

Nuclear Astrophysics in Germany

Report from a Community Meeting

Darmstadt, 15-16 November 2016

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TECHNISCHE
UNIVERSITÄT
DARMSTADT



Nuclear Astrophysics

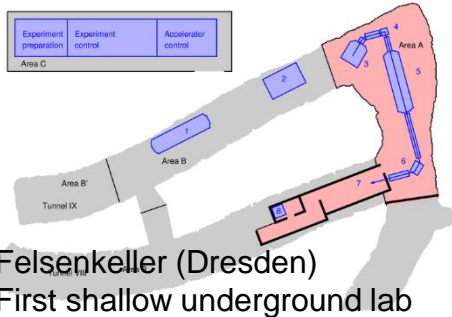
- Interdisciplinary field using a variety of research tools addressing broad science questions in distinct areas:
 - What are the nuclear processes that drive the evolution of the stars, galaxies and the Universe?
 - Where are the building blocks of life created?
 - What is the nature of matter at extreme conditions and densities?
- Major advances currently happening in scientific areas
 - Observations: multi-messenger astronomy (from radio to gamma, CRs, GWs, ν 's), and 'big data' (e.g. Gaia)
 - Modelling: multidimensional stellar models, dynamical chemical evolution models.
 - Experimental nuclear physics: precision frontier (small scale facilities), Exotic nuclei in explosions (FAIR)
 - Theory: Extending ab-initio approaches to heavy nuclei

Interconnection between areas (groups) is fundamental.

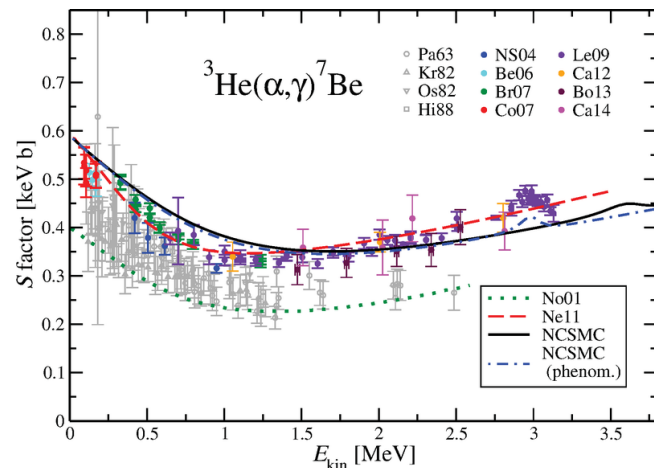
Solar models: precision frontier

Low background labs: reactions at low energies

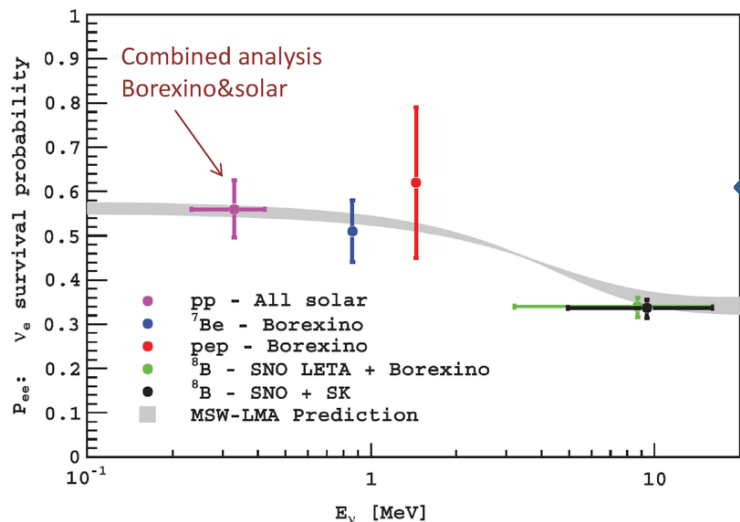
LUNA (Gran Sasso)



