

**Working Group to Examine Funding
Support for the Long Range Plan for
Astronomy and Astrophysics**

Phase 1 and 2 Report

November 2005

Working Group Report – Phases 1 and 2

Preamble

The Long Range Plan for Astronomy and Astrophysics (LRP) is the result of a coherent, science driven exercise to set priorities for the future of Canadian astronomy. The LRP panel was established (by NRC and NSERC in cooperation with the Canadian Astronomical Society (CASCA)) in 1998 and began its work in 1999. It considered a range of possible directions, new facilities and partnerships before making recommendations which were released in May 2000 (www.casca.ca/lrp/). In 2004, CASCA struck a Mid Term Review (MTR) Committee to evaluate progress on the LRP. Their report was published in early 2005 (www.casca.ca/lrp/mtr_approved.pdf).

The Coalition for Canadian Astronomy was formed in 2000, shortly after the release of the LRP. Its mandate is to harness the skills and resources of CASCA, the Canadian university research community, and Canadian industry to secure the goals of the LRP. While we have had substantial success overall, it has become increasingly clear that funding a broadly based and long-term community driven research plan is extremely difficult within the current structure for science funding in Canada.

In November 2004 representatives of the Coalition for Canadian Astronomy, the Canada Foundation for Innovation (CFI), the Canadian Space Agency (CSA), the National Research Council of Canada (NRC), and the Natural Sciences and Engineering Research Council (NSERC) met to discuss issues related to funding of the Long Range Plan for Astronomy and Astrophysics (LRP). As a consequence of that meeting it was agreed that a Working Group (WG) should be formed to examine LRP funding challenges, particularly in the context of Canada's current system of science funding. The WG was to consist of Coalition members with the participation of Vice Presidents of the four agencies and a representative of the Office of the National Science Advisor (ONSA).

Subsequent to that meeting, Terms of Reference and a Work Plan were drafted and accepted in principle by the Coalition Co-Chairs and the invited participants. In July 2005, this group met again to plan the next steps of the process. It was agreed that the current experience of the Coalition was sufficient to deal with many of the items named in Phase 1 and Phase 2 of

the Work Plan and that the Coalition should prepare a report to be distributed to all participants before the next meeting. This document is that report.

Phase 1

Our process begins by identifying the current status of LRP funding, both successes and failures, and will concentrate primarily on specific recommendations and projects from the LRP.

Examples of success:


In the past five years there has been substantial progress in many areas. We are a partner in the James Webb Space Telescope (JWST) and the Atacama Large Millimetre Array (ALMA) through the NAPRA (North American Partnership in Radio Astronomy) agreement; both projects are currently in advanced stages of development and construction. Canadian astronomers are also partners in the early phases of design for a Thirty Metre Telescope (TMT) and remain active members of the Steering Committee for a proposed Square Kilometre Array (SKA) radio telescope. The Receiver and Correlator setups within NRC (specifically funded by the LRP) were strengthened to provide support for new and current projects, and Canada continues to make significant new scientific and technical contributions to the twin Gemini telescopes. These projects are the substance of the LRP's first six strong recommendations.

Universities across Canada are hiring more astronomers than ever before and graduate student numbers are increasing as well. In 2005 CASCA membership is 514, an all-time high, of which 139 (27%) are graduate students. By comparison, in 2000 CASCA had 371 members, including 50 (13%) graduate students. Canada Research Chairs held by researchers in astronomy number 23, proportionately more than twice the fraction of that cohort funded by NSERC. The Association of Canadian Universities for Research in Astronomy (ACURA) was formed in 2004. Currently it includes 22 universities from 8 provinces with each institution represented at a senior level of administration. This organization demonstrates the commitment of Canadian universities to research in astronomy and will provide a national university voice as we work to secure the goals of the LRP.

Has the funding system failed? How? Why?

With these successes it may appear that all is well with funding the LRP. But the process has taught us otherwise. The main problems we have encountered are twofold:



- the need to get funding from many agencies with different criteria and timelines
- the current practise of the Central Agencies of the Federal Government to provide specific funding for no more than five years.

