

## Experimental Proposal **S358**

- Title: **“Study of the nuclear spatial structure of neutron-rich B and C isotopes by proton elastic scattering in inverse kinematics”**
- Spokesperson: **A.Khanzadeev, PNPI**
- GSI Contact Person: **P.Egelhof, GSI**
- Year of Approval: **2008**
- Shifts: **39 shifts approved (main) with Committee recommendation to focus on the carbon chain because of the expected discovery potential**

# Physics Motivation

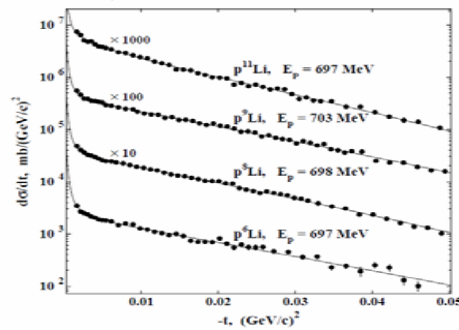
Goal of our program - investigating the evolution of nuclear sizes and shapes of light nuclei from the valley of beta-stability to the drip-line. In the nuclei near the drip line the valence nucleon(s) may have a very extended density distribution, called “halo”.

At the last step of our program we are going to study nuclear sizes and shapes of isotopic chain **C<sub>12,14,15,16,17</sub>** by small-angle proton elastic scattering in inverse kinematics at intermediate energy (**~ 700 MeV/u**).

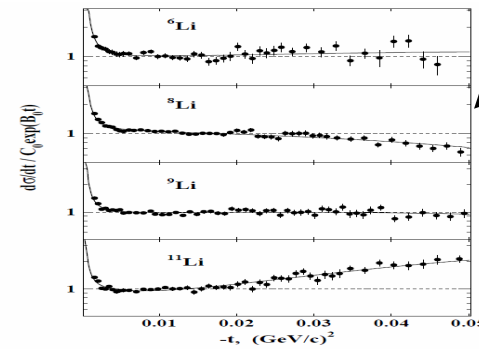
IKAR experiment measures the absolute elastic cross-section  **$d\sigma/dt$**  in the range  **$0.002 \geq |t| \geq 0.050 \text{ (GeV/c)}^2$**  of the four-momentum transfer squared  **$t$** . Glauber multiple scattering theory relates the measured cross-sections with the studied density distributions giving simultaneously the matter, core and valence nucleon(s) r.m.s. radii.

This method was proved in experiments **S105** on **p-He<sub>4,6,8</sub>** (1993) and **p-Li<sub>6,8,9,11</sub>** (1996), and **S247** on **p-Be<sub>7,9,10,11,12,14</sub>** and **p-B<sub>8</sub>** (2005-2006)

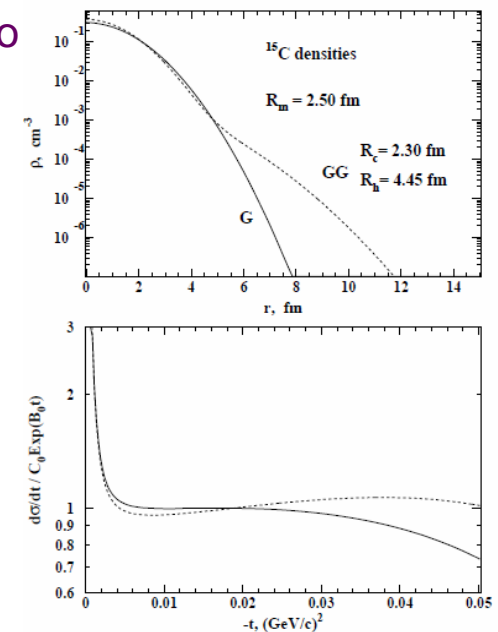
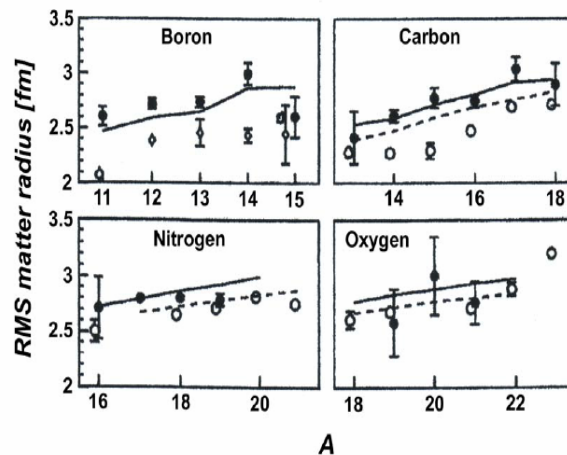
## Cross-sections of elastic scattering on Li isotopes