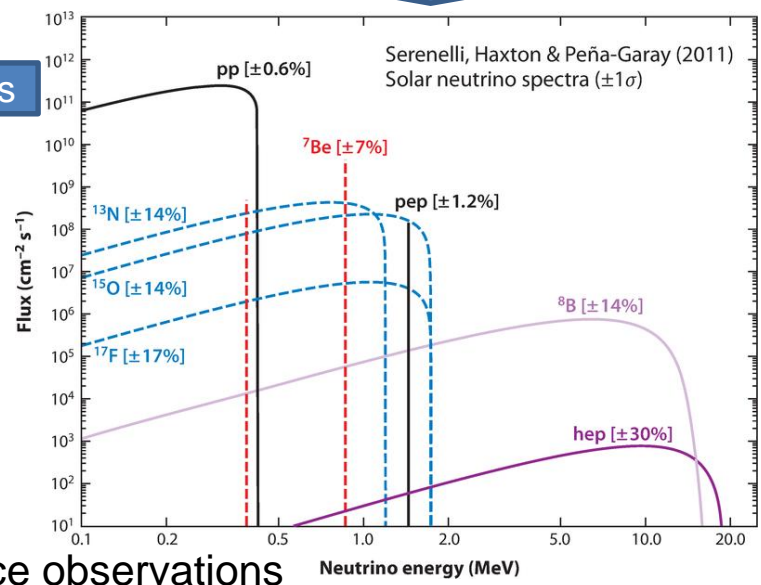
Theory



Modelling

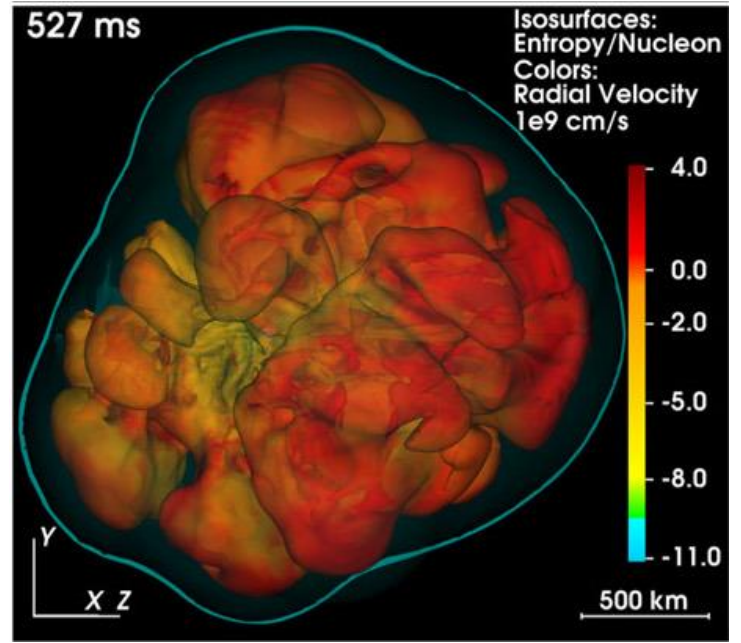
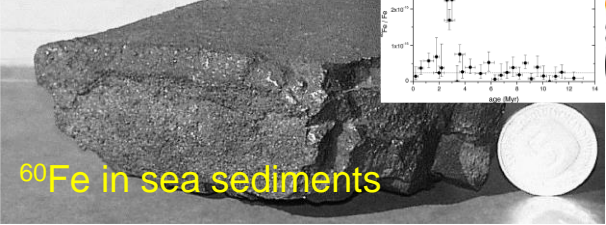
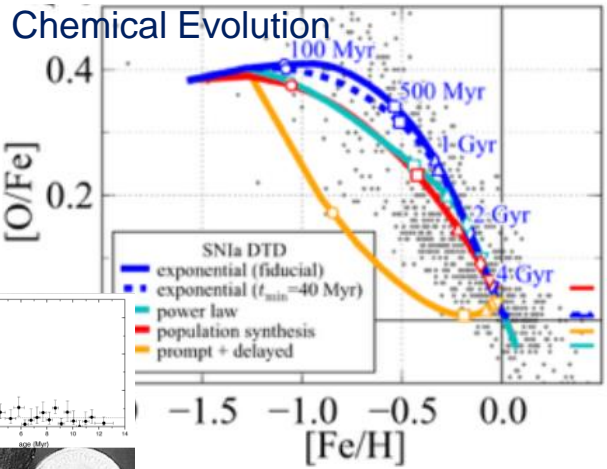
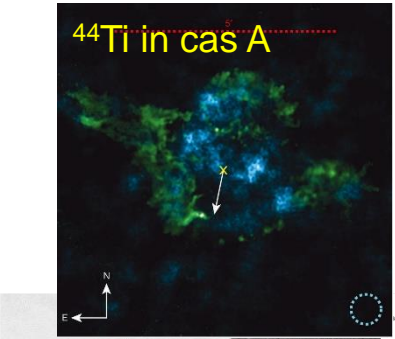
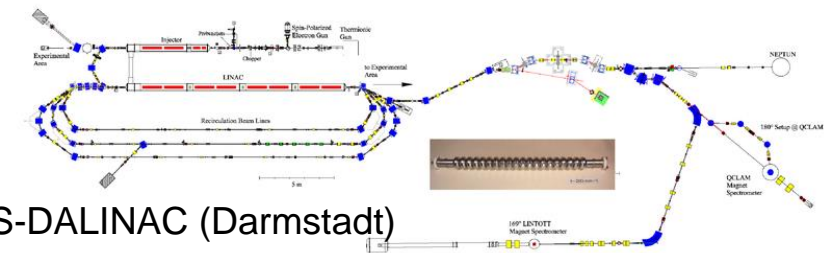
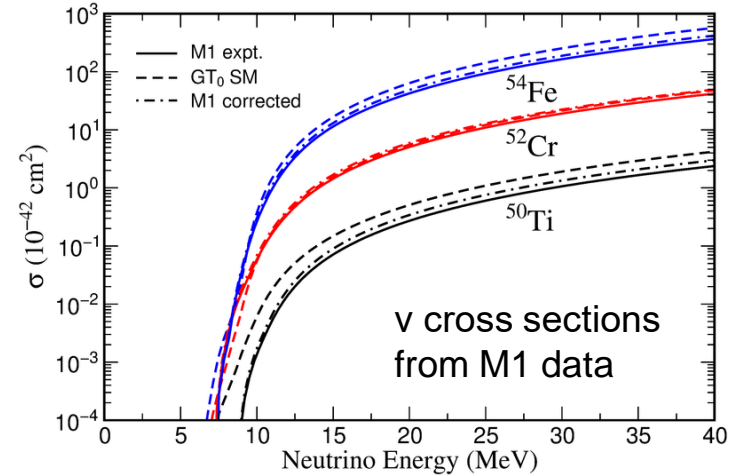
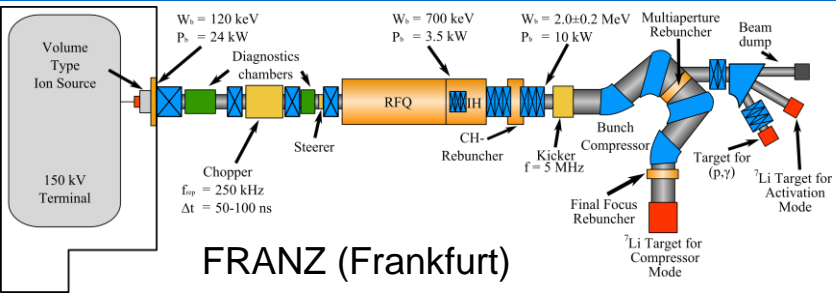