The reality is that Canada is not currently set up to handle large science projects and there is no accepted ion for the place of such projects within the Canadian Science and Technology landscape. There is no single mechanism to promote, recommend and fund large science programs such as the LRP or the projects it recommended. It is possible that the Major Science Initiatives Framework being developed by the ONSA may partly fill this gap. But it was agreed at the WG meeting in July 2005 that we cannot wait. The LRP is underway and needs support now. Therefore, our immediate aim is to develop a coordinated effort among the community representatives and the agencies to secure the necessary funding for the Canadian astronomy LRP, in a timely fashion.

LRP funding at present:

Below is a brief summary of the major recommendations of the LRP currently operational or at advanced stages of construction, and issues related to their funding.

Gemini:

By the late 1980s Canadian astronomers had begun the process of setting priorities for the next major optical telescope initiative, building on the knowledge and success of the CFHT. This led to Canada's current 15% share in the twin 8-metre Gemini telescopes which the LRP ranked as the highest priority for ongoing operation and support. Recently a five year plan for operation of the telescopes and development of new instruments has been developed and is expected to commence in 2006. This initiative will require an crease in Canada's financial contribution to Gemini over the next five year. der the terms of the Gemini Agreement, a large fraction of the increased contributions will return to Canada, in the form of contract work related to the design and construction of new Gemini instruments and software.

JWST:



Commitment to Canadian partnership in the James Webb Space Telescope (JWST) might be called the first success of the LRP as this was the highest priority for a major new space based facility. Through the CSA we are a partner in this major undertaking which will be the successor to the immensely successful Hubble Space Telescope (HST). The CSA funding to date is \$8.3M and the total expenditure by launch will be \$50M US (about \$60M Cdn). Our partnership has led to Canada being awarded responsibility for the crucial Fine Guidance Sensor and Tuneable Filter (FGS-TF) for imaging in narrow wavelength bands. A \$26.2M contract for the FGS-TF was recently awarded to EMS Technologies. The CSA remains firm in its commitment to this project. A complement to Canadian partnership in the JWST was the establishment of high profile fellowships of the stature of the NASA Hubble Fellows. This recommendation of the LRP has not yet been implemented.


ALMA:

Participation in the Atacama Large Millimetre Array (ALMA) was the LRP's highest priority for a major new ground-based observatory and, with the signing of the bilateral NAPRA agreement between NRC and the US National Science Foundation in 2003, became an example of a success within the broad LRP. However, this success was extremely hard won; at times it even seemed that Canada would not secure the funds to participate in ALMA. The reasons for this are strongly rooted in the nature of the science funding structure in Canada, the scale of the project (both physical and financial), the time frame for design and construction (~10 years) and the need to seek funds from several sources with different time lines and rules. The CFI expert science panel which reviewed the ALMA project ranked both it and Canada's role extremely highly. But, because NRC/HIA scientists and engineers were so crucially a part of Canada's participation and government agencies are not eligible to receive CFI funding, the CFI funds awarded were for the site access fee but not the larger expense of correlator development. Canada is now a partner in ALMA because of the work of the Coalition and the support of the federal government through funds provided by NRC. Without the support of the NRC and key federal politicians and ministry officials, Canada would have lost access to this outstanding observatory and international credibility for future partnerships.

TMT and SKA:



The LRP also strongly recommended that Canada position itself to play major roles in two future world observatories: a large optical telescope (now the TMT) and a major centimetre-wave radio telescope (the SKA). Both of these projects are still in early stages of development and will be considered more fully as case studies in Phase 3; they will therefore be mentioned only briefly here.

 a result of international opportunities arising from the U.S. Astronomy Decadal Survey, the TMT project has developed much more rapidly than anticipated in the LRP and careful study of possible options being considered around the world has led to Canada's current partnership in the design phase. At present Canada has secured commitment, through a CFI grant and the Minister of Industry  the \$25M necessary to participate at this stage. However, not all of these funds are in hand and we do not yet know when the money will be formally transferred. Nonetheless, the Canadian commitment has already led to investments in Canadian companies for telescope structure and enclosure, studies of mirror coatings and design of an extreme adaptive optics unit for the TMT.

