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Status of the DIANA Project Alberto Lemut

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10/02/2011

Alberto Lemut

Talk Outline

- Very Brief DUSEL Project Overview
 - \diamond DIANA
 - Collaboration
 - Science Overview
 - Facility Design Overview
 - Status of the Project:
 - Accelerators & Beam Lines Design
 - Target Stations Design
 - Detector Design
 - Passive Shielding Design
 - Project Cost & Schedule



DUSEL Project





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Current DUSEL S4 Awards



♦Long Baseline Neutrino Experiment (LBNE).♦Dark Matter Searches:

- COUPP.
- GEODM.
- LZ3.
- MAX

♦ Neutrinos-less Double Beta Decay Searches:

- EXO.
- 1TGE (Majorana).

♦ Low Background Facility: FAARM.

♦Nuclear Astrophysics: DIANA.

♦ Biology, Geo-science, and Engineering (BGE): 7 S4 Grants
♦ Many other non S4 awarded projects.

DUSEL Project Schedule



- 1. The Preliminary Design Report (PDR) is due to NSF by the end of March 2011.
- 2. The review panel recommendation will be given immediately in preliminary form, and in full within a week or so (April 2011).
- 3. Then, the National Science Board (NSB) will vote for final funding approval (decision expected to be taken within August 2011).
- If approved, by September 2011 start of Final Design, Procurement and Construction. DUSEL should be ready for experiment installations in (about) 2018.

The DIANA Collaboration

Dakota Ion Accelerators for Nuclear Astrophysics



Michael Wiescher (University of Notre Dame) Principal Investigator Daniela Leitner (Michigan State University) Technical Director Adrian Hodgkinson (Lawrence Berkeley National Laboratory) Project Manager



DIANA Science Overview





- 1. Solar neutrino sources and the metallicity of the Sun: With high precision measurements of the neutrino production rates coupled with the observation of the solar neutrino flux, the metallicity of the solar core can be directly derived.
- 2. Carbon-based nucleosynthesis: Particularly critical are reactions such as ${}^{12}C(\alpha,\gamma){}^{16}O$ and ${}^{16}O(\alpha,\gamma){}^{20}Ne$ that define the ${}^{12}C/{}^{16}O$ abundance ratio in the subsequent carbon burning stage that is driven by fusion processes such as ${}^{12}C+{}^{12}C$ and ${}^{16}O+{}^{12}C$.
- 3. Neutron sources for the production of trans-Fe elements in stars: The s-process nucleosynthesis of heavy elements in stars depends on the neutron flux in stars. The reactions ${}^{13}C(\alpha,n){}^{16}O, {}^{17}O(\alpha,n){}^{20}Ne$, and ${}^{22}Ne(\alpha,n){}^{25}Mg$ are considered the most likely sources for neutron production in a variety of stellar helium burning and also carbon burning environments . The low energy cross-sections of these reactions determines the neutron flux at the various burning conditions and therefore determine the production of s-process elements.

DIANA Facility Overview





DIANA @ DUSEL 4850 Level





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DIANA Project Status



Low Energy Accelerator Design (LBNL):

- Ion source: Almost Specified, Mechanical and Electrical Designs will start as soon as possible.
- Accelerator Tube, HV Platform: Specified, Quote Requests out soon.
- Movable Gap: Specified, Mechanical Design in progress.
- HV Power Supplies: Specified, Quote Request out soon.
- Solenoids and Analyzing Magnet and PS's: Specified, 3D Field Modeled, Mech. Design Completed, Quote Requests out soon.

High Energy Accelerator Design (LBNL, ND):

 Specified: Ion source = Pantechnik Nanogun, Injection System = Einzel Lenses + Small Analyzing Magnet, Accelerator Tube, Switching/Analyzing Magnet. Quote request sent out to vendors.
 Together with one of the proposed vendors, a customary injection system and accelerator column are under design.

Beam Lines Design (ND, LBNL):

- Layout: Specified, All Magnets (Quads, Switching/Dipoles), 3D Field Modeled, Mech. Design Completed, Quote requests out soon.
- Pumping Stations: Work in Progress.
- Beam Instrumentation (Beam Viewers, Emittance Scanners, Profile Monitors): Work in progress.
- Calorimeters: Specified, Electrical and Mechanical Design in progress.

Low Energy Ion Source Design





Low Energy Accelerator



MAIN ACCELERATION COLUMN (0 TO 400 kV)

HIGH ENERGY BEAMLINE

HIGH VOLTAGE APERTURE

> MOVEABLE GROUND APERTURE WITH ELECTROSTATIC ELECTRON TRAP (To maintain space charge neutralization after acceleration)

HIGH V

ION S

Beam Current up to 50 -100 mA

Movable Gap Design





Low Energy Design







Low Energy Design





⁴He⁺ 60 kV 50 mA 90 % Neut



⁴He⁺ 400 kV 50 mA 90 % Neut



High Energy Column Design







DIANA Jet Gas Target Design



Supersonic Jet Gas Targets Stations Design (ND-Naples, CSM):
The two supersonic jet gas targets have been specified: design in progress.



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Jet Stream constrains the Low Energy beam diameter to be ≤ 1 cm 17

DIANA Detector Design



Detector Design (UNC, ND):

- Gamma Detectors: Work in progress (several ULB solutions are under consideration).
- Neutron Detector: a ULB Polyethylene Moderated ³He counter is currently under development at ND and soon will be tested underground at WIPP or DUSEL. (Ideally a liquid scintillation spectrometer would be the best).



DIANA Shielding Design



Shielding (ND, WMU):

• Shielding Design: Work in progress.



Pictures from LUNA ³He(α,γ)⁷Be Setup

High Purity, Ultra Low Activity Materials

Radon Box Fluxed with High Purity Nitrogen



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DIANA Project Cost & Schedule

PRELIMINARY



| ltem | Labor (k\$) | Material (k\$) | Total (k\$) | Total+Cont. (k\$) | |
|-----------------|-------------|----------------|-------------|-------------------|--|
| Low Energy | 250 | 3800 | 4050 | 5670 | |
| High Energy | 250 | 7500 | 7750 | 10850 | |
| Beam Lines | 150 | 2000 | 2150 | 3010 | |
| Target Stations | 900 | 1900 | 2800 | 3920 | |
| Detectors | 600 | 1300 | 1900 | 2660 | |
| Shielding | 50 | 550 | 600 | 840 | |
| Miscellaneous | 1000 | 1140 | 2140 | 3000 | |
| Total | 3200 | 18190 | 21390 | 29950 | |

The DIANA Preliminary Design Report (PDR) is due to NSF by the end of September 2012 (end of FY 2012).

If Approved, we would like to build and test the 400 kV accelerator @ LBNL

| 2012 | 2013 | 2014 | 2015 | 2016 | 2ا | 2017 | 2018 | 2019 | 2020 |
|-------------|----------|-------|----------------------|---------------|----|--------------|---------------|---------|------|
| Present PDR | Final De | esign | Procurer Construe | nent ction | | Setup LBL | UG Install | Running | |
| 10/02/2011 | | | Alb | erto Lemut | | (00) | Setup | | 20 |

The DIANA Team



@ DUSEL Workshop

Thank You for Your Patience!!!









UNIVERSITY OF NOTRE DAME

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Thursday, October 1st 2009, Lead SD

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