https://www.youtube.com/watch?v=LkhOlsKmDbk

THE UNIVERSITY of EDINBURGH

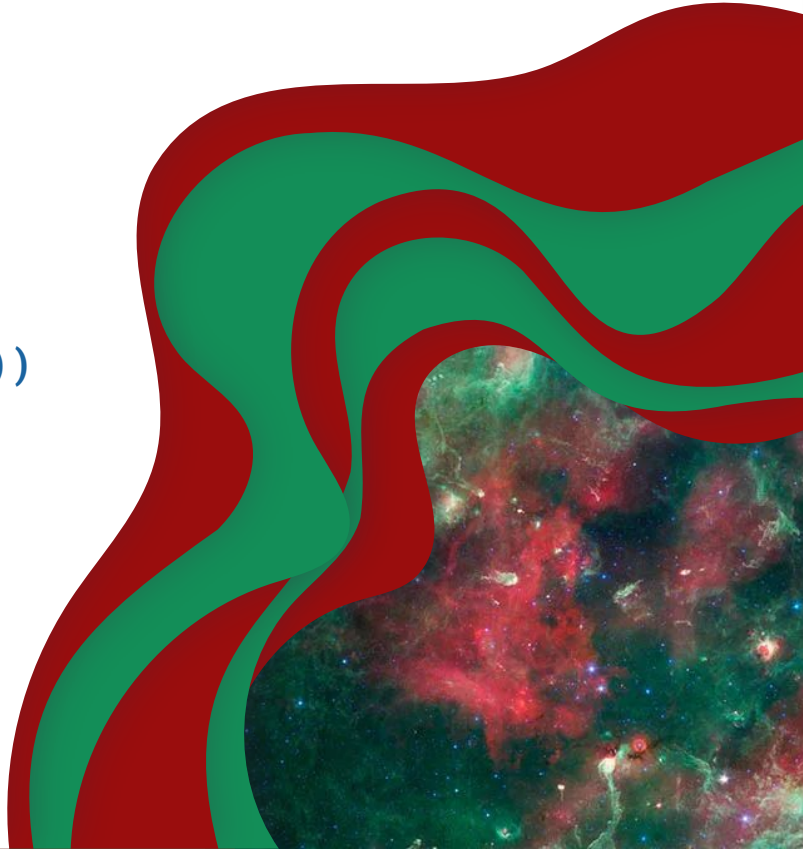
The 12 Days of Christmas:

PhD edition sing-along

Lucy Kotsiopoulou
Supervisor: Dr. Andrzej Szelc

SING with me!

(Or else… Krampus will eat you :))



NASA/JPL-Caltech/Harvard-Smithsonian CfA

1: PhD

On the ... day of Christmas my true love gave to me:

1: PhD

My first day at the office in September 2023!

2: Experiments

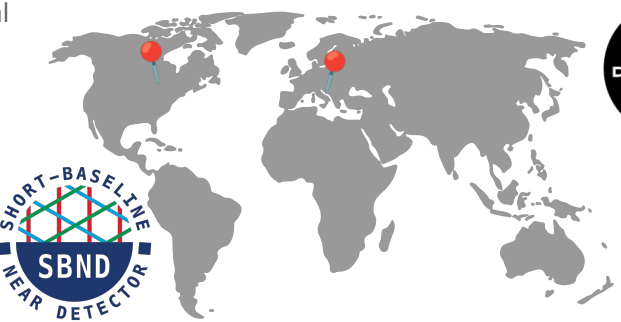
On the … day of Christmas my true love gave to me:

1: PhD
2: Experiments

I work on 2 experiments, SBND and DarkSide-20k!

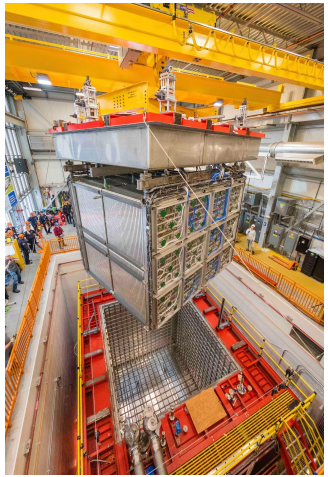
FNAL (Fermilab National Accelerator Laboratory)
📍 ~Chicago, U.S.