Observations

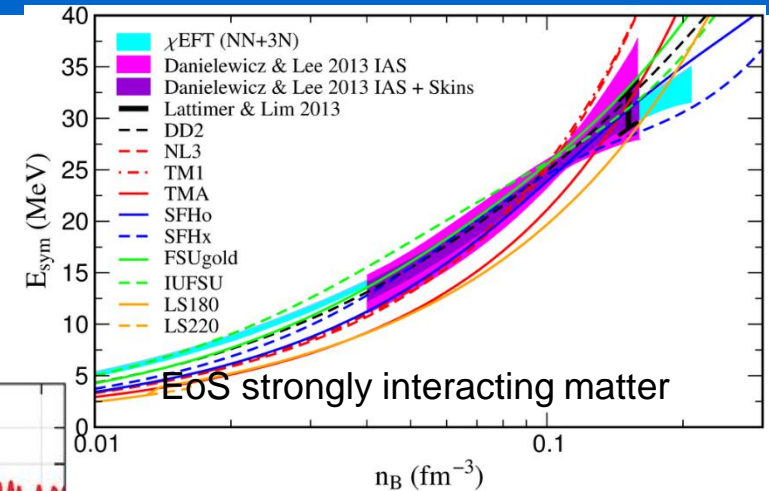
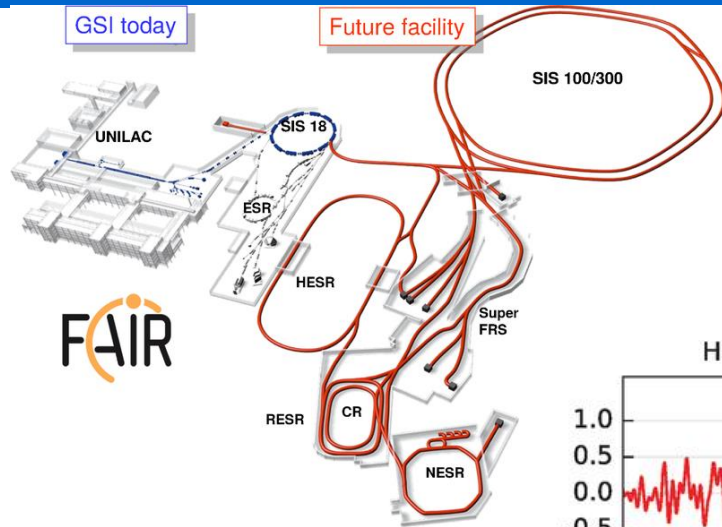


