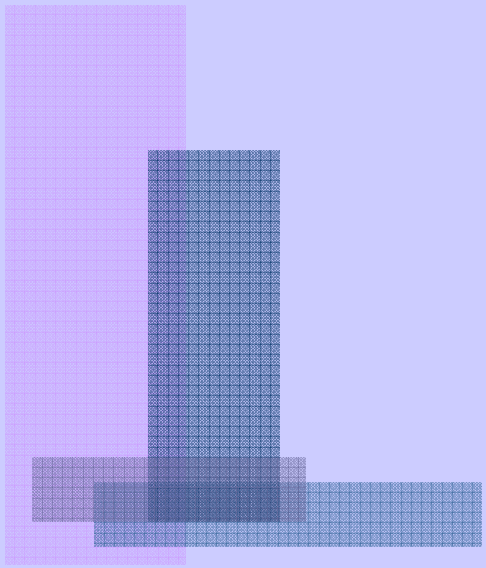
Searching for White Dwarfs using Web Services and .NET



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Outline

- Grid Computing, Service-Orientation, and Web Services
- WS-GAF
- White Dwarfs application
- Conclusions

Acknowledgements

- This is really their work
  - Bob Mann (ROE)
  - Nigel Humbly (ROE)
  - Martin Hill (ROE)
  - Rumesh Machap (ex-SDIA student, now doing a PhD)
    - Bob Mann
    - William O'Mullane

E-Science

"E-science is about global collaboration in key areas of science, and the next generation of infrastructure that will enable it"

John Taylor
Director General of the UK Research Councils

The promises

Grid

- Build applications that span organisations
- Create virtual organisations
- Seamless integration
- Hide (virtualise) or share use of resources, network, infrastructure

Web Services

- Glue for heterogeneous platforms/applications/systems
- Cross- and intra-organisation integration
- Standards-based distributed computing
- Interoperability
- Composability

