

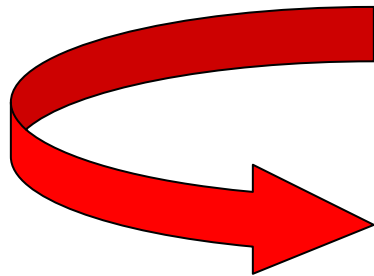
JRA Proposal full Title:

Characterization
of Advanced Diamond for
Particle Detection

Acronyms proposed so far :

CARADD CHADD

CARAD CHAD



CARAD is elected!

Objectives of the Proposal (as of June 29, 2007)

The development of large-area SCD vertex devices, junction-type sensors as well as beam monitors and trigger detectors of low material budget have been so far unreachable tasks for CVD-diamond detectors.

Recent progress in CVD-diamond growth processes led to diamond materials of very promising characteristics with respect to the above applications. Objective of this proposal is the **ChAR**acterization of thereby produced **A**dvanced **D**iamond (**CARAD**) for material research and aiming for the following detector types :

- Monolithic large-area (2 x 3 cm²) strip detectors made of heteroepitaxial SC diamond grown on Iridium (Iridium wafers Ø = 100mm);
- Multi-layer detectors for improved HI spectroscopy and neutron detection;
- SCD trigger devices and X-ray beam monitors of a thickness ≤ 50µm.

Objectives / some more text ...

A variety of nuclear methods and solid-state characterization techniques for DD materials has been worked out and successfully tested on SCD in the framework of NoRHDia. These tools are ready for use and will be easily adapted in CARAD to the new material types and detector designs... thus ... efficient work-off of the ambitious R&D programme is ensured.

...

Particular attention will be added to the surface preparation and characterization of HPHT substrates ...dislocations propagating in the homo-SCD layers. Furthermore, to the morphology and the crystalline structure of the CVD-diamond surface and of the metal-diamond interfacekey issues ..detector electrodes.

Objectives Last issue ...

A "*White Mini-Book for Diamond detectors*" (a primer) will be created, where the investigated diamond materials will be classified regarding key detector categories and their corresponding Front-End Electronics (FEE). This mini-book will provide to diamond detector users a clear, correct, and compact presentation of principles for detector design, signal processing, and FEE possibilities from single- to multi-channel advanced diamond detectors for *Hadron Physics*.

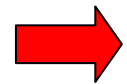
 *to do 1):*

Worthy to propose or not ?

It is a lot of work: but is it useful too ?

Implementation Plan of the JRA

Preliminary assumption: 3 years



to do 2) :

- Annual plan of your intendend work,*
- Plan of first 18 months .*

Interest and Qualification of Contractors

Augsburg Univ.	Heteroepitaxial SCD growth on Iridium, substrate optimization, solide-state meth.
CEA	Diamond P-I-N structures growth and characterization with solid-state methods
DESY-Zeuthen	HEP BeamCal Detectors, Char. Lab-&In-Beam, electron damage new data (10MeV)
ESRF	X-ray Characterization, micro-mapping, dislocation studies, strip detectors
JW NanoFabric.Centre, Glasgow Univ.	μ -Lithography, metallizations, diamond postprocessing
GSI	Coordination, Defend, AnnReps, Common Financing; Central" Detector characterization station" (nuclear methods), incl. ADD+FEE; Iridium-Diamond strip-and timing detectors, basic invest. to FEE with spiral model, ASIC (PADI) tests with DD, Radiation-hardness with Univ.of KA.
Surrey Univ., GBR	Characteriz., IBIC p- and a-particles, graphitized contacts by boron implantation
IFIN-HH	Fast electronics for MIP timing, laboratory- and beam tests
INFN & Uni-Milano	Ultra low noise cs FEE(<20 e- rms @ 6 μ s semi-gaussian shaping time), Fano-Factor measurements; low-noise fast cs preamps rise time < 1 ns and equivalent noise <200 e @ 10 pF
KIP, Uni-Heidelberg	Diamond surface- and Metal-diamond Interface (IR, BESSY); Metal growth on diam
Rom, Tor Vergata	Growth and char.: diode-like SCD devices, neutron monitors, B doped electrodes.
Wits Univ., Johannesburg, RSA	HPHT substrates, strain and dislocations characterization, post processing

Interest and Qualification of

Other involved Institutions

Diamond Center, AIST Tsukuba, JPN	Diamond surface functionalization, characterization (solid-state methods)
Hasylab/PetraIII, GER	Synchrotron radiation beam tests, interests identical to ESRF
IKP, Karlsruhe Univ., GER	Radiation hardness studies, beam-loss monitors
MSU, East Lansing, USA	Heteroepi SCD growth on Iridium, saphir substrates, heavy-ion beam detectors
VERA Laboratory, Vienna, AUT	Natural DD, LE HI detector characteriz., Rad- hard diamondlike-carbon contacts