Canadian scientists and engineers continue to be strong participants in the International SKA Steering Group (ISSG). NRC-HIA is continuing to support technical development related to the SKA, notably the development of the Canadian Large Adaptive Array, which includes a phased focal-plane array of radio receivers suspended by an aerostat that is tethered above an adaptable radio dish fixed on the ground. Recently, NRC-HIA, ACURA and Industry (private sector) representatives have formed the Canadian SKA Consortium to guide the project development within Canada and to seek supporting resources from a wide array of agencies. The SKA is a fully global project and similar development studies are underway in several countries, but decisions on site selection and telescope design are likely to be taken only toward the end of this decade. 

Computation:

LRP recommendations in the area of computation focussed on the Canadian Astronomy Data Centre (CADC) and High Performance Computing (HPC). The CADC is an important Canadian resource for archiving and data retrieval meeting a growing need for data storage and access. But the demands on the CADC are great. The MTR recommended continuing support for the CADC while maintaining strong oversight over its evolving

role and Canada's participation. The LRP also noted the lack of a "Tier 1" system available to Canadian researchers in astrophysics. Currently researchers requiring such computational capability must rely on access to systems in other countries, primarily the United States and Europe. The broader HPC community in Canada has been exploring various options, but a broad interdisciplinary plan has only recently been completed.  Because the need for such capability to support astronomical research, we recommend that a Canadian astronomy involvement in an HPC facility be considered as the third test case in Phase 3. 

People:

Although the number of Canadians doing astronomical research has grown markedly in the past five years, several LRP recommendations related to the university community and its research capability have not yet been funded and implemented. The LRP recommended an increase in the number of HIA staff astronomers, the creation of prestigious postdoctoral fellowships, and the creation of university laboratories for experimental astrophysics. Progress in all of these areas has been limited or non-existent and the MTR strongly recommended strategies to ensure that all of the LRP targets be met. An important component is the training of HQP, in research and instrument development, to provide the next generation of scientists in support of Canada's number one science. This will require a stronger effort within the universities and use of NSERC resources in astronomy.

Outreach:

A major recommendation of the LRP was allocation of 1.5% of any project budget to the support of related outreach efforts. Although progress has been made in this direction (i.e. CASCA Education and Outreach, NRC/HAI Centre of the Universe etc.), this recommendation has not been addressed in a coordinated way. The strong public interest in astronomy is a major strength when trying to get funding for the LRP and it should be developed and encouraged.

Do some agencies work better than others? How? Why?

Given the number of agencies involved in funding the LRP and the difficulties which have arisen and continue to plague LRP realization, it might be imagined that a simple solution would be to select one agency with which to work. In considering this option we would need to examine how each agency works for the LRP and just pick the best fit.

The scientists and engineers at the NRC/HIA have substantial experience in running major telescopes and in instrument development. Moreover, NRC has a well recognized role as the Canadian signatory in international agreements. This role is based on the mandate placed upon NRC within its enabling legislation, “to operate and administer any astronomical observatories established or maintained by the Government of Canada”. However, the financial resources required for Canadian participation in the next generation of major astronomical facilities cannot be found within its current allocation of funds. Moreover, stability and predictability are key when working with international partners on major projects. Although a government agency can often provide these qualities, not all sources of funding may be available to that agency. Capital funds are available from the CFI, but these awards come with many constraints and cannot be used to directly support work undertaken by government agencies. Also, since any CFI award requires securing of matching funds, we still need to look elsewhere. For projects costing hundreds of millions of dollars, the matching fund requirement becomes another major barrier. The CSA provides funds to develop, build and launch spacecraft but little support the research undertaken using that facility. NSERC is the agency to which university-based scientists turn for ongoing support of their research. When one considers the excellence and impact of Canadian astronomical research, the level of NSERC support is arguably lower than expected, partly because NRC provides full access to the telescopes it alone supports for all qualified Canadian astronomers without charge.

The remarkable gains of the LRP have been supported at some level by all four agencies, but none has the resources and funding structure to secure the LRP on its own. In addition, the fact that the majority of the funds provided to date have been new money specifically designated for the LRP underlines the reality that current agency funding resources are not enough.

Phase 2

In this section we briefly consider what is needed to fund the remaining elements of the LRP and when that funding is required. We will also discuss the problems that may be encountered based on our experience to date as well as the ramifications of incomplete funding.

What funding is required to complete the LRP? When is it needed?

