty/Romano method applicable?
  - » **Should we construct filters for GWs associated with specific GRB emitters?**

…