- ...Based on the concepts of Service Orientation

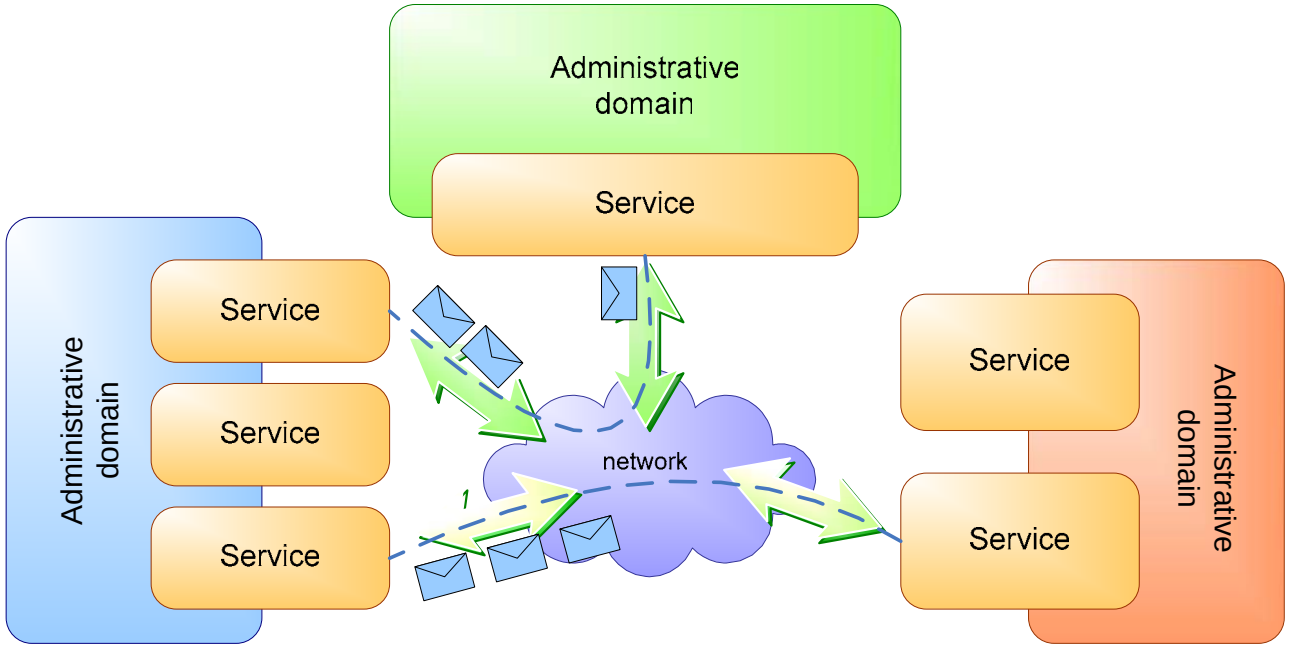
Service Orientation

- Built around the concepts of service and message
- *A service is the logical manifestation of some physical or logical resources (like databases, programs, devices, humans, etc.) and/or some application logic that is exposed to the network*
  and
- *A message is a unit of communication for exchanging information. All communication between services is facilitated by the sending and receiving of messages*

- A service adheres to a contract
  - Describes the format of the messages exchanged
  - Defines the message exchange patterns in which a service is prepared to participate
- Services are governed by policy
  - Declaratively describe service interaction requirements, quality of service, security, etc
- Focus on messages (message-orientation)

Services exchange messages

- Service-orientation (and Web Services) helps architects achieve the following properties (but do not guarantee them)
  - Scalability, encapsulation, maintenance, re-use, composability, loose coupling, etc.



The WS-* space

Metadata (WSDL, Policy)

Security (WS-Security, WS-Trust, WS-SecureConversation)

Reliable messaging (WS-ReliableMessaging)

Transactions (WS-AT/BA, WS-TransactionManagement)

Quality of service

Addressing, notification, enumeration, etc. (WS-Addressing, WS-MessageDelivery, WS-Eventing, WS-Notification, WS-Enumeration)