The MTR reviewed the current status of the LRP goals and made recommendations for the five years from 2006 to 2010. Because the time scale for many of the major facilities, including design, development and operation, will carry beyond 2010, the MTR also included funding recommendations for another five years beginning in 2011. Tables 1, 2 and 3 from their report are included as appendices. Also included is a spreadsheet of expenditures projected to 2012, prepared by Greg Fahlman, HIA Director General. It is based on current funding in hand and assumptions of likely, though not determined, expenditures both within and external to NRC. In addition to participation in new projects, the MTR made clear recommendations for phasing out Canadian involvements in facilities such as CFHT and JCMT. This will allow diversion of resources to the new initiatives. The rapid advance of the TMT and Canada's participation in it mean that the crucial time period for the LRP is actually seven years. We will need approximately \$235M over seven years to maintain participation in current partnerships and achieve the new ones already described. This figure is somewhat larger than in the LRP, primarily because of the rapid development of the TMT project which has resulted in funding needed in the second five years of the LRP rather than in the 2011+ time frame.

How is the money to be delivered?

This report has already discussed the difficulties which have arisen because the LRP is not a single project or facility built and used by a single agency. In addition, the funds awarded are often not for a single item; they must be distributed and that distribution may need to be done in coordination with other projects or agencies or university groups or even the international partners. As previously mentioned, this cannot always be managed through NRC which would be a natural choice because of their mandate to operate national astronomy facilities and because of their ability to negotiate and sign international agreements. ACURA, as a member corporation of Canadian universities engaged in astronomy, might be a good alternative. This is an untested option, but one being considered in the case of the TMT and SKA projects. We recommend that this issue be considered in the case studies to be examined in Phase 3.

What are the obstacles to future funding?

Clearly, if things do not change, obstacles to future funding will also not change. Our current major obstacles, as already discussed are:

- lack of a single agency or mechanism for securing funding
- funding time scales of 3-5 years are much less than the decade time scales now common for the initial planning and construction phases of LRP projects
- need for inclusion of funds for the full life of a project: planning, development and operating

Again, the present lack of a policy for large science projects and a long term vision for funding them is at the core of our problems. We as a community have created a coherent plan, based on extensive consultation and hard choices. Carrying through on the LRP will allow us to build on our strengths and maintain Canadian astronomical excellence into the future. Our energies should be focussed on competition and research on the international scene, rather than dissipative efforts to deal with the present system.

Phases 3 and 4

With this background, it is now time for us to consider models for future LRP projects and priorities. This exercise will likely include consideration of the ways in which such projects are funded in other countries and how those models may give guidance. Therefore, we recommend that the next stage of the Working Group activities should incorporate both Phase 3 and Phase 4 as defined in the Work Plan of the Terms of Reference.

The TMT, SKA and a Canadian HPC consortium have been recommended as projects to be considered in the case study process. At the July 2005 meeting, it was agreed that this be done in the context of various funding models and an evaluation of the effectiveness of each model for the three cases. The task now is to confirm which projects are to be included in the cases studies, select funding models to be considered, and then carry out the case studies.

List of Acronyms

ALMA:	Atacama Large Millimetre Array
CADC:	Canadian Astronomy Data Centre
CASCA:	Canadian Astronomical Society
CFHT:	Canada France Hawaii Telescope
CFI:	Canadian Foundation for Innovation
CSA:	Canadian Space Agency
HIA:	Herzberg Institute for Astrophysics
HPC:	High Performance Computing
HST:	Hubble Space Telescope
JCMT:	James Clark Maxwell Telescope
JWST:	James Webb Space Telescope
LRP:	Long Range Plan for Astronomy and Astrophysics
MTR:	Mid Term Review
NAPRA:	North American Partnership for Radio Astronomy
NRC:	National Research Council of Canada
NSERC:	Natural Sciences and Engineering Research Council of Canada
ONSA:	Office of the National Science Advisor
SKA:	Square Kilometre Array
TMT:	Thirty Metre Telescope
VLOT:	Very Large Optical Telescope
WG:	Working Group

Table 1: Recommended Expenditures for the Period 2005-2011
(millions of dollars)