- Confirmation MSW mechanism ν oscillations
- Sun core temperature known with a 1% precision
- Solar abundance problem: consistency with abundance observations

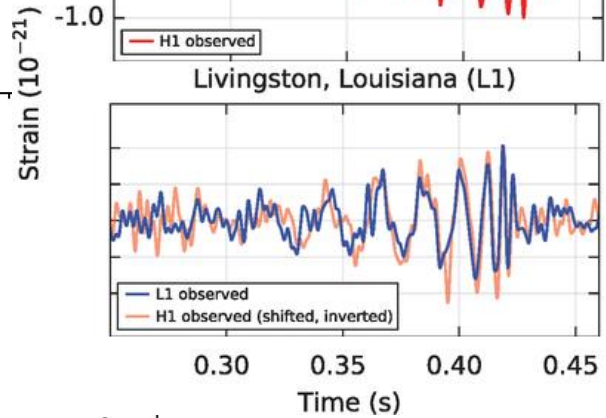
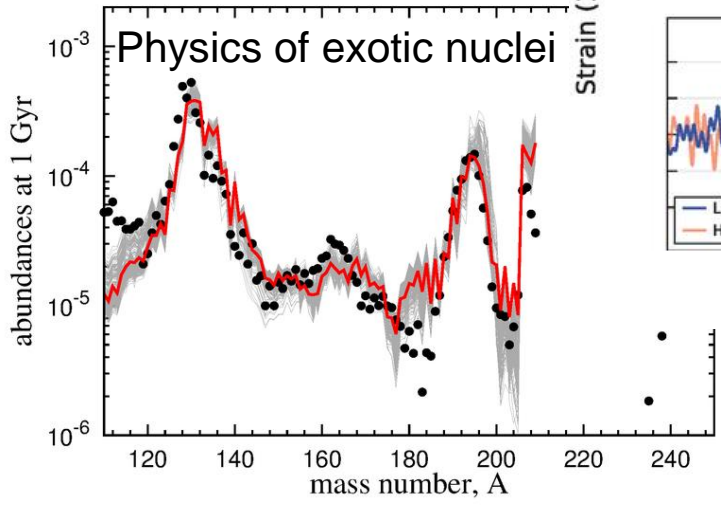
Stars and supernovae creating elements of life (C, O, Ca, Si, Fe, ...)



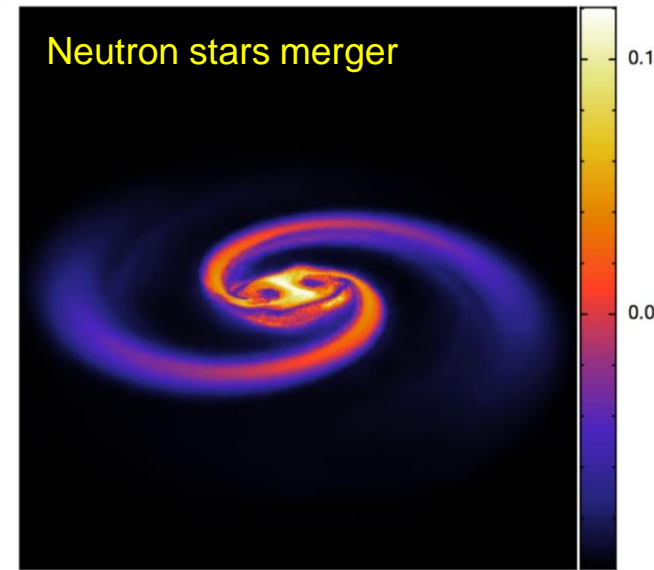
The r process site: the origin of gold



GW signatures of EoS



Electromagnetic transients from r-process material



Nuclear Astrophysics in Germany

20 groups
~ 80-100 persons

Nuclear Physics (KHuK)