## Qualitative indication of possible halo existence

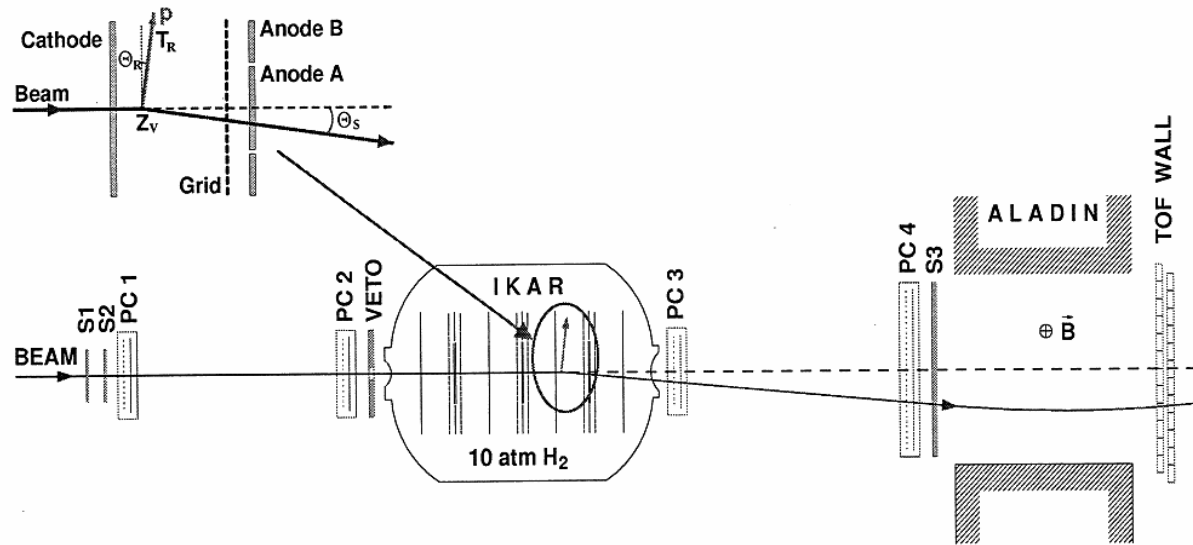


Information on halo structure in carbon isotopes is rather contradictory. There is evidence of one neutron structure in **C19** and **C15**. For **C16** reaction cross-section measurement suppose 2-n halo, but a relatively broad momentum distribution of breakup fragments for **C16** shows no halo formation. Contradictory results we have for **C17** also.



# Setup

- FRS focal planes equipment

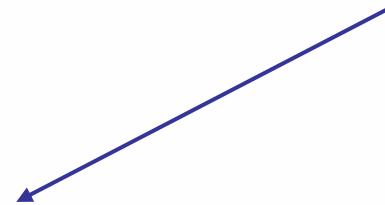


- Is the setup ready? **All parts were revised and ready**
- Is there any new or non-standard equipment required? **No**
- Is there a modification or a new DAQ required? **May be some minor modification is required**

- What is the requested primary beam and intensity?

	particle / spill	MeV/A	mg /cm <sup>2</sup>	composition
	<sup>18</sup> O beam			
<sup>12</sup> C	3.8·10 <sup>7</sup>	760	800	<sup>12</sup> C (99.7%) <sup>14</sup> N (0.2%) <sup>10</sup> B (0.1%)
<sup>14</sup> C	3.3·10 <sup>7</sup>	760	1000	<sup>14</sup> C (99.8%) <sup>16</sup> N (0.1%) <sup>12</sup> B (0.1%)
<sup>15</sup> C	6.9·10 <sup>7</sup>	754	800	<sup>15</sup> C (99.5%) <sup>13</sup> B (0.2%) <sup>12</sup> B (0.2%) <sup>17,18</sup> N (0.1%)
<sup>16</sup> C	2.1·10 <sup>8</sup>	754	800	<sup>16</sup> C (98.5%) <sup>13</sup> B (1.5%)
	<sup>22</sup> Ne beam			
<sup>17</sup> C	1·10 <sup>10</sup>	760	1200	<sup>17</sup> C (99.0%) <sup>16</sup> C (0.5%) <sup>14</sup> B (0.4%) <sup>18</sup> C, <sup>15</sup> B (0.1%)

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- How many shifts are requested for 2010? **39 shifts**