Messaging

SOAP

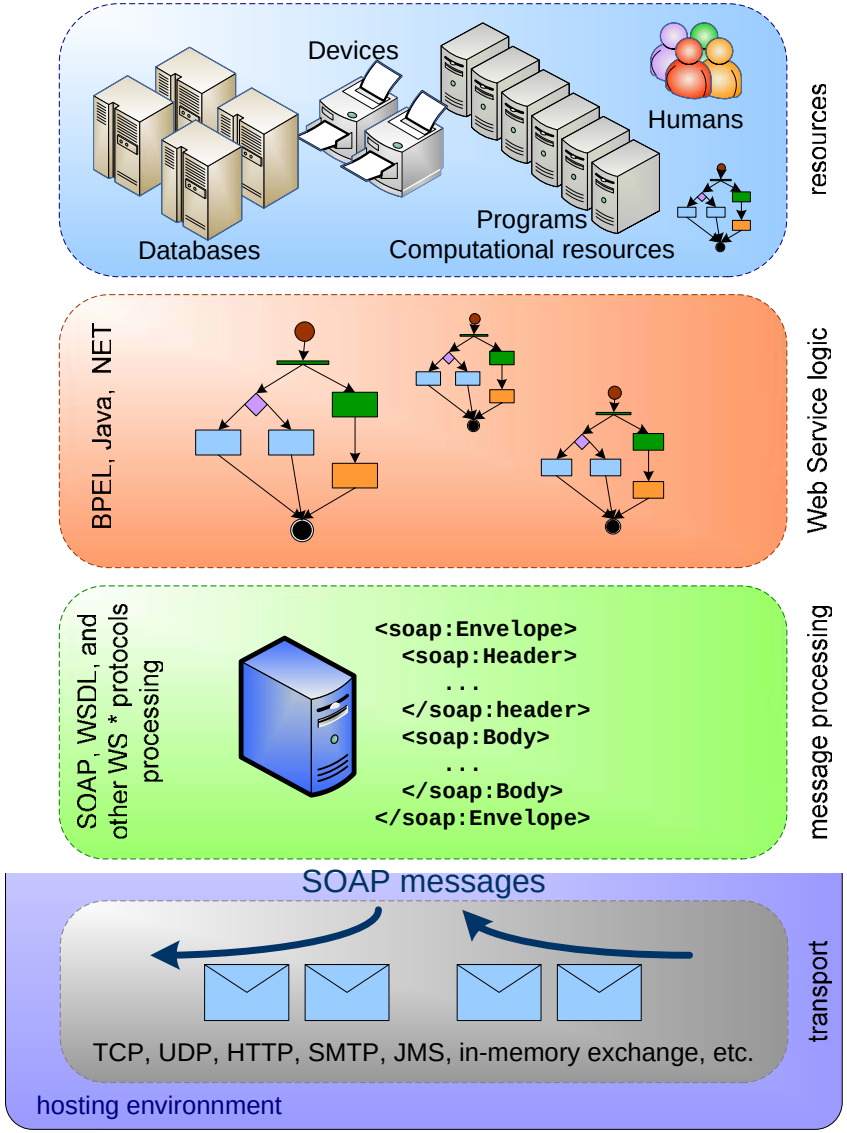
Transfer

Inter-process communication, TCP, UDP, HTTP, SMTP, JMS, etc.

Transport

The Anatomy of a Web Service

- Specifications for
  - Security
  - Orchestration
  - Reliability
  - Policies
  - Federation
  - Management
  - etc.



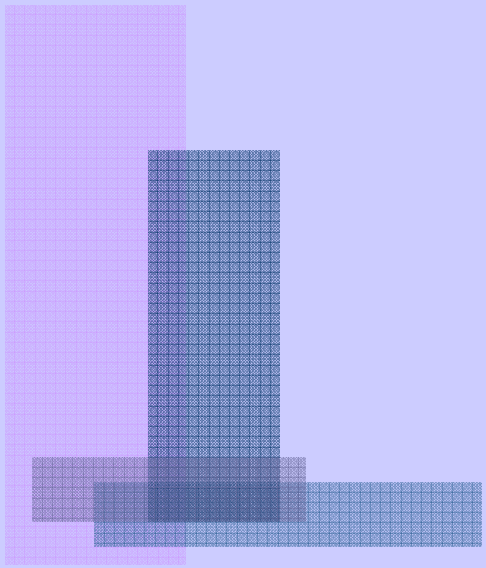
WS-GAF Motivation

- Milestones
  - OGSI release
  - WS-GAF paper
  - WS-RF release
  - Community concerns over WS specification instability
- We now focus on creating applications and demonstrating ideas
  - Feedback from the community
  - Decided to create risk-based profiles for building Grid applications based on risk/value assessment
  - Distinction between production and experimental deployments

WS-GAF Applications

- We need to build large-scale Grid applications using Web Services in order to find out what is actually required
- Aims
  - Define the characteristics of a “typical” Grid application
  - Demonstrate the applicability of the WS-GAF approach in building Grid applications
  - Learn from the challenges of constructing a truly global, distributed, scalable, loosely-coupled application
- Tools
  - .NET 2.0 Beta 1 & .NET 1.1
  - VS.NET 2005 Beta 1 & VS.NET 2003
  - Web Services Enhancements 2.0 SP1