Justification of Financing Requested

Cost of the Project and Community Contribution Requested (k€)

EC Contribution Requested (k€) (2009-2012)

(As from the Meeting at GSI)

Item	GSI	IKP	Hasy-lab	DESY-Zeuthen	ESRF	CEA	Glasgow	IFIN	KIP	INFN-Milano	Augs-burg	Surrey	Praha	Roma	Grand Total
Personnel	320	30	-	96	140	264	140	123	192		210	162	148	60	
Equipment	-	4	-			-	-	-	-	-	-	-	-		
Consumables	50	20	-	50		30	20	25	70	5	70	10	40	35	
Travel	100*	8		6		20	10	10	10		15	10	20	20	
Overhead	64	6	-	19	28	53	28	25	38		42	34	30	12	
Total	534	68	-	126	168	367	198	183	310		337	216	238	127	2845

* To be occasionally distributed ?

see next slides 

Justification of Financing Requested

Financing (k€) requested from EC over the period 2009-2012

Manpower	Equipment	Consumables	Travel	Overhead	Total
850	0	245	135	170	1400

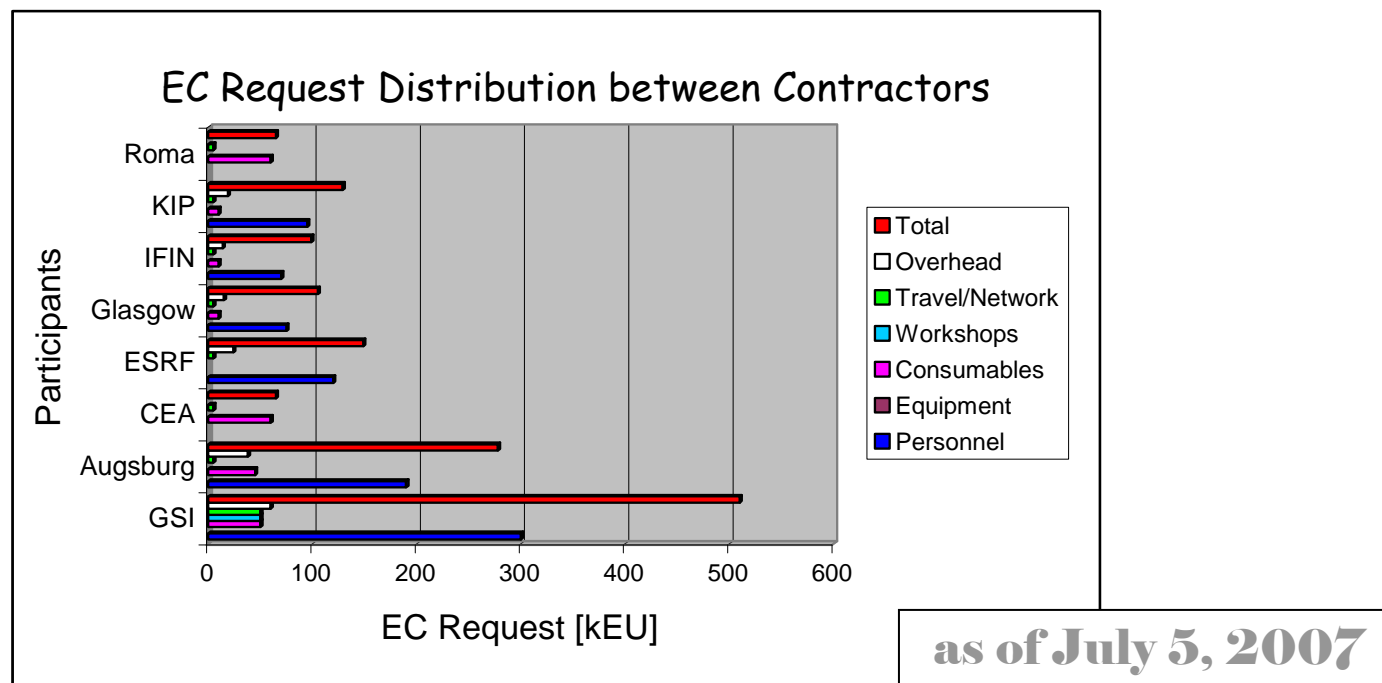
Still unclear, I try to minimize it.