Bonn, Bochum, Darmstadt,
Dresden, Erlangen, Frankfurt,
Garching, Gießen, Heidelberg,
Jülich, Köln, Mainz, Münster,
Rostock, Tübingen

Astrophysical Modelling

Berlin, Bonn, Frankfurt,
Garching, Heidelberg

Emerging chance
to answer big
questions by
working together

KAT

Observations

Bonn, Erlangen, Garching,
Heidelberg, Potsdam,
Würzburg

RDS

German NA meeting (Darmstadt, 15-16.11.2016)

Two day meeting on status and perspectives of Nuclear Astrophysics in Germany

<http://theorie.ikp.physik.tu-darmstadt.de/astro/astromeeing/index.html>

		Science Workshop "Nuclear Astrophysics in Germany"	15/16 Nov 2016
		<i>Darmstadtium, Darmstadt (D)</i>	<i>(Program version 9, 11 Nov 2016)</i>
		Day 1 = 15 Nov 2016	
Time	End	Title	Speaker
11:00	11:15	Welcome and Introduction	Diehl, Roland
11:15	11:40	Observations: Stars across the ages	Christlieb, Norbert
11:40	12:05	Observations: Stellar abundance issues	Bergemann, Maria
12:05	12:20	Observations: Stellar abundance specifics	Hansen, Camilla
12:20	13:20	<i>Lunch Break</i>	
13:20	13:45	Observations: Interstellar gas	Diehl, Roland
13:45	14:00	Observations: presolar grains and meteorites	Hoppe, Peter
14:00	14:15	Observations: Cosmic rays	Pohl, Martin
14:15	14:30	Cosmic Compositional Evolution	Diehl, Roland
14:30	15:10	<i>Discussion: Observations Perspectives</i>	<i>all</i>
15:10	15:40	<i>Coffee Break</i>	
15:40	16:05	NuclearPhysics & Theory	Hebeler, Kai
16:05	16:30	NuclearPhysics & Theory	Martinez-Pinedo, Gabriel
16:30	17:10	<i>Discussion: Nuclear Physics Theory Perspectives</i>	<i>all</i>
17:10	18:00	<i>Strategies</i>	Reifarth; Diehl; all
18:00		<i>end</i>	

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		Day 2	
Time	End	Title	Speaker
09:30	09:50	Nuclear Laboratories and Experiments: HZDR	Bemmerer, Daniel
09:50	10:10	Nuclear Laboratories and Experiments: FRANZ, GSI	Reifarh, Rene
10:10	10:20	Nuclear Laboratories and Experiments: GSI and connections	Litvinov, Juri
10:20	10:30	Nuclear Laboratories and Experiments: Darmstadt's facilities	Pietralla, Norbert
10:30	11:00	<i>Coffee Break</i>	
11:00	11:10	Nuclear Laboratories and Experiments: Munich Tandem	Faestermann, Thomas
11:10	11:20	Nuclear Laboratories and Experiments: Cologne Tandem	Scholz, Philipp
11:20	12:00	<i>Discussion: Nuclear Laboratories and Experiments Perspectives</i>	<i>all</i>
12:00	13:00	<i>Lunch Break</i>	<i>all</i>
13:00	13:25	Source Models: Stellar and binary evolution	Abate, Carlo
13:25	13:50	Source Models: Supernovae	Röpke, Fritz
13:50	14:15	Source Models: Compact object aspects	Rezzolla, Luciano
14:15	14:45	<i>Discussion: Source Models Perspectives</i>	<i>all</i>
14:45	15:25	<i>Discussion: Strategies to support Nuclear Astrophysics</i>	<i>all</i>
15:25	15:30	Farewell	<i>all</i>

Goals and outcome

- Identification of common interests and priorities
- Strengthen coherence in German nuclear astrophysics community
- Emerging need for joint initiatives and funding for collaborative work between interconnected areas
- Joint application for a DFG Priority Program
Focus on elements that are basis of life (C, O, Fe, ...)

Everybody is welcome to join!