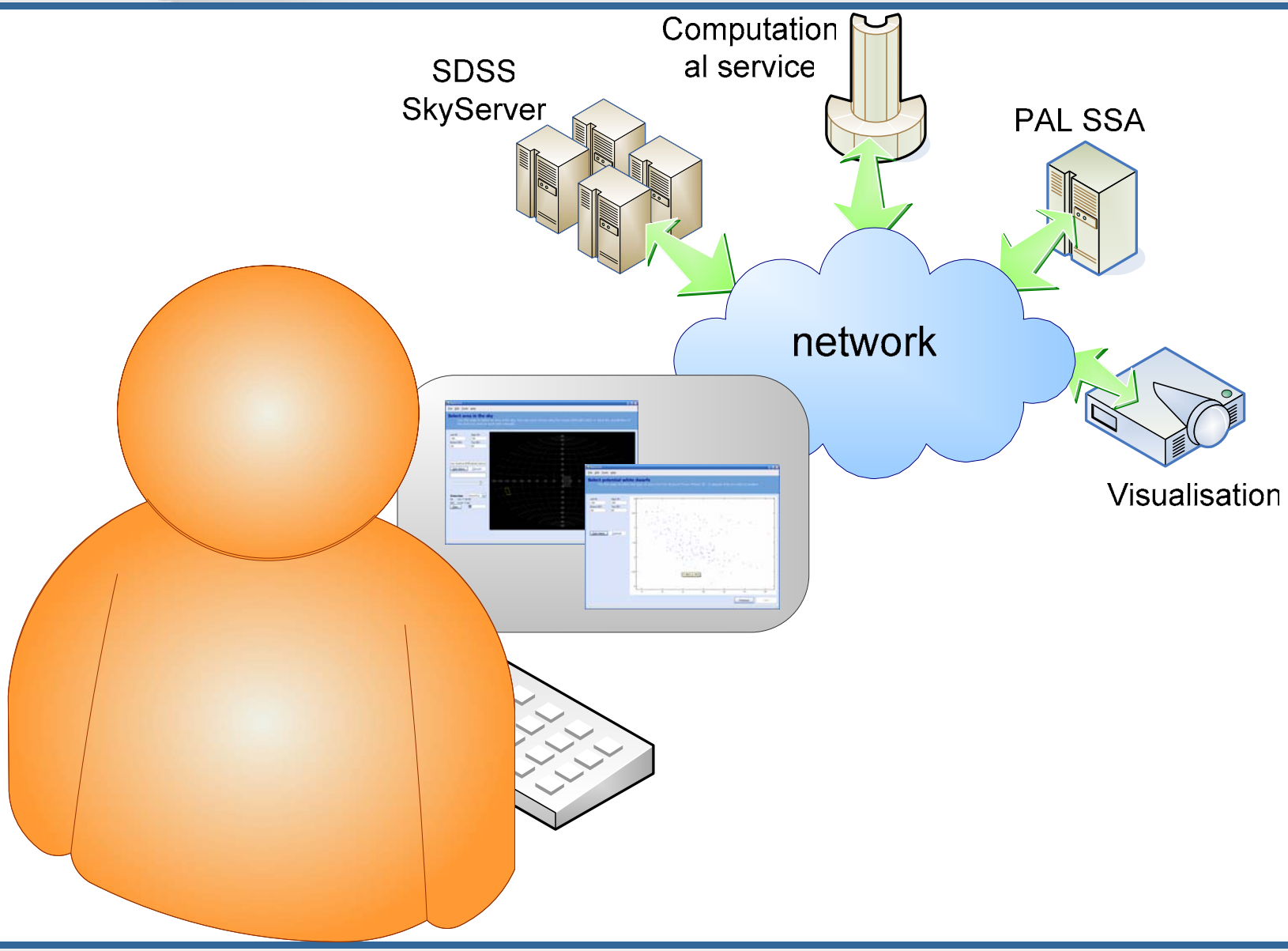
Searching for White Dwarfs



Approach

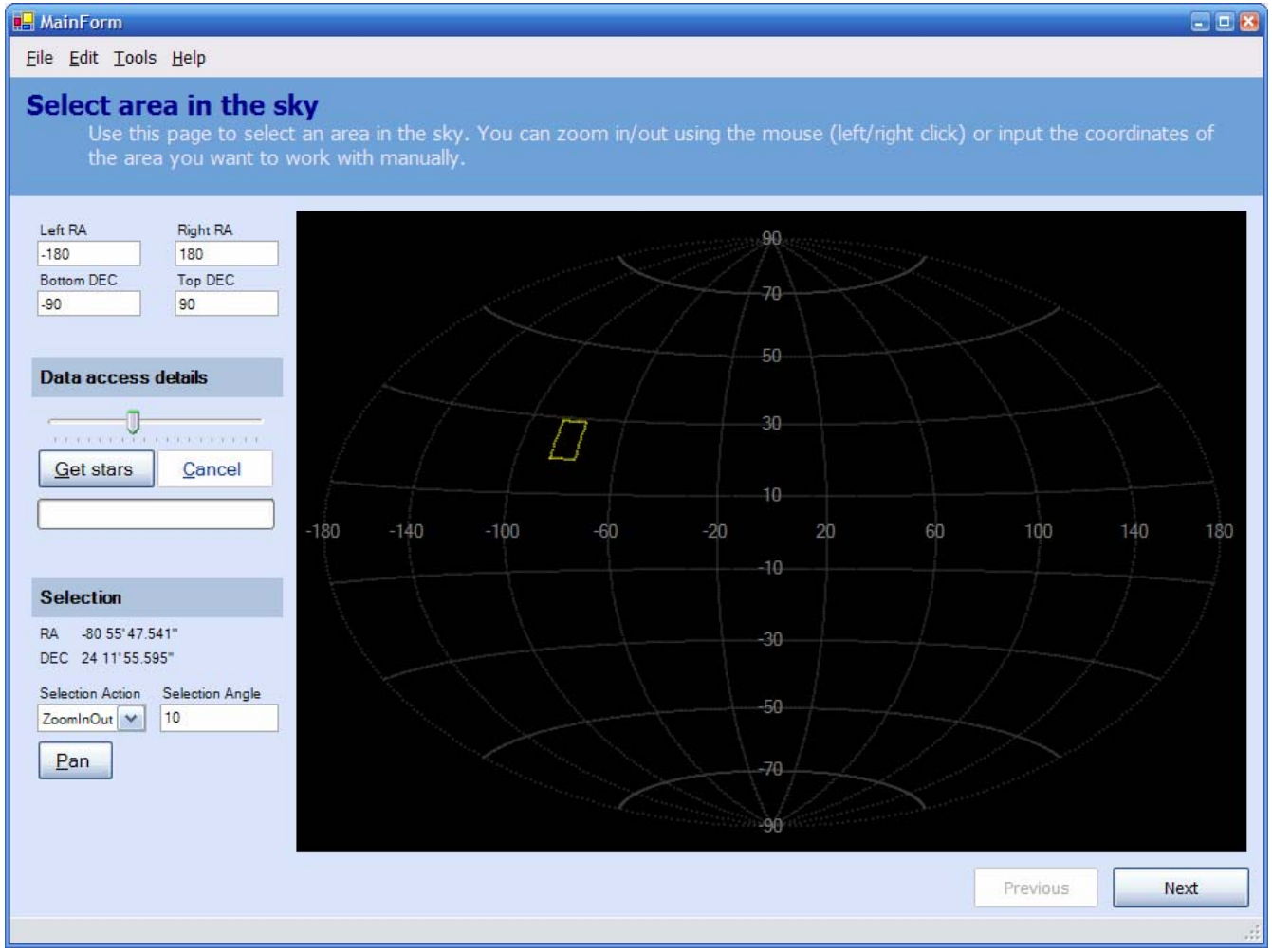
- Plot a view of our galaxy based on the number of stars available
- Select an area
- Get all stars for that area from the SuperCosmos archive
- Plot the Reduced Proper Motions (Hr) – of the selected stars for R – I
- Select the potential white dwarfs
- For all the selected stars get more information from the SDSS DR1 archive
- Perform the analysis
- Return results
- Visualise