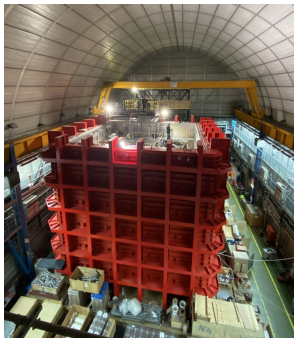
Neutrino beam experiment



LNGS (Gran Sasso National Laboratory)
📍 ~L'Aquila, Italy

Direct dark matter detection





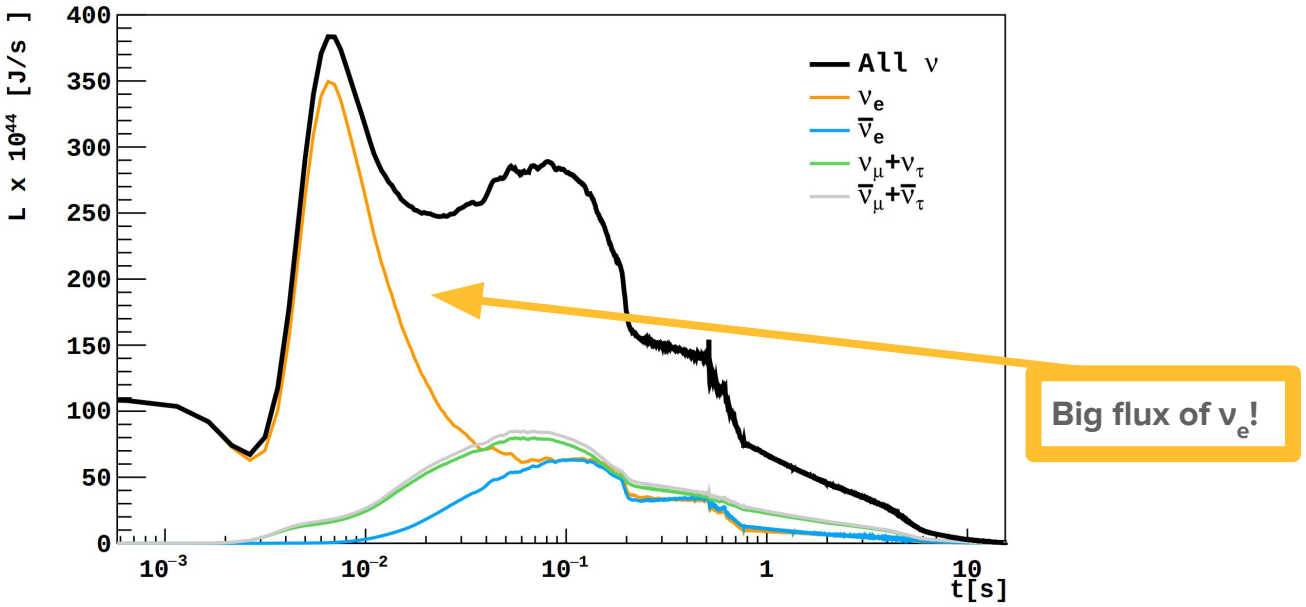
3: Flavours

On the ... day of Christmas my true love gave to me:

1: PhD
2: Experiments
3: Flavours

All 3 neutrinos come out a supernova explosion!

Neutrino flux of supernova over time:



Sensitivity of future liquid argon dark matter search experiments to core-collapse supernova neutrinos, **The DarkSide-20k Collaboration**, (2020).

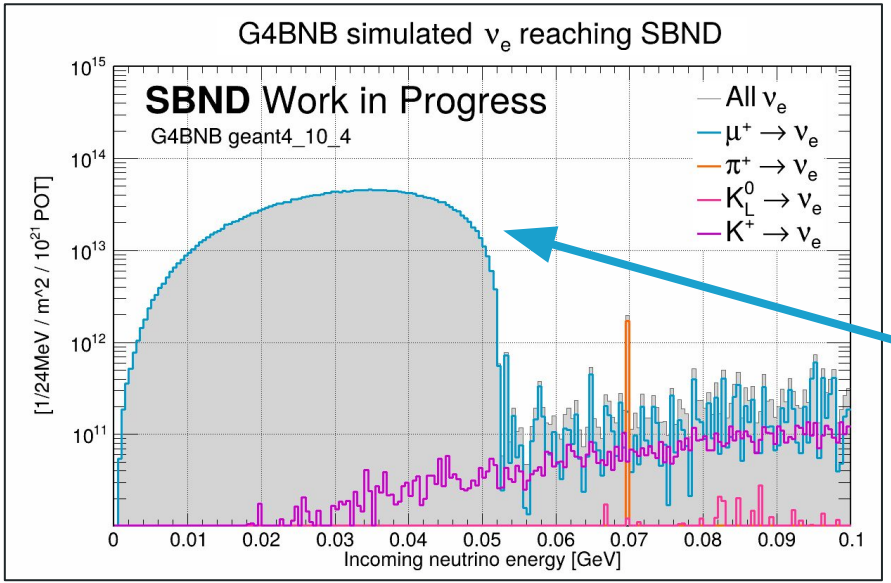
4: Fluxes

On the … day of Christmas my true love gave to me:

1: PhD
2: Experiments
3: Flavours
4: Fluxes

Man-made neutrino beam at Fermilab makes 4 ν_e fluxes!

"Low energy" (<100MeV) neutrino fluxes reaching SBND:



Big flux of ν_e from μ decaying at rest!

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Fermilab neutrino beam

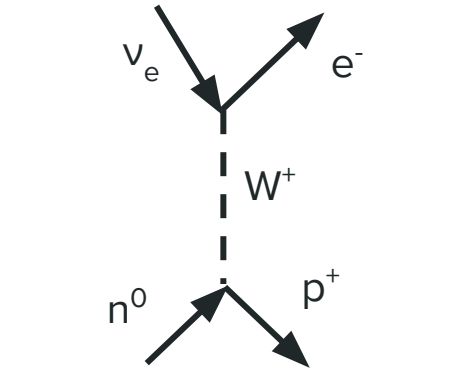
5: Particles

On the ... day of Christmas my true love gave to me:

1: PhD
2: Experiments
3: Flavours
4: Fluxes
5: Particles

ν_e on Argon cross section we want to measure!

Observe the process involving 5 particles:



$$\nu_e + {}^{40}Ar \rightarrow e^- + {}^{40}K^*$$

Charged current inelastic cross section at <100 MeV energies

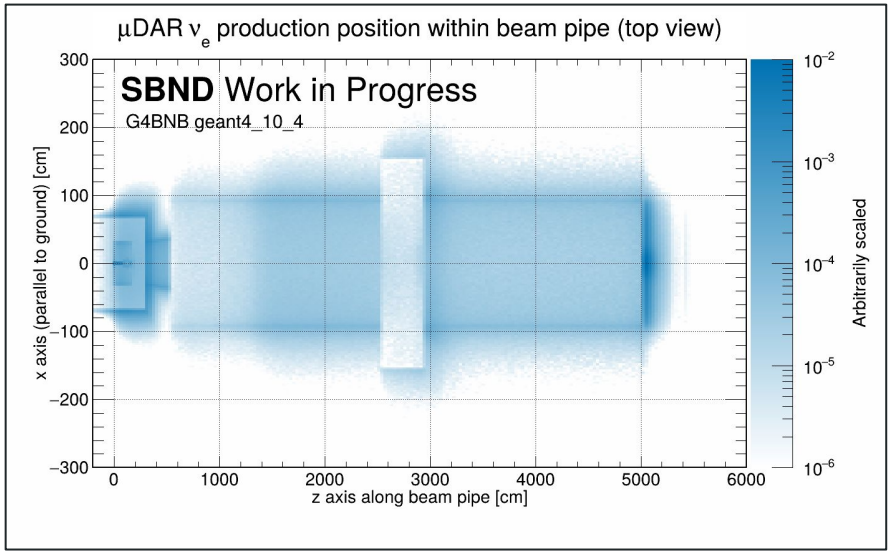
6: Materials

On the ... day of Christmas my true love gave to me:

1: PhD
2: Experiments
3: Flavours
4: Fluxes
5: Particles
6: Materials

Muons can bump on to 6 things and decay at rest to ν_e !

Top view on beam decay pipe:



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- Concrete
- Beryllium
- Dolomite
- Steel
- Aluminium
- Air