		Priority	Ground-based	Space-based
World Facilities	ALMA	*	22	
	SKA	*	24.5	
	VLOT/TMT	*	125	
	JWST	*		60.6
	Subtotals		171.5	60.6
Moderate Projects	Herschel/Planck	*		8.9
	Other space projects			15.6
	Gemini	*	21.3	
	Receiver/Correlator groups		2.0	
	DAO Telescopes		0.25	
	Subtotals		23.6	24.5
People	HIA Research Staff	*	4.3	
	Herzberg Fellowships	*	3.2	
	CSA Fellowships	*		1.5
	NSERC Fellowships	*	1.6	
	Experimental Astro Labs		4.9	
	Research grants		2.1	
	Subtotals		16.1	1.5
Computing	CVO		3.0	
	HPC		15.0	
	Equipment grants		3.5	
	Subtotals		21.5	
	Education & Outreach		3.0	1.3
	Totals		235.7	87.9

* indicates association with a strong recommendation.

**Table 2: Estimated costs and expenditures from the LRP and MTR
(millions of dollars)**

	Item	LONG RANGE PLAN				MID TERM PLAN				
		Source	2001-05	2006-10	2011-15	Source	2002-06		2007-11	2012-16
							Existing*	New*		
World Facilities	ALMA Construction	NRC	24.5	23		NRC	16.3		12	
						CFI	7.9			
	EVLA*					NRC	20			
	ALMA Operations	NRC		2.5	10	NRC			10	20
	SKA Studies*	NRC	3.4	8.5	1	NRC	2.4	9.5	15	
	SKA Construction	NRC			30	TBD				TBD
	VLOT Studies	NRC	22.4	22.4		NRC	4.3			
	VLOT Construction	NRC			30					
	TMT DDP Study*					CFI		4		
						Match (TBD)		6		
					TBD		15			
	TMT Construction*				TBD			100	125	
	TMT Operations*				TBD				50	
	JWST	CSA	38	38		CSA	31.3		36.4	
Moderate Projects	Herschel/Planck	CSA	9.5	9.3		CSA	13.6		5.3	
	Space VLBI/other	CSA	1	1		CSA	16.8		9.3	
	Gemini/JCMT/CFHT*	NRC	3.5	8	5	NRC	6.4	15	6.3	6.3
	MegaPrime	NRC	0.5	0.6						
	WIRCAM	NRC	3.8							
	Receiver Group	NRC	1	1	1	NRC	1		1	1
	Correlator Group	NRC	1	1	1	NRC	1.1		1	1
	CGPS Extension	NRC	2.6			NRC	0.53			
	DAO Telescopes	NRC	0.5	0.5	0.5	NRC	0.25		0.25	0.25
People	HIA Research Staff*	NRC	3	3	3	NRC	1.9	0.34	4	5
	Herzberg Fellowships*	NRC	1.7	2.1	2.1	NRC		0.42	2.8	3.5
	CSA Fellowships*	CSA	0.85	1.05		CSA	0.12	0.09	1.4	1.7
	NSERC Fellowships*	NSERC	0.85	1.05	1.05	NSERC		0.21	1.4	1.7
	Exp. Astro. Labs	NSERC	3.5	3.5	3.5	NSERC		1.4	3.5	3.5
	Research Grants	NSERC	1.5	1.5	1.5	NSERC		0.6	1.5	1.5
Computing	CADC (CVO)	NRC	1.5	1.5	1.5	NRC	1.56		3	1.75
	HPC (Tier 1 facility)	NRC	1.5	0.5	0.5	TBD		15		
	Equipment Grants	NSERC	2.5	2.5	2.5	NSERC		1	2.5	2.5
E&O	Education & Outreach*	NRC	0.9	0.9	0.9	NRC		0.37	0.6	0.4
		CSA	0.6	0.6		CSA	0.13	0.37	0.9	TBD
		CASCA	0.1	0.1	0.1	CASCA	0.11		0.1	0.1
						TBD		0.45	1.5	TBD
Totals		NRC	71.8	75.5	86.5	NRC	55.7	25.6	56	39.2
		CSA	50	50		CSA	62	0.5	53.3	TBD
		NSERC	8.4	8.6	8.6	NSERC		3.2	8.9	9.2
		CFI				CFI	7.9	4		
		TBD				TBD		36.4	101.5	TBD