as of July 5, 2007

EC Contribution Requested

Item	GSI	Augsburg	CEA	ESRF	Glasgow	IFIN	KIP	Roma	Grand Total	% of Total
Personnel	300	190		120	75	70	95		850	60.7%
Equipment										
Consumables	50	45	60		10	10	10	60	245	17.5%
Workshops	50								50	3.6%
Travel/Network	50	5	5	5	5	5	5	5	85	6.1%
Overhead	60	38		24	15	14	19		170	12.1%
Total	510	278	65	149	105	99	129	65	1400	100.0%
% of Total	36.4%	19.9%	4.6%	10.6%	7.5%	7.1%	9.2%	4.6%	100.0%	



Distribution of Funds between Contractors

	Participating Institution	EC Country	% of Grand Total
1	Institut für Physik, Augsburg Univ.	GER	20.6
2	CEA/List-Saclay	FRA	5.0
3	DESY-Zeuthen	GER	-
4	ESRF	FRA	9.6
5	J. Watt NanoFabrication Centre, Glasgow Univ.	GBR	7.1
6	GSI Darmstadt	GER	36.4
7	IFIN-HH, Bucharest	ROU	7.1
8	INFN & Milan Univ.	ITA	-
9	Physics Department, Univ. of the Witwatersrand (Wits), Johannesburg	RSA	-

as of July 5, 2007

Justification of Financing Requested

 *to do 3) : please fill in your part*

Non-EC Contribution (k€) (2009-2012)

Item	GSI	IKP	Hasy-lab	DESY-Zeuthen	ESRF	CEA	Glasgow	IFIN	KIP	INFN-Milano	Augs-burg	Surrey	Roma	Grand Total
Personnel *														
Equipment														
Consumables														
Travel														
Overhead														
Total														

* FTE in man months only, is not accepted!
Too big variations between Participating Institutions!

Other Items of the Proposal (to fill in)

Risk Assessment *(IMPORTANT!!!!)*

 *to do 4) : Please send me a sentence to your part!!*

Ideas of Others, not attending this meeting

❖ Wits University Johannesburg, Simon H Connell:

Form a previous mail, we settled on the following task for our group :

"the study of the electronic properties of diamond specifically the influence of strain distributions to the charge collection."

The idea would be to use HPHT and CVD samples where the strain distribution is well characterised

by X-ray techniques. One would then do micro-mapped IBIC measurements to correlate the charge

carrier response parameters to the strain maps.

Now, we may consider also the following as a result of our additional communications:

1 - *Our program on "X-ray optical diamond" with ESRF has a significant component for surface studies by grazing incidence reflectivity, GISAXS and GID. This means that both specular and Bragg reflectivity are done with surface sensitivity (adjustable penetration distance from nm to um) at and near both the specular and Bragg condition. With very similar techniques, one can get information on both the physical surface and the lattice quality near the surface. There will be also an exploration of a range of surface processing techniques. This is also of interest to you, and we could merge our program here.*

Ideas of Others, not attending this meeting

❖ Kurchatov Institute Moscow, Vitaly Liechtenstein

I am going to want to prepare a preliminary document (proposal) on *development and evaluation of advanced DLC based contact layers with improved resistance against radiation damage for DDs nowadays..*

Many thanks for your interest and willingness to consider *my suggestions on radiation hard contacts* at the first FP7 GSI meetings.

I will gladly send you a couple of slides for presentation if it is still OK
Have a Great weekend

Ideas of Others, not attending this meeting

❖ MSU East Lansing (USA), Brage Golding, Andreas Stolz

- ... project for (1) *improving heteroepitaxial diamond growth*, (2) *fabrication of detectors*, and (3) *evaluation of devices by a variety of nuclear methods*.
... *epitaxial iridium on a-plane sapphire*.
Nucleation and growth on substrates up to 5 cm will be explored by scaling the dc-bias process that precedes growth.
..... products will be characterized by scanning microscopies, high-resolution TEM and XRD, and by optical methods. *Strip detectors will be prepared using lithographic method and ohmic and Schottky contacts evaluated.* The electronic properties of heteroepitaxial diamond will be measured by time-of-flight response to alpha particles and to heavy ions to obtain electron and hole mobilities. Of particular interest is the identification of defects and impurities that act as scattering sites or traps, and act to limit or modify the electronic response.
- *Facilities in place include:* reactors for diamond growth, e-beam and sputtering equipment for epitaxy and metallization, SEM, HRTEM, XRD, nuclear instrumentation, beam time with heavy ion beam at the NSCL, and alpha sources. *We request half-time support for a postdoctoral student who is presently working on a related, but different, project. This will enable us to contribute immediately to this research without startup delays. The student will focus on the diamond heteroepitaxy, characterization, and spectroscopies.*
- *Proposed budget:*

Postdoctoral student (1/2 time/y: crystal growth/characterization)	33,000 €
Supplies and services (shopwork, microfab, repair, travel)	16,000 €
Total (annual):	49,000 €