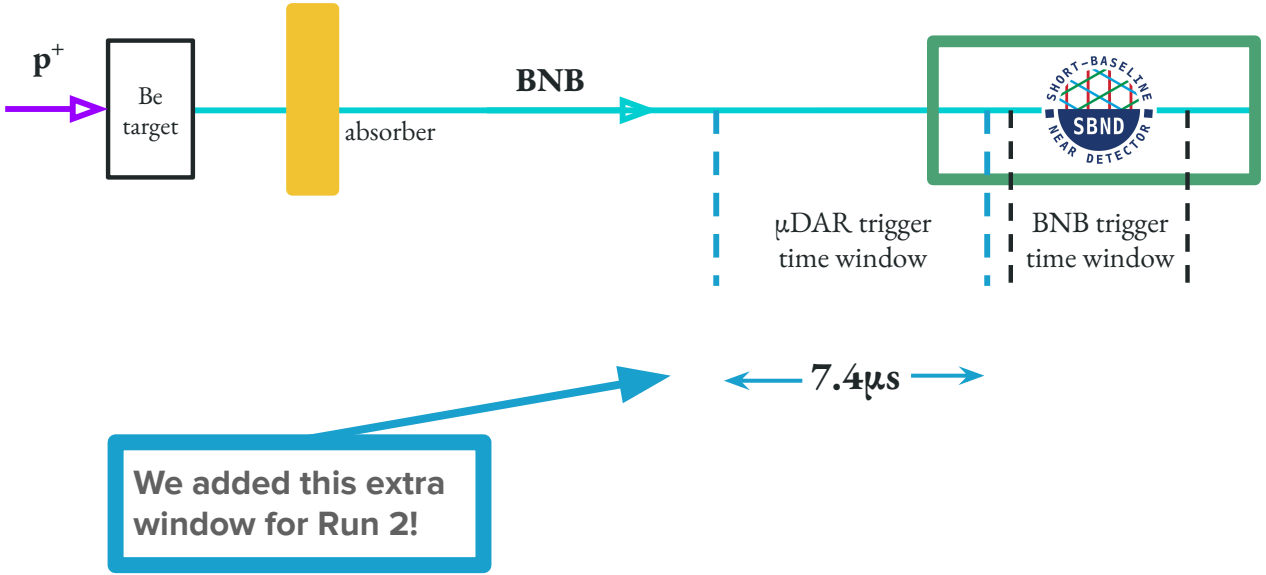
7: μs

On the ... day of Christmas my true love gave to me:

1: PhD
2: Experiments
3: Flavours
4: Fluxes
5: Particles
6: Materials
7: μs

We "open" trigger system for 7.4μs to catch these ν_e !

Trigger windows for SBND:



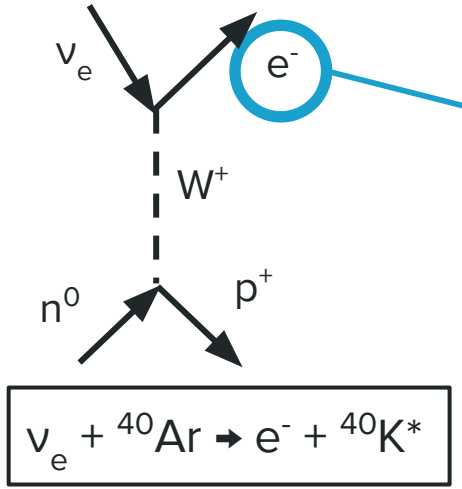
8: cm

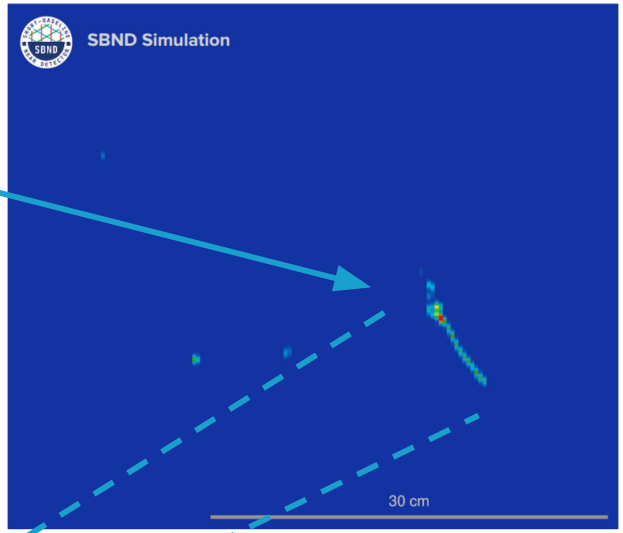
On the … day of Christmas my true love gave to me:

1: PhD
2: Experiments
3: Flavours
4: Fluxes
5: Particles
6: Materials
7: μs
8:

Final state e- of interaction is 8cm long in SBND

Neutrino flux vs. time of a Type II core-collapse supernova:





~ 8cm long

9: 99%

On the … day of Christmas my true love gave to me:

1: PhD
2: Experiments
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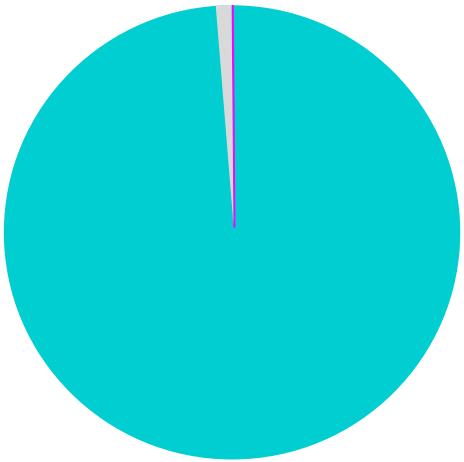
4: Fluxes
5: Particles
6: Materials
7: μs
8: cm
9: 99%

Neutrinos carry away 99% of the entire supernova energy!

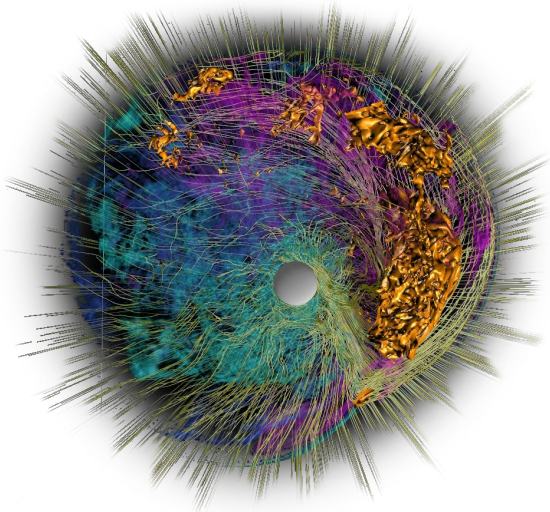
(For a Type II core-collapse supernova)



0.01% EM radiation

1% Kinetic energy of external star's layers

99% ν̈eutrinos



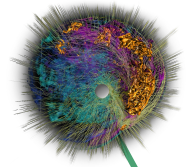
Neutrinos from a core collapse supernova, *Blondin and Mezzacappa* (2016).

10: kiloparsec

On the ... day of Christmas my true love gave to me:

1: PhD
2: Experiments
3: Flavours
4: Fluxes
5: Particles
6: Materials
7: µs
8: cm
9: 99%
10: kiloparsec

Now studying supernovae 10kpc away (~ Earth to centre of galaxy)



Could DarkSide-20k see supernova neutrinos???