Searching for White Dwarfs - High-level view



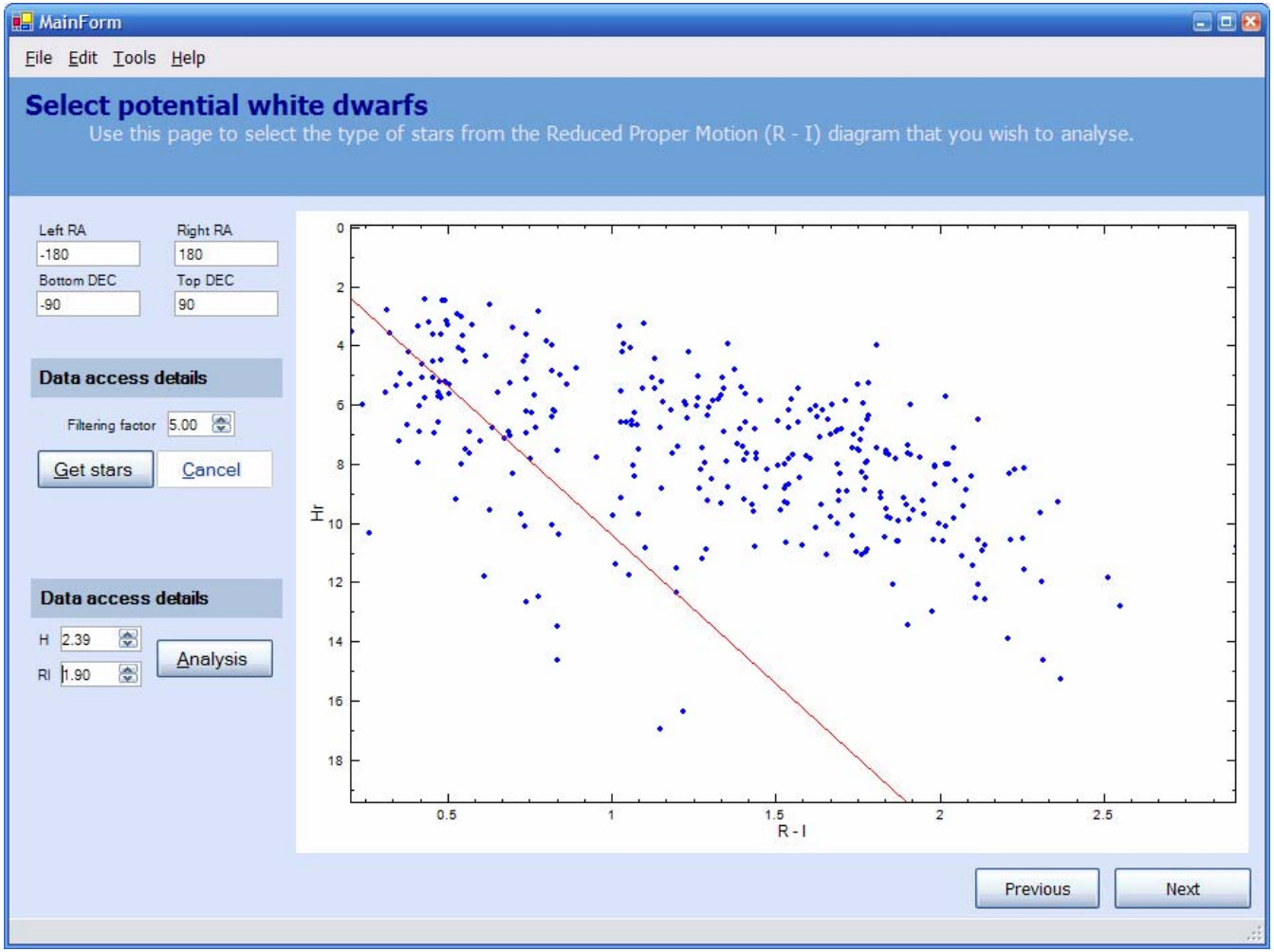
Application Interface

- Select area of the galaxy



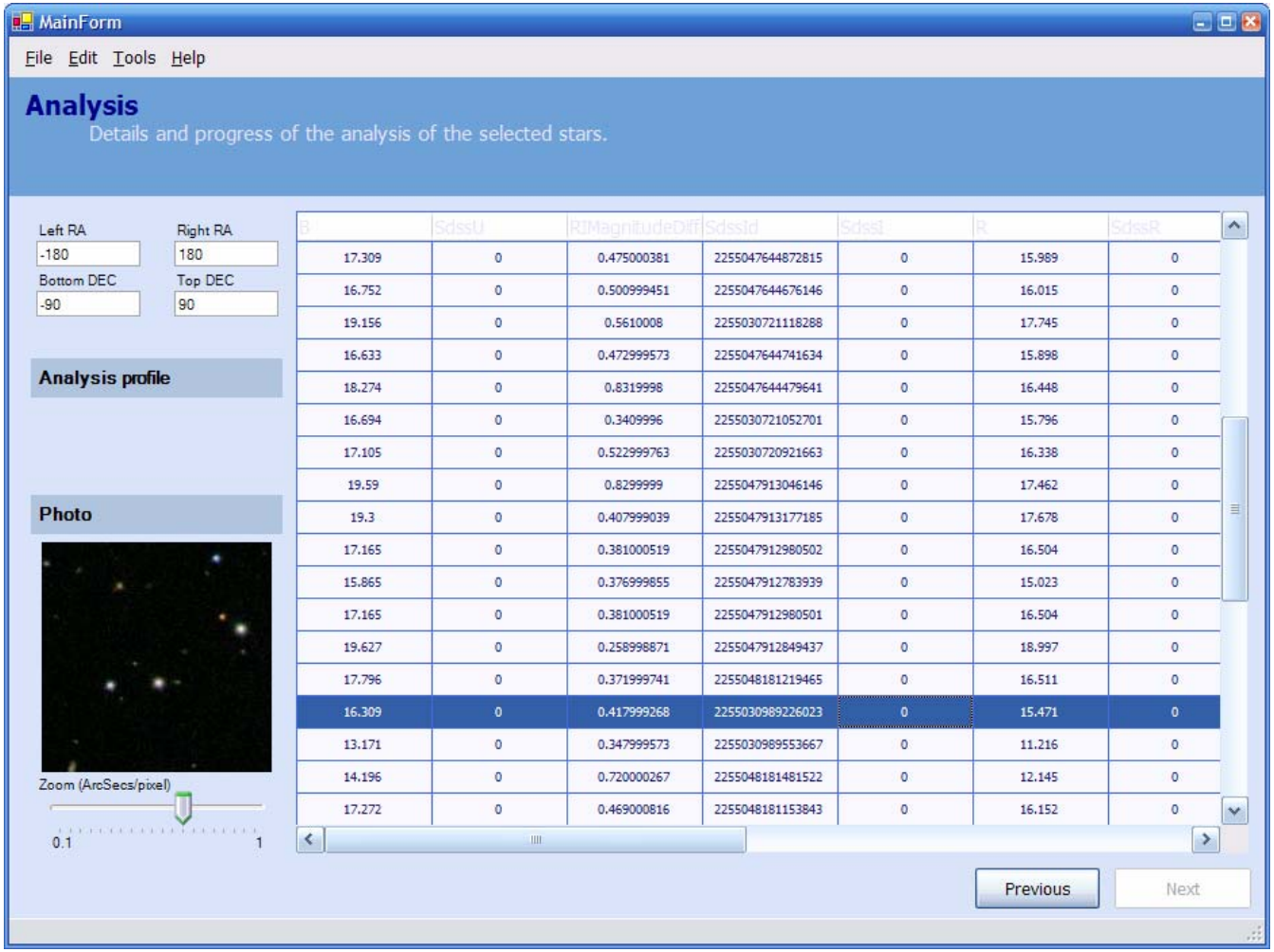
Application Interface

- Reduced Proper Motion



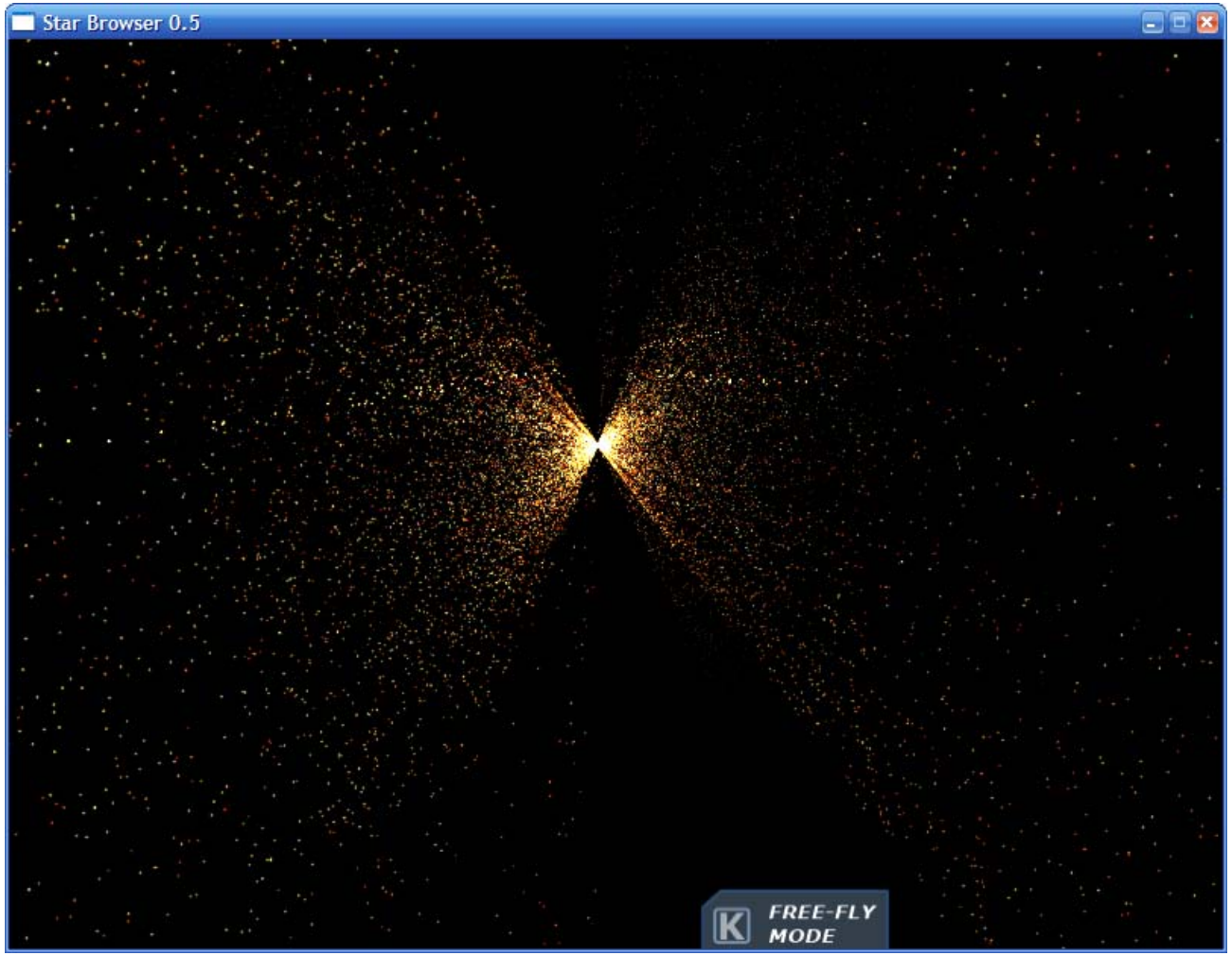
Application Interface

- Browse results



Application Interface

- 3D visualisation – (in the future… CAVE)



Things to Consider

- Asynchrony
  - For any Graphical User Interface asynchrony is important
  - Existing WS tooling doesn't make it easy
  - Microsoft's ASP.NET and WSE provide asynchronous versions of the generated "calls"
  - Or, explicit management of threads to hide network latencies
- Message size
  - We can't cache the entire archives locally
  - We need to think about what we want to access/transfer
  - Streaming would have helped (separate investigation)
- Separation of data access from GUI