**Table 3: Recommended Expenditures for the Period 2005-2011
(millions of dollars)**

	Priority	Ground-based			Space-based	
		Start 2005**	2007-11	Total		
World Facilities	ALMA	*		22	22	
	SKA	*	9.5	15	24.5	
	VLOT/TMT	*	25	100	125	
	JWST	*				60.6
	Subtotals		34.5	137	171.5	60.6
Moderate Projects	Herschel/Planck	*				8.9
	Other space projects***					15.6
	Gemini	*	15	6.3	21.3	
	Receiver/Correlator groups			2.0	2.0	
	DAO Telescopes			0.25	0.25	
	Subtotals		15	8.6	23.6	24.5
People	HIA Research Staff	*	0.3	4	4.3	
	Herzberg Fellowships	*	0.4	2.8	3.2	
	CSA Fellowships	*				1.5
	NSERC Fellowships	*	0.2	1.4	1.6	
	Experimental Astro Labs		1.4	3.5	4.9	
	Research grants		0.6	1.5	2.1	
	Subtotals		2.9	13.2	16.1	1.5
Computing	CVO			3.0	3.0	
	HPC		15		15	
	Equipment grants		1	2.5	3.5	
	Subtotals		16	5.5	21.5	
Education & Outreach		0.8	2.2	3.0	1.3	
Totals		69.2	166.5	235.7	87.9	

* Indicates association with a strong recommendation.

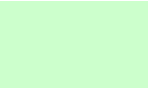

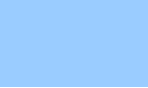

** These funds correspond to column "New" under 2002-06 in Table 2.

*** These projects include BLAST, FUSE, UVIT, CADC support, concept studies and new opportunities.

MTR: December 2004 evolution to July 2005

	Total	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
ALMA	22.00			2.40	4.40	4.40	4.90	5.90
SKA: July05	24.50	1.60	3.00	2.40	2.50	5.00	5.00	5.00
TMT: July 2005	125.00	15.00	10.00	10.00	15.00	25.00	25.00	25.00
Moderate Projects								
Gemini/JCMT/CFHT	21.30		4.26	4.26	4.26	4.26	4.26	
Receiver/Correlator Groups	2.00			0.40	0.40	0.40	0.40	0.40
DAO Telescopes	0.25			0.05	0.05	0.05	0.05	0.05
People								
HIA Research Staff	4.30	0.15	0.15	0.80	0.80	0.80	0.80	0.80
Herzberg Fellowships	3.20	0.20	0.20	0.56	0.56	0.56	0.56	0.56
NSERC Fellowships	1.60	0.10	0.10	0.28	0.28	0.28	0.28	0.28
Experimental Astro Labs	4.90	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Research grants	2.10	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Computing								
CVO	3.00		-	0.60	0.60	0.60	0.60	0.60

HPC	15.00	15.00	-					
Equipment grants	3.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Education & Outreach	3.00	0.40	0.40	0.44	0.44	0.44	0.44	0.44
TOTALS: Dec-04	235.65	33.95	19.61	23.69	30.79	43.29	43.79	40.53
One Year Requirement		33.95	5.35	19.43	26.53			
Two Year Requirement				24.78				
Three Year Requirement					51.31			

Colour Coding		These are the NRC-specific items that must be included in the LRP renewal in 2007/8.
		These Are unfunded items in FY2006/7. Ideally all of these should be funded. However, the priority is with the SKA/CLAR. One year of funding is useless: Suggest three years at \$8M.
		The SKA/CLAR funding is problematical. As above, I suggest that the CLAR development be funded for three years at \$8M and that the \$15M for a demonstrator be deffered to 2008/9.
		Industry Canada has promised full TMT-DDP funding.



This shows funded items. Includes the Telescope contributions and \$1.6M of money for CLAR this year. The TMT is also funded - albeit largely from non-NRC sources as shown.



Comment: July 2005

Construction: NRC-NSF agreement

Leave \$15M in for next-gen RA facility?

Will need another \$100M; the \$25M/yr would continue forever (operations) beyond 2015

NRC reallocation to fund telescopes approved: needs TBS OK

No Change

No Change

No Change: Drop 2005-06 and propagate everything else

No Change

Dead Horse: Other Options on table: Drop this

No Change: Drop 2005-06 and propogate everything else

No Change: Drop 2005-06 and propogate the rest;
HIA can assume 1/3.

Exclusive of TMT in 2006-07

Includes TMT funding in 07-08

Includes TMT funding in 07-09