Red lines are a 10kpc distance

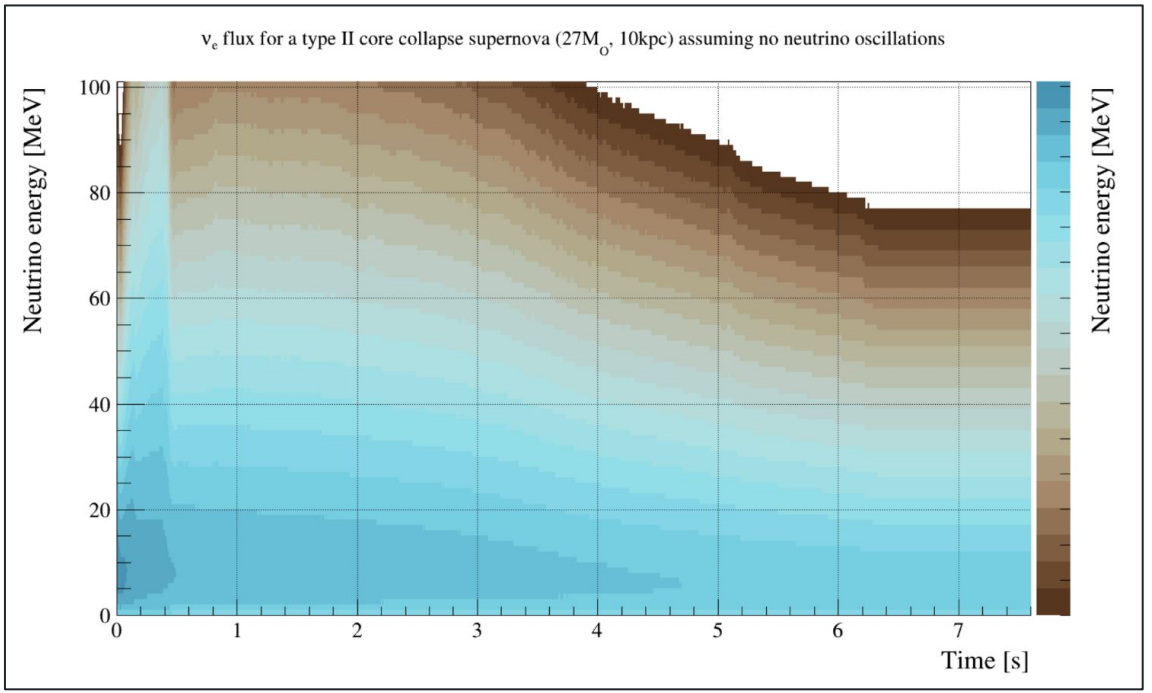
11: Solar masses

On the … day of Christmas my true love gave to me:

1: PhD
2: Experiments
3: Flavours
4: Fluxes
5: Particles
6: Materials
7: μs
8: cm
9: 99%
10: kpc
11: Solar masses

~~New~~ Will study supernovae of $11M_{\odot}$ progenitor star mass!

Observe neutrino flux over time and energy of $27M_{\odot}$ (didn't have the other plot :( )



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12: LTA months

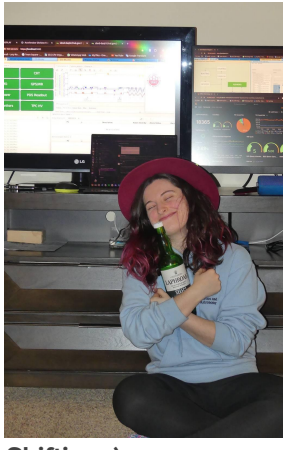
On the ... day of Christmas my true love gave to me:

1: PhD
2: Experiments
3: Flavours
4: Fluxes
5: Particles
6: Materials
7: μs
8: cm
9: 99%
10: kpc
11: Solar masses
12: LTA months

Had an amazing time on LTA in Fermilab (Chicago)!

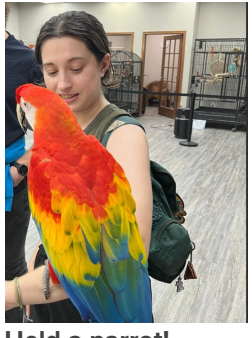
Thank you PPE for sending me :D

Hosted a wine club at Fermilab



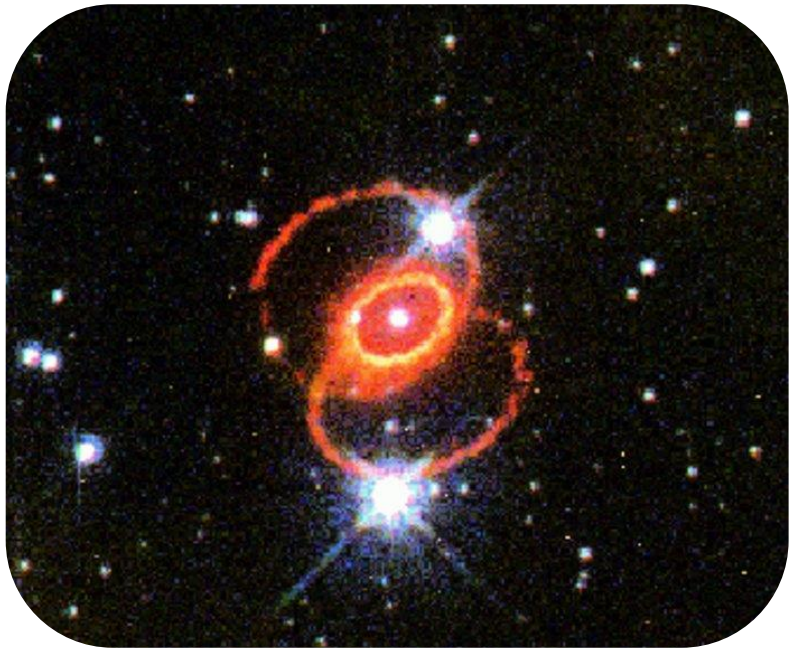
Shifting :)

Made many new wonderful friends :)



Held a parrot!

Thanksgiving in Fermilab control room!



A photo of Supernova 1987A's remnants as seen in 1995 by the Hubble space telescope, **GSFC/NOAO/NASA/ESA/STIS Instrument Definition Team** (1995)

Thank you!

Backup slides