  - Interfaces/plugins helped in abstracting the data stores
  - Memory management issues

Major Issues

- Get my head around the astronomy
- Remember trigonometry
- Graphical user interface
- Architecture

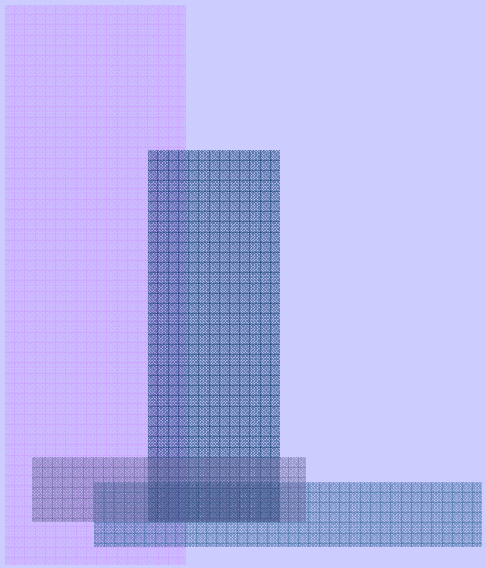
- WS stuff the most trivial

- Issues with the availability of production-quality interfaces to the data stores
- WS try to limit the functionality that DBMSs provide
  - E.g. SQL, batch SQL statements, etc.
  - CAS-Jobs excellent utility

Status

- Most of the infrastructure is in place
- X.509-based security in place (waiting for the service)
- Some issues with the WS access to the SSA
- Currently PSSA has EDR data
- The 3D visualisation doesn't load information lazily
- Performance tuning hasn't been done

Demo
(praying to the coding gods)



Summary

- WS are a good technology for building Internet-scale applications
- The WS space will become clearer over time
  - initially only low-level infrastructure specifications standardised
  - later, high-level specs will stabilise (notification, workflow…)
- We are developing a wide range of Grid applications using this approach
- .NET platform excellent for building Web Services applications
- WSE supports message-oriented implementations of Web Services

People and Links

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- Savas Parastatidis (Savas.Parastatidis@newcastle.ac.uk)
- Jim Webber (Jim.Webber@newcastle.ac.uk)

Web Services Grid Application Framework (WS-GAF)

http://www.neresc.ac.uk/ws-gaf

Mailing list (>90 people from all over the world)

ws-gaf@newcastle.ac.uk

Join by sending a message to mailbase@newcastle.ac.uk including the following line in the body

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Thanks

- DTI
- JISC
- UK e-Science Core programme